IDENTIFYING MOOD- AND AGE-RELATED DIFFERENCES IN ATTENTIONAL BIASES IN DYSPHORIA: AN EYE TRACKING STUDY

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To Steve, Oscar, and Felix

I love you all the love in the world

ABSTRACT

Previous research has indicated that individuals who experience depression selectively attend to negative information for greater periods of time than non-depressed individuals. This negative bias may reflect difficulty disengaging from negative stimuli that is not seen in non-depressed individuals. While there has been a high level of researcher interest in this arena, no studies have investigated the presence of a negative bias in older adults. Accordingly, the present study employed eye tracking techniques to investigate differences in negative biases between dysphoric (n = 27; 14 younger adults; 13 older adults) and non-dysphoric (n = 29; 14 younger adults; 15 older adults) participants by presenting competing emotionally valenced stimuli. In an additional stage of the experiment, the presence of an interpretation bias was investigated whereby participants rated the previously viewed images for perceptions of 'mood'. Results from the eye tracking task were mixed, with partial support being found for a negative bias in dysphoric participants. Similarly, partial support was found for the hypothesis that non-dysphoric participants would attend to positive stimuli for greater periods of time than dysphoric participants. No age-related differences were found in the non-dysphoric group when attending to sad and happy images. However, when attending to sad images, younger dysphoric participants showed greater average glance durations than older dysphoric participants. Results from the rating task were also mixed. No evidence of a negative interpretation bias was found in the dysphoric group. Similarly no evidence of a positive interpretation bias was found in the non-dysphoric group. Consistent with previous research, older non-dysphoric participants provided more positive ratings for happy images compared to younger non-dysphoric participants. Although overall results are not consistent with previous research, methodological issues in the present study may go some way to explain these inconsistencies. Limitations in using eye tracking techniques on older adults offer one possible explanation. Further, the sub-clinical level of dysphoria in the present sample suggests that negative biases are most evident at severe, clinical levels of depression.

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GLOSSARY OF TERMS

Dysphoric and non-dysphoric

The terms 'dysphoric' and 'non-dysphoric', when applied to this study's participants, are used as categorical identifiers only. These terms in no way suggest that participants met criteria for clinical depression. These terms merely reflect the groups of participants whose CES-D scores were either above or below the cut-off score at the time of testing.

Younger adults and older adults

These terms are applied for categorical simplicity. Typically, the term 'younger adults' refers to adults who are of working age, while 'older adults' refers to those of retirement age. When used in discussion of the present study's participants, 'younger adults' refers to those participants aged between 19 and 39 years, while 'older adults' refers to those participants aged between 69 and 80 years.

Late-life depression and late-onset depression

Late-onset depression refers to the experience of depression with onset of symptoms occurring for the first time in late life (usually quantified as 60 years or older). This is distinctly different from late-life depression, which refers to the experience of depression by those aged 60 years or older, irrespective of previous depressive episodes that may have occurred in earlier adulthood, adolescence, or childhood.

Eye tracking

The term eye tracking is used in the current study to refer to use of an eye-gaze system to track how long and how often participants spent looking at images presented on a computer screen rather than to track eye movements or ascertain time spent inspecting individual elements within the images.

Sad images

The term 'sad' in relation to the experimental images is an umbrella term deemed to best engender a sense of sadness in the viewer, or the perception that the depicted scene displays sadness, sorrow, or mourning. These images could also be described as

'negative' in nature, though not in a fear-provoking manner (which would be the case for the threatening images).

Happy images

'Happy' images consist of those images considered to elicit a sense of joy, pleasure, or happiness in the viewer, or images that depict scenes of laughter, pleasant social interactions, and optimism. These images could also be described as 'positive' in nature.

Threatening images

'Threatening' images portray scenes that evoke a sense of threat or fear in the viewer, or that can typically be described as violent, aggressive, or frightening.

Neutral images

'Neutral' images are images considered to evoke little emotional response from the viewer, or images that depict items of little emotional regard.

ACRONYMS

AIM	Affect Infusion Model
ANOVA	Analysis of Variance
BDI	Beck's Depression Inventory
CES-D	Centre for Epidemiologic Studies Depression Scale
DAH	Differential Activation Hypothesis
DASS-21	Depression Anxiety and Stress Scale – Short Form
DOAT	Deployment-of-attention Task
DSM-5	Diagnostic and Statistical Manual of Mental Disorders 5th Edition
HADS	Hospital Anxiety and Depression Scale
MoCA	Montreal Cognitive Assessment
SPSS	Statistical Package for the Social Sciences
SST	Socioemotional Selectivity Theory

PREFACE

Depression, aging, and eye tracking! One could ask why, or even how, this became a topic of interest. In reality, the coming of age of this topic was somewhat serendipitous. It started with a conversation between myself and Associate Professor John Podd, with whom I had previously worked (although on completely unrelated topics). I can't recall the exact nature of the conversation other than there was some mention of the School of Psychology's recent acquisition of an eye tracking device, which John was keen to put to good use. As John has a keen interest in research pertaining to older adults and the effects of aging, and I had developed a curiosity in psychogeriatrics from an undergraduate paper I had completed a few years earlier, it seemed pertinent to include aging in our investigation. But aging, eye tracking, and what? A few psychological conditions were considered and quickly dismissed for logistical and ethical reasons. The idea of depression was raised, for which John was none too keen! He was already researching older adults and depression, and finding the recruitment of older depressed adults to be a difficult task. But I persevered and (extremely naively) put to John that I would be able to do the impossible and recruit the required number of clinically depressed participants. It is at this point that I can say, he was right; I was wrong. But I cannot state that I regret not listening. While I may not have recruited the necessary depressed participants, I believe I learned a great deal about depression and aging, which I will firmly carry with me into my clinical practice. But there was another reason for which I was so insistent about investigating depression in older adults. A very personal reason…

I have some very good friends whose father sadly committed suicide in late life. It was an event that left them, among other things, with a number of unanswered questions and an incessant need to understand why he did what he did. This is often the case with suicide – it simply does not make sense to those left behind. I remember a conversation I had whereby my friend said, "I just want to know why he did it". I had no answer; I did not know. I could not provide my friend with some, albeit momentary, reprieve from his pain. Suicide is a permanent solution to a temporary problem. It is difficult to understand for those of us who have no inkling to engage in this kind of behaviour, who see the future looking that much brighter. But I wanted to

understand it better for myself so I could help people, like my friend, understand it too, even if this understanding was ever so slight.

It would seem sensible that suicide should then become the focus of any future research. But to me, researching suicide was a bit like putting an ambulance at the bottom of the cliff. If I wanted to understand why people suicided, I needed to understand the risk factors associated with suicide, none so great as depression. And that is what I did - depression, aging, and eye tracking. It took some twists and turns, but what follows is the product of several years work trying to understand the differences in how older and younger adults may experience depression. Of course, I do not think for a minute that this research holds the key to why people suicide. Nor does it help me respond to my friend's desire to understand his father's death any better. But, what I do know is researching depression has taught me that there are distinct differences in the way older and younger adults present with depression. The current ways of responding to these differences by medical and mental health practitioners may not be identifying the true extent of depression in this older cohort, which means many are going either undiagnosed or misdiagnosed. And with that, I truly believe that every piece of research conducted in the area of aging and depression adds value to our knowledge base, aiding us to understand, interpret, assess, diagnose, and treat depression in older adults in a manner that is beneficial to this cohort, and ultimately reducing the number of future suicides.

Remaining lost are the words I needed to find to help my friend understand his father's death. But gained is the knowledge I now have that will aid me in helping others not reach such depths of depression as to find a similar fate. I still don't know why people suicide, but I do have a greater understanding of what they experience leading up to that point. It is here that the ambulance is firmly planted at the top of the cliff, in a proactive position, where it needs to be. And in understanding what those experiences of depression are like, it is through the experiential looking glass of Andrew Solomon, reflecting on a tree in a forest that had become encapsulated by vine, that others may come to see the desperation, despair, and unrelenting torment experienced in clinical depression:

> *My depression had grown on me as that vine had conquered the oak; it had been a sucking thing that had wrapped itself around me, ugly and more alive than I. It had had*

a life of its own that bit by bit asphyxiated all of my life out of me. At the worst stage of major depression, I had moods that I knew were not my moods: they belonged to the depression, as surely as the leaves on that tree's high branches belonged to the vine. When I tried to think clearly about this, I felt that my mind was immured, that it couldn't expand in any direction. I knew that the sun was rising and setting, but little of its light reached me. I felt myself sagging under what was much stronger than I…Its tendrils threatened to pulverize my mind and my courage and my stomach, and crack my bones and desiccate my body. It went on glutting itself on me when there seemed nothing left to feed it.

I was not strong enough to stop breathing. I knew then that I could never kill this vine of depression, and so all I wanted was for it to let me die. But it had taken from me the energy I would have needed to kill myself, and it would not kill me. If my trunk was rotting, this thing that fed on it was now too strong to let it fall; it had become an alternative support to what it had destroyed. In the tightest corner of my bed, split and racked by this thing no one else seemed to be able to see, I prayed to a God I had never entirely believed in, and I asked for deliverance…the very worst pain is the arid pain of total violation that comes after the tears are all used up, the pain that stops up every space through which you once metered the world, or the world, you. This is the presence of major depression (2001, pp. 18-19).

Chapter One

DEPRESSION

This chapter provides an overview of depression, including nosologic symptoms in both younger and older adults, as well as diagnostic complexity when assessing older adults for depression. Prevalence, incidence, and gender differences in depression are presented, followed by the psychosocial implications of experiencing depression. The chapter concludes with a brief synopsis of cognitive theories pertinent to this study, incorporating theories related to late-life depression.

DEPRESSIVE SYMPTOMOLOGY

In its various forms, depression has been recognised for over two millennia (Gilbert, 1992). Descriptions of evil spirited dark moods, black bile, and melancholia abound in biblical, historic, and ancient Greek and Roman literature. During Hippocratic times, melancholia, along with mania and phrenitis, were considered forms of madness (Jackson, 1986). In terms of symptomology, some of the earliest notions of melancholia remain today, but have rightfully shifted away from the concept of madness and now recognise depression (and other affective disorders[1]) as forms of mental illness. Although modern understandings of depression have changed substantially since these early musings, there still remains much to be discovered and better understood.

Although not defined as a spectrum disorder, the severity of symptoms often referred to as 'depression' are wide ranging. Along this continuum are major depressive disorder, dysthymic disorder, sub-clinical depression, dysphoria, and low mood. Regardless of the terminology, it is widely accepted that these conditions typically share many symptoms, with the main distinction being one of severity and time-course of symptom presentation. Furthermore, the subjective experience of depression is ego-dystonic in which the individual is aware the symptoms are not in keeping with their typical emotional state (Nydegger, 2008).

According to the American Psychiatric Association (2013), major depressive disorder is characterised by depressed mood, diminished pleasure or interest, changes in sleep, appetite,

[1] It is noted that several types of depressive disorders fall under the term 'affective disorder', which can be unipolar or bipolar in nature. The focus of this thesis is solely on unipolar depression and therefore bipolar depression is excluded from the review. Furthermore, participants were screened for bipolar disorder and excluded from participation if they experienced bipolar depression.

and psychomotor activity, fatigue, feeling worthless or guilty, poor concentration, and thoughts of suicide. Five or more of these symptoms need to be present for more days than not over the same two-week period (or longer) for a diagnosis to be warranted. Although the term 'major depressive disorder' suggests the greatest effects on an individual relate to emotion, it is clear from the above symptoms that depression also affects cognitive, behavioural, and physical domains.

Affective symptoms

The emotional or affective symptoms associated with depression primarily relate to changes in mood state, or lowering of mood. Such changes leave the individual with constricted mood, resulting in a reduction of positive mood reaction (Mondimore, 2006). The subjective feeling of sadness, while typically seen as the mainstay of depression, is far from being the only affective symptom. Individuals can experience negative feelings, often aimed at the self, including worthlessness, guilt, disappointment, and disgust (Gotlib & Hammen, 1992). Loss of pleasure, or anhedonia, is also a common affective symptom, which leads to the behavioural symptom of withdrawal. A. Beck (1967) suggests further affective symptoms to include loss of emotional attachment and difficulty responding to humour (loss of mirth response). Although depressed mood is considered the core symptom of depression, approximately 50% of individuals with depression do not report feeling depressed (Sadock & Sadock, 2007). Rather, irritability, apathy, affective depersonalisation, and/or emptiness often replace depressed mood (American Psychiatric Association, 2000).

Cognitive symptoms

A reduction in concentration and disruptions to decision making are frequently indicated as cognitive symptoms of depression. Rumination, although thought to contribute more to the onset of depression, when combined with other cognitive factors, can lead to increased duration of a depressive episode (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008).

Unrealistic negative evaluation can result in a range of cognitive distortions, such as attributing blame to the self for experiencing depression, a sense of failure, and self-criticism (A. Beck & Alford, 2009). There is also a tendency to view the world and others in a pessimistic manner, with more than 78% of depressed individuals reporting negative expectations, compared with 22% of non-depressed individuals (A. Beck & Alford, 2009).

Suicidal ideation is another cognitive symptom of depression. Estimates of suicidal ideation in those experiencing depression range from 16-74% (A. Beck & Alford, 2009; Casey et al., 2008; Spijker, Graaf, ten Have, Nolen, & Speckens, 2010). Suicidal ideation can present in many forms, which can be passive or active, occurring sporadically or persistently. Sadly, this culminates in 4-9% of depressed individuals committing suicide (Fergusson, Woodward, & Horwood, 2000; Nada-Raja, Skegg, Langley, Morrison, & Sowberry, 2004; Oakley Browne, Wells, & Scott, 2006; Weissman et al., 1999).

Behavioural symptoms

A reduction in typical daily behaviours and diminished motivation to engage in social activities are common behavioural symptoms seen in depression. Such behavioural inactivation can include the reduction of hygiene practices, reduced motivation to engage in physical activities, general avoidance of daily activities or responsibilities, decreased interest in sex, and increased dependency on others.

The selection of activities that are least energy consuming, or least demanding of initiative or responsibility is common; A. Beck and Alford (2009) refer to these as *regressive behaviours*. As a consequence, individuals experiencing depression have a tendency to become passive and dependent, engaging in problem avoidance rather than problem solving, while seeking immediate, albeit transient, satisfaction from the limited activities engaged in.

Physiological symptoms

Physiological diagnostic indicators of depression include psychomotor retardation or agitation, changes to sleep and appetite, and feeling fatigued. Changes to psychomotor activity can affect gross motor activity, discrete body movements, and motor reaction time (Mondimore, 2006). Paucity of speech can also occur with depressed individuals prone to using monotonic phrases, poor articulation, and increased pauses between words (Sobin & Sackeim, 1997).

Appetite changes usually take the form of a reduction in eating with corresponding weight loss. Disruption to sleep, typically a reduction of sleep, has been reported to exist in 87% of severely depressed individuals (A. Beck & Alford, 2009). Changes to sleep can involve difficulty getting to sleep, difficulty staying asleep, or increased nocturnal awakening (Hammen & Watkins, 2008). Increases in sleep (hypersomnia) and appetite (hyperphagia) can also occur, but these are more symptomatic of atypical depression.

Issues with sleep result in increased tiredness and subsequent lethargy or fatigue, which ultimately exacerbate behavioural withdrawal. The way in which symptoms feed into and aggravate other symptoms can extend the life of a depressive episode.

Depressive symptoms in older adults

The accurate diagnosis of depression in later life remains an area of concern for psycho-gerontologists, especially as the diagnostic items of the DSM-V (American Psychiatric Association, 2013) are considered to be more discriminating of younger adult depression (Balsis & Cully, 2008). Assessment interviews and psychometric measures may result in the mischaracterisation of certain cognitive, physical, or somatic symptoms in older adults that are in fact present as part of the natural process of aging. Conversely, older adults themselves may misinterpret symptoms of depression (for example, cognitive or memory decline) for other conditions typically seen in aging, such as dementia (Balsis & Cully, 2008). Furthermore, medication side effects, medical conditions, or alcohol or other substance use/misuse can create a murky clinical picture.

Emphasising affective symptoms in late-life depression may aid in correctly diagnosing depression. However, older adults with depression have a tendency to report feeling irritable rather than dysphoric, expressing depressive symptoms as somatic complaints (Munk, 2011; Nydegger, 2008). Thus, the issue may not be one of symptomology, but of how symptoms present differently in older adults. Some important indicators of depression in older adults can include persistent complaints of memory impairment, diurnal variation of mood, anger, frequent vague physical complaints, decreased personal care, crying, loss of self-worth, excessive or inappropriate guilt, feeling hopeless or discouraged, hostility, slowing of speech and movements, and social withdrawal (Blazer, 2002; Munk, 2011; Nydegger, 2008).

DIAGNOSING DEPRESSION IN OLDER ADULTS

Like all psychiatric diagnoses, a comprehensive assessment (usually comprising of a clinical interview, observational data, and psychometric measures) underpins the diagnosis of depression. However, in older adults, this diagnosis is not as straightforward as it is often confounded by medical ailments, neurodegenerative conditions, interference of pharmacological treatments, and physical decline.

Somatic complaints can also interfere with the clinical picture, as many somatic symptoms indicative of depression can occur as part of the normal aging process. Thus, measures that are weighted heavily on somatic items can lack specificity when used with older adults, causing an increase in false positive diagnoses. Furthermore, self-report measures are vulnerable to social desirability bias, something that is all the more significant in an older cohort whereby mental illness is not as readily accepted as it is in younger generations. As a result of these generational differences, older adults may also have less insight and be less psychologically minded than younger adults. Older adults with depression visit their general practitioner more frequently, have a tendency to report physical complaints more often than affective symptoms, and rate the quality of their received health care as poorer than their non-depressed counterparts (Nydegger, 2008).

In a generation that was raised to endure hardship, many experiencing wars and financial struggles, older adults experiencing depression may have a tendency to become somewhat passive in their response to depression, having grown up in an environment where complaining about one's problems is frowned upon. This is coupled with ageist beliefs by some medical professionals that dysphoric mood is normal in older adults (Sadock & Sadock, 2007). As a result, the stigma attached to mental illness in older adults may leave some of them reluctant to seek help, with only half of those experiencing depression actually receiving treatment (Berman & Furst, 2011).

Given that most depressive symptoms in older adults have a propensity to be expressed as somatic and therefore assessed and treated accordingly, it appears that the identification of affective symptoms commonly found in late-life depression should be emphasised more during the assessment process. Current measures used to screen for depression have predominantly been developed based on depressive symptoms known to occur in younger adults. These measures are typically subjective in nature and therefore are vulnerable to many of the issues previously mentioned. Thus, identifying differences in depression between older and younger adults is vital to the development of more objective ways of detecting depression in older adults, which would subsequently lead to a quicker diagnosis and the implementation of treatment in a timely manner.

PREVALENCE AND INCIDENCE

Depression is one of the most common psychological conditions, with lifetime prevalence rates estimated at 17% (Kessler, Chiu, Demler, & Walters, 2005) with 50-85% experiencing subsequent episodes (Boland & Keller, 2009). Initial onset of depression occurs between the ages of 20 and 50 years in 50% of those who develop depression (Sadock & Sadock, 2007). The New Zealand Mental Health Survey found lifetime prevalence rates of New Zealanders experiencing major depressive disorder at 16%, and in those aged 65 years and over, at 9.8% (Oakley Browne et al., 2006). Furthermore, it was estimated that lifetime risk of developing major depressive disorder by age 75 was 25.7%.

There is inconsistency in the literature regarding changes in incidence rates across the lifespan. Some researchers suggest an increase in the occurrence of depression with age (Luppa et al., 2012), while others suggest no change (Beekman, Copeland, & Prince, 1999) or a decrease (Segal, Qualls, & Smyer, 2011). It has been suggested that lower incidence rates in older adults may be due to an increase in resilience, underreporting, or premature mortality due to suicide or increased physical comorbidity (Buchtemann, Luppa, Bramesfeld, & Riedel-Heller, 2012). By contrast, increases in depression with aging have been associated with an increase in adverse living conditions and negative life events experienced by this cohort, leading to increased physical decline, cognitive impairment, increased institutionalisation, and increased chronic health conditions (Buchtemann et al., 2012; Chapman & Perry, 2006).

The distinction in terminology between late-life depression (older adults with a history of depression) and late-onset depression (first depressive episode occurring in late life) may add to the equivocal reporting of incidence rates in the literature. This is further compounded by the operational definition of 'late life' with variations in age ranging from 55 years or older to 75 years or older. Definitions of what constitutes depression introduce a final layer of confusion, with some literature referring to major depressive disorder, while others incorporate sub-threshold depression. In the latter group, prevalence rates of sub-threshold depression in older adults are estimated to be four times greater than those of major depressive disorder (Nydegger, 2008). Furthermore, psychosocial factors within the older cohort can lead to variations in prevalence rates. For example, in community dwelling older adults, prevalence rates for depression are similar to those of younger adults. However, prevalence rates for depression are much higher in hospitalised or rest home

residents, with estimates ranging between 20-50% (Blazer, 2003; Munk, 2011; Nydegger, 2008). Half of all older adults who experience depression have their first episode in later life (Segal et al., 2011), and prevalence rates within the older cohort increase with age, with the highest rates seen in those aged 85 years or older (Burke, Burke, Regier, & Rae, 1990; Munk, 2011; Palsson, Ostling, & Skoog, 2001).

GENDER DIFFERENCES IN DEPRESSION

The prevalence, incidence, and morbidity rates for mood disorders are highest for women (Nolen-Hoeksema, 1990). Prevalence rates typically suggest women are up to three times more likely to experience depression than men (Kaelber, Moul, & Farmer, 1995). Traditional explanations for such differences have focussed on male reluctance to report depression, greater externalising behaviours exhibited in men (resulting in higher levels of alcoholism, aggression, and engagement in high-risk behaviours), and reporting of milder symptoms by women. In a review of gender differences conducted by Piccinelli and Wilkinson (2000), adverse childhood experiences, experiencing depression in childhood and adolescence, socio-cultural gender roles with associated risk factors (for example, sexual assault), and poor coping skills and vulnerability to negative life events are likely to be implicated in the gender divide. Poor social support, and genetic and biological factors were found to have little effect on gender differences. While the determinants of gender differences are an ongoing source of investigation, research strongly suggests that gender differences in depression are genuine.

The tendency for depression to occur more commonly in women does not stand true across the lifespan. For example, prepubescent boys are more likely than prepubescent girls to develop depression (Piccinelli & Wilkinson, 2000). While it has been suggested that gender differences in adults aged over 65 years appear to diminish (Nolen-Hoeksema, 1990), the literature is less clear about the existence of such differences. Harwood, Barker, Ownby, Mullan, and Duara (1999) found that older women are twice as likely to experience significant depressive symptoms as men in the same demographic group. This trend has been supported by other studies (Hybels & Blazer, 2003; Wu & Anthony, 2000).

WIDER IMPLICATIONS OF DEPRESSION

The impact of depression can disrupt nearly all aspects of an individual's daily functioning, including relationships, family functioning, employment, academic performance, and social activities. Quality of life can lessen and there is an increased risk of developing other psychological or medical conditions (Nydegger, 2008). These consequences are not exclusively restricted to the sufferer; many negative effects impact on family members or close others.

In older adults, myriad negative consequences have been identified. Increased risk of developing medical diseases such as cardiovascular disease, diabetes, and cancer has been linked to late-life depression (Balsis & Cully, 2008; Munk, 2011). Late-life depression has been associated with an increased risk of developing Alzheimer's disease and vascular dementia (Diniz, Butters, Albert, Dew, & Reynolds, 2013). Additionally, in early onset depression (before age 65), severity of depressive symptoms and number of depressive episodes are positively correlated with increased risk of developing dementia (Byers & Yaffe, 2011; Dotson, Beydoun, & Zonderman, 2010). Co-existing psychiatric conditions also occur, of which anxiety disorders are the most common, with estimates of between 38-58% of depressed older adults also meeting criteria for an anxiety disorder (Alexopoulos, 1991).

Depressive episodes in older adults typically last longer than those in younger adults (Nydegger, 2008). Furthermore, without treatment 50-90% of older adults will experience recurrent episodes of depression (Reynolds et al., 2006). A number of psychosocial implications are related to episode length and episode frequency, including stigmatisation, conflict with others who do not understand the pathology of depression, and increased feelings of guilt and hopelessness (Gotlib & Hammen, 1992). Of most concern is the increased risk of suicide. In New Zealand/Aotearoa, within a 12-month period, prevalence rates for suicide attempts by adults aged 65 and over are reported at 0.1% (Oakley Browne et al., 2006). However, it is unclear if this refers to completed suicides or non-fatal suicide attempts. Nonetheless, the use of more lethal methods amongst this cohort is recognised, with older adults having fewer non-fatal attempts than younger adults (Beautrais, 2003). Studies have found a strong link between depression and suicide in older adults, with as many as 74% of individuals who suicide in late life meeting criteria for a lifetime history of depression (Beautrais, 2002; Conwell, Duberstein, Herrmann, Forbes, & Caine, 1996).

Although not all suicides can be attributed to depression, it appears that depression is one of the most common risk factors for suicide in late life (Bhar & Brown, 2012).

THEORIES OF DEPRESSION

A multitude of theories exist that attempt to explain the etiological basis of depression, including those from both biological and psychological paradigms. As interesting as many of these theories may be, the current review will focus on the main theories germane to the present study, namely cognitive theories and their equivalent variants explaining late-life depression, where applicable.

Many theories pertaining to late-life depression are specifically related to *late-onset* depression. As late-onset depression was not the focus of the present study, the following commentary on theories of depression in late life is limited to those that attempt to explain late-life depression rather than late-onset depression. Typically, these theories can be applied to younger adults also. What distinguishes between theories of depression in older and younger people is the emphasis on environmental factors that are more frequently seen in late life and are thought to contribute to the development of depression in the older cohort.

Beck's cognitive theory

Three dysfunctional patterns of cognition underpin Beck's cognitive theory of depression: negative cognitive triad, distorted thinking, and negative schemata (A. Beck, 1967). The core premise of this theory is that cognitive symptoms of depression precede affective symptoms (A. Beck, 1976). According to A. Beck (1976), individuals who experience depression hold a negative view of themselves (viewed as inadequate, deficient, unworthy), the world (viewed as disparaging, depriving, defeating), and their future (viewed as bleak, unrelenting of hardship and deprivation). Beck's theory suggests that many secondary symptoms of depression can be understood in terms of this negative cognitive triad. That is, operating through the negative cognitive triad, individuals will develop depressed mood, loss of positive motivation, avoidance and withdrawal, suicidal wishes, and increased dependency on others (A. Beck & Alford, 2009).

Individuals experiencing depression are prone to systematic errors in information processing that can lead to the distortion and misinterpretation of information. As a result, the

depressed individual develops unhelpful thinking styles that can be overly negative or self-defeating. Types of cognitive distortions include overgeneralisation regarding adversity, arbitrary inference, selective abstraction, magnification of negative information, and minimisation of positive information (A. Beck & Alford, 2009). According to Beck's theory, these information processing errors are not deliberate, but rather occur spontaneously and automatically (Hammen & Watkins, 2008). These negative cognitions and unhelpful thinking styles are theorised to further exacerbate depressive symptoms, particularly as they maintain hyperattentiveness towards negative stimuli.

The third component of Beck's theory refers to negative schemata or 'core beliefs'. The term *schema* refers to the way experiences are organised and represented in one's memory (A. Beck & Alford, 2009). The schema acts as a type of template of previous experiences, and mentally filters the selection, interpretation, and recall of certain information (Hammen & Watkins, 2008). The incorporation of negative schemata in Beck's theory commonly refers to self-schemata where the negative beliefs are held predominantly about the self. In this way, positive stimuli are filtered out while negative information is selectively attended to.

It is posited that early critical or negative experiences in childhood can lead to the formation of negative schemata. They are derived from messages received by others. Through a critical event or life stressor, usually one that is synonymous with the originating event responsible for the development of the core belief, negative schemata are activated which trigger negative automatic thoughts. These negative automatic thoughts lead to affective symptoms of depression, which in turn, cycles back and generate further negative automatic thoughts (J. Beck, 1995).

Once formed, negative schemata develop into attentional biases in information processing that are mood-congruent in nature. In depression, the mood-congruent bias is negative, and operates on the attention, memory, perception, and reasoning aspects of information processing (Bradley, Mogg, & Lee, 1997; Bouhuys, Geerts, & Gordijn, 1999; Bouhuys, Geerts, & Mersch, 1997). The depressed individual selectively attends to negative stimuli more readily, with minimal regard for neutral or positive stimuli (Hammen & Watkins, 2008). In this manner, negative schemata play an important role in the development and maintenance of depression.

Beck's cognitive theory adapted for late life

Gallagher and Thompson (1983) have drawn on Beck's cognitive theory of depression to explain aspects of late-life depression. Although the basic premise of Beck's theory remains, Gallagher and Thompson have suggested that there are situations specific to late life that can lead to depression in older adults. For instance, older adults may view their future to exist of physical ailments and reduced finances. Experiencing a decline in physical or cognitive abilities may lead older adults to view themselves as incapable, inadequate, or worthless. Negative self-schemata can give rise to statements such as, "I am a burden to others". Similarly, cognitive distortions take on ageist themes such as, "I am treated differently because I am old" or, when discovering an ailment, "At my age, it must be cancer" (Blazer, 2002). Therefore, the activation of negative self-schemata in older adults could be due to experiences that were not present in younger adulthood. If negative self-schemata were formed in childhood, perhaps through observing an ailing grandparent, it is possible that these schemata are activated in response to one's own decline in physical, cognitive, financial, and social domains, thus contributing to the development of depression in late life.

Differential activation hypothesis

The differential activation hypothesis (DAH), developed by Teasdale (1988), draws on the concept of *cognitive reactivity*. Cognitive reactivity suggests that, when presented with a negative situation, previously depressed individuals will show greater negative thinking and reaction to these events than individuals with no experience of depression (Hammen & Watkins, 2008). The DAH proposes that, while all individuals would experience an increase in negative thinking under these conditions, individuals with a history of depression would experience more extreme reactions (Gilboa & Gotlib, 1997). It is claimed that this occurs when previously depressed individuals activate their pre-existing "global negative self-evaluation" (Teasdale & Dent, 1987, p.114). The experience of low mood triggers memories that are linked to painful or negative events, which intensify the affective state, and thus lowers mood. In other words, negative cognitions are only activated once the depressed state has occurred (Gotlib & Hammen 1992). When faced with negative situations, non-depressed individuals may not have the same negative representations associated with low mood as depressed individuals and therefore do not experience a worsening of mood. Non-depressed individuals are able to manage low mood more effectively than depressed individuals, and can reduce the period of time the low mood may last (Gilboa & Gotlib, 1997).

Although the DAH attempts to explain how severe or mild a depressive episode may occur based on eliciting certain characteristics of depression that typically lie dormant, this hypothesis is best seen as a theory of recurrent depression. It does not explain underlying causes or predispositions to developing depression in the first instance. However, similar to Beck's model, the DAH holds that depressed mood can activate negative biases in information processing that direct attention towards negative stimuli further aggravating the mood state (Lau, Segal, & Williams, 2004).

To date, there appears to be no distinction across the life span with this model. However, as with the adaptation of Beck's model to explain depression in older adults, it seems the DAH could also be applied to late-life depression, particularly as this model proposes increased susceptibility to depression through subsequent depressive episodes. That is, a history of depression throughout adulthood could leave the older adult especially vulnerable to further depressive episodes, with increasingly less severe stressors needed to activate depression.

Diathesis-stress model

The diathesis-stress model has been used to explain depression across the life span (Munk, 2011). This model takes a dual approach to the developmental pathway of depression and other mental health conditions. According to this model, the presence of both a diathesis (or predisposition – either genetic or neurobiological) and a stressor must be present for depression to develop (Nydegger, 2008). Thus, an individual may be predisposed to depression but, in the absence of an environmental or physical stressor, will not develop depression (Gotlib & Hammen, 1992; Hammen & Watkins, 2008).

It has been suggested that this model requires more research and development, with increased attention needing to be paid to the interaction between the diathesis and stress components, particularly as these two factors may influence each other (Hammen & Watkins, 2008). As with the DAH, with each subsequent depressive episode, less stress is required to produce similarly severe episodes of depression.

Although the diathesis component of the diathesis-stress model suggests a more genetic or neurobiological form, many models of depression, including Beck's cognitive theory are often treated as diathesis-stress models (Abela & D'Alessandro, 2002; Hammen & Watkins, 2008; Lewinsohn, Joiner, & Rohde, 2001). The suggestion here is that cognitive schemas or dysfunctional thinking styles represent the diathesis. These are activated in ways that are

self-deprecating, eliciting a sense of helplessness and worthlessness, and ultimately leading to depressive symptom presentation.

The effects of depression on attention

The effects of depression on attention are discussed at length in the following chapter. However, at this point, some general conclusions can be drawn from the above literature and how this relates to attention. As noted, symptoms of depression affect several domains, including that of cognitions. It has been found that difficulties in language (such as word-finding), slowing of motor speed, and difficulties problem-solving are common cognitive declines found in depressed individuals (Johnson & Proctor, 2004). Deficits in both memory and attention are also recognised in depressed populations. However, not all types of attention appear to be affected by depression. More specifically depression has its greatest impact on selective attention, whereas attention span and divided attention are relatively unaffected (Eizenman et al., 2003; Johnson & Proctor, 2004; Suslow & Dannlowski, 2005).

In order to attend to a particular stimulus (target), other stimuli (distractors) must be rejected (Johnson & Proctor, 2004). Accordingly, the aforementioned theories indicate that, in general, depression interferes with attentional ability by drawing attention to negative stimuli and away from other affective stimuli (Mathews & MacLeod, 2005). This results in maintained attention on negative stimuli as well as filtering out positive stimuli, leading to attention being attended to for longer periods of time by depressed individuals compared with non-depressed individuals. Additionally, exposure to, and regular engagement with negative stimuli is theorised to lead to hyperattentiveness towards mood-congruent stimuli, such that depressed individuals being exposed to negative material are primed for it, which leads to further attention being paid to negative stimuli (Bower, 1981). Therefore, these theories suggest that mood not only influences where attention is allocated, but how long stimuli are attended to (Johnson & Proctor, 2004).

Summary

The major distinction between these theories on depression is one of endurance versus latency. The diathesis-stress model and A. Beck's (1967) theory suggest the trait-like existence of enduring negative biases is implicated in depression (Bouhuys et al., 1999). Conversely, Teasdale's (1988) theory views negative biases as state-dependent, thus only occurring during the depressive episode. Nonetheless, the foundations of these theories share some commonalities. On some level, they all suggest that the existence of a negative

bias contributes to the persistence of depression, operating in many areas of information processing. Therefore, unhelpful, biased information processing can be implicated in the etiology of depression, specifically in connection to attentional biases. The negative bias is the principal attentional bias associated with depression, which forms the topic of the next chapter.

Chapter Two

ATTENTIONAL BIAS

This chapter begins with a brief overview of attention, including neural and hypothetical models of attention, with an emphasis on visual attention. Cognitive biases are highlighted, with prominence given to attentional and negative biases. A review of the research literature is presented with a discussion of the more frequently recognised pitfalls known to occur when investigating negative biases. Next, the literature on attentional and negative biases in older adults is considered. In light of the present study comprising of two experimental stages (eye tracking and rating), this chapter concludes with a brief outline of the literature pertaining to the interpretation of emotional stimuli for both younger and older adults, which relates to the rating component of the present study.

ATTENTION

Attention – in hearing the word most would have a reasonable understanding of what this term means. Yet what seems like a fairly basic term is really not a simple concept. It is best thought of as a hypernym for a range of psychological phenomena, including concentration, focus, memory, perception, and information processing (Pashler, 1998; Styles, 2006).

William James (1890) distinguished between two types of attention: *active* and *passive*. Active attention occurs in a controlled manner, governed by an individual's goals and expectations (e.g., reading a book), and is understood as a kind of top-down processing. Passive attention occurs in an external fashion, usually interrupting one task to attend to another (e.g., the phone ringing interrupting the reading of a book), and is understood as bottom-up processing (Eysenck & Keane, 2010). Central to the concept of attention are two primary themes: *selectivity* and *capacity limitation*. The former concept refers to the prioritisation of information being processed, while the latter concept alludes to the notion that the prioritisation of material is restricted by the amount of attention being paid elsewhere (Matthews & Wells, 1999; Pashler, 1998).

A range of different types of sensory attention can occur, including olfactory, auditory, tactile, and visual. Some may occur more frequently than others, while some of these can occur through divided attention. However, divided attention is often at the mercy of capacity limitations. Although different types of attention to sensory input may occur simultaneously, visual attention is the focus of the present study.

Neural circuitry of attention

The advanced processing of visual stimuli is thought to occur via two neural pathways, as shown in Figure 2.1. The early processing of visual stimuli occurs in the primary visual cortex, Area V1, located in the occipital lobe, before further processing via one of two pathways (Pashler, 1998). The ventral visual pathway is thought to control object-based and cognitive processing (Duchowski, 2007; Weierich & Feldman Barrett, 2010). It encompasses neural processes that allow for the recognition of objects and faces, hence also being known as the 'what' pathway (Pashler, 1998). The dorsal visual pathway, also known as the 'where' pathway, links the occipital and parietal lobes. In the parietal lobe visual stimuli are managed in terms of sensorimotor processing where, amongst other things, the spatial location of visual stimuli is determined (Duchowski, 2007; Pashler, 1998; Weierich & Feldman Barrett, 2010). While these separate pathways exist, there is considerable overlap of functions.

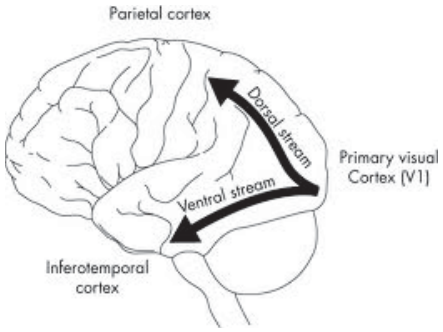

Figure 2.1. Graphical overview of two neural visual pathways.

Visual attention

Visual attention refers to the process of shifting the eyes to locate a stimulus and to fixate upon it (Duchowski, 2007). However, fixating on a particular spot in the visual field does not totally remove awareness of nearby areas. For example, when fixating on this asterisk: *, one can notice surrounding words, page edges, and even the background it is placed upon (Styles, 2006). Similar to James' (1890) concepts of active and passive attention, in visual attending, *endogenous spatial attending* refers to deliberate, intentional, goal-directed attending to a specific location, while *exogenous spatial attending* refers to involuntary visual attending, which is triggered by an external stimulus such as a loud noise (Eysenck & Keane, 2010). Exogenous spatial attending often occurs through the detection of stimuli in the periphery, which is why exogenous cues are also known as peripheral cues (Johnson & Proctor, 2004). It is generally accepted that the endogenous stimulus fixated on is, for some

finite period of time, the object of one's attention and is brought into awareness and processed accordingly (Duchowski, 2007). Therefore, eye gaze can be considered an index of visual attention.

Integrated competition hypothesis

The integrated competition hypothesis (Duncan, Humphreys, & Ward, 1997) is a useful way of thinking about how capacity limitations occur in attention. The foundations of this hypothesis rest on the notion that, because of the sheer volume of stimuli in the environment, all aspects of stimuli entering the brain cannot be interpreted and retained. Therefore, competition among stimuli occurs (Ruff, 2011). There are three central tenets to this hypothesis. Firstly, visual input activates many brain systems. These systems can be activated by different types of input, which ultimately compete. According to this principle, a gain in activity in one system results in a loss in activity for other systems (Desimone & Duncan, 1995). Secondly, as brain systems are interconnected, when a dominant activity emerges in one system, other systems treat it as the dominant activity too, providing more attentional resources for that stimulus (Duncan et al., 1997). As a result, attention is directed towards the dominant stimulus while previously competing stimuli are suppressed. Thirdly, attention can be directed to relevant stimulus properties through goal-directed or top-down processing. This occurs when, for example, participants are required to visually search for particular colours, numbers, or letters. The advantage provided to a specific brain system is that it is primed to respond (attend) to the instructed stimulus, whereas other brain systems are not (Duncan et al., 1997). However, these top-down processes can also refer to cognitive processes implicated in depression. Thus, individuals who experience depression are likely to be primed to attend to negative stimuli more readily than non-depressed individuals.

Attention in older adults

Early studies had reported attentional deficits in the elderly (Backman, 1989), and for some time this appeared to be the commonly held consensus. However, the generalisation of attentional deficits in aging has been challenged more recently. Indeed, age-related decline appears to be dependent on the complexity of the task being attended to (Cavanaugh & Blanchard-Fields, 2015). More specifically, while attentional deficits can be seen in older adults (e.g., divided attention), these are typically seen when tasks become complex or when older individuals experience difficulty with tasks (Grady, 2012; Rizzuto, Cherry, &LeDoux, 2012). Furthermore, attentional problems are minimised when training or guidance is

provided, thus suggesting that deficits may be moderated by the novelty of the task or lack of clear instruction (Backman, 1989; Cavanaugh & Blanchard-Fields, 2015).

ATTENTIONAL BIAS

Research addressing the link between cognition and emotional disorders has focussed on a range of cognitive biases, including memory, the interpretation of ambiguous material, inhibitory control, reasoning, and attention (Fox & Georgiou, 2005; Hertel & Mathews, 2011; Mathews & MacLeod, 2005; Peckham, McHugh, & Otto, 2010). Evidence shows that individuals with depression exhibit memory biases (they are more prone to recall negative information; e.g., Bradley & Mathews, 1988; Dalgleish & Watts, 1990; Mathews & Bradley, 1983; Mathews & MacLeod, 2005), and interpretation biases (they interpret information in a more negative manner; e.g., Mogg, Bradbury, & Bradley, 2006). However, the research surrounding attentional biases is less clear.

As attentional biases are believed to be mood-congruent in nature (Koster, De Raedt, Goeleven, Franck, & Crombez, 2005; Williams, Watts, MacLeod, & Mathews, 1988), different mood states can lead to hyper-attentiveness to certain stimuli. Most of the research in this area has focused on two specific types of mood state: anxious and depressed. The majority of the literature, and corresponding research, has focused on anxiety. A consistent finding is that individuals with anxiety experience attentional biases towards threat-related material when compared with controls (Bradley, Mogg, & Millar, 2000; Eysenck & Keane, 2010; MacLeod, Mathews, & Tata, 1986; Mogg & Bradley, 1998).

The specific attentional bias thought to occur in depression is the *negative bias*, so called because of the theoretical link between depressed mood and increased attending to negative stimuli. This negative bias is thought to be a causal factor in the development of depression (Wells & Beevers, 2010). Whereas research has produced reasonably convincing findings regarding attentional biases in anxiety, the literature is less conclusive regarding the existence of attentional biases in those experiencing depression[2]. There are several possible explanations for this, detailed in the following section.

[2] From here on in, the term *negative bias* will refer to attentional biases in depression.

Research methods

Research methods employed to identify the existence of negative biases have changed considerably over time. Earlier research investigating the negative bias has often been conducted using lexical stimuli (e.g., emotional Stroop task, dot detection task, deployment-of-attention task; Gotlib, McLachlan, & Katz, 1988; MacLeod et al., 1986; McCabe & Gotlib, 1995; Williams & Nulty, 1986). The dependent measure for these tasks is typically reaction time.

The emotional Stroop task requires participants to read aloud the colour of the ink emotionally valenced words are printed in. The reasoning behind this task is that participants experiencing emotional disorders, when compared to controls, will show delays in colour-naming for words congruent with their emotional state (Peckham et al., 2010). However, it has been shown that when the emotional Stroop task is employed, differences found between depressed and non-depressed individuals are more likely the result of psychomotor slowing in the depressed sample than actual attentional differences (Kertzman et al., 2010).

The dot probe task, developed by MacLeod et al. (1986), involves the simultaneous presentation of two words – one emotionally valenced, the other neutral. Following the presentation of the stimuli on a computer screen, a dot is presented, spatially-located where either word was previously displayed. Participants are required to press a button as soon as the dot is visually detected. Detection latency is the dependent measure, with the general principle being that emotionally valenced words would hold the attention of individuals experiencing emotional and affective disorders more than normal controls. When the dot appears on the opposite side of the screen from the emotionally valenced word, a greater attentional shift is needed, thus increasing response latency in these individuals.

The deployment-of-attention task (DOAT; Gotlib et al., 1988) involves a series of word pairs being presented, each word pair differing in combinations of emotionally valenced words (e.g., depressed-neutral, manic-neutral, or depressed-manic). Word pairs are then replaced with coloured bars presented simultaneously. The participant is then required to state which colour bar was presented first. The assumption is that whichever word was previously displayed where the stated colour bar appeared was the word being attended to. According to Gotlib et al. (1988), the DOAT does not rely on reaction time, making it a more appropriate

task than the emotional Stroop and the dot probe when researching negative biases. This is because depression may affect reaction time due to psychomotor slowing.

As indicated, the evidence supporting a negative bias in depression is equivocal. Yet it seems that there is slightly more support for the existence of a negative bias (e.g., Bradley, Mogg, & Lee, 1997; Gotlib & McCann, 1984; Gotlib, Krasnoperova, Neubauer Yue, & Joorman, 2004; Nunn, Mathews, & Trower, 1997; Joorman & Gotlib, 2007; Shane & Peterson, 2007) than not (e.g., Gotlib et al., 1988; MacLeod et al., 1986; McCabe & Gotlib, 1995; Mogg, Bradley, Williams, & Mathews, 1993; Mogg, Millar, & Bradley, 2000). However, there are plausible explanations in some studies where a negative bias was not found. For instance, MacLeod et al. (1986) using a dot probe task to investigate attentional biases in both depressed and anxiety-disordered participants, used only threat-related stimuli. In keeping with the mood-congruent nature of attentional biases, it is not surprising that no evidence for a negative bias was found in the depressed sample when dysphoric or negative material was not used.

Different results in the literature could stem from the different stimuli used. As noted, most of these tasks typically use lexical stimuli, but some studies have used pictures or faces instead of words (e.g., Bradley, Mogg, & Lee, 1997; Bradley et al., 2000; Gilboa-Schechtman, Ben-Artzi, Jeczemien, Marom, & Hermesh, 2004; Gotlib et al., 2004; Joorman & Gotlib, 2007; Mogg et al., 2000; Shane & Peterson, 2007). However, in a meta-analysis investigating the magnitude of negative biases, no significant differences were found between studies using lexical tasks and those using non-lexical tasks (Peckham et al., 2010).

Other possible reasons for the contradictory findings in negative biases is that the tasks used have been criticised for their lack of ecological validity, the use of ambiguous material, the presentation of single stimuli (e.g., Stroop task), and poor ability to differentiate between attentional effects and other factors such as motor response and response selection (Bradley et al., 2000; Eizenman et al., 2003; Peckham et al., 2010; Suslow & Dannlowski, 2005). Furthermore, these tasks are unable to provide information about the time course of attention allocation. That is, are negative biases evident at certain stages of information processing but not at others?

Information processing stages

In an attempt to understand the lack of consistent research findings, investigations have turned to stages of information processing to understand these inconsistencies. The suggestion here is that negative biases occur at later stages of processing than attentional biases in anxiety (Gotlib et al., 2004; Mathews & MacLeod, 2005; Mogg & Bradley, 2005). Some studies that did not find support for a negative bias presented stimuli subliminally (e.g., Mogg et al., 1993; Mogg, Bradley, & Williams, 1995). But when stimuli are presented for longer periods of time, evidence for a negative bias is found. For example, Bradley, Mogg, and Lee (1997) found a negative bias in depressed participants when negative words were presented for 500 milliseconds and 1000 milliseconds. The same negative bias was not evident when negative words were presented for 14 milliseconds. However, in the 14 millisecond condition, anxious participants showed an attentional bias towards threatening words, suggesting that a negative bias is evident in later stages of processing, while attentional biases are evident in pre-conscious levels of processing (this is sometimes referred to in the literature as effortful versus automatic processing). Evidence of a negative bias found under longer durations of stimulus presentation have been found in other studies (e.g., Gotlib et al., 2004; Shane & Peterson, 2007).

Not all studies using longer durations for stimulus presentation have found evidence of a negative bias (e.g., Mogg et al., 2000). Similarly, not all psychophysiological studies have found support either. For example, in an event-related potential study Deldin, Keller, Gergen, and Miller (2001) found no evidence of a negative bias in depressed participants. Interestingly, they found evidence of a 'positivity bias' (discussed in further detail later in this chapter) in the control group.

The concept of negative biases occurring in later stages of processing, however, is somewhat simplistic in that attentional processing cannot be considered unitary (Bradley, Mogg, & Lee, 1997). As distinct components of attentional processing exist, such as shifting and maintaining attention (Allport, 1989; LaBerge, 1995), it seems plausible that negative biases may be the result of impairment in some attentional processes but not in others. Posner and Peterson (1990) have posited that the orienting of attention involves attentional shifting, engagement, and disengagement. In an attempt to explain why negative biases do not occur in pre-attentive stages of information processing, Bradley, Mogg, and Lee (1997) suggest that once a negative stimulus has become the focus of attention, depressed individuals are less able to disengage from it than non-depressed individuals.

Impaired disengagement

Researchers have addressed the notion of impaired disengagement. Koster et al. (2005) assessed attentional engagement and disengagement in a sample of dysphoric students, finding that, when compared to non-dysphoric controls, the dysphoric participants attended to negative stimuli. Subsequent studies have found similar results in both depressed and formerly depressed participants (e.g., Goeleven, De Raedt, Baert, & Koster, 2006). Following these findings, Koster, De Lissnyder, Derakshan, and De Raedt (2011) proposed the impaired disengagement hypothesis. Effective responding to rumination underpins this hypothesis. It is theorised that, when internal (e.g., negative affect) or external (e.g., job loss) stressors occur, ruminative thinking is triggered which is self-critical and negative in nature. The general function of (non-pathological) rumination is to generate effective problem solving aimed at tackling the rumination-causing stressor. In order to do this, cognitive conflict occurs, with the preferred outcome being the self-regulation of emotions. If the cognitive conflict is high, disengagement from negative thoughts will occur, allowing the individual to reappraise the situation or divert attention towards positive distracters. But if cognitive conflict is low, prolonged rumination occurs. According to the hypothesis, this is likely the result of two possibilities. Firstly, low cognitive conflict may be caused by negative self-schemas whereby increased negative self-thinking does not elicit enough cognitive conflict. This possibility has been supported by research that has found low cognitive conflict in depressed individuals when presented with negative stimuli (Foti & Hajcak, 2010). Or, secondly, the presence of low attentional control causes inward focus that maintains attention for self-referent negative information.

Although support has been found for this hypothesis (e.g., Koster et al., 2011; Koster et al, 2005; Goeleven et al., 2006), discrepant findings have also been reported. For instance, van Deurzen et al. (2006) attempted to replicate the Koster et al. (2005) study without success. Rather than the hypothesised difficulties disengaging from negative stimuli, the van Deurzen study found the presentation of negative stimuli facilitated disengagement. However, this study presented stimuli for 1000 milliseconds as opposed to 1500 milliseconds by Koster and colleagues. Furthermore, the van Deurzen study does not clearly outline how they determined which participants qualified as 'depressed'. Rather, they mention, "using the full spectrum of depressive symptoms instead of dichotomized groups" (p. 259), with the most severely depressed participants (determined by a score of 14 or greater on the BDI) consisting of only nine of the 85 participants. Therefore, it is possible van Deurzen and

colleagues did not find support for the disengagement hypothesis due to too few participants being depressed in addition to the brevity of stimulus presentation.

The idea of impaired disengagement has been further supported by research that has found no evidence for a bias in initial orienting to negative stimuli (Caseras, Garner, Bradley, & Mogg, 2007; Kellough, Beevers, Ellis, & Wells, 2008; Sears, Thomas, LeHuquet, & Johnson, 2010). That is, when presented with competing, emotionally valenced stimuli, depressed and non-depressed individuals do not differ in the type of emotional image (e.g., negative, positive, threatening, neutral) initially oriented to. Therefore, it appears that attention is not drawn to negative stimuli in depressed individuals. Rather, once a negative stimulus has been attended to, depressed individuals find it difficult to shift attention away from this. What is not known is whether depressed individuals, if capable of disengaging in a similar manner to non-depressed individuals, would shift their attention towards more positive stimuli. Based on the aforementioned research, it appears that depressed individuals have a greater propensity to maintain attention towards negative stimuli, thus implicating impaired disengagement in the perpetuation of depression (Caseras et al., 2007; Kellough et al., 2008).

Protective and positivity bias

A further point of contention in the negative bias literature is the proposition that non-depressed individuals have a 'protective bias' whereby they are better able to disengage from negative stimuli, or a 'positivity bias' in which positive stimuli are favoured (Bradley, Mogg, Millar et al., 1997; Gotlib et al., 1988; Mogg et al., 1991). It is unclear how (or if) these positive biases are somehow different from impaired disengagement in depressed people or whether it is simply the opposite side of the same coin. However, support for the positive biases in non-depressed individuals has stemmed from research suggesting an 'even-handedness' in depressed individuals when attending to negative, positive, and neutral stimuli. That is, this view holds that there is no evidence of a negative bias in depressed individuals who exhibit equal levels of attention to different types of emotional stimuli. Conversely, non-depressed individuals have been found to shift their attention towards positive stimuli or have shown avoidance of attending towards negative stimuli (Gotlib et al., 1988). Support for a positivity bias has been found in both experimental and neuropsychological studies (e.g., Deldin et al., 2001; Joorman & Gotlib, 2007).

Having said this, the evidence for a positivity or protective bias is not unequivocal, with similar even-handedness also being found in control groups. For example, no attentional

bias was found in control groups when presented with depressed, manic, or neutral words (e.g., Gotlib & McCann, 1984) or sad, happy, angry, or threatening faces (e.g., Gotlib et al., 2004; Mogg et al., 2000). Furthermore, some studies have found evidence for a positivity bias in non-depressed controls as well as a negative bias in depressed participants (e.g., Joorman & Gotlib, 2007; Nunn et al., 1997). Given these findings, and considering the mood-congruent nature of attentional biases, the most appropriate stance to take regarding negative biases is that depressed individuals demonstrate a negative bias while non-depressed individuals demonstrate a protective or positivity bias.

ATTENTIONAL BIAS IN OLDER ADULTS

While numerous studies have investigated the existence of a negative bias in depressed adults (Bouhuys et al., 1999; Bradley et al., 2000; Goeleven et al., 2006), the same cannot be said for older adults. Although there has been reasonable interest in researching attentional biases in non-clinical older adults, there is a paucity of research that has investigated negative biases in older *depressed* individuals.

Non-clinical samples

Regarding age-related differences in non-clinical samples, there is clear evidence that older adults selectively attend to positive stimuli more than younger adults (Carstensen & Mikels, 2005; Mather & Carstensen, 2003, 2005). Some researchers have applied the term *positivity effect* to describe this shift away from negative information and towards positive information in older age (Reed & Carstensen, 2012; Samanez-Larkin, Robertson, Mikels, Carstensen, & Gotlib, 2009). The Socioemotional Selectivity Theory (SST; Carstensen, 1992), a life-span theory of motivation, has been proposed to explain the increased positivity found in aging (Carstensen, 2006; Carstensen, Isaacowitz, & Charles, 1999). According to this theory, the perception of time left in life motivates individuals towards certain types of goals. When the future is perceived as lengthy, goals are typically future-oriented, and involve the pursuit of relationships and acquisition of knowledge (Carstensen, Mikels, & Mather, 2006). When the future is perceived as limited, goals become present-oriented, whereby emotional gratification and meaningfulness in present experience are favoured (Murphy & Isaacowitz, 2008). It is this present-oriented focus on emotional gratification that is implicated in the positivity bias found in older adults. This theory differs from other life span theories in that it is the *perception* of time that is relevant, rather than actual chronological time (Carstensen et al., 2006). So, while it would stand to reason that younger adults would perceive a lengthier

future than older adults, the SST posits that when younger adults perceive their future as time limited, or older adults perceive their future as relatively lengthy, age-related differences in positivity effects are diminished (Reed & Carstensen, 2012).

Clinical samples

Of the limited research investigating negative biases in older depressive adults, none involved comparisons across age groups. Three studies were found, two of which provided support for negative biases in older depressed individuals when compared to non-depressed same-aged peers (e.g., Broomfield, Davies, MacMahon, Ali, & Cross, 2007; Dudley, O'Brien, Barnett, McGuckin, & Britton, 2002). Interestingly, the Dudley et al. (2002) study also included a group of Alzheimer's patients, finding the Alzheimer's sample performed similarly to the control group, while the depressed sample showed increased response time to negative words in an emotional Stroop task.

McIlwraith (2009) used a dot probe task and found no evidence for a negative bias, which was contrary to the study's expectations. However, this study did not control for comorbid anxiety in the depressed sample, with over 50% meeting criteria for a comorbid anxiety condition. In fact, in some cases as many as *three* coexisting anxiety conditions were present in the same participant. Thus, it is plausible that when participants experience both depression and anxiety, that an attentional bias for anxiety dominates a negative bias.

While it is risky to draw conclusions from such a small body of literature, it appears that when depressed, older adults perform similarly to their younger depressed counterparts, showing hyperattentiveness towards negative stimuli. It seems that the mood-congruent nature of attentional biases holds true for older adults as well as younger adults. If this is the case, then cognitive theories of depression are likely to be applicable to older as well as younger adults.

SUMMARY OF THE NEGATIVE BIAS LITERATURE

To summarise, a raft of methods and stimuli have been used to investigate the existence of a negative bias in depressed individuals with findings being equivocal. Plausible explanations for these varying results are many. Firstly, the type of task employed has been criticised for not providing a sensitive enough measure of attention, with results confounded by the lack of mood-congruent stimuli used or person-specific factors such as motor-response slowing.

Secondly, the brief duration of stimulus presentation has been implicated in the lack of bias-consistent findings. That is, the time course of attention allocation has been highlighted as an important factor in identifying negative biases, with it commonly recognised that negative biases occur in later stages of information processing, while attentional biases in anxiety occur in earlier, pre-conscious stages of information processing. Thirdly, rather than having an attentional bias towards negative stimuli, it has been posited that depressed individuals may experience difficulty disengaging from negative stimuli. Finally, the converse has also been proposed, whereby non-depressed individuals possess a protective or positivity bias. That is, depressed individuals may not possess a negative bias; rather, the lack of a protective or positivity bias is contributing to the differences in attending to both positive and negative material in depressed and non-depressed individuals.

There are several explanations for these alternative research findings. Nonetheless, it appears that depressed individuals, under certain experimental conditions, are prone to attend to negative stimuli more so than their non-depressed counterparts. Although there is a scarcity of research investigating negative biases in older depressed individuals, it seems that older and younger depressed individuals perform similarly on experimental tasks, and in a different manner to their non-depressed counterparts.

NEGATIVE INTERPRETATION BIAS

The manner in which individuals selectively attend to various emotional stimuli demonstrates how attention is allocated in different ways depending on an individual's mood state. However, it does not provide information about the way different stimuli are interpreted. At this point, a distinction is necessary between making *interpretations* at the time information is presented, as opposed to making *judgements* about events from the past or future (Mathews & MacLeod, 2005).

The theories used to explain mood-congruent effects in attention also apply to other aspects of information processing, including memory, learning, interpretations, and judgements. For example, A. Beck's (1967) cognitive theory suggests that through the development of negative schemata, mood-congruent effects can operate on interpretation and other areas of information processing. Other theories that consider the mood-congruent nature of information processing include Bower's (1981) network theory, which incorporates the notion of *thought congruity*. Thought congruity refers to the mood-congruent judgements,

thoughts, interpretations, and free associations that an individual experiences (Eysenck & Keane, 2010). Similarly, the Affect Infusion Model (AIM), through the complementary dual mechanisms of affective-priming and heuristic processing, holds that affective information exerts an influence on processing and becomes incorporated into judgements and prejudicing them (Forgas, 1995, 1999). In the case of depression, priming towards negative information and negative heuristic processing leads to judgements that are also negative.

Common across all these theories is the mood-congruent nature with which information is processed, something that is supported by the research literature. For instance, in a mood induction experiment, Forgas and Locke (2005) found, that when presented with workplace situation vignettes, current mood state influenced judgements such that participants in a negative mood provided more critical judgements while those in a positive mood were more optimistic.

Inducing positive and negative mood states in experimental groups does not necessarily reveal information about clinical populations, as the mood state is transient and may not reflect similar patterns of interpretative processing in those with depression of a more pervasive nature. In assessing interpretation biases with depressed samples, Hindash and Amir (2012) used a word sentence association task which required participants to read an ambiguous statement (e.g., "You get a new job") displayed on computer screen. Such a statement is followed by either a negative (e.g., "Unqualified") or benign ("Qualified") unambiguous word associated with the statement. Participants are required to indicate if the statement and the word are related. The dependent measures are both endorsement rate and response latency. For the negative words, it was found that depressed participants endorsed these more than non-depressed participants, and were faster in their response times, providing evidence for a negative interpretation bias. Conversely, non-depressed participants endorsed more benign words, although no group differences were found for response latencies. Additional evidence for a negative interpretation bias has been supported by other studies (e.g., Beevers, Wells, Ellis, & Fisher, 2009; Lawson, MacLeod, & Hammond, 2002; Safford, Alloy, Abramson, & Crossfield, 2007).

Some studies, however, have failed to find evidence of an interpretation bias. Using a similar (auditory rather than visual) semantic priming task to Hindash and Amir (2012), Bisson and Sears (2007) presented ambiguous auditory statements, followed by negative, positive, or neutral words. It was expected that depressed participants would produce

larger response latencies for negative words, but findings failed to yield support for this hypothesis. Likewise, Lawson and MacLeod (1999) found no evidence of a negative interpretation bias, also using a semantic priming task. Instead, they found the non-depressed group demonstrated greater priming effects for negative words, something that was expected from the depressed group.

While research findings have been equivocal, clarification may come in the form of additional research that has found mixed evidence for negative interpretation biases within the same study (e.g., Mogg et al., 2006; Sedikides, 1994; Wenzlaff and Bates, 1998). For instance, in a study that asked participants to describe themselves after a mood-induction task, it was found that sad mood resulted in mood-congruent (negative) self-descriptions initially, but over the course of time, self-descriptions became more positive (Sedikides, 1994). Subsequently, it has been suggested that negative interpretation biases may be produced when information processing involves more extensive processing but not when simple interpretations can be made (Eysenck & Keane, 2010; Forgas & Locke, 2005). Indeed, the AIM identifies four processing strategies, noting that some involve affect infusion while others do not (Forgas, 1995). Briefly, the *direct access* strategy refers to the retrieval of crystallised, pre-existing cognitive content. The *motivated processing* strategy occurs in relation to a pre-existing goal. Affect infusion does not influence either of these strategies, which require little constructive processing. Conversely, *heuristic processing* is employed when simple, relatively effortless processing is needed. This relies on limited information being available, with no motivational goal or pre-existing knowledge, and is therefore guided by current emotion (Eysenck & Keane, 2010). Finally, *substantive processing* involves relating existing knowledge to the selection, learning, and interpretation of information, using the most constructive processing strategy (Eysenck & Keane, 2010; Forgas, 1999).

Because the substantive processing strategy requires the most constructive processing it is believed to be heavily governed by current mood state. These latter two strategies are thought to involve affect infusion, either indirectly (through priming effects) or directly (Forgas & Bower, 1988). Therefore, negative interpretation biases are theorised to occur more readily under these constructive processing conditions. For instance, Mogg et al. (2006) found no evidence for a negative interpretation bias when depressed participants were presented with a semantic priming task. However, support was found when the same participants were presented with a homophone task. This involved listening to a word with two possible spellings (either negative or positive, e.g., dye/die or pane/pain) and the

participants were asked to write the word down. As hypothesised, depressed participants wrote more negative words than the non-depressed participants. Further, the Mogg et al. study included a rating and recall task whereby participants listened to a list of positive and negative words in which they were asked to indicate (yes/no) if the word described them. This was immediately followed with a not previously revealed recall task in which participants were asked to recall as many words as possible within a 2-minute time frame. Results showed that depressed participants endorsed more negative words as self-descriptive, and recalled more negative words than the non-depressed participants.

The idea that negative interpretation biases are more likely to occur when the presented stimuli are self-referent has been further supported by Hertel and El-Messidi (2006). They used a homograph task to compare depressed and non-depressed individuals. In this task, participants are provided with a word that has one spelling but can have a negative or neutral meaning (e.g., tear meaning either to rip or to cry). Participants were requested to compose a sentence using the word, with the prediction that depressed participants would construct sentences using the word's negative connotation, while non-depressed participants would construct sentences using positive connotations. However, in each mood group, participants underwent a thought induction task resulting in half the participants completing a self-focused thought induction, while the other half completed an other-focused thought induction. While depressed participants constructed more negatively connoted sentences, this was only the case for those given the self-focused thought induction.

While there appears to be reasonable evidence of a negative interpretation bias in depressed individuals, it is not known if similar biases would be found in older adults. A search of the literature did not reveal (published) research on interpretation biases pertaining to older adults. However, a myriad of research exists in relation to memory and attentional biases in older adults, revealing a positivity effect in this cohort (Carstensen & Mikels, 2005). Accordingly, older adults generally focus more on positive stimuli than their younger counterparts. As outlined previously, there is a distinct lack of research investigating cognitive biases in older adults with depression or low mood. Nevertheless, it appears that positive and negative biases are relatively robust across the different types of cognitive biases. Based on the aforementioned findings from attentional biases in older depressed adults, it is likely that they would also exhibit a negative interpretation bias.

SUMMARY OF THE NEGATIVE INTERPRETATION BIAS LITERATURE

Although the findings from various studies have been mixed, there appears to be more support than not for a negative interpretation bias in depressed individuals. Certainly, this evidence appears more robust when stimuli are self-referent, allowing for more elaborative processing. Still, evidence for a negative interpretation bias also exists when these conditions are not met, suggesting that depressed individuals have a propensity towards generating negative interpretation biases, as Beck's (1967) cognitive theory would predict. However, studies have neglected to address age-related differences in interpretation biases; tentative conclusions have to be made from studies relating to other types of cognitive biases. These suggest that non-depressed older adults are more positive than their younger counterparts, while older non-depressed adults are negatively biased in a wide range of cognitive domains. What is not known, given the lack of studies investigating age-related differences within a particular mood group, is whether older and younger depressed, or non-depressed, individuals would differ in cognitive biases.

Chapter Three

EYE TRACKING

The use of eye tracking as a research method is initially considered, including discussion of the dependent measures typically used to assess negative biases in the eye tracking field. This is followed by a review of the limited number of studies that have employed eye tracking methods to investigate negative biases. The chapter concludes with a brief appraisal of the literature pertaining to age-related differences in cognitive biases that have also utilised eye tracking methods.

APPROPRIATENESS OF EYE TRACKING AS A RESEARCH METHOD

The previous chapter provided an overview of the negative bias literature, emphasising more traditional research methods. Many of these traditional methods have been criticised for their limited ability to capture attentional processing, or limitations in controlling for extraneous variables (e.g., relying on response time which is affected by psychomotor slowing in depression). However, more recently, technological advances have allowed for attentional and negative biases to be assessed through the tracking of eye movements. It has been suggested that eye tracking methods provide a continuous display of visual attention allocation over an extended period of time that is rapid, naturalistic, and automatic (Hermans, Vansteenwegen, & Eelen, 1999; Jonides, 1981; Sears, Newman, Ference, & Thomas, 2011). Thus, it can be argued that the focus of attention and direction of eye gaze are tightly connected. Therefore, by tracking an individual's eye movements, the path of attention can be followed (Duchowski, 2007; Wright & Ward, 2008).

As previously mentioned, depression can cause psychomotor slowing, which has been problematic in studies relying on response time as an indicator of negative bias (Broomfield et al., 2007). However, eye movements are deemed to be relatively unaffected by psychomotor slowing, further supporting the application of eye tracking as an appropriate method in assessing negative biases (Mogg et al., 2000). Additionally, several studies have attempted to determine if there is a difference in response latency in initial orienting towards presented stimuli between depressed and non-depressed individuals. Results show no differences in the response time between these two groups in how quickly they attend to presented stimuli, further suggesting that eye movements are unaffected during depressive episodes (e.g., Caseras et al., 2007; Mogg et al., 2000).

Measurement of negative bias through eye tracking

Most eye tracking studies present competing emotional stimuli and record eye movements to ascertain how long different images are viewed. Thus, the broad measurement of interest in assessing negative biases is *time*. There are several ways that time has been operationally defined. Consistent across most eye tracking studies has been the comparison between groups of the total amount of time spent viewing the presented stimulus, often referred to as fixation time (Eizenman et al., 2003; Leyman, De Raedt, Vaeyens, & Philippaerts, 2011). Some researchers treat this as absolute time while others convert it to a percentage of total time (Kellough et al., 2008). Nonetheless, the notion of 'total time' refers to the complete amount of time spent viewing a particular region, section, or emotionally valenced image.

Measuring total amount of time does not establish if there are problems with engagement or disengagement. To investigate this, researchers also gather data on the number of times a region was fixated on, also referred to as fixation frequency. That is, how many times gaze is directed to, and re-directed to, a particular image. If problems with disengagement are evident in depressed individuals, it would seem logical that depressed individuals would have relatively low fixation frequencies when viewing negative material. However, in line with Beck's (1967) cognitive theory, it could also be that depressed individuals are hyperattentive to negative material, resulting in the frequent re-engagement with this material. Therefore, while fixation frequencies provide useful information in terms of engagement and disengagement, it is a supplementary measure that should be used in conjunction with other dependent measures. Caution is needed with this measure, as the number of fixations does not directly relate to total time. For example, a depressed individual may obtain one fixation frequency for a particular image, compared with five for the same image by a non-depressed individual. However, the total time for the depressed individual may be 6 seconds but only 3 for the non-depressed individual.

In order to combat problems with fixation frequencies, a third measure is typically obtained in the negative bias/eye tracking literature. The average glance duration, often calculated by dividing the total time by fixation frequency, allows the average amount of time spent within the boundaries for each defined screen area to be established. This allows researchers to establish the amount of time, on average, that an individual spends looking at a particular image each time that attention is drawn to that area.

The way negative biases are assessed through eye tracking does not rely on the exact specifics of the image that are fixated on. The dependent measure is time spent within the specified boundaries of an image but where the eye fixated within the boundaries is usually unimportant. While there are studies that are interested in where the eye fixates, or in following the trajectory of gaze (e.g., Rutherford & Towns, 2008), eye tracking studies investigating negative biases are not.

FINDINGS FROM PREVIOUS EYE TRACKING STUDIES

Whilst a large body of research exists that has investigated the presence of a negative bias in depressed individuals (Bouhuys et al., 1999; Bradley et al., 2000; Goeleven et al., 2006), very little research has been conducted with such individuals using eye tracking techniques. The vast majority of studies using eye tracking have focused on anxiety and the affiliated attentional bias. Very few studies have been conducted investigating negative biases in depression through eye tracking. Of the studies that have examined depression, the majority provide relatively robust support for the existence of a negative bias.

The seminal work investigating negative biases through eye tracking was conducted by Eizenman and colleagues (2003). They investigated the presence of a negative bias by presenting participants (n = 8 depressed; n = 9 controls) with slides displaying, in quadrant style, four emotionally themed images (social, neutral, threatening, and dysphoric) while tracking their eye movements. Three dependent measures were observed: fixation time, fixation frequency, and glance duration. It was found that depressed participants spent more time viewing dysphoric images than controls. However, no differences were found between groups for fixation frequency, providing support for the hypothesis that depressed participants find it difficult to disengage from dysphoric images through maintained engagement with negative stimuli. Interestingly, it was also found that both depressed and non-depressed participants had similar glance durations when viewing social, neutral, and threatening themes. Glance duration times were significantly larger for depressed individuals viewing dysphoric images, suggesting that depressed individuals selectively attend to mood-congruent material.

In response to the very small sample size in the Eizenman et al. (2003) study, several researchers have attempted to replicate this study. For instance, Kellough et al. (2008) investigated a negative bias in depressed individuals using similar methods to Eizenman et

al. (2003). With an increased sample size of *n* = 86, Kellough and colleagues found that depressed participants spent more time looking at dysphoric images. Contrary to Eizenman's study, depressed participants also had greater fixation frequencies for dysphoric images. However, no significant differences were found between depressed and non-depressed in terms of average glance duration. In addition to the three dependent measures assessed by Eizenman et al., the Kellough et al. study also investigated the orientation of the first fixation. No differences were found between depressed and non-depressed in the first image attended to, with findings revealing that all participants attended to either threatening or positive images first. This initial fixation orienting has been investigated by other researchers, all with similar findings of no differences between depressed and non-depressed individuals (e.g., Caseras et al., 2007; Mathews & Antes, 1992; Sears et al., 2011; Sears et al., 2010), suggesting that differences in negative biases become evident in later, more elaborative stages of processing.

Further support for the existence of a negative bias in depression has been found. Caseras et al. (2007) focused primarily on initial orienting; their dependent variables were gaze direction (first image fixated on), latency of first shift in gaze, and duration of gaze on first image fixated. No differences were found for the first image fixated on or for the time taken to shift initial gaze. For duration of gaze on the first image fixated, it was found that depressed participants looked at negative images longer than non-depressed participants.

Although additional support for a negative bias has also been found (e.g., Leyman et al., 2011; Mathews & Antes, 1992), no studies have found support across all dependent measures. Leyman et al. (2011) presented faces displaying emotional expressions (angry, neutral, sad, and happy) to 39 participants (*n* = 19 dysphoric). In order to test the hypothesis that cognitive biases are not caused by biased information processing through familiarity of facial features, they incorporated a face inversion element. For the face inversion trials, no differences were found between depressed and non-depressed participants. For the correctly placed face trials, depressed participants obtained greater glance durations when viewing sad faces than the non-depressed participants. No group differences were found for fixation frequency or fixation time when viewing sad faces. However, non-depressed participants spent more time looking at happy faces than depressed participants, suggesting the presence of a positivity bias.

Not all eye tracking studies have found support for a negative bias. One such study, conducted by Ellis and colleagues (2011) found evidence for a positivity bias in that non-depressed participants spent more time viewing positive stimuli, but no differences were found between mood groups when negative stimuli was presented. However, the presented stimuli were dysphoric, aversive, neutral, and positive *words.* As was seen in the previous chapter, often evidence for a negative bias in depression occurred when the presented stimulus was ambiguous, and therefore depressed individuals were considered to apply negative connotations to this material. The words selected in the Ellis et al. study were specifically chosen for their lack of ambiguity, which may have contributed to the lack of negative bias found in the depressed sample.

One other study reviewed did not find evidence for a negative bias. Mogg et al. (2000) used a dot probe task with eye tracking to investigate negative and attentional biases. Presented stimuli were faces depicting threatening, sad, or happy expressions, paired with neutral faces. They measured cognitive biases in terms of whether participants directed gaze towards or away from the different facial expressions, as well as response latency. Findings indicated that no negative bias was evident in the depressed sample. However, this study compared depressed individuals with those experiencing generalised anxiety disorder; there was no control group. Within the depressed group (n = 15), 14 participants had at least one concurrent anxiety disorder, making it difficult to differentiate the effects of anxiety from the effects of depression within the so-called depressed group. The lack of findings could have stemmed from the strong similarities between the groups in terms of anxiety conditions.

Two further studies have been conducted with mixed results. In replication of the Eizenman et al. (2003) study, Sears et al. (2010) found that depressed participants spent less time looking at positive images but no differences were found when negative images were viewed. However, they did find that depressed participants were slower at disengaging from negative stimulus compared with non-depressed participants. In a subsequent study (Sears et al., 2011), they obtained similar findings with evidence being stronger for a positivity bias than a negative bias.

Based on the aforementioned studies, it appears there is more evidence supporting a negative bias when using eye tracking methods. And while it appears that there are differences in these findings based on the different dependent measures, it can be concluded that, in general, depressed individuals do selectively attend to negative material for greater

periods of time than non-depressed individuals. This conclusion is supported by a meta-analysis conducted on eye tracking studies that found depressed individuals were characterised by a reduction in attending to positive stimuli and an increase in attending to negative stimuli (Armstrong & Olatunji, 2012).

Summary of eye tracking studies

Although there is a distinct lack of research using eye tracking methods to investigate negative biases, of the small body of research that does exist, there appears to be more evidence for a negative bias in depressed individuals than not. The two studies that did not find evidence of a negative bias were methodologically flawed, which may have contributed to their contrary findings. Two further studies reported mixed results. While these studies were unable to find evidence of a negative bias *per se*, they did find evidence of problems with disengaging from negative material by depressed individuals.

EYE TRACKING AND OLDER ADULTS

Previous research conducted in aging using eye tracking methods has been limited. Indeed, there have been no studies to date that have investigated negative biases through eye tracking in older adults *with depression.* What follows is a review of age-related differences in selective attention through eye tracking in non-clinical (i.e., euthymic) adults.

Derek Isaacowitz has conducted the vast majority of research in the area of age-related cognitive biases using eye tracking methods with relatively consistent findings. Accordingly, as was the case with more traditional methods assessing cognitive biases, there is robust evidence that older individuals exhibit a positivity bias when compared to their younger counterparts (Isaacowitz, Allard, Murphy, & Schlangel, 2009; Isaacowitz, Toner, & Neupert, 2009; Isaacowitz, Wadlinger, Goren, & Wilson, 2006a, 2006b).

While the majority of studies have used non-clinical populations, some studies have attempted to incorporate mood state as a variable. One such study, conducted by Isaacowitz, Toner, Goren, and Wilson (2008), used a mood-induction technique to produce positive, negative, or neutral mood states in their participants. Participants were presented with facial images depicting happy, sad, afraid, and angry expressions. Overall, it was found that older adults preferred neutral faces, while younger adults preferred emotional faces. Accounting for mood state, younger participants in both the positive and neutral

mood state were found to have a preference for happy faces. For older adults induced with a positive or neutral mood, performance was consistent across all four facial expression types. For the participants induced with a negative mood, mood-congruent preferences were moderated by age. That is, the older negative participants exhibited a preference away from sad and angry faces and towards happy faces. Conversely, the younger negative participants showed a preference toward angry and afraid faces. Still, these were not participants experiencing depression whereby long-lasting negative mood states would be present. Furthermore, the authors do not operationally define 'negative' moods, such that this mood state may not be similar to that experienced in depression. Additionally, determination of the different mood groups occurred through self-report, which may have been influenced by social-desirability.

In a subsequent study, Stanley and Isaacowitz (2011), using the same facial expressions and mood-induction process, categorised older and younger participants into the following mood categories: 'increasingly positive', 'increasingly negative', 'positive to neutral' and 'negative to neutral'. Overall, the 'increasingly negative' group were found to spend less time looking at happy faces compared to the 'positive to neutral' group, regardless of age.

Summary of eye tracking and older adults

There is relatively consistent evidence for a positivity bias in older non-depressed individuals that spans more traditional research methods, as well as eye tracking methods. It is difficult to draw conclusions about age-related differences in depressed individuals in relation to negative biases. The Stanley and Isaacowitz (2011) study provides the only available clue as to how older depressed individuals may compare to younger depressed individuals, with what appears to be a dominance for depression to override the positivity effects typically found in non-depressed older adults. In other words, while a positivity bias is evident in non-depressed older individuals, the presence of depression seems to deplete this effect, resulting in no age-related differences in negative biases being found in depressed older and younger individuals.

Chapter Four

PRESENT STUDY

The present study is a partial replication of the research conducted by Eizenman et al. (2003) discussed in Chapter Three. Expanding on the Eizenman study, this study includes an exploration of age-related differences between older and younger adults. In addition, a rating component is employed to investigate interpretation biases. This chapter outlines the importance of the present study, including aims and objectives, and concludes with the present study's hypotheses.

RATIONALE

The previous chapters have explored a range of topics related to depression/dysphoria and attentional, negative, and interpretative biases. The more recently employed eye tracking method was introduced, emphasising the appropriateness of its use regarding the investigation of attentional and negative biases. Although these reviewed studies have been instrumental in developing our understanding of how cognitive biases and depression/dysphoria interact, there remains a paucity of research investigating age-related differences in this area. The vast majority of cognitive biases research on older adults has focused on age alone, using non-clinical participants. Of the extremely limited research using older *depressed* participants, comparisons have been made only between mood groups within the same age cohort (e.g., depressed and non-depressed older individuals). To date, no research on negative biases has been conducted that has also compared age-related differences within mood groups (e.g., older and younger depressed/dysphoric individuals; older and younger non-depressed/non-dysphoric individuals). Furthermore, a similar lack of research pertaining to age-related differences in interpretative biases was highlighted. Accordingly, the significance of the present study is that it addresses these gaps in the literature through the following aims and objectives.

AIMS AND OBJECTIVES

The primary aim of the present study was to investigate the presence of a negative bias across two factors: Mood (dysphoric and non-dysphoric) and Age (younger adults aged between 20 and 40 years and older adults aged between 70 and 80 years). A further aim of the study was to compare the way participants rated emotionally salient images for their interpretation of 'mood' (sad and happy).

Eye tracking stage

Using a quasi-experimental approach, the present study partially replicated the Eizenman and colleagues (2003) study presented in Chapter 3, using a similar eye tracking method. A range of methods have been previously employed to investigate cognitive biases. Hermans et al. (1999) propose that tracking eye gaze is an effective means of assessing attentional processing, suggesting that the time spent viewing emotionally themed images relative to the mood of the individual is a valid measure of negative bias. Tracking eye movements provides a continual trace of attention allocation, which is especially worthwhile when competing stimuli are presented (Sears et al., 2011).

While tracking eye movements is a valid measure of attention allocation, there are many ways 'time' can be measured. In keeping with the Eizenman et al. (2003) study, the measurement of attention allocation in the eye tracking stage included three dependent variables. Firstly, the total time spent looking at each image type (quadrant) was the first measure of attention allocation. This was averaged out over the 20 experimental slides such that for each participant, the total number of raw gaze points for each of the four image types was converted to a percentage of time, summed, and then averaged. While Eizenman et al. did not convert total time to a percentage, other researchers have (e.g., Ellis et al., 2011; Kellough et al., 2008). This dependent variable is referred to as the 'percentage of total time'.

Secondly, the mean number of times a participant's gaze shifted to a particular image type was calculated. This involved the number of times gaze entered, and re-entered, the quadrant boundaries of each of the four image types. This dependent variable is referred to as 'fixation frequency'; it provides a clearer understanding of attentional and negative biases providing information about how often attention is drawn to particular image types. Noteworthy, a 'fixation' is determined by the number of times an individual looks at an area for a specified time, determined as 100 milliseconds (or more).

The final dependent variable is referred to as 'average glance duration'. This is defined as the average amount of time each participant's gaze stayed within the boundaries of a particular image type for each fixation, and is reported as a percentage of time. A computer programme was written that recorded the order the images were viewed, as well as the amount of time (in milliseconds) each image was viewed for that particular entry into each quadrant. The amount of time for each quadrant was summed and then divided by the number of visual entrances into that quadrant to provide an average amount of time per

entry. This was then converted to a percentage of time to provide the average glance duration. This dependent measure provides information on how long attention was allocated on average on each separate viewing occasion for a particular image type.

While each of the aforementioned dependent variables[3] are provided as a measure of attention allocation, it is clear that each provides a different yet complementary way of assessing negative biases. Not only was information provided on how much time was spent viewing particular image types, but information on selective attention and disengagement of attention was established also.

On the basis of previous research that has found depressed/dysphoric individuals demonstrate a negative bias, it was hypothesised that dysphoric participants in the present study would attend to sad images for longer, fixate more frequently on sad images, and have greater average glance durations when viewing sad images than non-dysphoric participants. Conversely, non-dysphoric participants were hypothesised to attend to happy images for longer, fixate more frequently on happy images, and have greater average glance durations when viewing happy images compared to dysphoric participants.

There has been limited research investigating age-related differences in cognitive biases in those experiencing mood conditions. However, it seems that older dysphoric individuals have a tendency to attend more to negative stimuli than their non-dysphoric counterparts. It was therefore expected that older and younger dysphoric participants would exhibit similar patterns of attending to sad images. Therefore, no age-related differences were expected in the dysphoric group when sad images were viewed. However, in non-clinical samples, older adults were expected to exhibit a positivity effect, for which it was hypothesised that older non-dysphoric participants would attend to happy images for longer than younger non-dysphoric participants.

Rating stage

A novel addition to the present study was a rating component, whereby emotionally salient images from the eye tracking stage were rated for 'mood' (happy to sad). This task was included to provide an indication of the possible differences in interpretative biases between mood and age groups. This was important because while the negative bias findings would

[3] Importantly, the dependent variables are not independent as average glance duration is a 'composite' of the other two dependent variables.

explain what differences occur in attention, it would not necessarily explain why. For instance, when dysphoric individuals attend to negative stimuli for longer periods of time, is it because they are hyperattentive to negative material and, as demonstrated in cognitive theory, see things through a negative framework, resulting in the selective attention towards such negative material? Or is it possible that those with depression do not interpret a negative stimulus as negatively when compared with non-dysphoric individuals? If the latter is likely, dysphoric individuals could potentially not feel the same aversion to negative material, and therefore, the need to disengage from it would not be as great.

In drawing on the research literature surrounding interpretation biases, it is hypothesised that dysphoric participants would exhibit a negative interpretation bias, rating sad images less positively when compared to non-dysphoric participants. No age-related differences were expected. When rating happy images for mood, it was hypothesised that non-dysphoric participants would provide more positive ratings than dysphoric participants. However, the positivity effect was expected to be present within the non-dysphoric group, with older non-dysphoric participants hypothesised to provide more positive mood ratings for happy images than younger non-dysphoric participants.

HYPOTHESES

The following hypotheses are based on the existing literature.

For the eye tracking stage of the study, it was hypothesised that:

For percentage of total time:

(1) Dysphoric participants would attend to sad images longer than non-dysphoric participants, irrespective of age.

(2) Non-dysphoric participants would attend to happy images longer than dysphoric participants.

(3) Older non-dysphoric participants would attend to happy images longer than younger non-dysphoric participants.

For fixation frequencies:

(4) Dysphoric participants would fixate more frequently on sad images than non-dysphoric participants, irrespective of age.

(5) Non-dysphoric participants would fixate more frequently on happy images than dysphoric participants.

(6) Older non-dysphoric participants would fixate more frequently on happy images than younger non-dysphoric participants.

For average glance duration:

(7) Dysphoric participants would obtain longer average glance durations when viewing sad images than non-dysphoric participants, irrespective of age.

(8) Non-dysphoric participants would obtain longer average glance durations when viewing happy images than dysphoric participants.

(9) Older non-dysphoric participants would obtain longer average glance durations when viewing happy images than younger non-dysphoric participants.

For the rating stage of the study, it was hypothesised that:

For sad images:

(10) Dysphoric participants would rate the sad images less positively than non-dysphoric participants, irrespective of age.

For happy images:

(11) Non-dysphoric participants would rate the happy images more positively than dysphoric participants.

(12) Older non-dysphoric participants would provide more positive ratings than younger non-dysphoric participants when rating happy images.

Chapter Five

METHOD

A quasi-experimental design was employed to address the aims of the study. The study involved a two-stage process; one stage related to tracking eye movements while emotional stimuli were presented, the second stage required the acquisition of valence ratings related to the stimuli presented in the first stage. This chapter outlines the methods employed, including details of the participant sample and the process of recruitment. The stimuli, apparatus, and the psychometric tests administered are described, followed by the procedure used to collect the data. Ethical and safety issues are considered and the chapter concludes with a description of how raw data were converted to analysable data.

AIM

The aim of the study was to compare attentional biases in high and low mood groups, and younger (20-40 years) and older (70-80 years) age groups. To achieve this, eye tracking methodology was used whereby participants viewed a series of slides (presented in quadrant style; refer Figure 5.1) displaying images deemed to best represent different emotional themes. Eye movements were recorded, with the time spent looking at each quadrant the measure of attentional bias.

Of additional interest to the study was the comparison between age and mood groups as to how differently images were emotionally perceived. A rating task was employed to assess differences in rating each image for both 'mood' (sad to happy) and 'threat'.

PARTICIPANTS

A variety of mechanisms were employed to recruit participants. Poster-style advertisements (refer Appendix A) were placed on numerous community notice boards, including Massey University, Palmerston North Library, medical and mental health centres, and various organisations for the elderly. Notices were also published in local newspapers, as well as newsletters for mental health and aging organisations. Staff at both Massey University's Psychology Clinic and Massey University's Student Counselling Services were informed of the study and asked to pass on the *Recruitment Information Sheet* (refer Appendix B) to clients deemed suitable for the study, that is, those experiencing low mood. In-person recruiting

was also conducted through Massey University undergraduate psychology classes, mental health support groups, and community groups for older adults.

According to Faul, Erdfelder, Lang, and Buchner (2010), assuming a large effect size and family-wise significance level of $p = .05$, the number of participants required to reach a power of .80 was 15 in each of the four experimental groups. A total of 65 individuals (18 male and 47 female) volunteered to participate. One male and two female participants were excluded from the study due to not meeting participation criteria or not complying with the experimental instructions resulting in no data being collected for both stages of the study. Due to difficulties recruiting, the age criterion was reduced by a year in each group to 19 and 69 years. Each participant received a $20 shopping mall voucher as gratuity.

Owing to the inconsistent nature of recording eye movements (discussed further in the *Data* section of this chapter), 6 participants' data were unable to be used in the final analysis of the eye tracking stage of the experiment. Therefore, the number of participants varied between the two stages of the experiment. The number of participants included in analysis for the eye tracking stage was 56 (17 male and 39 female), and in the rating stage was 62 (17 male and 45 female). Table 5.1 presents these data per experimental group for both stages of the experiment. All participants were of New Zealand European ethnicity, except for three participants in the younger adult group who were of Indian ethnicity.

Table 5.1.
Age (years) and Gender Across Experimental Groups and Stages

	Eye Tracking Stage			
	Female	Male	Age Range	Mean Age
Younger non-dysphoric	10	4	19-36	25.50
Younger dysphoric	10	4	19-39	25.93
Older non-dysphoric	11	4	69-78	74.07
Older dysphoric	8	5	69-78	73.23
	Rating Stage			
	Female	Male	Age Range	Mean Age
Younger non-dysphoric	10	5	19-36	25.40
Younger dysphoric	12	3	19-39	27.07
Older non-dysphoric	12	4	69-78	74.00
Older dysphoric	11	5	69-80	74.25

Note. This table shows the final categorisation of participants in each mood group after a median split was performed (rather than using the originally planned cut-off score). This is discussed further in Chapter 6.

STIMULI

The study utilised images obtained from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005). The NIMH Centre for the Study of Emotion and Attention (Centre for the Study of Emotion and Attention [CSEA-NIMH], 1999) developed the IAPS with the goal of producing a large set of standardised images that, when viewed, can evoke a range of emotional responses. The database includes 944 colour photographs that have been rated for valence (ranging from pleasant to unpleasant), arousal (ranging from excitement to calm), and dominance (ranging from influential to controlled). The IAPS manual states children aged from 7-14 years and college students (ages are not reported) were among those who rated the images. Ratings for the images across different groups of participants were found to be highly similar for mean valence (r = .99) and mean arousal (r = .97). Dominance ratings were not reported. The valence ratings were the primary ratings of interest to the present study and were used initially to single out certain images for later categorisation (described below). The valence ratings were not relied on for the complete selection of images based on the way the IAPS ratings were obtained. For example, when asking participants to rate images for valence, multiple terms were used to represent feeling 'happy' (e.g., if you feel happy, pleased, satisfied, contented, hopeful) or feeling 'unhappy' (e.g., if you feel unhappy, annoyed, unsatisfied, melancholic, despaired, bored; Lang et al., 2005). Therefore, to select images from the IAPS that best represented the four image types required for the present study ('sad', 'happy', 'threatening', or 'neutral'), the following procedure was used.

The aim of this preliminary stage was to select and categorise the images most representative of the thematic categories required for use in the main study. The experiment required 20 experimental images in each of the four image type categories, plus an additional 80 neutral images to be used as distractor images. The use of distractor slides was necessary to reduce desensitisation to the emotional content of the experimental images.

Participants

A sample of convenience, consisting of 10 (7 female and 3 male) mostly-psychology doctoral students was recruited to categorise the images (one participant was not a student). Ages ranged from 24-46 years, with a mean age

of 31.7 years. Each participant received a $10 petrol voucher as gratuity. Participation was confidential and anonymous.

Procedure

Initial image selection consisted of extracting all images from the database that had mean valence ratings between 1.50 and 2.99[4] (deemed to best represent 'sad' and 'threatening' image types), between 5.00 and 5.99 (deemed to best represent 'neutral' images) and ≥ 7.50 (deemed to best represent 'happy' images). Of this sub-set, all images that had a standard deviation ≥ 2.00 were removed to restrict variability in the images. Additionally, images that were deemed too disturbing (e.g., images of erotica, mutilation, and suicide) were also removed. The remaining sub-set of 283 images comprised the images to be categorised. The images were randomly assigned (a number drawn from a bag) for the order of presentation, with the restriction that no more than two images perceived to be of a similar thematic content would be presented in a row.

The categorisation of the images was conducted individually. An information sheet was presented (refer Appendix C), and after receiving consent, the images were displayed on an Apple MacBook Air laptop in slide show format. Based on the theme being portrayed in the image, participants were asked to respond with one of the following five options: 'happy', 'neutral', 'threatening', 'quite sad', or 'extremely sad[5]'. Responses were recorded with pen and paper by the researcher. Upon completion, participants were given an opportunity to discuss their participation and enquire about the study. Enquiry was made to assess whether participants had incurred undue harm or discomfort from participating (all participants reported no discomfort or harm). With thanks, participants were given a $10 voucher as gratuity.

Results

The images were rank-ordered from highest percentage of agreement to lowest in each of the categories. A minimum of 80% agreement was required to accept an image into a relevant category. As a result of the categorisation task, 20 each

[4] The final categories no longer exclusively contained images within these valence rating ranges due to the categorisation process.

[5] The 'quite sad' and 'extremely sad' options were offered in order to determine which images were judged to be most sad.

of happy, threatening, and neutral experimental images were selected with 100% participant agreement. The 'quite sad' and 'extremely sad' responses were collapsed, resulting in the selection of 17 experimental images with 100% agreement and 3 experimental images with 90% agreement. However, of the 80 distractor (neutral) images required, too much variance occurred in the participant responses, resulting in less than 80 images with high enough agreement. As a result, more images were selected from the full database. To do this, the ranges of mean valence ratings previously used were widened to include images between 4.50 and 6.50 (as neutral). Of the 10 participants who categorised the images, eight consented to categorise the new images. The second categorisation task resulted in 80 neutral (distractor) images being selected with 80% agreement or more (47 images had 100% agreement, 30 images had 90% agreement, and 3 images had 80% agreement). The final selection of images, with mean valence ratings and percentage of agreement, can be seen in Appendix D.

Examples of the scenes depicted in the sad images included children crying, funeral scenes, accidents, injured or unwell individuals, and malnourished individuals. Happy images portrayed social scenes, children playing, beaches, and themes parks. Threatening images were represented by scenes showing assault, weapons (e.g., guns, knives, bombs, batons), racial hatred (e.g., Nazi paraphernalia, Ku Klux Klan), and vicious animals (e.g., shark, dog with snarled teeth). Neutral images included everyday items (e.g., umbrella, light bulb, pegs), nature scenes, and everyday structures (e.g., fire hydrant, bow of a ship, staircase, doorway).

Slide composition for the eye tracking stage

Once the final set of images were selected and categorised, they were arranged in terms of slide composition. This was different for each stage of the experiment.

The eye tracking study required 20 experimental and 20 distractor slides. Each experimental slide included a sad, threatening, happy, and neutral image, presented in quadrant style, while the distractor slides were all neutral images. In order to draw more sound conclusions about eye movements related to valence, it was necessary to keep the arousal ratings of the four images within each experimental slide similar. Therefore, the slide composition was

determined by selecting images with no more than two mean arousal ratings from each other, with the exception of the neutral images. This was due to the relationship that the sad, threatening, and happy images were hypothesised to have with the theory of attentional bias, including both a negative and protective bias. However, the neutral images used in the experimental slides were grouped as close as possible to similar arousal rating sets. Each distractor slide included four neutral images, also presented in quadrant style. The composition of these slides was achieved through random assignment.

To control for participants setting their gaze in the same quadrant (to avoid viewing, or targeting, a particular theme), the positioning of each image within the quadrant was randomly assigned. This was achieved by listing the images in each slide-set in the same order (i.e., all slide-sets were listed in the order sad, threatening, happy, neutral). Four small stones were numbered one through four, and were randomly drawn from a bag. The first number drawn was assigned to the sad image, the second to the threatening, and so on. This was repeated for each experimental slide-set.

Once the image placement of the 20 experimental slides was achieved, to control for 'placement effects' it was necessary to ensure that each image category was equally distributed across the four possible quadrant positions. For example, of the 20 sad images, five would be located in the top left, top right, bottom left, and bottom right quadrants respectively. The initial random assignment resulted in only four slides requiring adjustment to achieve equal distribution.

Finally, the order the slides were presented in was random. Each slide-set was assigned a number from 1 to 40. Forty small stones were numbered and randomly drawn from a bag. The order that the numbers were drawn in determined the order of presentation, with the exception that an experimental or distractor slide could not appear more than three times in a row. If a number was drawn that resulted in, for example, four experimental slides appearing in a row, that number was placed back in the bag and a new number was drawn.

Once the quadrant placement and slide order was finalised, the images were resized to fit the computer screen of 1024 x 769 pixels. The images were saved in jpeg image file format, each image being 449 x 321 pixels. A gap of 42 pixels was placed between the images and the outer border. An example of the slide composition is provided in Figure 5.1.

Figure 5.1. Example of an experimental slide showing four image types and quadrant placement.

Slide composition for the rating stage

The rating stage only required the emotionally laden images (sad, happy, and threatening) to be used. Order of presentation was again arranged through random assignment, whereby each image was given a number (from 1 to 60) that was randomly drawn from a bag. It was ensured that no more than two images from the same category could be presented sequentially by returning the number to the bag and selecting a new number. The images were presented on screen individually, each image sized to 449 x 321 pixels. The image was centred in the top-half of the screen. Two Likert scales appeared below the image (see Figure 5.2). Noteworthy, the inclusion of the 'threat' rating was to act as a distractor.

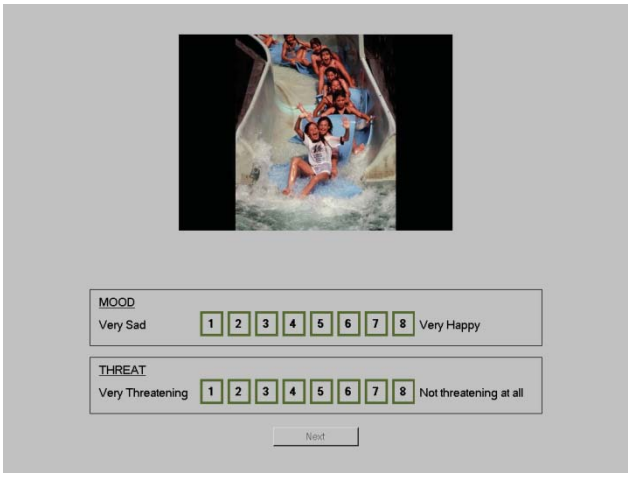

Figure 5.2. Example of the rating stage slide presentation including the rating scales.

APPARATUS

Eye tracking equipment

The LC Technologies Eyegaze System (LC Technologies, 2008) was used during the eye tracking stage. This system is designed to record where individuals look on a 17-inch computer screen, using a computer-mounted remote dual video camera. The device operates at a rate of 60 Hz, thus recording 120 raw gaze points per second (due to the dual camera system i.e., 60 raw gaze points per camera). The system allows for pupil drift and other tracking errors up to 0.63 cm and tolerates head movement within a 3.8 cm range. Detecting gaze is accomplished using the pupil-centre/corneal reflection method, whereby a low power infrared light emitting diode illuminates the eye, causing a reflection on the cornea allowing the camera to detect the centre of the pupil (Duchowski, 2007). According to the developers, the LC Technologies Eyegaze System accommodates variation in the size of the pupil and iris brightness, allows for the wearing of corrective lenses (both glasses and contact lenses), and can track "90 to 95% of the human population" (LC Technologies, 2008, p. 5).

The LC Technologies Eyegaze System includes software to record eye movements on a Windows NT/2000 computer. Massey University's School of Psychology's computer programmer designed a parallel programme. This programme was specifically designed to meet the operational requirements of the present study, including the collection of the raw gaze points and number of fixations, both as totals for the entire slide and for each quadrant within a particular slide.

MEASURES

Of the measures outlined below, it is important to note that all measures *except* one (the CES-D) were used to determine eligibility to participate in the study. The CES-D was implemented to categorise participants into one of two mood groups.

Near vision eye test

This eye test measures the level of visual acuity when material is viewed at close proximity. The specific card used was the Hilco® Near Vision Card (refer Appendix E), which offers 10 lines of random letters, decreasing in font size. Included on the card is detailed information on visual effectiveness as a percentage, and conversions for the correlating distance vision

(e.g., 20/20 vision). The card was attached to a wall at approximate eye-level, in an area that was well illuminated.

Administration and scoring

Standing at a distance of 40 centimetres and viewing with both eyes, each participant was instructed to "*Please read aloud the last line with the smallest print size*". If an error was made, they were asked to read the next line above, and so on, until no mistakes were made. Visual effectiveness of 85% (equivalent to 20/40 vision) or greater was required to continue in the study. Of those agreeing to participate, none were excluded from participation due to limited visual acuity.

Montreal Cognitive Assessment (MoCA)

The MoCA (Nasreddine et al., 2005; refer Appendix F) is a brief examination used to screen for mild cognitive impairment (MCI) and dementia. Individuals are evaluated on a 30-point questionnaire, with measures including short-term memory recall, visuo-spatial abilities, executive functioning, attention, concentration, working memory, language, and orientation to time and place.

Administration and scoring

Although designed for use with older adults suspected of experiencing MCI or dementia, for the purpose of standardisation, both younger and older participants were administered the MoCA, which took approximately 10 minutes. Standardised instructions were read out, with responses being made either verbally or written, depending on the requirements of each sub-test. The scores on each sub-test were totalled to provide an overall score, with a maximum of 30. A score lower than 26 was indicative of MCI and therefore would result in exclusion from the experiment. No participants scored below 26.

Psychometric properties

Research has found the MoCA to be an especially robust tool for detecting MCI (Luis, Keegan, & Mullan, 2009). Comparisons with the Mini Mental Status Examination (MMSE; Folstein, Folstein, & McHugh, 1975) suggest that sensitivity for detecting MCI is 18% for the MMSE compared with 90% for the MoCA. For detecting mild Alzheimer's disease, the MoCA was found to achieve 100% sensitivity, and in both conditions, 100% specificity (Nasreddine et al., 2005).

Centre for Epidemiologic Studies Depression Scale (CES-D)

The CES-D (Radloff, 1977; refer Appendix G) is a 20-item self-report tool designed to measure depressive severity in adults in the community. Although initially developed for use with adults up to the age of 65 years, research has since validated the CES-D for use on adults aged between 18 and 96 years (Beekman et al., 1997; Haringsma, Engels, Beekman, & Spinhoven, 2004; Himmelfarb & Murrell, 1983; Lewinsohn, Seeley, Roberts, & Allen, 1997). Comprised of statements that are based on internal feelings and affect, the CES-D is a more appropriate measure for use with older adults than those that focus largely on somatic symptoms (for example, the Beck Depression Inventory (BDI); A. Beck, Steer, & Brown, 1996).

Administration and scoring

The CES-D takes approximately 5 minutes to complete. Following the standardised instructions provided on the CES-D form, participants were asked to respond to each of the statements, based on how they had felt or behaved in the previous 7 days. The four possible response options are provided in both quantitative and qualitative terms: *rarely or none of the time (less than 1 day); some or a little of the time (1-2 days); occasionally or a moderate amount of time (3-4 days); all of the time (5-7 days).* In accordance with the CES-D Scoring Sheet, a specific score is assigned to each statement's response, and then summed to provide a total score, ranging between 0-60. Research suggests a score of 16 to be the optimum cut-off score in detecting depression for those aged up to 65 years (Radloff, 1977), as well as those aged between 55 and 85 years (Beekman, et al., 1997). Therefore, participants who scored 16 or greater were included in the 'dysphoric' group. Conversely, participants who scored less than 16 were included in the 'non-dysphoric' group[6].

Psychometric properties

The CES-D offers high internal consistency. Coefficient alphas range from 0.85 in the general population to 0.90 in psychiatric populations, while criterion validity is reported as ranging from 0.51-0.61, offering moderate validity (Radloff, 1977). Beekman et al. (1997) reported 100% sensitivity and 88% specificity in detecting major depressive disorder in adults aged between 55 and 85 years, when using a cut-off score of 16 or greater.

[6] This was not the final cut-off score, which was determined by median split. This procedure is presented in Chapter 6.

Hospital Anxiety and Depression Scale (HADS)

In any research focusing on depression, it is important to factor in the high levels of comorbidity with anxiety disorders. Beuke, Fischer, and McDowall (2003) provide a valid argument for including anxiety measures in research on depression, namely due to the fact that if measures of anxiety are not included, one cannot infer that the results are exclusively related to depression. Therefore, the HADS[7] (Zigmond & Snaith, 1983) was administered to screen for the presence of comorbid anxiety.

The HADS is a self-report measure that screens for the presence of both anxiety and depression. It is comprised of 14-items, seven related to anxiety (HADS-A) and seven related to depression (HADS-D). It was originally designed to detect the presence of anxiety and/or depression in medical patients aged 18-65 years. However, its use in psychiatric settings and with older adults (up to the age of 89 years) has been well established and validated (Gale et al., 2010; Johnston, Pollard, & Hennessey, 2000; Kenn, Wood, Kucyj, Wattis, & Cunane, 1987).

Administration and scoring

Taking approximately 5 minutes to complete, participants are asked to make responses to a series of statements based on frequency of occurrence within the last 7 days, using a 4-point scale ranging from 0 (not at all) to 3 (very often indeed). Scores are summed to provide a separate total score for depression and anxiety. Suggested cut-off scores for interpreting each scale are: 0-7 = normal; 8-10 = mild; 11-14 = moderate; 15-21 = severe.

Psychometric properties

Internal consistency for the HADS-A and HADS-D range from 0.78-0.93 and 0.82-0.90, respectively, with discriminant validity between the anxiety and depression scales ranging from 0.49-0.74 (Moorey et al., 1991; Smarr, 2003). Compared to other depression and anxiety measures (BDI-II, State-Trait Anxiety Inventory, Symptom Checklist-90-Revised), correlations with the HADS-D and HADS-A range from 0.60-0.80 (Smarr, 2003). In relation to the present research, the HADS-A is the primary measure of interest. Dennis, Boddington, and Funnell (2007) investigated the validity of a number of self-report anxiety measures on older adults (aged 65-86, mean age of 75 years). They found the HADS-A resulted in 80% sensitivity and 70% specificity when using a cut-off score ≥ 8. Given the high

[7] A copy of the HADS is not included in the Appendix as this is copyrighted material that is not for publication in the public domain.

correlation between anxiety and depression conditions, it was deemed too restrictive in obtaining the required participant numbers to adhere to the suggested cut-off of 8. Therefore, participants with a score on the HADS-A of 15 or above (moderate range) were excluded from the study. Of the candidates wishing to participate, only one person was excluded from the study due to this criterion. It was decided that statistical analysis would be performed to compare the group with HADS-A scores in the moderate range (11-14) with those in the lower ranges. However, only three participants scored within this range and therefore, analysis could not be performed on such a small group.

PROCEDURE

Although initial consideration was given to combating order effects by randomly assigning participants to differently ordered stages (i.e., completing the rating stage before the eye-movement stage), it was decided that all participants would complete the study in the same order of stages. This way, participants would not have already seen the images in the eye-movement stage, and therefore would not have been motivated to attend to, or disengage from, particular images due to familiarity.

Screening for eligibility

Individuals interested in participating were able to contact the primary researcher via telephone or email. At that stage, the study was explained in more detail, the age of the individual was checked, and the self-identified mood was obtained (this was done so the order participants were scheduled to complete the experiment alternated both for age and mood[8]). For those expressing a willingness to continue with the study, a *Recruitment Information Sheet* (refer Appendix B) and *Screening Questionnaire* (refer Appendix H) was either posted (with a pre-paid return envelope) or emailed out. Responses to a range of medical and psychological conditions were required on the *Screening Questionnaire.* Conditions that would result in exclusion included experiencing mild cognitive impairment, Alzheimer's disease, Parkinson's disease, or other forms of dementia, epilepsy, stroke (where paralysis of the face had occurred), diabetes (where vision was impaired), bipolar conditions, psychotic conditions, traumatic brain injury (within the previous 6 months), current alcohol or substance dependence, or, on the day of testing, the use of alcohol or other non-prescribed substances. Of particular importance is the impact of certain medications on eye

[8] Alternating mood states was not achieved due to some participants scores on the CES-D indicating the opposite mood state from the self-identified mood state.

movements. The use of anti-anxiety medication would also result in exclusion from the study due to the tranquilising nature of these types of medications and the effect this is known to have on eye movements (Reilly, Lencer, Bishop, Keedy, & Sweeney, 2008). Several studies have concluded that both SSRI's and tricyclic antidepressants do not affect eye movements in both single dose use (Green, King, & Trimble, 2000; Mercer, Allen, Jones, Marshall, Wroe, & Richens, 2007; Morrens, Wezenberg, Verkes, Hulstijn, Ruigt, & Sabbe, 2007) and maintenance use (Wilson, Bailey, Alford, Weinstein, & Nutt, 2002). Therefore, antidepressant use did not result in exclusion from the study. Upon receipt of the completed *Screening Questionnaire*, individuals were contacted and advised of their eligibility to participate and a time was arranged to complete the experiment at Massey University's School of Psychology.

Each participant completed the experiment individually, which was conducted in the School of Psychology's psychophysiology laboratory. Within this laboratory, two adjoining rooms were utilised; the first room allowed for the administration of the various measures and other paperwork; the second room was equipped with the eye tracking device and associated computer equipment needed for the eye-movement and rating stages. The two rooms were similar in size (4 metres x 5 metres), with no windows, and lit with fluorescent tube and incandescent lighting. The level of illumination was controllable.

Initially, the participant was provided with a *Participant Information and Consent Form,* a handout on *Sources of Mental Health Assistance* (refer Appendix I and J, respectively), and a $20 shopping voucher as gratuity. Once consent was obtained, the administration of the various measures occurred in the following order: near-vision eye-test, MoCA, CES-D, and HADS. Feedback was provided for each measure, with emphasis on clearly stating that the results were not diagnostic. Elaboration occurred as and when necessary. A break was offered before moving on to the next stage.

Eye tracking stage

Once in the testing room, the participant was seated in a 'dentist-style' chair at a distance of 50 centimetres from the computer screen and Eyegaze System. Attached to the chair was a moveable headrest, which was positioned behind the head, ensuring minimal head movement during the experiment. It was ensured the participant was comfortable and seated in a natural position (i.e., that the head or neck was not bent forward or backward). The researcher read out standardised instructions (refer Appendix K) before the Eyegaze

System was calibrated. The calibration process involved fixating on a small dot as it moved around the screen while the eye tracking device located the eye, a process taking approximately 15 seconds.

Once calibrated, further instructions were read out (refer Appendix L), including an example of how the images would look on screen. Any queries were answered before starting the programme that presented the slides for viewing. At the beginning, and between each slide, an image of a cross-hair was displayed on screen for 1 second (in order to realign the participant's gaze back to the centre of the screen). Each slide was presented for 10 seconds. During this process, the participant was asked to remain still, only moving the eyes while perusing the images. The requirement for this stage was to simply watch the images, allowing the gaze to shift to wherever it was naturally drawn; no other task was required. Once the slide presentation started, the researcher moved to the adjacent room to remove possible distractions and to reduce any sense of nervousness from being watched during the task. The programme automatically stopped once the 40 slides had been presented, and the Eyegaze System ceased recording. The participant was advised that the Eyegaze System had stopped and that they could move. Another opportunity for a break was offered at this point.

Rating stage

This task involved rating each of the 'sad', 'happy', and 'threatening' images seen in the eye-movement stage for both 'mood' and 'threat'. Ratings were made on two 8-point Likert-type scales anchored with 'very sad' to 'very happy' for the mood scale, and 'very threatening' to 'not threatening at all' for the threat scale.

After completing the eye tracking task, the participant was seated (in a regular office chair) at the same computer used in the eye tracking stage. Instructions for the final stage were read out (refer Appendix M), again including an example of how the image and associated rating scales would appear. The rating of the images required the use of the computer mouse, to click the numbers on screen. The assumption could not be made that all participants would be proficient in using computer equipment. Thus, an opportunity to practise rating a sample of previously unseen IAPS images was given. The programme was also designed so that the computer keyboard could be used instead of the computer mouse; however, all participants completed the rating stage using the computer mouse.

After practising, the programme was started which presented the images individually for rating along with both rating scales. The researcher again moved to the adjacent room. This was particularly important as the participant's ratings may have been affected if they were being observed. The participant governed the speed the slides were shown. This was warranted as adding a time limit in conjunction with novice users of computer equipment may have resulted in errors or missed ratings. The programme was designed so that either scale could be rated first, and ratings could be altered. Ratings were locked in once the button on screen displaying 'next' was pressed and the next image appeared.

Upon completion of the rating stage, the participant was offered an opportunity to discuss their experience and ask questions. Informal questioning was made, enquiring of any ill effects from the study. A summary of the results was posted or emailed to those who requested a copy after the analysis was completed.

ETHICAL AND SAFETY CONSIDERATIONS

The Central Regional Ethics Committee, a branch of the Health and Disability Ethics Committee (HDEC), provided ethical approval for the study. Approval was granted on the 17th of February 2010, with the ethics reference of CEN/11/EXP/09.

The safety and wellbeing of the participants was paramount, with every effort being made to mitigate any potential distress or harm occurring as a result of participation. In recruiting individuals who may have been experiencing a depressive episode, attention was given to the effects of viewing images that may have caused distress or exacerbated depressive symptoms. Therefore, all participants (regardless of mood state) were informally questioned at the end of the study to enquire if they had experienced any ill effects from viewing the images (or any other aspect of the study). All participants responded positively, with no negative effects being reported. Nonetheless, all participants were provided with a list of agencies that could be contacted (refer Appendix J) should assistance have been necessary.

The length of time to conduct the study was considered in terms of general fatigue, loss of motivation, and physical discomfort (during the eye-movement task participants were required to remain seated and to not move the head). These were factors deemed to primarily (though not exclusively) affect older participants and those who may have been experiencing depression, or low mood. To combat this, multiple opportunities were

provided for participants to break between the various stages of the experiment. Water and biscuits were automatically provided, and tea or coffee was offered.

Care was taken with providing feedback of the outcome scores on the CES-D and HADS, especially as these measures are screening tools, not diagnostic tools. Particular care was required if a participant self-identified as not experiencing low mood while obtaining a high score on the CES-D. Throughout the data collection process this did not occur, but the reverse did in that some participants who self-identified as experiencing depression, or low mood, obtained scores indicating the absence of depressive symptoms. In cases where scores on the CES-D were high, offers were made to follow-up with the participant, and/or assistance in making an appointment with a psychological service (a range were offered). Of the participants where this was offered, one participant consented to a follow-up call, while all others preferred to self-manage as needed. Likewise, with the HADS, some participants obtained slightly elevated scores when they did not self-identify as experiencing anxiety. Discussion revealed two main possibilities for this; firstly, some participants attributed the experience of anxiety to general nervousness about the experiment. Secondly, many younger participants attributed the higher HADS-A scores to sitting university examinations in the week leading up to their participation in the experiment. With all participants, it was explained that the scores obtained on the depression and anxiety measures were not diagnostic, and participants were encouraged to contact the researcher if they found any depressive or anxious symptoms continuing beyond the following two weeks. No contact was made with regards to this.

In a similar vein, discussion was planned with participants whose scores on the MoCA were less than 26, but as previously noted, all participants obtained scores of 26 or above.

DATA

Unforeseen difficulties in collecting data occurred resulting in the loss of recorded raw gaze points. While it was expected that some loss of data could occur, through, for example, eye blinks, the amount of lost data that eventuated was not expected. Interestingly, the problem with lost data was disproportionately greater for the older participants. The achievement of 100% recorded eye movements from every participant for every slide was not realistic and therefore, it was necessary to set a minimum amount of recorded eye movements as the criterion for admission to analysis. If 100% of the eye movements were recorded this would

equate to 1200 raw gaze points (per slide) being collected. It was decided that, in order to be permitted for data analysis, at least 80%[9] raw gaze points would need to be recorded. In other words, no more than two seconds of data could be lost per participant, per slide. This resulted in all analysable slides obtaining between 960-1200 raw gaze points.

Because of the above requirement, not all participants achieved 20 slides of analysable data. As a result, not all slides were analysed with the same number of participants. In such cases, this was treated as missing data for analysing purposes. The average number of missing participants for any given slide was 8.2 (range 6-11). Therefore, the least number of participants providing data for analysis in any one slide was 45. Given that different participants were contributing to the loss of data, it was not reasonable to exclude these participants entirely from the study's analysis. As few participants obtained 20 slides of usable data, entire exclusion of those who did not provide 20 slides of usable data would have resulted in too few participants and thus a study with extremely low power. One solution to this would have been to recruit more participants. However, recruitment options had been exhausted, with previous attempts achieving limited response. For example, speaking to an organisation of elderly people with an audience of 60 people resulted in three people offering to participate.

As a consequence of the aforementioned criteria used to determine eligibility for analysis and the resultant 960 to 1200 raw gaze point range, it was determined that the best way to treat these data for analysis purposes was to convert the raw data into a percentage. The raw gaze points recorded for each slide included both a total number of raw gaze points for the slide as well as the number of raw gaze points per quadrant, within that slide. The number of raw gaze points in each quadrant was then divided by the total number of raw gaze points for that slide (a value between 960 and 1200) and multiplied by 100 to establish the percentage of total time spent viewing that particular quadrant. It was this percentage of total time that then became the analysable data for the dependent variable, *percentage of total time*. A further dependent variable from the eye movement stage of the study (*fixation frequencies*) refers to the mean number of times gaze entered into each quadrant and even though missing data would have influenced these amounts, there was no mechanism for converting this for analysis. The final dependent variable used to measure 'time' was *average glance duration*. How this was calculated was presented earlier (p. 40).

[9] A review of the literature did not identify this type of problem in eye tracking methods. Therefore, how other researchers dealt with the problem was not found in the literature.

Chapter Six

RESULTS

The statistical findings of the study are presented in this chapter. An overview of the data analysis procedure is presented first, along with a rationale for, and results from, the median split. This is followed by the results from the eye-movement stage of the study for the three dependent variables, percentage of total time, fixation frequency, and average glance duration. Finally, the results from the rating stage of the study are presented for the mood ratings.

OVERVIEW OF THE DATA ANALYSIS

Statistical analysis

Data were analysed using SPSS v. 19.0.0. The investigation of main effects and interactions for each dependent variable were analysed using 2 x 2 analyses of variance (ANOVA), with between-subjects factors of Mood (dysphoric and non-dysphoric[10]) and Age (older adults and younger adults). The criterion used to perform simple main effects analyses was governed by effect size rather than significance level of .05. That is, follow-up analysis was conducted whenever an interaction effect was found to have a medium effect size or larger. Where independent *t*-tests have been performed, the results are reported for two-tailed tests. Where Levene's test of equality has been violated, degrees of freedom have been adjusted as indicated by partial numbers (reported to two decimal places). The formula used for calculating Cohen's $d = (M_1 - M_2) / SD_{pooled}$ (Cohen, 1988). Corresponding qualitative terminology for effect sizes (both Cohen's *d* and partial eta squared) can be found in Appendix N. All analyses were conducted using an alpha level of .05 (unless otherwise stated). Pre-analysis checks were performed, confirming normal distributions and an absence of outliers within the data set.

Reported results

Data were collected for each of the four image types (sad, threatening, happy, and neutral in the eye tracking stage, and sad, threatening, and happy in the rating stage). While the means and standard deviations for each image type are presented, only analysis that is pertinent to the hypotheses is reported (sad and happy images). The presentation of descriptive statistics for all four image types is warranted as they provide comprehensive information about the

[10] The terms 'dysphoric' and 'non-dysphoric' are used as categorical identifiers only. Refer to Glossary of Terms for a detailed explanation.

collected data, and aid in providing clarity to questions beyond the scope of the study's aims.

Median split

The CES-D cut-off score used to determine which participants belonged to either mood group, at the time of experimental testing, was 16, with those scoring above this being categorised as dysphoric participants. Due to insufficient numbers of older participants scoring above this, a median split was performed using SPSS. This was problematic for two reasons. Firstly, while keeping participant numbers in each mood group reasonably similar (n = 26 non-dysphoric; n = 30 dysphoric in the eye-movement stage, and n = 28 non-dysphoric; n = 34 dysphoric in the rating stage), the older and younger participant numbers within each mood group were disproportionate (e.g., in the non-dysphoric group for the rating stage, there were 18 older participants and 10 younger participants). Secondly, when reviewing the new cut-off scores, it was found that there were participants in the non-dysphoric group with *higher* CES-D scores than participants in the dysphoric group. While the latter problem could have been addressed by the researcher performing the median split (i.e., not using SPSS), this would have resulted in even greater disproportionate numbers of participants in each group. Therefore, following the procedure used by Holdaway (2011), a dual median split was performed, one for each age group, using the median CES-D score to divide participants into dysphoric and non-dysphoric groups[11].

As a result of the dual median split, the cut-off score was reduced to 11 for the younger participants (n = 28) and 5 for the older participants (n = 28) for the eye-movement stage of the study[12]. For the rating stage, the new cut-off score for younger participants (n = 30) was 12 and, for the older participants (n = 32), the new cut-off score was 5. The means and standard deviations for CES-D scores for each stage of the study are presented in Table 6.1. To determine if the mood groups differed on CES-D scores, independent t-tests were performed for both experimental stages.

[11] A comparison was made between the dual median split results and those from the single median split. Overall statistical significance of the main results did not differ between the two types of median split.

[12] Due to the different cut-off scores used within each mood group, all reported interactions should be interpreted with caution.

Eye tracking stage

Dysphoric participants obtained higher CES-D scores than non-dysphoric participants, $t(31.35) = 7.44$, $p < .001$, $d = 2.02$. Younger participants had higher CES-D scores than older participants, $t(45.39) = 3.07$, $p = .004$, $d = 0.93$. Within each mood group, younger dysphoric participants obtained significantly higher CES-D scores than older dysphoric participants, $t(25) = 3.89$, $p = .001$, $d = 1.50$. Younger non-dysphoric participants were also found to have higher CES-D scores than older non-dysphoric participants, $t(27) = 2.99$, $p = .006$, $d = 1.10$. Within each age group, younger dysphoric participants obtained higher CES-D scores than younger non-dysphoric participants, $t(17.56) = 7.65$, $p < .001$, $d = 2.89$. Older dysphoric participants obtained higher CES-D scores than older non-dysphoric participants, $t(13.61) = 4.91$, $p < .001$, $d = 1.91$.

Table 6.1.
Means and Standard Deviations for CES-D Scores for each Experimental Stage

Eye Tracking Stage						
Dysphoric State	Younger Adults		Older Adults		Overall Mood Sample	
	M	SD	M	SD	M	SD
Non-dysphoric	6.00	3.06	3.27	1.71	4.59	2.78
Dysphoric	22.00	7.20	11.92	6.16	17.15	8.35
Overall Age Sample	14.00	9.79	7.29	6.14		
Rating Stage						
Dysphoric State	Younger Adults		Older Adults		Overall Mood Sample	
	M	SD	M	SD	M	SD
Non-dysphoric	6.40	3.33	3.38	1.71	4.84	3.00
Dysphoric	21.80	6.86	12.44	5.67	16.97	7.79
Overall Age Sample	14.10	9.46	7.91	6.18		

Rating stage

The mean CES-D scores for dysphoric and non-dysphoric participants differed significantly with dysphoric participants obtaining higher scores than non-dysphoric participants, $t(38.72) = 8.09$, $p < .001$, $d = 2.05$. Younger participants had greater CES-D scores than older participants, $t(49.44) = 3.03$, $p = .004$, $d = 0.77$. Comparing age differences within each mood group, in the dysphoric group younger participants differed significantly from older participants, $t(29) = 4.15$, $p < .001$, $d = 1.55$, with younger dysphoric participants obtaining higher CES-D scores. In the non-dysphoric group, younger participants had higher CES-D scores than older participants, $t(29) = 3.21$, $p = .003$, $d = 1.14$. Within each age group, younger dysphoric participants scored higher than younger non-dysphoric participants, $t(20.27) = 7.82$, $p < .001$, $d = 2.86$, while older dysphoric participants obtained higher CES-D scores than older non-dysphoric participants, $t(17.70) = 6.12$, $p < .001$, $d = 2.16$.

To summarise, differences in CES-D scores were similar across the two experimental stages. As expected, the dysphoric group obtained higher CES-D scores than the non-dysphoric group. Younger participants scored higher than their older counterparts in both mood groups, which is likely a reflection of the lower cut-off score assigned to the older group. However, when comparing between mood states for the two age groups, unsurprisingly, both older and younger dysphoric participants' CES-D scores were higher than their non-dysphoric counterparts.

EYE TRACKING DATA

All data in the eye tracking stage of the study were analysed using 2 x 2 ANOVAs with between-subjects factors of Mood (dysphoric, non-dysphoric) and Age (older, younger).

Table 6.2.
Means and Standard Deviations for Percentage of Total Time, Fixation Frequency, and Average Glance Duration

Image Type	Percentage of total time		Fixation frequency		Average glance duration	
	M	SD	M	SD	M	SD
Sad						
Younger non-dysphoric	27.56	6.02	1.86	0.34	15.08	3.50
Younger dysphoric	31.85	9.87	1.79	0.32	18.23	6.29
Older non-dysphoric	27.07	8.23	1.72	0.56	16.40	5.39
Older dysphoric	26.21	5.92	2.04	0.47	13.58	4.75
Happy						
Younger non-dysphoric	29.96	7.04	2.04	0.32	14.87	3.48
Younger dysphoric	24.61	3.96	1.75	0.39	14.47	2.83
Older non-dysphoric	27.39	4.83	1.80	0.42	15.68	4.75
Older dysphoric	27.09	5.38	2.15	0.53	12.86	2.11
Threatening						
Younger non-dysphoric	23.22	6.69	1.73	0.31	13.56	4.04
Younger dysphoric	22.97	4.09	1.56	0.25	14.91	3.60
Older non-dysphoric	23.61	5.78	1.57	0.41	15.72	4.67
Older dysphoric	23.88	5.69	1.98	0.39	12.57	4.71
Neutral						
Younger non-dysphoric	19.25	5.10	1.84	0.40	10.56	2.23
Younger dysphoric	20.56	9.39	1.52	0.37	13.44	4.96
Older non-dysphoric	21.94	7.45	1.49	0.38	15.15	4.71
Older dysphoric	22.83	3.71	1.98	0.46	11.87	2.21

Note. Younger non-dysphoric n = 14; younger dysphoric n = 14; older non-dysphoric n = 15; older dysphoric n = 13. Percentage of total time = percentage of time each image type was fixated on. Fixation frequency = mean number of times attention shifted to each image type. Average glance duration = average amount of time gaze stays within the boundaries of each image type, reported as a percentage of time.

Independent samples t-tests were employed to assess the simple main effects. The results are reported separately for each dependent variable (percentage of total time; fixation

frequency; average glance duration). Table 6.2 displays the means and standard deviations for each of these dependent variables for the eye-movement stage.

Percentage of total time

'Percentage of total time' refers to the percentage of time each participant fixated on a particular image type (quadrant) within each experimental slide, averaged over the 20 slides. The mean percentage of total time, as displayed in Table 6.2, is graphically presented in Figure 6.1. As shown, more time was spent viewing the sad and happy images than threatening and neutral images. The neutral images were viewed for the least amount of time, while the threatening images were viewed for almost the same proportion of time across the different participant groups.

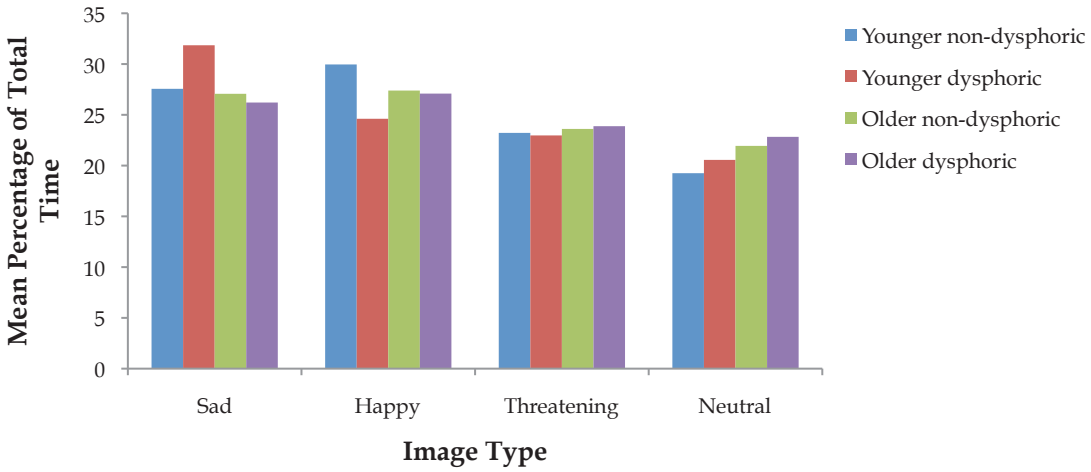

Figure 6.1. Mean percentage of total time for each image type.

Planned analysis

A 2 x 2 ANOVA was conducted to test the hypotheses that:

(1) Dysphoric participants would attend to sad images longer than non-dysphoric participants, irrespective of age

(2) Non-dysphoric participants would attend to happy images longer than dysphoric participants

(3) Older non-dysphoric participants would attend to happy images longer than younger non-dysphoric participants

Total time spent looking at sad images

The mean percentage of total time spent looking at sad images is graphically presented in Figure 6.2. Younger dysphoric participants spent the most amount of time viewing sad

images, while the group that spent the least amount of time were the older dysphoric participants. Statistical analysis revealed no significant main effect for Age, $F(1, 52) = 2.19$, $p = .145$, $\eta_p^2 = .04$, or Mood, $F < 1$, suggesting that the percentage of total time sad images were viewed was not affected by age or mood. No interaction was found between Mood and Age, $F(1, 52) = 1.55$, $p = .219$, $\eta_p^2 = .03$.

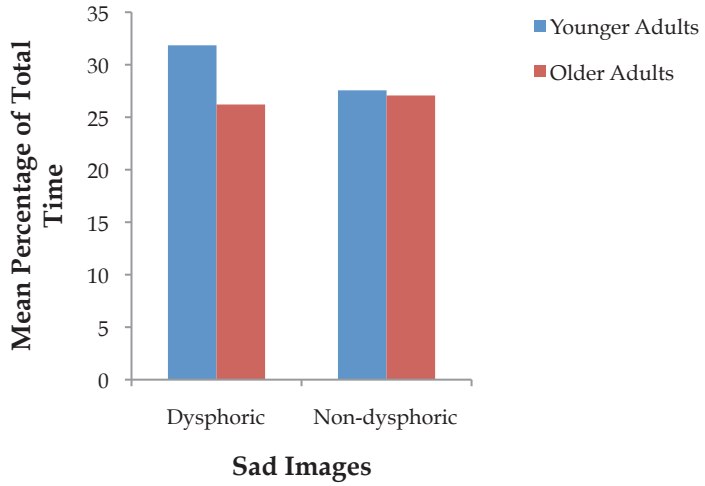

Figure 6.2. Mean percentage of total time for sad images by Age and Mood.

Total time spent looking at happy images

Figure 6.3 graphically presents the mean percentage of total time spent viewing happy images. While it was expected that non-dysphoric participants would spend more time looking at happy images, older participants in the two mood groups appeared to have viewed happy images for similar amounts of time.

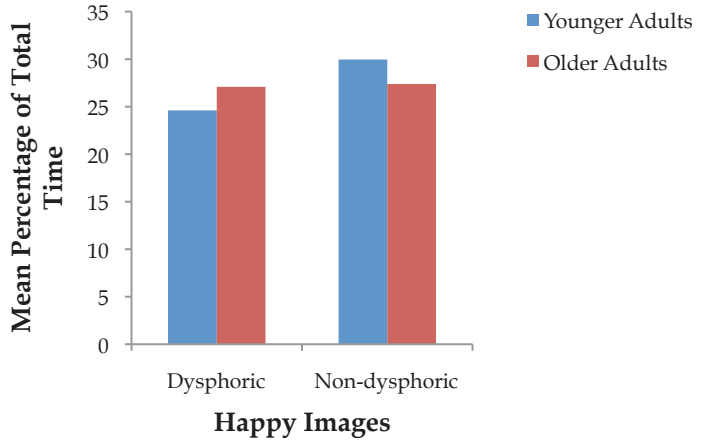

Figure 6.3. Mean percentage of total time for happy images by Age and Mood.

Results from the 2 x 2 ANOVA found no main effect for Age, $F < 1$. However, there was a near-significant main effect for Mood, $F(1, 52) = 3.80$, $p = .057$, $\eta_p^2 = .07$. The interaction between Age and Mood was not significant, $F(1, 52) = 3.04$, $p = .087$, $\eta_p^2 = .06$, although a medium effect size was found. As shown in Figure 6.3, younger dysphoric participants spent *less* time viewing happy images than their older counterparts, while in the non-dysphoric group, younger participants spent *more* time than their older counterparts. The limited difference in the older cohort suggests that the percentage of total time spent viewing happy images is affected by age. Pairwise comparisons were performed on this interaction effect. Table 6.3 outlines the results from the independent *t*-tests performed on the relevant group combinations when viewing happy images.

Table 6.3.
Independent t-tests for Percentage of Total Time for Happy Images

Age/Mood Pairs	*n*	*M*	*SD*	*df*	*t*	Sig. (two-tailed)	Cohen's *d*
Younger dysphoric	14	24.61	3.96	25	1.37	.182	0.53
Older dysphoric	13	27.09	5.38				
Younger non-dysphoric	14	29.96	7.04	27	1.15	.259	0.43
Older non-dysphoric	15	27.39	4.83				
Younger dysphoric	14	24.61	3.96	26	2.48	.020	0.94
Younger non-dysphoric	14	29.96	7.04				
Older dysphoric	13	27.09	5.38	26	0.16	.878	0.06
Older non-dysphoric	15	27.39	4.83				

No significant differences were found comparing age groups within each mood group, although a medium sized effect was found between younger and older dysphoric participants, with older dysphoric participants spending more time viewing happy images. Comparing mood groups within each age group, no significant differences were found in the time spent viewing happy images between older dysphoric and older non-dysphoric participants. Younger dysphoric and younger non-dysphoric participants differed significantly, with younger non-dysphoric participants spending more time viewing happy images. A large effect size was revealed.

Summary of results for the percentage of total time

No significant difference was found between dysphoric and non-dysphoric participants when sad images were viewed. Thus, Hypothesis 1 was not supported. As expected, age had no effect.

A medium effect size showed that non-dysphoric participants spent more time viewing happy images, as predicted in Hypothesis 2. No support was found for Hypothesis 3, with younger and older non-dysphoric participants viewing happy images for similar amounts of time.

Fixation frequency

'Fixation frequency' refers to the mean number of times a participant shifted attention to a particular image type. That is, the number of times gaze entered, and re-entered, the quadrant boundaries of each of the four image types. Figure 6.4 graphically presents the mean fixation frequencies for each image type. Interestingly, the older dysphoric participants had the highest fixation frequencies for all image types. It appears the younger dysphoric and older non-dysphoric participants have performed similarly to each other for all image types.

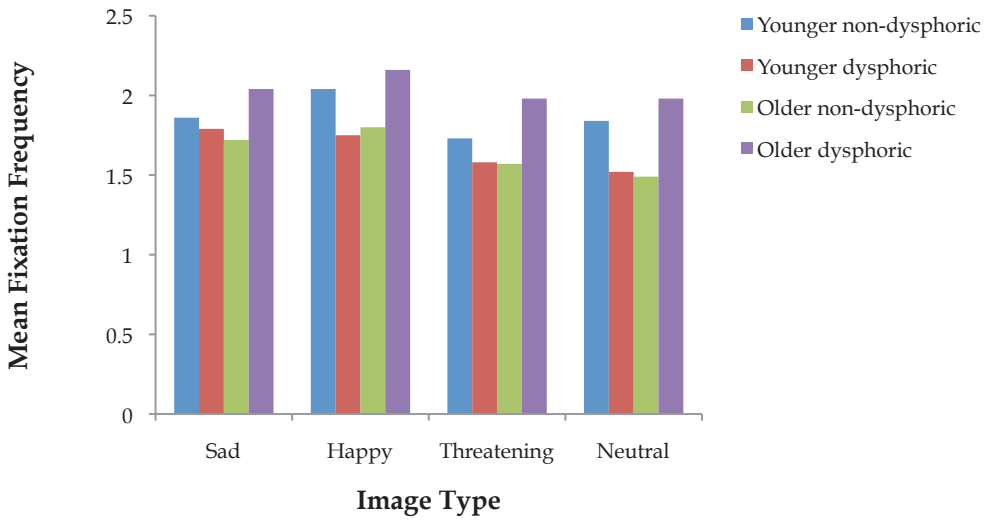

Figure 6.4. Mean fixation frequency for each image type.

Planned analysis

A 2 x 2 ANOVA was conducted to test the hypotheses that:

(4) Dysphoric participants would fixate more frequently on sad images than non-dysphoric participants, irrespective of age

(5) Non-dysphoric participants would fixate more frequently on happy images than dysphoric participants

(6) Older non-dysphoric participants would fixate more frequently on happy images than younger non-dysphoric participants

Fixation frequencies when looking at sad images

Figure 6.5 presents the mean fixation frequencies when sad images were viewed. Noteworthy, in the younger age group, dysphoric participants had fewer fixation frequencies than non-dysphoric participants. In the older age group, a larger difference in fixation frequencies was found. However, no significant main effect for Age, $F < 1$, or Mood, $F(1, 52) = 1.10$, $p = .299$, $\eta_p^2 = .02$, was found, indicating that the fixation frequencies of older and younger participants, as well as dysphoric and non-dysphoric participants, when viewing sad images, were generally the same.

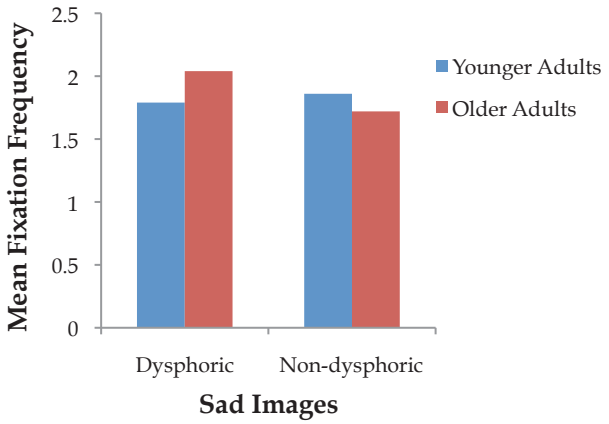

Figure 6.5. Mean fixation frequencies for sad images by Age and Mood.

The interaction effect between Age and Mood can be seen in Figure 6.5 but was not significant, $F(1, 52) = 2.93$, $p = .093$, $\eta_p^2 = .05$. However, the interaction produced a near-medium effect; therefore, analyses of simple main effects were performed, with the results displayed in Table 6.4.

Table 6.4.
Independent t-tests for Fixation Frequencies for Sad Images

Age/Mood Pairs	*n*	*M*	*SD*	*df*	*t*	Sig. (two-tailed)	Cohen's *d*
Younger dysphoric	14	1.79	0.32	25	1.66	.109	0.62
Older dysphoric	13	2.04	0.47				
Younger non-dysphoric	14	1.86	0.34	27	0.83	.415	0.30
Older non-dysphoric	15	1.72	0.56				
Younger dysphoric	14	1.79	0.32	26	0.61	.545	0.21
Younger non-dysphoric	14	1.86	0.34				
Older dysphoric	13	2.04	0.47	26	1.64	.114	0.62
Older non-dysphoric	15	1.72	0.56				

As shown in Table 6.4, no significant differences were found in any of the pairwise comparisons. However, a medium-sized effect was found between younger and older dysphoric participants, suggesting a small age-related difference within the dysphoric group. Also, a medium effect was found between older dysphoric and older non-dysphoric participants, indicating that mood-related differences are mediated by age.

Fixation frequencies when looking at happy images

The mean fixation frequencies when viewing happy images are presented in Figure 6.6. Interestingly, the lowest fixation frequencies for happy images were obtained from the younger dysphoric participants, while the highest were obtained from the older dysphoric participants. Conversely, it was the older non-dysphoric participants who obtained fewer fixation frequencies than the younger non-dysphoric participants. Analysis confirmed this interaction as significant, with a large associated effect size, $F(1, 52) = 8.06$, $p = .006$, $\eta_p^2 = .13$. This result shows that, while younger participants fixated on happy images in the direction expected, older participants fixated in the reverse of that expected, suggesting that fixation frequencies when viewing happy images are moderated by age. There were no main effects for Age or Mood with both Fs < 1.

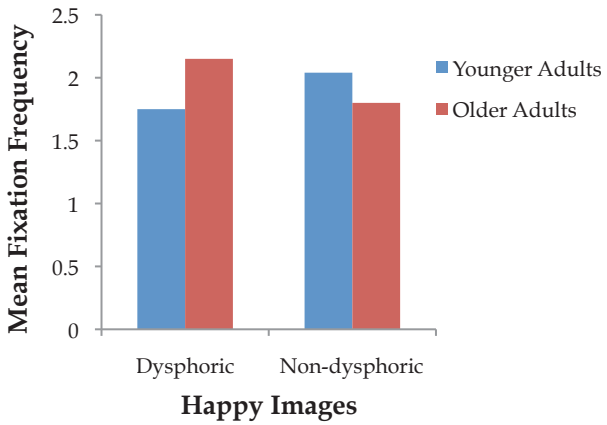

Figure 6.6. Mean fixation frequencies for happy images by Age and Mood.

Again, follow-up analyses were conducted on this interaction. Table 6.5 displays the results from the independent *t*-tests for the frequency of fixations when happy images were viewed. Age-related differences were found in the dysphoric group, with older dysphoric participants fixating more frequently on happy images than younger dysphoric participants. Surprisingly, older dysphoric participants fixated more frequently on happy images than

any of the other participant groups, an unexpected result. In the non-dysphoric group, younger participants had greater fixation frequencies than their older counterparts, showing a medium effect size. Younger dysphoric and younger non-dysphoric participants differed in their fixation frequencies, and in the direction expected with younger non-dysphoric participants fixating more frequently on happy images. While no significant differences were found between older dysphoric and older non-dysphoric participants, a near-large effect size emerged.

Table 6.5.
Independent t-tests for Fixation Frequencies for Happy Images

Age/Mood Pairs	*n*	*M*	*SD*	*df*	*t*	Sig. (two-tailed)	Cohen's *d*
Younger dysphoric	14	1.75	0.39	25	2.23	.035	0.86
Older dysphoric	13	2.15	0.53				
Younger non-dysphoric	14	2.04	0.32	27	1.72	.096	0.66
Older non-dysphoric	15	1.80	0.40				
Younger dysphoric	14	1.75	0.39	26	2.14	.042	0.81
Younger non-dysphoric	14	2.04	0.32				
Older dysphoric	13	2.15	0.53	26	1.94	.063	0.75
Older non-dysphoric	15	1.80	0.42				

Summary of results for fixation frequencies

Hypothesis 4 was not supported with no difference in fixation frequencies between dysphoric and non-dysphoric participants when viewing sad images. Again, age did not affect the viewing of sad images in terms of fixation frequencies. Simple main effect analyses (performed as a result of the interaction revealing a medium effect size) lend further support to the findings of no effect of age or mood.

Regarding Hypothesis 5, overall, non-dysphoric participants did not fixate more frequently than dysphoric participants when viewing happy images. However, younger non-dysphoric participants fixated more frequently on happy images than younger dysphoric participants. The same was not found when comparing older adults. Within the non-dysphoric participants, no significant differences were found between older and younger adults, thus finding no support for Hypothesis 6.

Average glance duration

'Average glance duration' refers to the average percentage of each participant's gaze stays within the boundaries of a particular image type, for each time they directed their attention

to the quadrant. Figure 6.7 graphically presents the mean average glance durations for each image type from Table 6.1. The non-dysphoric participants had the longest average glance durations for happy images. While the younger dysphoric participants had the longest average glance durations when sad images were viewed, interestingly, the older dysphoric participants had the briefest of all participant groups. Across all image types, the older participants appear relatively consistent in average glance durations, whereas the younger participants appear to have more variability.

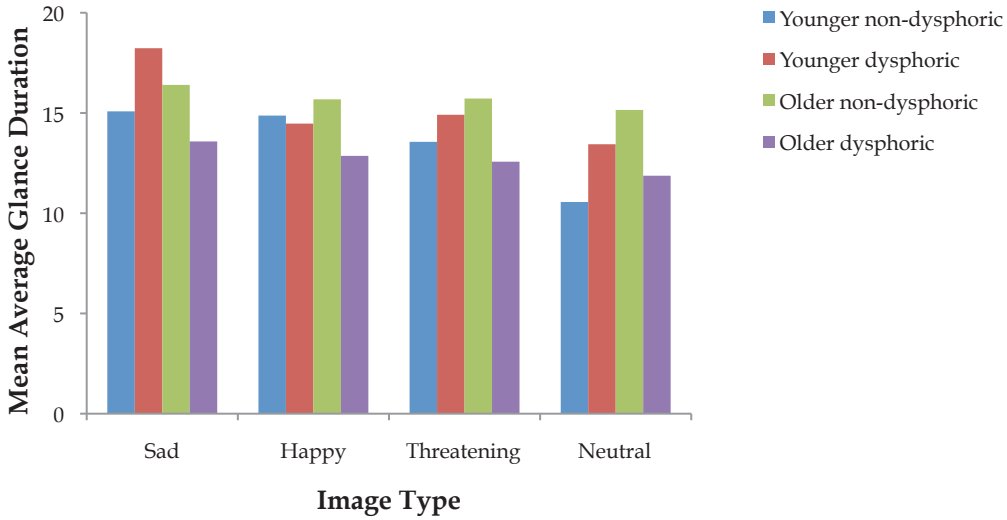

Figure 6.7. Mean average glance duration for each image type.

Planned analysis

A 2 x 2 ANOVA was conducted to test the hypotheses that:

(7) Dysphoric participants would obtain longer average glance durations when viewing sad images than non-dysphoric participants, irrespective of age

(8) Non-dysphoric participants would obtain longer average glance durations when viewing happy images than dysphoric participants

(9) Older non-dysphoric participants would obtain longer average glance durations when viewing happy images than younger non-dysphoric participants

Average glance durations when looking at sad images

Figure 6.8 presents the mean average glance duration for sad images. In the younger group, dysphoric participants had longer average glance durations than non-dysphoric participants. However, in the older group, dysphoric participants had the briefest average glance durations across all groups. Statistical analysis confirmed the Mood x Age interaction as significant, $F(1, 52) = 4.78$, $p = .033$, $\eta_p^2 = .08$. Once more, it appears that age is a moderating

factor for average glance durations when sad images are viewed. No main effect for Age, $F(1, 52) = 1.49$, $p = .227$, $\eta_p^2 = .03$, or Mood, $F < 1$, was found.

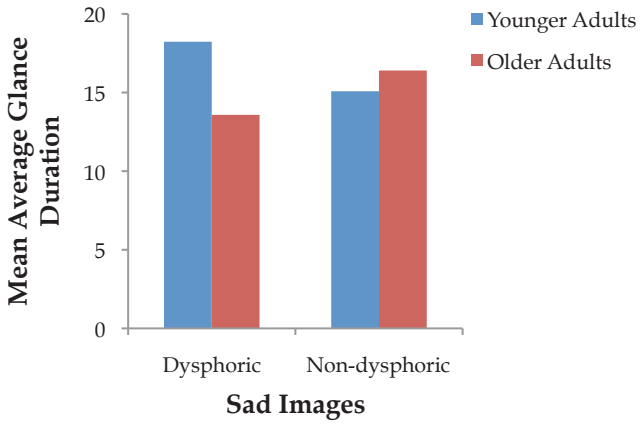

Figure 6.8. Mean average glance duration for sad images by Age and Mood.

Independent *t*-tests were conducted on the interaction found when sad images were viewed (Table 6.6). A significant difference was found between younger and older dysphoric participants, accompanied by a large effect size. Conversely, the non-dysphoric group revealed no age-related differences in their average glance durations for sad images. Within each age group, no significant differences occurred, although medium effect sizes were found. These suggest that, in terms of average glance durations, the viewing of sad images was affected by mood state for both older and younger participants, with age-related differences occurring only within the dysphoric group.

Table 6.6.
Independent t-tests for Average Glance Durations for Sad Images

Age/Mood Pairs	*n*	*M*	*SD*	*df*	*t*	Sig. (two-tailed)	Cohen's *d*
Younger dysphoric	14	18.23	6.29	25	2.15	.041	0.83
Older dysphoric	13	13.58	4.75				
Younger non-dysphoric	14	15.08	3.50	27	0.77	.446	0.29
Older non-dysphoric	15	16.40	5.39				
Younger dysphoric	14	18.23	6.29	26	1.64	.114	0.62
Younger non-dysphoric	14	15.08	3.50				
Older dysphoric	13	13.58	4.75	26	1.46	.157	0.56
Older non-dysphoric	15	16.40	5.39				

Average glance durations when looking at happy images

The mean average glance durations for happy images are presented in Figure 6.9. Little difference was found in the average glance durations of younger participants, regardless of mood state, with non-dysphoric younger participants having slightly longer glance durations when viewing happy images. Conversely, older non-dysphoric participants had the longest glance durations, while older dysphoric participants had the briefest across all groups. A 2 x 2 ANOVA indicated no significant Age x Mood interaction, $F(1, 52) = 1.67$, $p = .202$, $\eta_p^2 = .03$. No main effect for Age was found, $F < 1$. Although no statistically significant main effect for Mood was identified, $F(1, 52) = 2.98$, $p = .090$, a near medium-sized effect was found, $\eta_p^2 = .05$.

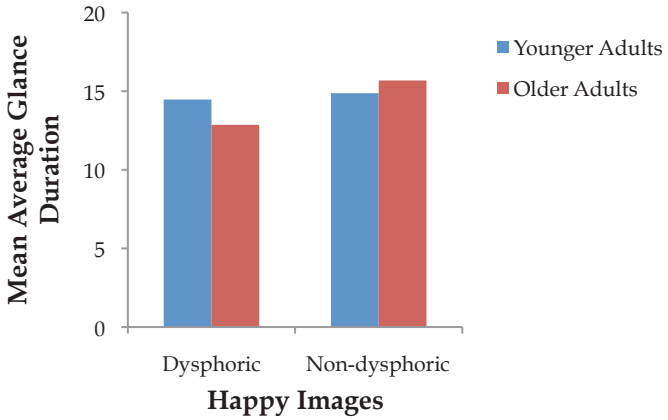

Figure 6.9. Mean average glance duration for happy images by Age and Mood.

Summary of results for average glance durations

Support was found for Hypothesis 7, with the dysphoric group spending longer looking at sad images than the non-dysphoric group, as demonstrated by a medium effect size for younger participants and a near-medium effect size for older participants. However, unexpectedly, an interaction was found (large effect size) between younger and older dysphoric participants.

Hypothesis 8 was supported by a near-medium effect size and in the direction predicted, with non-dysphoric participants obtaining greater average glance durations than dysphoric participants. Although older non-dysphoric participants had longer average glance durations than younger non-dysphoric participants, this difference was not significant and the effect size was small, finding no support for Hypothesis 9.

RATING DATA

All data in the rating stage of the study were analysed using a 2 x 2 ANOVA with between-subjects factors of Mood (dysphoric, non-dysphoric) and Age (older, younger). Simple main effects analyses were conducted using independent *t*-tests. Table 6.7 displays the means and standard deviations for both 'mood' and 'threat' in the rating stage of the study.

Table 6.7.
Means and Standard Deviations for Mood and Threat Ratings

Image Type	Mood rating		Threat rating	
	M	SD	M	SD
Sad				
Younger non-dysphoric	1.61	0.56	4.72	1.08
Younger dysphoric	1.84	0.78	5.24	1.54
Older non-dysphoric	2.10	0.76	5.66	1.58
Older dysphoric	1.95	0.95	5.30	1.41
Happy				
Younger non-dysphoric	6.73	0.55	7.13	0.36
Younger dysphoric	6.61	0.62	7.11	0.64
Older non-dysphoric	7.12	0.45	7.22	0.68
Older dysphoric	7.03	0.28	7.08	0.55
Threatening				
Younger non-dysphoric	2.42	0.94	1.85	0.59
Younger dysphoric	2.93	0.77	2.65	1.80
Older non-dysphoric	2.25	1.10	2.64	2.11
Older dysphoric	2.27	1.02	2.25	1.47

Note. Younger non-dysphoric n = 15; younger dysphoric n = 15; older non-dysphoric n = 16; older dysphoric n = 16. Mood rating = ratings from 'very sad' (closest to 1) to 'very happy' (closest to 8) for each image type. Threat rating = ratings from 'very threatening' (closest to 1) to 'not threatening at all' (closest to 8) for each image type.

Mood rating

'Mood rating' refers to the ratings participants gave each sad, threatening, and happy image, on an 8-point Likert-type scale ranging from 'very sad' (anchored at 1) to 'very happy' (anchored at 8). Figure 6.10 presents the mean mood ratings for each image type as displayed in Table 6.7. Across the image types it can be seen that participants provided similar mood ratings. Sad images were rated least positively, followed by threatening images. The happy images were rated most positively.

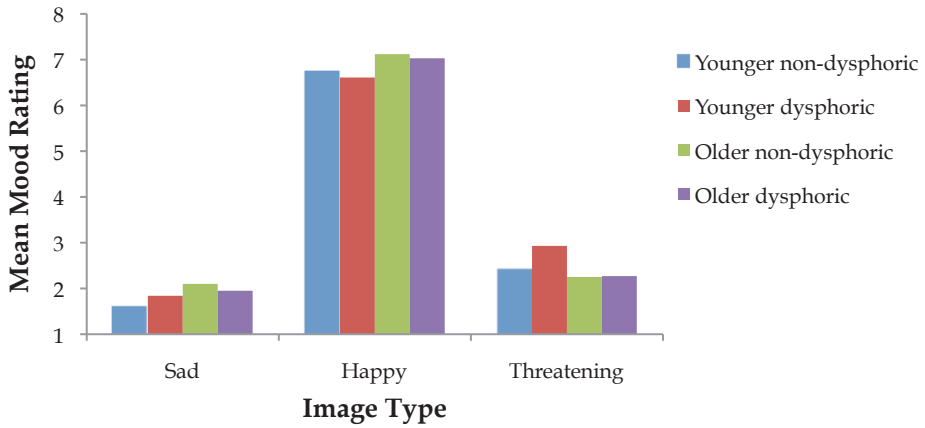

Figure 6.10. Mean mood ratings for each image type.
Note. The lower the value, the less positive the image was rated.

Planned analysis

A 2 x 2 ANOVA was conducted to test the hypotheses that:

(10) Dysphoric participants would rate the sad images less positively ('sadder') than non-dysphoric participants, irrespective of age

(11) Non-dysphoric participants would rate the happy images more positively ('happier') than dysphoric participants

(12) Older non-dysphoric participants would provide more positive ratings than younger non-dysphoric participants when rating happy images

Mood rating for sad images

Figure 6.11 presents the mean mood ratings for sad images. The largest difference in mood ratings occurred within the non-dysphoric group, with this group providing the least positive (by younger non-dysphoric) and most positive (by older non-dysphoric) ratings for sad images. While younger dysphoric participants provided slightly lower positive ratings than older dysphoric participants, there does not appear to be much difference in the ratings provided by the dysphoric group. Analysis revealed no main effect for Age, $F(1, 58) = 2.30$, $p = .135$, $\eta_p^2 = .04$, or Mood, $F < 1$, suggesting that the manner with which sad images were rated for mood was not affected by the mood or age of the participants. Similarly, there was no Mood x Age interaction, $F < 1$.

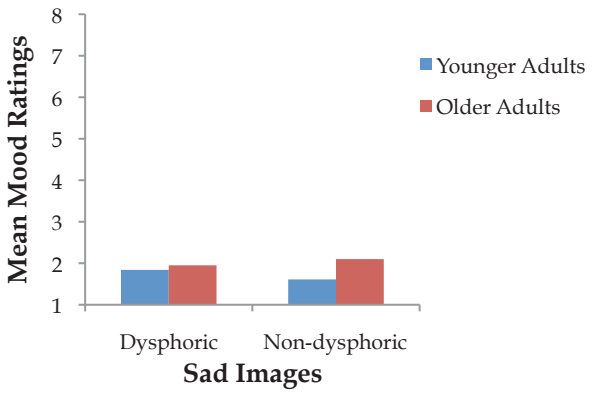

Figure 6.11. Mean mood ratings for sad images by Age and Mood.
Note. The lower the value, the less positive the image was rated.

Mood rating for happy images

The mean mood ratings for happy images are presented in Figure 6.12. Small differences appear to exist within each age group. However, within each mood group, older participants have provided slightly more positive ratings for happy images. Statistical analysis performed on these data indicated a significant effect for Age, $F(1, 58) = 10.52$, $p = .002$, $\eta_p^2 = .15$, confirming that the ratings for happy images are more positive from older participants than from younger participants. There was no main effect for Mood and no Mood x Age interaction, both Fs < 1.

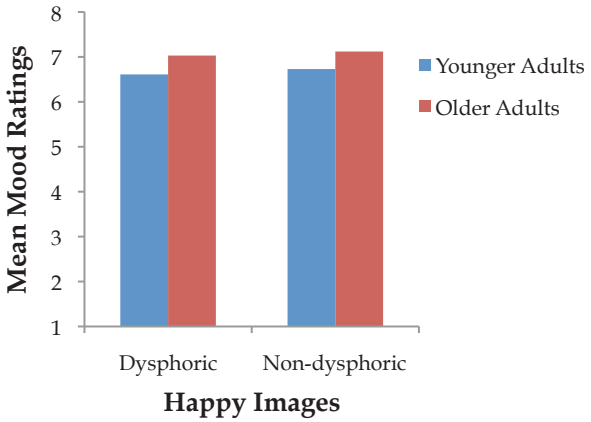

Figure 6.12. Mean mood ratings for happy images by Age and Mood.
Note. The lower the value, the less positive the image was rated.

Summary of results for mood ratings

Hypothesis 10 was not supported with no differences occurring in the way sad images were rated for mood between dysphoric and non-dysphoric participants. Again, there was no effect of age.

When rating happy images for mood, no differences were found between mood groups, offering no support for Hypothesis 11. However, a main effect for age occurred, suggesting that older and younger participants rated happy images differently, with older adults providing the more positive ratings. In the case of non-dysphoric participants, this finding provides support for Hypothesis 12.

FURTHER EXPLORATION

Due to the lack of solid effect sizes from the eye tracking and rating data, a quartile split was performed on the mood group. Data were re-analysed using the upper and lower quartiles (least dysphoric and highest dysphoric groups) for all types of analyses. Results did not reveal any statistically significant findings that were different from the aforementioned results using the full sample of participants.

While the above analysis only focused on presenting the results from the 'happy' and 'sad' image types, analysis was conducted on the other two image types ('threatening' and 'neutral'). It was found that age and mood did not affect the manner with which participants viewed or rated the threatening and neutral images. The analysis on these image types was not presented as the null findings were not pertinent to the study's hypotheses.

Post-analysis consideration was given to the CES-D as an appropriate measure in determining mood type, and if the HADS-D may have been more sensitive and specific in screening for depression than the CES-D was. Correlation analysis was performed between the CES-D and the HADS-D, which found a strong, positive correlation between the two measures, $r = .75$, $n = 62$, $p = < .01$. Therefore, re-analysing the data using the HADS-D would not have significantly altered the findings of the study. Additionally, the HADS was implemented to screen out anxiety, not to provide a measure for depression.

Chapter Seven

DISCUSSION

This final chapter discusses the present study's findings, linking them to previous research. The limitations of the present study are considered, along with suggestions for future research. Finally, the implications of the study are examined along with an overall conclusion.

SYNOPSIS OF THE PRESENT STUDY'S AIMS

The primary aim of the present study was to investigate the presence of a negative bias in dysphoric older and younger individuals using eye tracking techniques. In general terms, it was hypothesised that dysphoric participants, regardless of age, would attend to sad images for greater periods of time than non-dysphoric participants. Conversely, non-dysphoric participants were hypothesised to attend to happy images more than dysphoric participants. Three dependent variables were employed as a measure of time: percentage of total time, fixation frequency, and average glance duration.

A further aim of the study was to investigate age- and mood-related differences in the way participants rated emotionally valenced images for mood. It was hypothesised that dysphoric participants, irrespective of age, would be more negative in their ratings, thus exhibiting a negative interpretation bias, when compared to their non-dysphoric counterparts.

FINDINGS FROM THE EYE TRACKING STAGE

Viewing of sad images

When viewing sad images, dysphoric participants were hypothesised to spend more time, fixate more frequently, and have longer average glance durations than non-dysphoric participants. Support was not found for Hypotheses 1 and 4, with no differences in the total time and number of fixations between dysphoric and non-dysphoric participants. For these two hypotheses (1 and 4), it was expected that age-related differences would not be present, something that was supported by the findings. However, evidence was found to support Hypothesis 7[13], that dysphoric participants would show longer average glance durations than non-dysphoric participants when viewing sad images. The expectation that age would

[13] Caution is needed when interpreting the interaction pertaining to Hypothesis 7 due to the median split.

not affect these viewing patterns was not supported, with younger dysphoric participants exhibiting greater average glance durations than older dysphoric participants.

The lack of consistent findings across all three dependent measures indicates the importance of using multiple measures to operationally define 'time'. For example, if only *total time* was measured, valuable information on other measures of time would remain unknown. While these inconsistent results are intriguing, they are not uncommon. For example, Matthews and Antes (1992) found depressed participants had greater fixation frequencies, but no differences were found between depressed and non-depressed participants for the total time spent viewing sad images. Kellough et al. (2008) also found depressed participants fixated more frequently on dysphoric images and spent more total time viewing these images than non-dysphoric participants, yet no differences were found between groups for average glance durations. No differences were found in fixation frequencies, but support was found for total time and average glance durations by both Eizenman et al. (2003) and Leyman et al. (2011). Interestingly, all of these authors concluded that depressed individuals exhibit a negative bias, which raises the question, should all dependent measures support the hypotheses in order to state such a claim? Each dependent variable provides interesting information on its own, so this is not to suggest that all three measures should be supported in order to state the presence of a bias. However, the present results should be interpreted with caution. While theoretical explanations exist to account for the lack of support regarding fixation frequencies (see below), arguing that a negative bias exists solely on the basis of greater average glance durations requires caution, especially as this was only found for the younger dysphoric group. Had the present study also found support for the total time spent viewing sad images, perhaps a stronger claim could be made in support of a negative bias interpretation. But this was not the case. There are several possible explanations for the lack of support for a negative bias in percentage of total time and fixation frequencies.

Firstly, fixation frequencies were similar between the mood groups, but because average glance durations were longer for the dysphoric group, it is apparent that more time was spent looking at the sad images *each* time these images were attended to, for the dysphoric group. This suggests that dysphoric individuals experience difficulties disengaging from negative material. Conversely, the non-dysphoric group were better able to disengage and avoid returning their attention back to negative stimuli, suggesting that non-dysphoric individuals are prone to avoiding negative stimuli, thus exhibiting a protective bias.

A second possibility for the lack of consistent support over the three dependent variables was the limited ability to recruit the necessary number of clinically depressed individuals and the subsequent need to perform a median split. It is likely that the dysphoric sample in the present study was not overly dysphoric. Thus, the mood groups may have been quite similar, making it more likely that group performance would be similar. However, the mean scores on the CES-D were found to be significantly different between the two mood groups. Even so, the standard deviation in the dysphoric group is three times greater than in the non-dysphoric group, suggesting greater variability in the CES-D scores of the dysphoric group. Similarly, the mean CES-D scores in the dysphoric group across age groups (M = 22.00 for younger participants; M = 11.92 for older participants) were significantly different. Although there were significant differences for age within the non-dysphoric group, these differences were much smaller (M = 6.00 for younger participants; M = 3.27 for older participants) than those seen in the dysphoric group. This large variation in the dysphoric group's scores may help explain the unexpected finding of age-related differences in the dysphoric group for average glance durations.

The variation in CES-D scores between both age and mood groups may also partially explain the lack of support for a negative bias in general, as the older dysphoric participants attenuated the overall level of dysphoria. For instance, the means for percentage of total time were highest for the younger dysphoric participants (M = 31.85) yet lowest for the older dysphoric participants (M = 26.21); indeed, lower than the non-dysphoric group. However, if this was the case, a negative bias should still have been found for the younger dysphoric participants for the percentage of total time, but this was not found. The evidential support for a negative bias for average glance durations but not for percentage of total time is interesting, particularly as this is consistent across age groups for the dysphoric participants' total time results. It is possible that dysphoria holds attention to negative images for longer each time an image is examined but does not affect the overall time spent examining negative images amongst a set of other images. However, considering average glance durations were calculated using the same data for the percentage of total time, it would seem logical that the results pertaining to average glance durations and percentage of total time would be relatively consistent. That this was not the case suggests that, even though the dysphoric group had greater average glance durations, these durations were not sufficiently different to produce a significant outcome. Accordingly, while the dysphoric participants may have selectively attended to sad images longer than the non-dysphoric participants, this was not long enough to yield significant differences or medium (or greater) effect sizes.

Another possible explanation for the lack of consistent support for a negative bias across all three dependent variables could relate to the stimuli used. Smith et al. (2006) found the effects of a negative bias were eliminated when positive material was made available. It has been suggested that older adults attend less to negative information when presented with multiple stimuli types (Mather & Carstensen, 2003; Mather & Knight, 2006; Mather, Knight, & McCaffrey, 2005; Rosler et al., 2005). Another study found that older (non-depressed) adults avoided negative material under full attentional conditions, but this was reversed during divided attention trials (Knight et al., 2007). Yet, like the present study, several previous studies have employed quadrant style presentation and also used images from the IAPS database (e.g., Eizenman et al., 2003; Kellough et al., 2008). If too much competition, or the specific images used were confounding the results, it would be expected that this would also be the case for previous studies. The Smith et al. study was conducted with non-depressed individuals. Given what is known about a protective bias, it is not surprising that non-depressed individuals would attend to positive stimuli over negative stimuli. Still, given the lack of severity in depressive symptoms in the present study's sample, it is possible that many participants in the dysphoric group were more symptomatically similar to the non-depressed sample. To check this would involve analysing the overlap of items endorsed, which would have been difficult and beyond the scope of the present study.

A further issue with the stimuli used in the present study relates to how self-referential the material may, or may not, have been. Several authors have suggested that the effect of a negative bias is most pronounced when the material presented is self-referential in nature (e.g., De Raedt & Koster, 2010; Joorman & Gotlib, 2007; Koster et al., 2005; Leyman, De Raedt, Schacht, & Koster, 2007; Nunn et al., 1997). It is possible that the stimuli used were not relevant enough to elicit a negative bias. For example, an image of a vehicle accident could be more self-referential for participants who had been involved in a vehicle accident as opposed to participants with no such history. However, many other studies have used images from the IAPS database, although the exact images selected across studies is likely to have differed. Short of asking each participant to comment on the self-referential nature of each image, there is limited ability to know if the images used in the present study were, or were not, self-referent.

Viewing of happy images

According to Hypotheses 2, 5[14], and 8, non-dysphoric participants would spend a greater percentage of total time, would fixate more frequently, and have greater average glance durations when looking at happy images than dysphoric participants. Indeed, non-dysphoric participants did spend longer in total looking at happy images and obtained greater average glance durations, supporting the prediction of a positivity bias. However, while non-dysphoric participants fixated more frequently on happy images, this was only true for the younger participants. For the older non-dysphoric participants, fixation frequencies were similar to those of both older and younger dysphoric participants.

As was the case for sad images, inconsistent support across the three dependent variables was found when happy images were viewed. In this case evidence was found to support the hypotheses that non-dysphoric participants would have greater percentages of total time and longer average glance durations. However, the hypothesis that non-dysphoric participants would fixate more frequently on happy images was only supported for the younger participants. Nonetheless, it can be concluded that the present study provides further support for the presence of a positivity bias in non-dysphoric individuals.

The fixation analysis showed that the younger non-dysphoric participants had a tendency to direct attention back to positive material more often than their older adult counterparts. This is a surprising result given the large volume of evidence supporting the positivity effect in older adults. A possible explanation for this outcome lies in the large amounts of lost eye tracking data from the older adults. It is also likely that the median split had an affect on these results, which must be interpreted with caution.

Comparing the number of participants for whom data were lost, it was found that 15 older participants lost data compared to 11 younger participants. Importantly, the total number of slides that could not be included in analysis because of lost data was 112 (20%) for the older participants compared with 50 (9%) for the younger participants. Accordingly, this loss of data could have seriously influenced the present study's results.

The unexpected lack of support for a positivity bias in the older non-dysphoric group may have occurred when these participants were directing, or re-directing, their gaze to the happy images at a time that coincided with equipment malfunction, eye blinking, or other

[14] Caution is needed when interpreting the interaction pertaining to Hypothesis 5 due to the median split.

issues causing data to not be recorded. However, this should not affect one image type alone, given the even distribution of image types into all four quadrants. Furthermore, if this were the case, it would be expected that the older dysphoric participants would also have fewer fixation frequencies, but the opposite was the case. It is noteworthy that the older dysphoric participants had the highest number of fixations of all groups when viewing happy images, including the younger non-dysphoric participants. This finding suggests that, with age, those with a history of dysphoria have developed adaptive strategies to prevent the onset of depressive symptoms by actively seeking out more positive material. However, it is possible that depressed/dysphoric older adults, or those with a history of depression/dysphoria, overcompensate in seeking out positive stimuli, resulting in the unexpected finding of group differences between older dysphoric and older non-dysphoric participants.

It was also found that older dysphoric participants fixated more frequently on all four image types than any of the other participant groups. What this suggests is that older dysphoric participants shifted gaze between the four images more often than any of the other participants. It is possible that this group applied a strategic approach to the way various material is selectively attended to. This may occur in an attempt to regulate mood in more ecological settings, and may have been a strategy that was also employed during the experimental process.

Another possible explanation for the unexpected findings for fixation frequencies for older participants relates to the low level of dysphoria in the sample. The likelihood that the mood differences among groups are not different enough for the groups to be categorically different in depressive symptoms is most evident in the older adult sample. Indeed, the CES-D cut-off score for the older adults was 5 compared with 11 for the younger adults. Although the mean score for the older dysphoric participants was 11.92 (with a standard deviation of 6.16), of the 13 older dysphoric participants, nearly half of those had CES-D scores ranging between 6 and 11. Thus, nearly half of the older dysphoric group had CES-D scores that were within the range meeting criteria for being classified as non-dysphoric in the younger group. Therefore, it is likely that the low CES-D scores in the older sample have influenced these null findings. Although a quartile split was performed revealing similar findings to that of the median split analysis, it seems clinical depression in the recruited sample was too low, affecting the chances of finding evidence of negative or positive biases.

In other words, even though there were clear differences between dysphoric and non-dysphoric group means, overall, dysphoria was quite low in both groups.

Because average glance duration was calculated using the other two dependent measures, the aforementioned issues with fixation frequencies may have weakened the potential for statistically significant evidence for a positivity bias for average glance durations (although a near-medium effect size was found). If certain participant groups have higher fixation frequencies and higher periods of time spent viewing an image (compared with a group with lower periods of time and lower fixation frequencies), the average glance durations can be similar. For example, one participant could view a particular image for 6 seconds, having fixated on that image 3 times, acquiring an average glance duration of 2 seconds (or 20% of the total time), compared with another participant who views the same image for 4 seconds with 2 fixations, also resulting in an average glance duration of 2 seconds (also 20% of the total time). Inspecting the data for the younger participants, the younger non-dysphoric participants had greater percentages of total time and fixation frequencies than the younger dysphoric participants, yet the average glance durations between the younger participants were nearly identical. Therefore, average glance durations may be an unreliable measure of 'time'.

Age-related differences when viewing happy images

For Hypotheses 3, 6, and 9, it was posited that within the non-dysphoric group, older adults would exhibit a positivity bias, thus resulting in greater attendance towards happy images for percentage of total time, fixation frequency, and average glance durations. However, none of these hypotheses were supported by the study's findings.

The lack of a positivity bias in the older non-dysphoric group was unexpected, especially in light of the number of studies supporting such a bias (Carstensen & Mikels, 2005; Mather & Carstensen, 2003, 2005). In reviewing the percentage of total time data for happy images, the older non-dysphoric group obtained a slightly larger group mean compared with the older dysphoric group. More unexpected was the fact that younger non-dysphoric participants spent even longer attending to happy images than the older non-dysphoric group (although this difference was not statistically significant, medium effect sizes were found for Hypotheses 3 and 6). While it was expected that the younger non-dysphoric participants would attend longer to happy images than either dysphoric group, it was also expected that

the older non-dysphoric participants would have the highest percentage of total time compared to all other groups.

In reflecting on why a positivity bias was not found across all three dependent measures, it might be worth considering the way 'age' is operationally defined. The majority of studies investigating positivity effects in older adults have been conducted by Isaacowitz (e.g., Isaacowitz, Allard et al., 2009; Isaacowitz et al., 2008; Isaacowitz, Toner et al., 2009; Isaacowitz, et al., 2006a, 2006b; Stanley & Isaacowitz, 2011). Of these six studies, five of them included participants from the age of either 57 or 58 years in the older adult classification. Only one study included participants from the age of 61. Although there is no formal operational definition of age for researchers in the field of aging to prescribe to, one common guideline often adhered to is to categorise older age as follows: young-old (65-74 years), old-old (75-84 years), and oldest-old (85+ years) (Erber, 2005). Given that these previous studies on age differences in positivity biases have studied adults in a lower age group than that typically considered 'old' may have meant their participants were less representative of an 'older adult' sample. It could be argued that the younger age range in the previous studies may have made the 'older' adult sample more similar to the younger adult sample, and therefore less likely that group differences would be found. However, it could also be the case that the use of younger-than-normal older adults may have resulted in different characteristics being present in the youngest 'older' adults. What the Isaacowitz studies may have actually revealed is that positivity biases are more prominent, not in older adults (i.e., aged 65+) *per se*, and not in younger adults either, but in those in their sixth decade (i.e., those in their 50s). But the presence of a positivity bias in the sixth decade that is not evident later on in life is in stark contrast with the Socioemotional Selectivity Theory, which argues that the time left in life can affect an individual's goal pursuits resulting in more positivity with increasing age (Carstensen, 1992). Even though the older non-dysphoric participants in the present study did not demonstrate a greater positivity bias towards happy images than their younger counterparts, they did attend to them in a biased fashion. For percentage of total time, this group had the second longest amount of time spent viewing happy images and the greatest average glance durations of all groups. Thus, it is clear that older non-dysphoric participants do exhibit a positivity bias, but it may be no *more* biased than the younger non-dysphoric participants. So why could this be? In considering the Socioemotional Selectivity Theory, it is the *perception* of time that determines the extent of the positivity effect (Carstensen et al., 2006). Accordingly, age-related differences in positivity effects are theorised to diminish if older adults do not perceive their time left in life as

limited (Reed & Carstensen, 2012). It is possible that the older participant group in the present study perceived their future to be relatively lengthy. It could be argued that those in the older participant group were 'young at heart', so that even though their chronological age would suggest a sense of limited time left in life, their altruistic attitude, lack of cognitive decline (as determined by their MoCA scores), and strong engagement in the community (many were recruited through community groups) provides them with a sense of physical and psychological well-being that has resulted in the perception of time left in life as lengthy. This argument applies to both older adult mood groups as they had very similar percentages of total time when viewing happy images; the lack of dysphoria in the older sample may have resulted in these groups being relatively homogeneous.

FINDINGS FROM THE RATING STAGE

Rating of sad images

According to Hypothesis 10, dysphoric participants would rate sad images less positively than the non-dysphoric participants. However, the results did not support this hypothesis, with it being found that dysphoric and non-dysphoric participants rated sad images similarly. However, the expectation that no age-related differences would be found when sad images were rated was supported by the results.

Many studies that have found support for a negative interpretation bias have used ambiguous stimuli, typically lexical in nature (either visual or auditory). In fact, it has been suggested that negative interpretation biases are strongest when the stimuli are ambiguous (Mogg et al., 2006). It is possible that the present study's lack of support for a negative interpretation bias occurred because images rather than words were the selected stimuli. The method of assessing interpretation biases employed in the present study was unique, with the presence of such biases being measured by individual ratings. This type of method may not be appropriate for assessing interpretative biases because the task is goal-directed. As discussed previously, according to the AIM, motivated processing of information occurs when individuals work towards a pre-existing goal (Forgas, 1995). The request to rate images may have resulted in the motivated processing strategy being employed, which is one of two strategies that are not influenced by affect infusion. It is through heuristic and substantive processing that mood-congruency effects are typically seen, and therefore, the lack of mood-congruent findings may have resulted in a different strategy being used to complete the task. Future research focussed on exploring varying outcomes affected by

methodological differences and/or methods used to elicit different processing strategies would be beneficial.

A further explanation for the null findings may stem from the unspecified length of time that the stimuli were presented. It has been suggested that mood-*incongruency* effects are evident after a particular period of time (Sedikides, 1994). The present study's findings may have occurred because the participants, rather than the experimenter, regulated the length of time each image was displayed. However, the Sedikides study found that mood-incongruency effects were evident after 13 minutes. While time taken to complete this task was not recorded in the present study (participants completed it in a room on their own), the researcher was able to observe the participants, and it appeared that most participants did not dwell on the images for any length of time (estimated to be no more than 30 seconds for most, 60 seconds for those who were unaccustomed to using computer equipment). Therefore, while mood incongruency effects are a plausible explanation for the null findings, it is considered a somewhat unlikely explanation. Accordingly, future research in this area may find it beneficial to determine if mood incongruency effects are found under shorter time conditions.

Rating of happy images

Hypothesis 11 predicted that non-dysphoric participants would rate the happy images more positively than the dysphoric participants. Again, this was not supported by the present study's findings. As was the case for the rating of sad images, it is suggested that the lack of mood-congruency effects when happy images were rated was due to the type of information processing strategy employed (motivated processing) by the participants.

A further possible explanation, which applies to the rating of sad images too, is that the selected images for use in the experiment were classified into thematic groups with very strong agreement across the categorisation participants. This means there was little ambiguity in the images used. Therefore, it is possible that the images were so strongly representative of the thematic categories that mood did not affect the way these were interpreted. This indicates that the interpretation of positive and negative material may not play an important role in depressive symptoms, especially related to cognitive symptoms. However, further research would be useful in determining the effect depression may have on interpretation biases, while also assessing if interpretation biases vary under certain methodological conditions, such as using images instead of lexical stimuli.

When rating happy images, Hypothesis 12 was supported in that older non-dysphoric participants provided more positive ratings than younger non-dysphoric participants, thus demonstrating a positive interpretation bias. This support for Hypothesis 12 is interesting (even though it was expected) in light of the lack of support for a positivity bias in the eye tracking results. Accordingly, while older non-dysphoric participants may not have exhibited the type of positivity bias expected, and therefore did not attend to positive material for significantly longer periods of time, they did interpret such material in a more positive way than their younger counterparts. These results indicate the need for future research investigating positivity biases to include the assessment of an interpretation bias.

LIMITATIONS

A major limitation of the present study was the loss of data that occurred during the eye tracking stage. This issue has been raised previously, but the point worth making here is that this was unforeseen. It was predicted that some loss of data would occur through actions such as eye blinks, but the sheer volume of lost data was surprising. What made the loss unforeseen is that, of all eye tracking studies reviewed, only three mentioned lost data (see Caseras et al., 2007; Isaacowitz et al., 2008; Sears et al., 2007). Of those that mentioned lost data, references were relatively unassuming, with statements such as "calibration loss, inadequate gaze tracking, or other equipment failure" (Sears et al., 2007, p. 1358). None outlined how much data were lost or what process was used to accommodate the loss. The novice eye tracking researcher would not have been aware that this type of problem could occur at such high volumes. Due to the lack of commentary in the literature, the solution employed in the present study may not have been the most appropriate. It would be unreasonable to expect that all participants would provide 100% of the possible raw data points. So what percentage would be acceptable? Was the 80% cut-off used in the present study too low? Should it also have been expected that the only participants included in analysis were those that provided the prerequisite percentage of raw gaze points for *all* 20 experimental slides? If this were the case, the present study would have had to remove a substantial number of participants from the analysis. It is suggested that more transparency is needed in studies using eye tracking methods to better guide future researchers in ways of dealing with the problem of missing data. If more information was provided on lost eye tracking data, there would be a greater chance of developing generally accepted protocols for dealing with this issue.

Interestingly, the lost data from older adults was disproportionately higher than for younger adults. The LC Technologies (2008) manual reports that the equipment used in the present study can track "90 to 95% of the human population" (p. 5). The manual's authors do not indicate if this statement excludes older adults. Failure to operate the equipment correctly cannot be an explanation, since minimal data were lost when the eye tracker was used with the younger participants. Therefore, it appears that there might be something different about older adults that interfered with the detection of their eye movements. One possibility is the existence of prodromal eye conditions in older adults such as glaucoma or cataracts. Although the present study enquired about these conditions (with confirmation of their existence resulting in exclusion from the study), the request did rely on participants' self-report. Additionally, it is possible that some older participants may have eye conditions (albeit in the prodromal stage) that they were not aware of. Furthermore, anatomical changes in the eyeball that occur with aging may have also affected the detection of eye movements. Indeed, with aging the eye alters such that the eyeball recedes into the eye socket, while the upper eyelid sags, blocking the field of vision (Nigam & Knight, 2008). Similarly, with aging, the lower eyelid also droops while skin fold is greater, further affecting the visual field (van den Bosch, Leenders, & Mulder, 1999). Moreover, the curvature of the cornea changes with age, resulting in alterations of the eye surface (Salvi, Akhtar, & Currie, 2006). Such changes to the anatomy of the eyeball or the area around the eye may have contributed to the difficulties obtaining recorded data from the older sample. Thus, one suggestion for future research is to employ more extensive screening of eye conditions in participants, especially those in late life. A further suggestion is that eye tracking studies comparing data loss in older and younger participants should be conducted to establish if older eyes make eye tracking more problematic.

Another limitation of the present study was the lack of depressive symptoms experienced within the dysphoric group. Although this has been discussed already as a possible explanation for the contrary findings, it is highlighted here as a limitation of the study. In part this occurred because of difficulties experienced in recruiting the desired number of depressed participants, particularly within the older adult group. While there are studies that have found evidence of a negative bias in dysphoria (sub-threshold depression), it is still likely that the present study's level of dysphoria was too low. While some participants would have been experiencing dysphoria, possibly even clinical depression, in the dysphoric group, there may have been participants in this group that had very few symptoms of depression, and most likely mild symptoms at that. Therefore, the least dysphoric

participants in this group are likely to have skewed the overall level of dysphoria in the entire sample, making it more representative of a non-dysphoric group, and therefore diminishing the chances of finding support for some of the hypotheses. The low levels of dysphoria were made further problematic when coupled with the median split, adding further limitations to the study. Conversely, by not performing the median split, participant numbers in some of the groups (i.e., older dysphoric) would have been incredibly small (i.e., two and three for the eye tracking and rating stage respectively) making comparisons between groups difficult. The lesser of two evils was selected, using two different cut-off scores for the different age groups, and because of this, results can only be interpreted with caution.

A further limitation of the present study was the relatively small number of participants in each of the four categories (which occurred when looking at age- and mood-related differences). There was a maximum of 16 participants in each of the four groups, meaning that the study was underpowered for many of the effect sizes obtained. Although calculations were performed that established that 15 participants were needed in each group (assuming a large effect size) to reach a power of .80, some of the groups had smaller effect sizes. In fact, the lowest number of participants in any one group was 13 in the older dysphoric group (for the eye tracking stage). This lowered sample size would have reduced power even further, resulting in an increased risk of Type II errors occurring. An increase in sample size would have combated this but logistically this was not possible given the recruitment difficulties and the time frame for completing the study. The present study looked beyond statistical significance and also considered results with medium or greater effect sizes, which has provided a more robust interpretation of the study's findings.

CONCLUSION

The present study found stronger evidence for the presence of a positivity bias in non-dysphoric individuals than a negative bias in dysphoric individuals. The lack of a negative bias could be due to issues such as a lack of sufficiently dysphoric participants in the sample, or problems in lost data, but it is also possible that dysphoria is not associated with a negative bias. Dysphoria may prohibit access to a positivity and protective bias, making dysphoric individuals less able to disengage from negative material and seek out positive material. This is an area that needs further attention in future research, with greater emphasis on teasing apart positivity/protective biases from negative biases. One aim would

be to establish if they are distinct concepts that exist like two sides of the same coin, such that for one to be present, the other must be absent, or if they are present only under certain circumstances, such as time, stimulus type, or methodological conditions.

Age-related differences were minimal, indicating that, when experiencing similar mood states, older and younger adults do not differ in the way they selectively attend to, and interpret, emotionally valenced stimuli. This is interesting, especially for the non-dysphoric group where previous findings support the idea of older adults being more positive. The major obstacle in understanding age-related differences in cognitive biases is the severe lack of research addressing cognitive biases in older adults.

The contrast in results between the two stages of the study is noteworthy. Given that there was more (partial) evidence for negative biases in the eye tracking stage than interpretative biases in the rating stage, it appears that negative biases are more sensitive measures of mood-related differences. Indeed, dysphoric and non-dysphoric individuals may interpret positive and negative stimuli in very similar ways, but it is the manner with which they visually attend to these images that seems most representative of cognitive biases theorised to exist in depression. The purpose of the rating stage was to establish if differences found in negative biases were consistent with interpretation biases. If so, is selectively attending to negative material for longer periods of time the result of negative material not being perceived as overly negative? It appears that this is not the case, which suggests that the latency of selectively attending to negative material occurs as a result of either difficulties with disengagement, or hyperattentiveness to negative stimuli. This validates Beck's cognitive theory of depression, in that individuals experiencing depression are prone to attend to information in an overly negative manner (A. Beck, 1967).

In sum, the present study has provided mixed results for the study of negative and interpretative biases in both dysphoric and non-dysphoric individuals. However, it has offered a unique glimpse into age-related differences in those experiencing dysphoria. It is clear that there is a need for more research to be conducted in this area. Furthermore, the employment of eye tracking methods will further advance the existing literature, with the potential for greater consistency to be found given the superiority of this method over traditional methods. The advancement of research with older adults and dysphoria (and depression) is no easy task, but the potential for a better understanding of depression in this cohort through research findings that can be implemented in clinical practice will result in

improving the wellbeing, quality of life, and life expectancy of those who experience depression across the life span.

REFERENCES

Abela, J. R., & D'Alessandro, D. U. (2002). Beck's cognitive theory of depression: A test of the diathesis-stress and causal mediation components. *British Journal of Clinical Psychology, 41*, 111-128.

Alexopoulos, G. S. (1991). Anxiety and depression in the elderly. In C. Salzman & B. Lebowitz (Eds.), *Anxiety in the elderly: Treatment and research* (pp. 63-74). New York: Springer.

Allport, A. (1989). Visual attention. In M. I. Posner (Ed.), *Foundations of cognitive science* (pp. 631-682). Cambridge, MA: Massachusetts Institute of Technology.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

American Psychiatric Association. (2013). *Desk reference to the diagnostic criteria from DSM-5*. Washington, DC: Author.

Armstrong, T., & Olatunji, B. O. (2012). Eye tracking of attention in the affective disorders: A meta-analytic review and synthesis. *Clinical Psychology Review, 32*, 704-723. doi: 10.1016/j.cpr.2012.09.004

Backman, L. (1989). Varieties of memory compensation by older adults in episodic remembering. In L. W. Poon, D. C. Rubin, & B. A. Wilson (Eds.), *Everyday cognition in adulthood and late life* (pp. 499-544). New York: Cambridge University Press.

Balsis, S., & Cully, J. A. (2008). Comparing depression diagnostic symptoms across younger and older adults. *Aging and Mental Health, 12*, 800-806. doi: 10.1080/13607860802428000

Beautrais, A. (2003). Suicide in New Zealand II: A review of risk factors and prevention. *Journal of the New Zealand Medical Association, 116*, 1-13.

Beautrais, A. L. (2002). A case control study of suicide and attempted suicide in older adults. *Suicide and Life-Threatening Behaviour, 32*, 1-9.

Beck, A. T. (1967). *Depression: Clinical, experimental, and theoretical aspects*. New York: Hoeber.

Beck, A. T. (1976). *Cognitive therapy and the emotional disorders*. New York: International Universities Press.

Beck, A. T., & Alford, B. A. (2009). *Depression: Causes and treatment* (2nd ed.). Philadelphia, PA: University of Pennsylvania Press.

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Beck Depression Inventory - Second Edition (BDI-II)*. San Antonio, TX: Psychological Corporation.

Beck, J. S. (1995). *Cognitive therapy: Basics and beyond*. New York: Guilford Press.

Beekman, A., Copeland, J., & Prince, M. J. (1999). Review of community prevalence of depression in later life. *The British Journal of Psychiatry, 174*, 307-311.

Beekman, A. T. F., Deeg, D. J. H., van Limbeek, J., Braam, A. W., De Vries, M. Z., & van Tilburg, W. (1997). Criterion validity of the Center for Epidemiologic Studies Depression scale (CES-D): Results from a community-based sample of older subjects in the Netherlands. *Psychological Medicine, 27*, 231-235.

Beevers, C. G., Wells, T. T., Ellis, A. J., & Fischer, K. (2009). Identification of emotionally ambiguous interpersonal stimuli among dysphoric and nondysphoric individuals. *Cognitive Therapy and Research, 33*, 283-290.

Berman, J., & Furst, L. M. (2011). *Depressed older adults: Education and screening*. New York: Springer.

Beuke, C. J., Fischer, R., & McDowall, J. (2003). Anxiety and depression: Why and how to measure their separate effects. *Clinical Psychology Review, 23*, 831-848.

Bhar, S. S., & Brown, G. K. (2012). Treatment of depression and suicide in older adults. *Cognitive and Behavioural Practice, 19*, 116-125. doi: 10.1016/j.cbpra.2010.12.005

Bisson, M. A. S., & Sears, C. R. (2007). The effect of depressed mood on the interpretation of ambiguity, with and without negative mood induction. *Cognition and Emotion, 21*, 614-645. doi: 10.1080/02699930600750715

Blazer, D. (2002). *Depression in late life* (3rd ed.). New York: Springer Publishing Company.

Blazer, D. G. (2003). Depression in late life: review and commentary. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 58*, M249-M265.

Boland, R. J., & Keller, M. B. (2009). Course and outcome of depression. In I. H. Gotlib & C. L. Hammen (Eds.), *Handbook of depression* (2nd ed., pp. 23-43). New York: Guilford Press.

Bouhuys, A. L., Geerts, E., & Gordijn, M. C. M. (1999). Depressed patients' perceptions of facial emotions in depressed and remitted states are associated with relapse: a longitudinal study. *Journal of Nervous and Mental Disease, 187*, 595-602.

Bouhuys, A. L., Geerts, E., & Mersch, P. P. A. (1997). Relationship between perception of facial emotions and anxiety in clinical depression: Does anxiety-related perception predict persistence of depression? *Journal of Affective Disorders, 43*, 213-223.

Bower, G. H. (1981). Mood and memory. *American Psychologist, 36*, 129-148.

Bradley, B. P., & Mathews, A. (1988). Memory bias in recovered clinical depressives. *Cognition and Emotion, 2*, 235-245.

Bradley, B. P., Mogg, K., & Lee, S. C. (1997). Attentional biases for negative information in induced and naturally occurring dysphoria. *Behaviour Research and Therapy, 35*, 911-927.

Bradley, B. P., Mogg, K., Millar, N., Bonham-Carter, C., Fergusson, E., Jenkins, J., & Parr, M. (1997). Attentional biases for emotional faces. *Cognition and Emotion, 11*, 25-42.

Bradley, B. P., Mogg, K., & Millar, N. H. (2000). Covert and overt orienting of attention to emotional faces in anxiety. *Cognition and Emotion, 14*, 789-808.

Broomfield, N. M., Davies, R., MacMahon, K., Ali, F., & Cross, S. M. B. (2007). Further evidence of attention bias for negative information in late life depression. *International Journal of Geriatric Psychiatry, 22*, 175-180. doi: 10.1002/gps.1655

Buchtemann, D., Luppa, M., Bramesfeld, A., & Riedel-Heller, S. (2012). Incidence of late-life depression: A systematic review. *Journal of Affective Disorders, 142*, 172-179. doi: 10.1016/j.jad.2012.05.010

Burke, K. C., Burke, J. D., Regier, D. A., & Rae, D. S. (1990). Age at onset of selected mental disorders in five community populations. *Archives of General Psychiatry, 47*, 511-518.

Byers, A. L., & Yaffe, K. (2011). Depression and risk of developing dementia. *Nature Reviews Neurology, 7*, 323-331. doi: 10.1038/nrneurol.2011.60

Carstensen, L. L. (1992). Social and emotional patterns in adulthood: Support for socioemotional selectivity theory. *Psychology and Aging, 7*, 331-338.

Carstensen, L. L. (2006). The influence of a sense of time on human development. *Science, 312*, 1913-1915.

Carstensen, L. L., Isaacowitz, D. M., & Charles, S. T. (1999). Taking time seriously: A theory of socioemotional selectivity. *American Psychologist, 54*, 165-181.

Carstensen, L. L., & Mikels, J. A. (2005). At the intersection of emotion and cognition: Aging and the positivity effect. *Current Directions in Psychological Science, 14*, 117-121. doi: 10.1111/j.0963-7214.2005.00348.x

Carstensen, L. L., Mikels, J. A., & Mather, M. (2006). Aging and the intersection of cognition, motivation, and emotion. In J. E. Birren & K. W. Schaie (Eds.), *Handbook of the psychology of aging* (pp. 343-362). San Diego: Academic Press.

Caseras, X., Garner, M., Bradley, B. P., & Mogg, K. (2007). Biases in visual orienting to negative and positive scenes in dysphoria: An eye movement study. *Journal of Abnormal Psychology, 116*, 491-497. doi: 10.1037/0021-843X.116.3.491

Casey, P., Dunn, G., Kelly, B., Lehtinen, V., Dalgard, O., Dowrick, C., & Ayuso-Mateos, J. (2008). The prevalence of suicidal ideation in the general population: Results from the Outcome of Depression International Network (ODIN) study. *Social Psychiatry and Psychiatric Epidemiology, 43*, 299-304. doi: 10.1007/s00127-008-0313-5

Cavanaugh, J. C., & Blanchard-Fields, F. (2015). *Adult development and aging* (7th ed.). Stamford, CT: Cengage Learning.

Centre for the Study of Emotion and Attention [CSEA-NIMH]. (1999). International Affective Picture System: Digitized Photographs. The Centre for Research in Psychophysiology, University of Florida, Gainesville, FL.

Chapman, D. P., & Perry, G. S. (2008). Depression as a major component of public health for older adults. *Preventing Chronic Disease, 5*, 1-9.

Cohen, J. (1988). *Statistical power analysis for the behavioural sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Conwell, Y., Duberstein, P. R., Cox, C., Herrmann, J. H., Forbes, N. T., & Caine, E. D. (1996). Relationships of age and Axis I diagnoses in victims of completed suicide: A psychological autopsy study. *American Journal of Psychiatry, 153*, 1001-1008.

Dalgleish, T., & Watts, F. N. (1990). Biases of attention and memory in disorders of anxiety and depression. *Clinical Psychology Review, 10*, 589-604.

De Raedt, R., Koster, E. H. W., & Ryckewaert, R. (2012). Aging and attentional bias for death-related and general threat-related information: Less avoidance in older as compared with middle-aged adults. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*. doi: 10.1093/geronb/gbs047

Deldin, P. J., Keller, J., Gergen, J. A., & Miller, G. A. (2001). Cognitive bias and emotion in neuropsychological models of depression. *Cognition and Emotion, 15*, 787-802. doi: 10.1080/02699930143000248

Dennis, R., Boddington, S., & Funnell, N. (2007). Self-report measures of anxiety: Are they suitable for older adults? *Aging and Mental Health, 11*, 668-677. doi: 10.1080/13607860701529916

Desimone, R., & Duncan, J. (1995). Neural mechanisms of selective visual attention. *Annual Review of Neuroscience, 18*, 193-222.

Diniz, B. S., Butters, M. A., Albert, S. M., Dew, M. A., & Reynolds, C. F. (2013). Late-life depression and risk of vascular dementia and Alzheimer's disease: Systematic review and meta-analysis of community-based cohort studies. *The British Journal of Psychiatry, 202*, 329-335. doi: 10.1192/bjp.bp.112.118307

Dotson, V. M., Beydoun, M. A., & Zonderman, A. B. (2010). Recurrent depressive symptoms and the incidence of dementia and mild cognitive impairment. *Neurology, 75*, 27-34. doi: 10.1212/WNL.0b013e3181e62124

Duchowski, A. T. (2007). *Eye tracking methodology: Theory and practice* (2nd ed.). London: Springer.

Dudley, R., O'Brien, J., Barnett, N., McGuckin, L., & Britton, P. (2002). Distinguishing depression from dementia in later life: A pilot study employing the emotional Stroop task. *International Journal of Geriatric Psychiatry, 17*, 48-53.

Duncan, J., Humphreys, G., & Ward, R. (1997). Competitive brain activity in visual attention. *Current Opinion in Neurobiology, 7*, 255-261.

Eizenman, M., Yu, L. H., Grupp, L., Eizenman, E., Ellenbogen, M., Gemar, M., & Levitan, R. D. (2003). A naturalistic visual scanning approach to assess selective attention in major depressive disorder. *Psychiatry Research, 118*, 117-128.

Ellis, A., Beevers, C., & Wells, T. (2011). Attention allocation and incidental recognition of emotional information in dysphoria. *Cognitive Therapy and Research, 35*, 425-433. doi: 10.1007/s10608-010-9305-3

Eysenck, M. W., & Keane, M. T. (2010). *Cognitive psychology: A student's handbook* (6th ed.). Hove, UK: Psychology Press.

Faul, F., Erdfelder, E., Lang, A., & Buchner, A. (2010). G*Power (Version 3.1.2).

Fergusson, D. M., Woodward, L. J., & Horwood, L. J. (2000). Risk factors and life processes associated with the onset of suicidal behaviour during adolescence and early adulthood. *Psychological Medicine, 30*, 23-29.

Field, A. (2009). *Discovering statistics using SPSS* (3rd ed.). London: Sage Publications.

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). Mini-mental state: A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research, 12*, 189-198. doi: 10.1016/0022-3956(75)90026-6

Forgas, J. P. (1995). Mood and judgment: The affect infusion model (AIM). *Psychological Bulletin, 117*, 39-66. doi: 10.1037/0033-2909.117.1.39

Forgas, J. P. (1999). Network theories and beyond. In T. Dalgleish & M. Power (Eds.), *Handbook of cognition and emotion* (pp. 591-611). Chichester, UK: John Wiley & Sons Ltd.

Forgas, J. P., & Bower, G. H. (1988). Affect in social judgments. *Australian Journal of Psychology, 40*, 125-145.

Forgas, J. P., & Locke, J. (2005). Affective influences on causal inferences: The effects of mood on attributions for positive and negative interpersonal episodes. *Cognition and Emotion, 19*, 1071-1081. doi: 10.1080/02699930541000093

Foti, D., & Hajcak, G. (2010). State sadness reduces neural sensitivity to nonrewards versus rewards. *Neuroreport, 21*, 143-147.

Fox, E., & Georgiou, G. A. (2005). The nature of attentional bias in human anxiety. In R. W. Engle, G. Sedek, U. von Hecker, & D. N. McIntosh (Eds.), *Cognitive limitations in aging and psychopathology* (pp. 249-274). New York: Cambridge University Press.

Gale, C. R., Allerhand, M., Sayer, A. A., Cooper, C., Dennison, E. M., Starr, J. M., . . . Deary, I. J. (2010). The structure of the Hospital Anxiety and Depression Scale in four cohorts of community-based, healthy older people: The HALCyon program. *International Psychogeriatrics, 22*, 559-571. doi: 10.1017/S1041610210000256

Gallagher, D., & Thompson, L. W. (1983). Cognitive psychotherapy of late-life depression. In L. D. Breslau & M. R. Haug (Eds.), *Depression and aging* (pp. 168-192). New York: Springer.

Gilbert, P. (1992). *Depression: The evolution of powerlessness*. London: The Guilford Press.

Gilboa, E., & Gotlib, I. H. (1997). Cognitive biases and affect persistence in previously dysphoric and never-dysphoric individuals. *Cognition and Emotion, 11*, 517-538. doi: 10.1080/026999397379881a

Gilboa-Schechtman, E., Ben-Artzi, E., Jeczemien, P., Marom, S., & Hermesh, H. (2004). Depression impairs the ability to ignore the emotional aspects of facial expressions: Evidence from the Garner task. *Cognition and Emotion, 18*, 209-231. doi: 10.1080/02699930341000176

Goeleven, E., De Raedt, R., Baert, S., & Koster, E. H. W. (2006). Deficient inhibition of emotional information in depression. *Journal of Affective Disorders, 93*, 149-157.

Gotlib, I. H., & Hammen, C. L. (1992). *Psychological aspects of depression: Toward a cognitive-interpersonal integration*. Chichester, UK: John Wiley & Sons.

Gotlib, I. H., Krasnoperova, E., Neubauer Yue, D., & Joormann, J. (2004). Attentional biases for negative interpersonal stimuli in clinical depression. *Journal of Abnormal Psychology, 113*, 127-135.

Gotlib, I. H., & McCann, C. D. (1984). Construct accessibility and depression: An examination of cognitive and affective factors. *Journal of Personality and Social Psychology, 47*, 427.

Gotlib, I. H., McLachlan, A. L., & Katz, A. N. (1988). Biases in visual attention in depressed and nondepressed individuals. *Cognition and Emotion, 2*, 185-200.

Grady, C. (2012). The cognitive neuroscience of ageing. *Nature Reviews Neuroscience, 13,* 491-505. doi: 10.1038/nrn3256.

Green, J. F., King, D. J., & Trimble, K. M. (2000). Antisaccade and smooth pursuit eye movements in healthy subjects receiving sertraline and lorazepam. *Journal of Psychopharmacology, 14*, 30-36.

Hammen, C., & Watkins, E. (2008). *Depression* (2nd ed.). Hove, UK: Psychology Press.

Haringsma, R., Engels, G. I., Beekman, A. T. F., & Spinhoven, P. (2004). The criterion validity of the Center for Epidemiological Studies Depression Scale (CES-D) in a sample of self-referred elders with depressive symptomatology. *International Journal of Geriatric Psychiatry, 19*, 558-563. doi: 10.1002/gps.1130

Harwood, D. G., Barker, W. W., Ownby, R. L., Mullan, M., & Duara, R. (1999). Factors associated with depressive symptoms in non-demented community-dwelling elderly. *International Journal of Geriatric Psychiatry, 14*, 331-337. doi: 10.1002/(sici)1099-1166(199905)14:5<331:aid-gps911>3.0.co;2-8

Hermans, D., Vansteenwegen, D., & Eelen, P. (1999). Eye movement registration as a continuous index of attention deployment: Data from a group of spider-anxious students. *Cognition and Emotion, 13*, 419 - 434. doi: 10.1080/026999399379249

Hertel, P. T., & El-Messidi, L. (2006). Am I blue? Depressed mood and the consequences of self-focus for the interpretation and recall of ambiguous words. *Behaviour Therapy, 37*, 259-268.

Hertel, P. T., & Mathews, A. (2011). Cognitive bias modification: Past perspectives, current findings, and future applications. *Perspectives on Psychological Science, 6*, 521-536. doi: 10.1177/1745691611421205

Himmelfarb, S., & Murrell, S. A. (1983). Reliability and validity of five mental health scales in older persons. *Journal of Gerontology, 38*, 333-339.

Hindash, A. H. C., & Amir, N. (2012). Negative interpretation bias in individuals with depressive symptoms. *Cognitive Therapy and Research, 36*, 502-511.

Holdaway, M. A. (2011). *The effects of late-life depression on memory.* (Doctoral dissertation). Retrieved from http://hdl.handle.net/10179/3331.

Hybels, C. F., & Blazer, D. G. (2003). Epidemiology of late life mental disorders. *Clinics in Geriatric Medicine, 19*, 663-696.

Isaacowitz, D. M., Allard, E. S., Murphy, N. A., & Schlangel, M. (2009). The time course of age-related preferences toward positive and negative stimuli. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 64B*, 188-192. doi: 10.1093/geronb/gbn036

Isaacowitz, D. M., Toner, K., Goren, D., & Wilson, H. R. (2008). Looking while unhappy: Mood-congruent gaze in young adults, positive gaze in older adults. *Psychological Science, 19*, 848-853.

Isaacowitz, D. M., Toner, K., & Neupert, S. D. (2009). Use of gaze for real-time mood regulation: Effects of age and attentional functioning. *Psychology and Aging, 24*, 989-994. doi: 10.1037/a0017706

Isaacowitz, D. M., Wadlinger, H. A., Goren, D., & Wilson, H. R. (2006a). Is there an age-related positivity effect in visual attention? A comparison of two methodologies. *Emotion, 6*, 511-516. doi: 10.1037/1528-3542.6.3.511

Isaacowitz, D. M., Wadlinger, H. A., Goren, D., & Wilson, H. R. (2006b). Selective preference in visual fixation away from negative images in old age? An eye-tracking study. *Psychology and Aging, 21*, 40-48. doi: 10.1037/0882-7974.21.1.40

Jackson, S. W. (1986). *Melancholia and depression: From Hippocratic times to modern times*. New Haven, CT: Yale University Press.

James, W. (1890). *The principles of psychology*. New York: Holt.

Johnson, A., & Proctor, R. W. (2004). *Attention: Theory and practice*. Thousand Oaks, CA: Sage Publications.

Johnston, M., Pollard, B., & Hennessey, P. (2000). Construct validation of the Hospital Anxiety and Depression Scale with clinical populations. *Journal of Psychosomatic Research, 48*, 579-584.

Jonides, J. (1983). Further toward a model of the mind's eye's movement. *Bulletin of the Psychonomic Society, 21*, 247-250.

Joormann, J., & Gotlib, I. H. (2007). Selective attention to emotional faces following recovery from depression. *Journal of Abnormal Psychology, 116*, 80-85. doi: 10.1037/0021-843X.116.1.80

Kaelber, C. T., Moul, D. E., & Farmer, M. E. (1995). Epidemiology of depression. In E. E. Beckham & W. R. Leber (Eds.), *Handbook of depression* (2nd ed., pp. 3-35). London: The Guilford Press.

Kellough, J. L., Beevers, C. G., Ellis, A. J., & Wells, T. T. (2008). Time course of selective attention in clinically depressed young adults: An eye tracking study. *Behaviour Research and Therapy, 46*, 1238-1243. doi: 10.1016/j.brat.2008.07.004

Kenn, C., Wood, H., Kucyj, M., Wattis, J., & Cunane, J. (1987). Validation of the Hospital Anxiety and Depression rating scale (HADS) in an elderly psychiatric population. *International Journal of Geriatric Psychiatry, 2*, 189-193. doi: 10.1002/gps.930020309

Kertzman, S., Reznik, I., Hornik-Lurie, T., Weizman, A., Kotler, M., & Amital, D. (2010). Stroop performance in major depression: Selective attention impairment or psychomotor slowness? *Journal of Affective Disorders, 122*, 167-173. doi: doi: 10.1016/j.jad.2009.08.009

Kessler, R. C., Chiu, W. T., Demler, O., & Walters, E. E. (2005). Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry, 62*, 617-627.

Knight, M., Seymour, T. L., Gaunt, J. T., Baker, C., Nesmith, K., & Mather, M. (2007). Aging and goal-directed emotional attention: Distraction reverses emotional biases. *Emotion, 7*, 705-714. doi: 10.1037/1528-3542.7.4.705

Koster, E. H. W., De Lissnyder, E., Derakshan, N., & De Raedt, R. (2011). Understanding depressive rumination from a cognitive science perspective: The impaired disengagement hypothesis. *Clinical Psychology Review, 31*, 138-145. doi: 10.1016/j.cpr.2010.08.005

Koster, E. H. W., De Raedt, R., Goeleven, E., Franck, E., & Crombez, G. (2005). Mood-congruent attentional bias in dysphoria: Maintained attention to and impaired disengagement from negative information. *Emotion, 5*, 446-455.

LaBerge, D. (1995). *Attentional processing*. Cambridge, MA: Harvard.

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (2005). *International affective picture system (IAPS): Instruction manual and affective ratings*. Technical Report A-6, The Center for Research in Psychophysiology, University of Florida, Gainesville, FL.

Lau, M. A., Segal, Z. V., & Williams, J. M. G. (2004). Teasdale's differential activation hypothesis: Implications for mechanisms of depressive relapse and suicidal behaviour. *Behaviour Research and Therapy, 42*, 1001-1017.

Lawson, C., & MacLeod, C. (1999). Depression and the interpretation of ambiguity. *Behaviour Research and Therapy, 37*, 463-474. doi: 10.1016/S0005-7967(98)00131-4

Lawson, C., MacLeod, C., & Hammond, G. (2002). Interpretation revealed in the blink of an eye: Depressive bias in the resolution of ambiguity. *Journal of Abnormal Psychology, 111*, 321-328. doi: 10.1037/0021-843X.111.2.321

LC Techologies. (2008). *The eyegaze analysis system users manual*. Fairfax, VA: LC Technologies, Inc.

Lewinsohn, P. M., Joiner, T. E., Jr., & Rohde, P. (2001). Evaluation of cognitive diathesis-stress models in predicting major depressive disorder in adolescents. *Journal of Abnormal Psychology, 110*, 203-215.

Lewinsohn, P. M., Seeley, J. R., Roberts, R. E., & Allen, N. B. (1997). Center for Epidemiologic Studies Depression Scale (CES-D) as a screening instrument for depression among community-residing older adults. *Psychology and Aging, 12*, 277-287.

Leyman, L., De Raedt, R., Schacht, R., & Koster, E. H. (2007). Attentional biases for angry faces in unipolar depression. *Psychological Medicine, 37*, 393-402.

Leyman, L., De Raedt, R., Vaeyens, R., & Philippaerts, R. M. (2011). Attention for emotional facial expressions in dysphoria: An eye-movement registration study. *Cognition and Emotion, 25*, 111-120. doi: 10.1080/02699931003593827

Luis, C. A., Keegan, A. P., & Mullan, M. (2009). Cross validation of the Montreal Cognitive Assessment in community-dwelling older adults residing in the Southeastern US. *International Journal of Geriatric Psychiatry, 24*, 197-201. doi: 10.1002/gps.2101

Luppa, M., Sikorski, C., Luck, T., Ehreke, L., Konnopka, A., Wiese, B., . . . Riedel-Heller, S. G. (2012). Age- and gender-specific prevalence of depression in latest-life - Systematic review and meta-analysis. *Journal of Affective Disorders, 136*, 212-221. doi: 10.1016/j.jad.2010.11.033

MacLeod, C., Mathews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology, 95*, 15-20.

Mather, M., & Carstensen, L. L. (2003). Aging and attentional biases for emotional faces. *Psychological Science, 14*, 409-415.

Mather, M., & Carstensen, L. L. (2005). Aging and motivated cognition: The positivity effect in attention and memory. *Trends in Cognitive Sciences, 9*, 496-502.

Mather, M., Knight, M., & McCaffrey, M. (2005). The allure of the alignable: younger and older adults' false memories of choice features. *Journal of Experimental Psychology: General, 134*, 38-51.

Mather, M., & Knight, M. P. (2006). Angry faces get noticed quickly: Threat detection is not impaired among older adults. *Journal of Gerontology, 61B*, 54-57.

Mathews, A., & Bradley, B. P. (1983). Mood and the self-reference bias in recall. *Behaviour Research and Therapy, 21*, 233-239.

Mathews, A., & MacLeod, C. (2005). Cognitive vulnerability to emotional disorders. *Annual Review of Clinical Psychology, 1*, 167-195. doi: 10.1146/annurev.clinpsy.1.102803.143916

Matthews, G., & Antes, J. R. (1992). Visual attention and depression: Cognitive biases in the eye fixations of the dysphoric and the non-depressed. *Cognitive Therapy and Research, 16*, 359-371.

Matthews, G., & Wells, A. (1999). The cognitive science of attention and emotion. In T. Dalgleish & M. Power (Eds.), *Handbook of cognition and emotion* (pp. 171-192). Chichester, UK: John Wiley & Sons Ltd.

McCabe, S. B., & Gotlib, I. H. (1995). Selective attention and clinical depression: Performance on a Deployment-of-Attention Task. *Journal of Abnormal Psychology, 104*, 241-245.

McIlwraith, S. (2009). *Attention bias for negative semantic stimuli in late life depression and clinical research portfolio.* DClinPsych, (Doctoral dissertation). Retrieved from http://eleanor.lib.gla.ac.uk/record=b2938978.

Mercer A., Allen, E. A., Jones, D., Marshall, R. W., Wroe, S., & Richens, A. (2007). The effects of minaprine and chlorpromazine alone or in combination on human psychomotor performance and mood. *British Journal of Clinical Pharmacology, 25*, 680-681.

Mogg, K., Bradbury, K. E., & Bradley, B. P. (2006). Interpretation of ambiguous information in clinical depression. *Behaviour Research and Therapy, 44*, 1411-1419.

Mogg, K., & Bradley, B. P. (1998). A cognitive-motivational analysis of anxiety. *Behaviour Research and Therapy, 36*, 809-848. doi: 10.1016/S0005-7967(98)00063-1

Mogg, K., & Bradley, B. P. (2005). Attentional bias in generalized anxiety disorder versus depressive disorder. *Cognitive Therapy and Research, 29*, 29-45. doi: 10.1007/s10608-005-1646-y

Mogg, K., Bradley, B. P., & Williams, R. (1995). Attentional bias in anxiety and depression: The role of awareness. *British Journal of Clinical Psychology, 34*, 17-36. doi: 10.1111/j.2044-8260.1995.tb01434.x

Mogg, K., Bradley, B. P., Williams, R., & Mathews, A. (1993). Subliminal processing of emotional information in anxiety and depression. *Journal of Abnormal Psychology, 102*, 304-311. doi: 10.1037/0021-843x.102.2.304

Mogg, K., Mathews, A., May, J., Grove, M., Eysenck, M., & Weinman, J. (1991). Assessment of cognitive bias in anxiety and depression using a colour perception task. *Cognition and Emotion, 5*, 221-238. doi: 10.1080/02699939108411036

Mogg, K., Millar, N., & Bradley, B. P. (2000). Biases in eye movements to threatening facial expressions in generalized anxiety disorder and depressive disorder. *Journal of Abnormal Psychology, 109*, 695-704. doi: 10.10371/0021-843X,109.4.695

Mondimore, F. M. (2006). *Depression: The mood disease* (3rd ed.). Baltimore, MD: John Hopkins University Press.

Moorey, S., Greer, S., Watson, M., Gorman, C., Rowden, L., Tunmore, R., . . . Bliss, J. (1991). The factor structure and factor stability of the hospital anxiety and depression scale in patients with cancer. *The British Journal of Psychiatry, 158*, 255-259. doi: 10.1192/bjp.158.2.255

Morrens, M., Wezenberg, E., Verkes, R. J., Hulstijn, W., Ruigt, G. S., & Sabbe, B. G. (2007). Psychomotor and memory effects of haloperidol, olanzapine, and paroxetine in healthy subjects after short-term administration. *Journal of Clinical Psychopharmacology, 27*, 15-21.

Munk, K. (2011). Depression in late life. In L. Larsen (Ed.), *Geropsychology: The psychology of the ageing person* (pp. 199-215). Aarhus, Denmark: Aarhus University Press.

Murphy, N. A., & Isaacowitz, D. M. (2008). Preferences for emotional information in older and younger adults: A meta-analysis of memory and attention tasks. *Psychology and Aging, 23*, 263-286. doi: 10.1037/0882-7974.23.2.263

Nada-Raja, S., Skegg, K., Langley, J., Morrison, D., & Sowberry, P. (2004). Self-harming behaviours in a population-based sample of young adults. *Suicide and Life-Threatening Behaviour 34*, 177-186.

Nasreddine, Z. S., Phillips, N. A., Bedirian, V., Charbonneau, S., Whitehead, V., Collin, I., . . . Chertkow, H. (2005). The Montreal Cognitive Assessment, MoCA: A brief screening tool for mild cognitive impairment. *Journal of the American Geriatrics Society, 53*, 695-699.

Nigam, Y., & Knight, J. (2008). Exploring the anatomy and physiology of ageing, part 6 - the eye and ear. *Nursing TImes, 104*, 22-23.

Nolen-Hoeksema, S. (1990). *Sex differences in depression*. Stanford, CA: Stanford University Press.

Nolen-Hoeksema, S., Wisco, B. E., & Lyubomirsky, S. (2008). Rethinking rumination. *Perspectives on Psychological Science, 3*, 400-424. doi: 10.1111/j.1745-6924.2008.00088.x

Nunn, J. D., Mathews, A., & Trower, P. (1997). Selective processing of concern-related information in depression. *British Journal of Clinical Psychology, 36*, 489-503. doi: 10.1111/j.2044-8260.1997.tb01256.x

Nydegger, R. (2008). *Understanding and treating depression: Ways to find hope and help*. Westport, CT: Praeger.

Oakley Browne, M. A., Wells, J. E., & Scott, K. M. (2006). *Te Rau Hinengaro: The New Zealand Mental Health Survey*. Wellington: Ministry of Health.

Palsson, S. P., Ostling, S., & Skoog, I. (2001). The incidence of first-onset depression in a population followed from the age of 70 to 85. *Psychological Medicine, 31*, 1159-1168.

Pashler, H. E. (1998). *The psychology of attention*. Boston, MA: Massachusetts Institute of Technology.

Peckham, A. D., McHugh, R. K., & Otto, M. W. (2010). A meta-analysis of the magnitude of biased attention in depression. *Depression and Anxiety, 27*, 1135-1142. doi: 10.1002/da.20755

Piccinelli, M., & Wilkinson, G. (2000). Gender differences in depression: Critical review. *The British Journal of Psychiatry, 177*, 486-492. doi: 10.1192/bjp.177.6.486

Posner, M. I., & Petersen, S. E. (1990). The attention system of the human brain. *Annual Review of Neuroscience, 13*, 25-42.

Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement, 1*, 385-401.

Reed, A. E., & Carstensen, L. L. (2012). The theory behind the age-related positivity effect. *Frontiers in Psychology, 3*, 1-9.

Reilly, J. L., Lancer, R., Bishop, J. R., Keedy, S., & Sweeney, J. A. (2008). Pharmacological treatment effects on eye movement control. *Brain and Cognition, 68*, 415-435.

Reynolds, C. F., Dew, M. A., Pollock, B. G., Mulsant, B. H., Frank, E., Miller, M. D., . . . Stack, J. A. (2006). Maintenance treatment of major depression in old age. *New England Journal of Medicine, 354*, 1130-1138.

Rizzuto, T. E., Cherry, K. E., & LeDoux, J. A. (2012). The aging process and cognitive capabilities. In J. W. Hedge & W. C. Borman (Eds.), *The Oxford handbook of work and aging* (pp. 236-255). New York: Oxford University Press.

Rosler, A., Ulrich, C., Billino, J., Sterzer, P., Weidauer, S., Bernhardt, T., . . . Kleinschmidt, A. (2005). Effects of arousing emotional scenes on the distribution of visuospatial attention: Changes with aging and early subcortical vascular dementia. *Journal of the Neurological Sciences, 229*, 109-116.

Ruff, C. C. (2011). A systems-neuroscience view of attention. In C. Mole, D. Smithies, & W. Wu (Eds.), *Attention: Philosophical and psychological essays* (pp. 1-23). New York: Oxford University Press.

Rutherford, M., & Towns, A. M. (2008). Scan path differences and similarities during emotion perception in those with and without autism spectrum disorders. *Journal of Autism and Developmental Disorders, 38*, 1371-1381. doi: 10.1007/s10803-007-0525-7

Sadock, B. J., & Sadock, V. A. (2007). *Kaplan and Sadock's synopsis of psychiatry* (10th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Safford, S. M., Alloy, L. B., Abramson, L. Y., & Crossfield, A. G. (2007). Negative cognitive style as a predictor of negative life events in depression-prone individuals: A test of the stress generation hypothesis. *Journal of Affective Disorders, 99*, 147-154.

Samanez-Larkin, G. R., Robertson, E. R., Mikels, J. A., Carstensen, L. L., & Gotlib, I. H. (2009). Selective attention to emotion in the aging brain. *Psychology and Aging, 24*, 519-529. doi: 10.1037/a0016952

Sears, C. R., Newman, K. R., Ference, J. D., & Thomas, C. L. (2011). Attention to emotional images in previously depressed individuals: An eye-tracking study. *Cognitive Therapy and Research, 35*, 517-528. doi: 10.1007/s10608-011-9396-5

Sears, C. R., Thomas, C. L., LeHuquet, J. M., & Johnson, J. C. S. (2010). Attentional biases in dysphoria: An eye-tracking study of the allocation and disengagement of attention. *Cognition and Emotion, 24*, 1349-1368. doi: 10.1080/02699930903399319

Sedikides, C. (1994). Incongruent effects of sad mood on self-conception valence: It's a matter of time. *European Journal of Social Psychology, 24*, 161-172.

Segal, D. L., Qualls, S. H., & Smyer, M. A. (2011). *Aging and mental health* (2nd ed.). Chichester, UK: Wiley-Blackwell.

Shane, M. S., & Peterson, J. B. (2007). An evaluation of early and late stage attentional processing of positive and negative information in dysphoria. *Cognition and Emotion, 21*, 789-815. doi: 10.1080/02699930600843197

Smarr, K. L. (2003). Measures of depression and depressive symptoms: The Beck Depression Inventory (BDI), Center for Epidemiological Studies-Depression Scale (CES-D), Geriatric Depression Scale (GDS), Hospital Anxiety and Depression Scale (HADS), and Primary Care Evaluation of Mental Disorders-Mood Module (PRIME-MD). *Arthritis Care and Research, 49*, S134-S146. doi: 10.1002/art.11410

Smith, N. K., Larsen, J. T., Chartrand, T. L., Cacioppo, J. T., Katafiasz, H. A., & Moran, K. E. (2006). Being bad isn't always good: Affective context moderates the attention bias toward negative information. *Journal of Personality and Social Psychology, 90*, 210-220. doi: 10.1037/0022-3514.90.2.210

Sobin, C., & Sackeim, H. A. (1997). Psychomotor symptoms of depression. *American Journal of Psychiatry, 154*, 4-17.

Solomon, A. (2001). *The noonday demon*. New York: Scribner.

Spijker, J., Graaf, R., ten Have, M., Nolen, W., & Speckens, A. (2010). Predictors of suicidality in depressive spectrum disorders in the general population: Results of the Netherlands Mental Health Survey and Incidence Study. *Social Psychiatry and Psychiatric Epidemiology, 45*, 513-521. doi: 10.1007/s00127-009-0093-6

Stanley, J. T., & Isaacowitz, D. M. (2011). Age-related differences in profiles of mood-change trajectories. *Developmental Psychology, 47*, 318-330. doi: 10.1037/a0021023

Styles, E. A. (2006). *The psychology of attention* (2nd ed.). Hove, UK: Psychology Press.

Suslow, T., & Dannlowski, U. (2005). Detection of facial emotion in depression. In A. V. Clark (Ed.), *Mood state and health* (pp. 1-32). Hauppauge, NY: Nova Science.

Teasdale, J. D. (1988). Cognitive vulnerability to persistent depression. *Cognition and Emotion, 2*, 247-274. doi: 10.1080/02699938808410927

Teasdale, J. D., & Dent, J. (1987). Cognitive vulnerability to depression: An investigation of two hypotheses. *British Journal of Clinical Psychology, 26*, 113-126. doi: 10.1111/j.2044-8260.1987.tb00737.x

van den Bosch, W. A., Leenders, I., & Mulder, P. (1999). Topographic anatomy of the eyelids, and the effects of sex and age. *British Journal of Ophthalmology, 83*, 347-352.

van Deurzen, P. A. M., Slaats-Willemse, D. I. E., Buitelaar, J. K., Roelofs, J., Rinck, M., & Speckens, A. E. M. (2011). Facilitated attentional disengagement from negative information in relation to self-reported depressive symptoms of Dutch female undergraduate students. *Psychological Reports, 108*, 252-262. doi: 10.2466/02.09.22.pr0.108.1.252-262

Weierich, M., & Feldman Barrett, L. (2010). Affect as a source of visual attention. In E. Balcetis & G. D. Lassiter (Eds.), *Social psychology of visual perception* (pp. 125-148). New York: Psychology Press.

Weissman, M. M., Bland, R. C., Canino, G. J., Greenwald, S., Hwu, H. G., Joyce, P. R., . . . Yeh, E. K. (1999). Prevalence of suicide ideation and suicide attempts in nine countries. *Psychological Medicine, 29*, 9-17.

Wells, T. T., & Beevers, C. G. (2010). Biased attention and dysphoria: Manipulating selective attention reduces subsequent depressive symptoms. *Cognition and Emotion, 24*, 719-728. doi: 10.1080/02699930802652388

Wenzlaff, R. M., & Bates, D. E. (1998). Unmasking a cognitive vulnerability to depression: How lapses in mental control reveal depressive thinking. *Journal of Personality and Social Psychology, 75*, 1559.

Williams, J. M. G., & Nulty, D. D. (1986). Construct accessibility, depression and the emotional Stroop task: Transient mood or stable structure? *Personality and Individual Differences, 7*, 485-491.

Williams, J. M. G., Watts, F. N., MacLeod, C., & Mathews, A. (1988). *Cognitive psychology and emotional disorders*. Chichester, UK: John Wiley & Sons.

Wilson, S. J., Bailey, J., Alford, C., Weinstein, A., & Nutt, D. (2002). Effects of 5 weeks of administration of fluoxetine and dothiepin in normal volunteers on sleep, daytime sedation, psychomotor performance and mood. *Journal of Psychopharmacology, 16*, 321-331.

Wright, R. D., & Ward, L. M. (2008). *Orienting of attention*. New York: Oxford University Press.

Wu, L. T., & Anthony, J. C. (2000). The estimated rate of depressed mood in US adults: Recent evidence for a peak in later life. *Journal of Affective Disorders, 60*, 159-171.

Zigmond, A. S., & Snaith, R. P. (1983). The Hospital Anxiety and Depression Scale. *Acta Psychiatrica Scandinavica, 67*, 361-370. doi: 10.1111/j.1600-0447.1983.tb09716.x

APPENDICES

Appendix A: Recruitment Poster

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA

Depression, Aging, and Eye-Gaze Study

Experiencing low mood or depression is a common mental health problem in New Zealand. Some symptoms that can occur in depression are frequently seen as part of the natural process of aging, making the diagnosis of depression in older adults complicated. Researchers are currently looking at tracking eye movements as a new technique to assist in the diagnosis of depression.

ARE YOU:

- **Currently experiencing depression?**

OR

- **Have never experienced depression?**
- **Aged between 20-40 or 70-80 years?**
- **Free from major visual impairment?**
- **Available for approximately one hour?**

If so, an invitation to participate in this innovative research is extended to you!

For more information, please contact:

Jodi Field
School of Psychology
Massey University

Email: EyegazeStudy@gmail.com
Phone: (06) 350 5577
022 018 2627

This study has been approved by the Central Regional Ethics Committee on 17 February 2011, reference CEN/11/EXP/09.

Appendix B: Recruitment Information Sheet

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Depression, Aging, and Eye-Gaze Study

INFORMATION SHEET

An invitation is extended to individuals who are interested in participating in this innovative research.

Experiencing low mood or depression is a common mental health problem in New Zealand. Some symptoms that can occur in depression are frequently seen as part of the natural process of aging, making the diagnosis of depression in older adults complicated. Researchers are currently looking at tracking eye movements as an innovative technique to assist in the diagnosis of depression.

Who is conducting this research?

My name is Jodi Field and I am the primary researcher of this study. I am conducting this research towards completion of my Doctorate in Clinical Psychology. I am working under the supervision of Associate Professor John Podd.

Who can participate?

Participation is open to individuals aged between 20-40 years and 70-80 years. We need people with a range of mood states. It does not matter whether you feel like you are depressed or that your mood is normal - you are eligible to apply to take part. Some individuals may not be able to participate, as certain medical conditions or some medications can affect eye movements. Once you have expressed an interest in taking part, you will be asked to complete a brief questionnaire to confirm your eligibility.

What will happen when I participate?

This research will be conducted at the School of Psychology at Massey University's Palmerston North campus and will take approximately one hour. You will undergo an eye-chart test, complete several brief questionnaires, and view a series of images while a special camera, mounted on a computer, will track your eye movements. Finally, you will rate these images. You will be given several opportunities to have a break during the study and are welcome to bring a support person with you. A $20 Plaza voucher will be provided as gratuity/koha for your time.

What are my rights as a participant?

The Central Region of the Health and Disabilities Ethics Committee has approved this study on 17 February 2011 (reference CEN/11/EXP/09). The ethical manner with which this study will be conducted ensures participants of the following rights:

- Participation is voluntary
- You may withdraw from the study at any time
- You can decline to answer questions
- You can ask questions at any stage
- Your participation is strictly confidential; no identifying material will be used in any reports on this study
- It is expected that no harm shall come to you as a result of participating
- Should this study raise issues of a sensitive nature, arrangements can be made to assist in this area (with your consent)
- If you were informed of this study from a psychologist, therapist, or other health practitioner, the treatment you are receiving will not be affected by your decision to accept or decline this invitation
- You are welcome to bring a whanau/family member, or other support person with you
- A summary of the results will be made available to you upon completion of the research

I'm interested! How can I participate?

Please provide your details below and return this form to me using the pre-paid envelope provided.

Name: _____

Phone: _____

Address: _____

Email: _____

Thank you very much for your interest in this research. I will contact you shortly to discuss your participation in this study. Should you have any queries, or wish to discuss this research further, please feel free to contact me:

Jodi Field
School of Psychology
Massey University

Email: EyegazeStudy@gmail.com
Phone: (06) 350 5577
022 018 2627

Or my supervisor:

Associate Professor John Podd
School of Psychology
Massey University

Email: J.V.Podd@massey.ac.nz
Phone: (06) 356 9099 ext 2067

This form will be securely held for a period of ten (10) years at which time it will be destroyed

Appendix C: Participant Information Sheet for Categorisation of Experimental Images

Depression, Aging, and Eye-Gaze Study

IMAGE SELECTION STUDY

Thank you for agreeing to assist with this study. Your participation is voluntary and confidential.

Shortly you will view a series of images on a computer screen. You may find some of the images to be sensitive in nature (for example, motor vehicle accidents, weapons, injured or ill people, deceased animals). While this may evoke an emotional reaction, these images are not deemed to be severe enough to cause any harm or ongoing distress. However, you may withdraw at any time. Should you decide to withdraw, you will still receive the $10 voucher to reimburse you for your time.

For each image, you are asked to indicate whether you think the image is best described by ONE of the following terms:

happy **threatening** **neutral** **quite sad** **extremely sad**

You do not need to remember these categories as they are displayed on the computer. The images are presented in slide-show format, with each image appearing for five seconds. If you wish, you can use the arrow key on the computer keyboard to navigate through the images faster. For each image, simply call out your response and I will record it for you.

This study is conducted in a manner that allows you to remain anonymous. The only personal details requested are:

Age: _____ Gender: _____

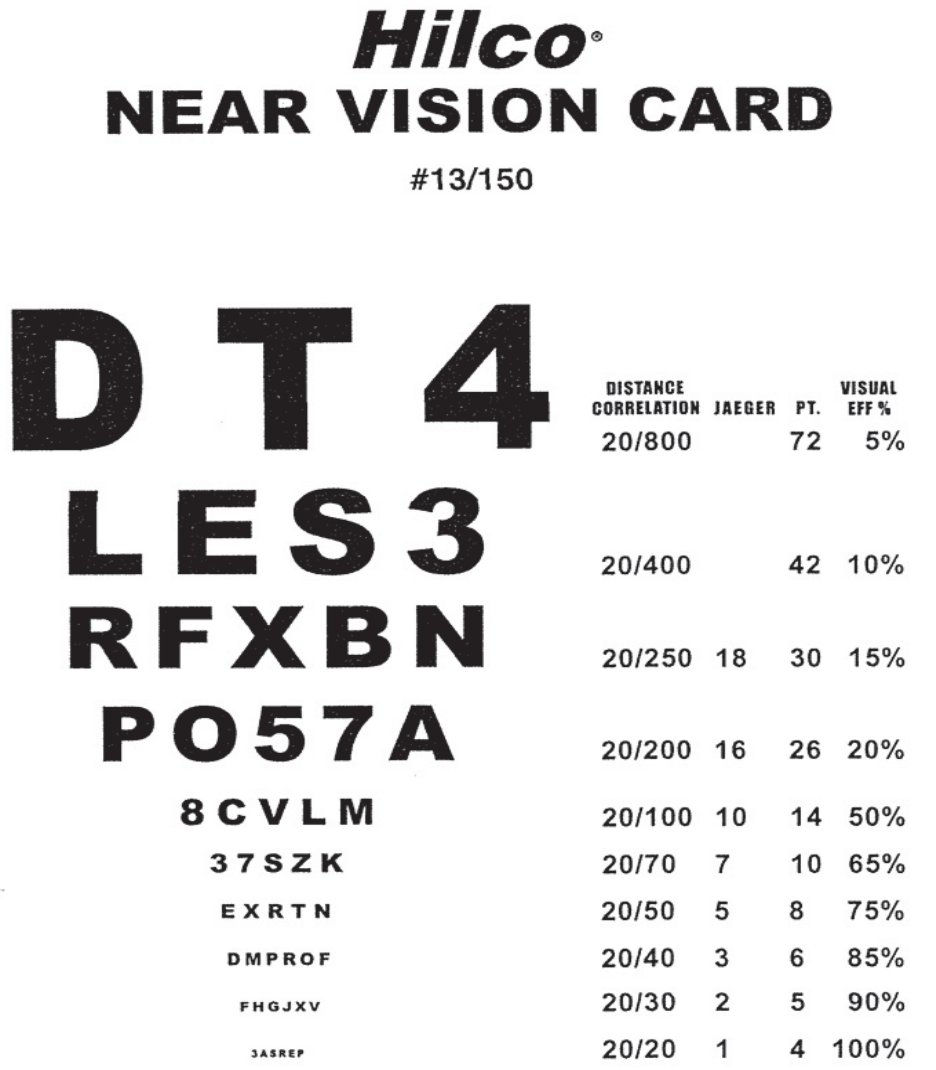
By completing these details, it is accepted that you have given your consent to participate. Thank you for participating in this study.

Appendix D: Experimental Images by Category with Mean Valence Ratings and Standard Deviations as Presented by IAPS

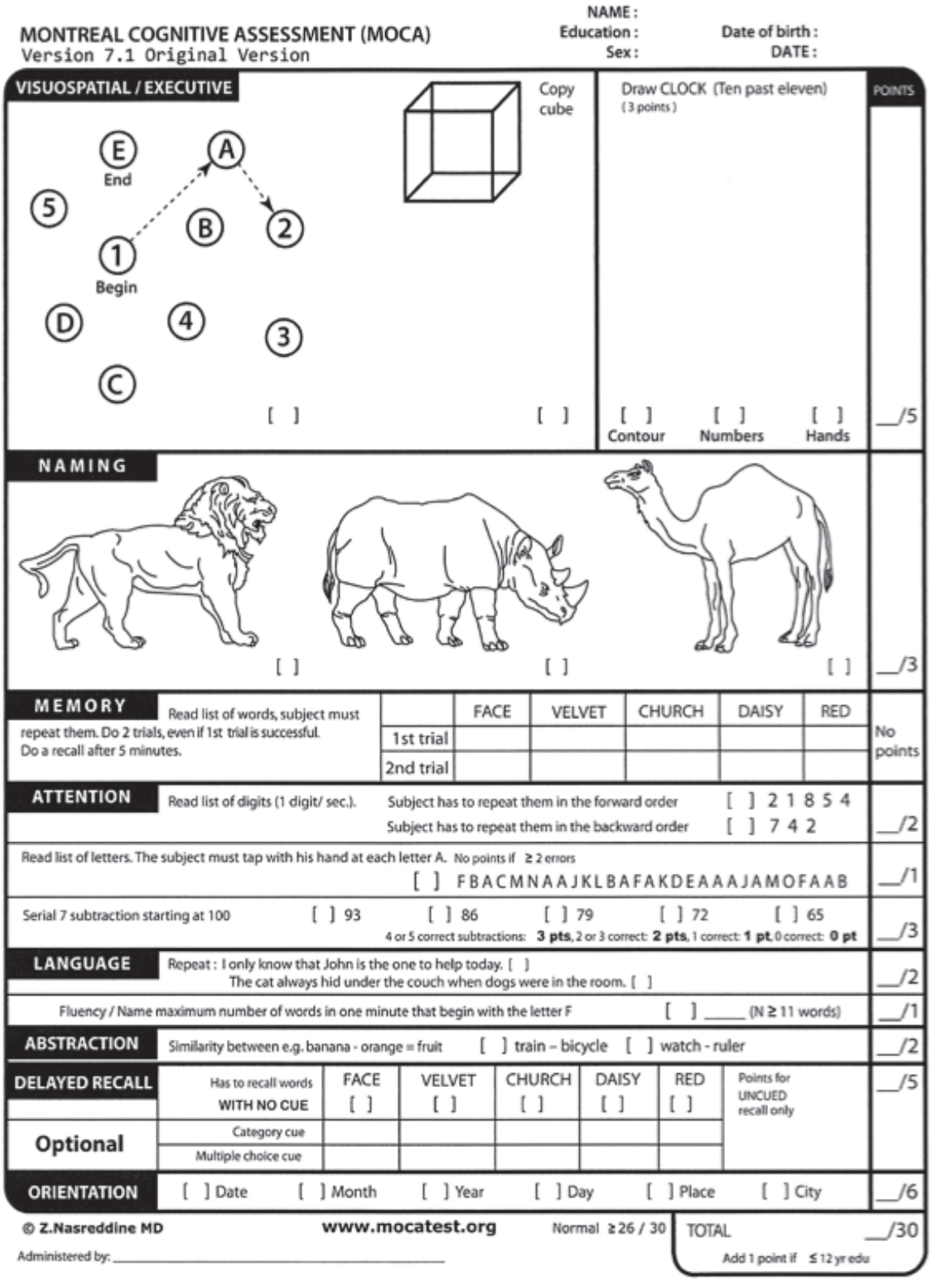
Threatening Images			**Sad Images**		
Description	Image Number	Valence Mean (SD)	Description	Image Number	Valence Mean (SD)
Attack Dog	1525	3.09 (1.72)	Toddler	2095	1.79 (1.18)
Shark	1930	3.79 (1.92)	Grieving	2141	2.44 (1.64)
Police	2682	3.69 (1.65)	Woman	2375.1	2.20 (1.31)
Bomb	2692	3.36 (1.61)	Sad Children	2703	1.91 (1.26)
Gun	2811	2.17 (1.38)	Funeral	2799	2.42 (1.41)
Attack	3500	2.21 (1.34)	Sad Child	2800	1.78 (1.14)
Aimed Gun	6210	2.95 (1.83)	Crying Boy	2900	2.45 (1.42)
Terrorist	6213	2.91 (1.52)	Burn Victim	3215	2.51 (1.32)
Gang	6242	2.69 (1.59)	Hospital	3220	2.49 (1.29)
Aimed Gun	6243	2.33 (1.49)	Dying Man	3230	2.02 (1.30)
Knife	6300	2.59 (1.66)	Disabled	3300	2.74 (1.56)
Abduction	6312	2.48 (1.52)	Injured Child	3301	1.80 (1.28)
Attack	6313	1.98 (1.38)	Dead Tiger*	6415	2.21 (1.51)
Knife Attack	6350	1.90 (1.29)	Assault*	9254	2.03 (1.35)
Attack	6370	2.70 (1.52)	Pollution	9342	2.85 (1.41)
Gang	6821	2.38 (1.72)	Soldier*	9400	2.50 (1.61)
Guns	6830	2.82 (1.81)	Soldier	9410	1.51 (1.15)
Assault	9425	2.67 (1.44)	Soldier	9421	2.21 (1.45)
Skinhead	9800	2.04 (1.57)	Accident	9435	2.27 (1.47)
KKK Rally	9810	2.09 (1.78)	Plane Crash	9611	2.71 (1.95)
Happy Images			**Neutral Images**		
Description	Image Number	Valence Mean (SD)	Description	Image Number	Valence Mean (SD)
Monkeys	1811	7.62 (1.59)	Farmer	2191	5.30 (1.62)
Porpoise	1920	7.90 (1.48)	Propeller	2575	5.46 (1.15)
Babies	2080	8.09 (1.47)	Shadow	2880	5.18 (1.44)
Family	2154	8.03 (1.13)	Boat	5395	5.34 (1.21)
Children	2216	7.57 (1.31)	Mushroom	5510	5.15 (1.43)
Family	2340	8.03 (1.26)	Mountains	5600	7.57 (1.48)
Couple	2530	7.80 (1.55)	Cave	5661	5.96 (1.41)
Chess	2580	5.71 (1.41)	Mountains	5700	7.61 (1.46)
Beer	2600	5.84 (1.85)	Flowers	5731	5.39 (1.58)
Dance	2606	5.92 (1.58)	Plant	5740	5.21 (1.38)
Wedding	4626	7.60 (1.66)	Nature	5760	8.05 (1.23)
Sunset	5830	8.00 (1.48)	Desert	5900	5.93 (1.64)
Beach	5833	8.22 (1.08)	Sky	5982	7.61 (1.48)
Street	7496	5.92 (1.66)	Train	7039	5.93 (1.58)
Castle	7502	7.75 (1.40)	Clothes Pegs	7052	5.33 (1.32)
Casino	7506	5.34 (1.46)	Fork	7080	5.27 (1.09)
Rafting	8370	7.77 (1.29)	Fire Hydrant	7100	5.24 (1.20)
Athletes	8380	7.56 (1.55)	Light Bulb	7236	5.64 (1.31)
Tubing	8420	7.76 (1.55)	Stairs	7504	5.67 (1.46)
Water Slide	8496	7.58 (1.63)	Bridge	7547	5.21 (0.96)

Note. Participant categorisation agreement for all experimental images was 100% except for images marked with an asterisk (*), where there was 90% agreement.

Appendix E: Hilco® Near Vision Card



Appendix F: MoCA



MONTREAL COGNITIVE ASSESSMENT (MOCA)
Version 7.1 Original Version

NAME :
Education : Date of birth :
Sex : DATE :

VISUOSPATIAL / EXECUTIVE — POINTS

Copy cube

[ ] [ ]

Draw CLOCK (Ten past eleven) (3 points)

[ ] Contour [ ] Numbers [ ] Hands

__/5

NAMING

[ ]

[ ]

[ ]

__/3

MEMORY Read list of words, subject must repeat them. Do 2 trials, even if 1st trial is successful. Do a recall after 5 minutes.

	FACE	VELVET	CHURCH	DAISY	RED
1st trial					
2nd trial					

No points

ATTENTION Read list of digits (1 digit/ sec.).

Subject has to repeat them in the forward order [ ] 2 1 8 5 4

Subject has to repeat them in the backward order [ ] 7 4 2

__/2

Read list of letters. The subject must tap with his hand at each letter A. No points if ≥ 2 errors

[ ] F B A C M N A A J K L B A F A K D E A A A J A M O F A A B

__/1

Serial 7 subtraction starting at 100 [ ] 93 [ ] 86 [ ] 79 [ ] 72 [ ] 65

4 or 5 correct subtractions: **3 pts**, 2 or 3 correct: **2 pts**, 1 correct: **1 pt**, 0 correct: **0 pt**

__/3

LANGUAGE Repeat : I only know that John is the one to help today. [ ]

The cat always hid under the couch when dogs were in the room. [ ]

__/2

Fluency / Name maximum number of words in one minute that begin with the letter F [ ] _____ (N ≥ 11 words)

__/1

ABSTRACTION Similarity between e.g. banana - orange = fruit [ ] train – bicycle [ ] watch - ruler

__/2

DELAYED RECALL

	Has to recall words WITH NO CUE	FACE [ ]	VELVET [ ]	CHURCH [ ]	DAISY [ ]	RED [ ]	Points for UNCUED recall only
Optional	Category cue						
	Multiple choice cue						

__/5

ORIENTATION [ ] Date [ ] Month [ ] Year [ ] Day [ ] Place [ ] City

__/6

© Z.Nasreddine MD www.mocatest.org Normal ≥ 26 / 30

TOTAL __/30

Add 1 point if ≤ 12 yr edu

Administered by: _____

Appendix G: CES-D

Center for Epidemiologic Studies Depression Scale (CES-D)

Date: _____

Below is a list of some of the ways you may have felt or behaved. Please indicate how often you've felt this way during the **past week**. Respond to all items.

Place a check mark (✓) in the appropriate column. **During the past week...**	**Rarely or none of the time (less than 1 day)**	**Some or a little of the time (1-2 days)**	**Occasionally or a moderate amount of time (3-4 days)**	**All of the time (5-7 days)**
1. I was bothered by things that usually don't bother me.				
2. I did not feel like eating; my appetite was poor.				
3. I felt that I could not shake off the blues even with help from my family.				
4. I felt that I was just as good as other people.				
5. I had trouble keeping my mind on what I was doing.				
6. I felt depressed.				
7. I felt that everything I did was an effort.				
8. I felt hopeful about the future.				
9. I thought my life had been a failure.				
10. I felt fearful.				
11. My sleep was restless.				
12. I was happy.				
13. I talked less than usual.				
14. I felt lonely.				
15. People were unfriendly.				
16. I enjoyed life.				
17. I had crying spells.				
18. I felt sad.				
19. I felt that people disliked me.				
20. I could not "get going."				

Source: Radloff, L.S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement, 1*: 385-401.

Appendix H: Screening Questionnaire

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Depression, Aging, and Eye-Gaze Study

SCREENING QUESTIONNAIRE

Certain conditions may exclude some individuals from being able to participate in this research, whereas other information is requested to help me understand the differences in eye movements. I would be grateful if you could complete this questionnaire as accurately as possible. Please feel free to contact me if you have any queries regarding this questionnaire (my details are at the end of this form).

Your responses are strictly confidential.

Are you currently experiencing depression or low mood? Yes / No

If yes, are you receiving treatment? Yes / No

If yes, what type of treatment?

☐ Medication - Please specify: _____

☐ Psychotherapy ☐ Other: _____

Have you previously received treatment for depression? Yes / No

If yes, what type of treatment?

☐ Medication - Please specify: _____

☐ Psychotherapy ☐ Other: _____

Are you currently experiencing anxiety? Yes / No

If yes, are you receiving treatment? Yes / No

If yes, what type of treatment?

☐ Medication - Please specify: _____

☐ Psychotherapy ☐ Other: _____

Have you previously received treatment for anxiety Yes / No

If yes, what type of treatment?

☐ Medication - Please specify: _____

☐ Psychotherapy ☐ Other: _____

Do you wear prescription glasses or contact lenses?

☐ No ☐ Yes – prescription glasses ☐ Yes – contact lenses

Have you been diagnosed with any condition that may impair your vision (for example, glaucoma, cataracts)? Yes / No

If yes, please specify the condition: _____

Have you been diagnosed with any condition that affects your eye movement (for example, ophthalmoplegia)? Yes / No

If yes, please specify the condition: _____

Please tick if you have ever been diagnosed with any of the following?

☐ Alzheimer's Disease/Other type of Dementia ☐ Epilepsy

☐ Parkinson's Disease ☐ Stroke

☐ Concussion or Mild Traumatic Brain Injury: If yes, how long ago: _____

☐ Diabetes: If yes, is your vision affected: _____

☐ Bipolar Disorder

☐ Psychosis

☐ Alcohol abuse or dependence: If yes, is this current: _____

☐ Substance abuse or dependence: If yes, is this current: _____

Please specify if you are affected by any other *medical condition* not previously mentioned above:

_____

_____

Please specify if you are affected by any other *psychological condition* not previously mentioned above:

_____

_____

Please specify if there is any other information you think is important for me to know that may affect your ability to take part in this research:

_____

_____

Finally, during the study, some of the images shown are slightly unpleasant. However, they are believed to have no lasting, negative effects. There may be certain material that you personally find frightening, or would prefer to not see (for example, snakes). If so, please specify any type of material you do not wish to view:

_____

_____

YOUR CONTACT DETAILS

Name: _____ Age: _____

Ethnicity: _____ Male / Female

Address: _____

Email: _____

Phone: _____

Thank you for completing this questionnaire. Please return it to me in the pre-paid envelope provided and I will contact you to discuss your participation.

Kind Regards

Jodi Field
School of Psychology
Massey University

Email: EyegazeStudy@gmail.com
Phone: (06) 350 5577
022 018 2627

This form will be securely held for a period of ten (10) years at which time it will be destroyed

This study has been approved by the Central Regional Ethics Committee on 17 February 2011, reference CEN/11/EXP/09.

Appendix I: Participant Information and Consent Sheet

Depression, Aging, and Eye-Gaze Study

PARTICIPANT INFORMATION SHEET

Thank you for participating in this study. You would have previously read the *Information Sheet* outlining details of this study. Please read this additional information sheet and complete the consent form if you are still happy to participate.

What will happen today?

Once you have given your consent to participate, we will begin with a brief eye test using an eye chart. Next I will ask you to complete a short questionnaire that will assess basic aspects of memory and attention. I will then ask you to complete two more brief questionnaires. These questionnaires will ask how you have been feeling within the last seven days. There are no right or wrong answers. These questionnaires will assist in identifying your current mood, which will help me better understand your responses on some of the experimental tasks. Completing the questionnaires will take about 15 minutes. At this time, you may wish to have a break.

The next stage involves tracking your eye movements. You will be seated in a chair with a neck-rest, which will help to keep your head still. Once you are comfortable we can start the eye tracking task. The eye tracking device, which is attached to the computer screen, needs to be calibrated. This involves following a dot as it moves around the screen. Once the device is calibrated, you will then view a series of images presented on the computer screen, keeping your head as still as you possibly can. You are not required to respond in any way; simply watch the images. This part of the study will take approximately 7 minutes. You can take a break if you wish, after you have viewed all the images.

Finally, I will show you some of the pictures from the eye tracking stage. This time, the pictures will be shown individually on the computer screen. Also shown on screen are two

rating scales. Using the computer mouse, you are asked to rate each picture based on the descriptions presented on screen. A new image will appear on the screen after you have given your ratings. Your eye movements will not be recorded during this stage and there is no time limit to the images being shown. Therefore, the time to complete this stage may vary but should take about 15-20 minutes. Once the experiment is over, you can ask me any questions you might have.

You do not need to remember all of this information. I will provide you with further instructions as we go along. You are welcome at any stage to ask questions, and you may chose to discontinue at any time.

What will happen to the information collected?

The information that is being collected from you today will be added to the results from other participants and conclusions will be made based on many people's results. No information will be used in the analysis or reporting of the results that could identify you. While I have collected personal details from you, as the primary researcher in this study, I am the only person who will have access to these details and I ensure you the strictest of confidentiality. All the information you provide will be stored in a locked file in the School of Psychology at Massey University for a period of ten years, upon which time it will be destroyed. We are required to keep all the information for that period of time.

What support is available?

The questionnaires that you complete at the beginning of this study are frequently used by mental health practitioners to assess mood and cognitive states. The results of these questionnaires may suggest that further assessment would be beneficial. I can provide you with a list of mental health practitioners and we can discuss making arrangements for you to see one of these, if you should so desire.

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TE KUNENGA KI PŪREHUROA

Depression, Aging, and Eye-Gaze Study

CONSENT FORM

Please tick the boxes if you agree with the following statements:

- ☐ I have read and understand the information sheet provided
- ☐ I agree to participate in this study under the conditions set out in the information sheet
- ☐ I have had an opportunity to discuss the study and my questions have been answered to my satisfaction
- ☐ I understand that I may ask further questions at any time
- ☐ I understand that taking part in this study is voluntary
- ☐ I understand that I may withdraw from the study at any time
- ☐ I understand that, if I withdraw, I will still receive a $20 Plaza voucher
- ☐ I understand that my participation in this study is confidential and that no material that could identify me will be used in any reports on this study
- ☐ I have received the handout on Sources of Mental Health Assistance and know who to contact if I have any negative effects as a result of participating in this study
- ☐ I wish to have a summary of the final results mailed/emailed to me
- ☐ The results from the questionnaires may warrant follow-up. You will be advised if this is desirable after you complete the questionnaires. Please tick the box if you consent to me making a follow-up call with you.

I hereby consent to take part in this study:

Signature: _____ Date: _____
Full name (printed): _____
Phone: _____
Address: _____
Email: _____

This consent form will be securely held for a period of ten (10) years at which time it will be destroyed

Appendix J: Sources of Mental Health Assistance Handout

MASSEY UNIVERSITY
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Depression, Aging, and Eye-Gaze Study

SOURCES OF MENTAL HEALTH ASSISTANCE

Massey University Psychology Clinic
Phone: (06) 350 5196
(Fees Apply)

Massey University Student Counselling
Phone: (06) 350 5935
(Free Service for Massey University Students)

Mid-Central District Health Board - Community Mental Health
Phone: (06) 350 8184
(Free Service)

Mid-Central District Health Board - Mental Health Emergency Team (for acute mental health emergency)
Phone: 0800 653 357
(Free Service)

Lifeline
Phone: 0800 543 354
(Free Service)

Youth One Stop Shop (YOSS)
Phone: (06) 355 5906
(Free Service for people aged 24 years or younger)

For your own personal reference, you may wish to complete the details of your General Practitioner below. He/she is also a suggested health professional you may contact if you require further assessment.

Your General Practitioner
Name: _____ Phone: _____

Please let me know if you require assistance in contacting a Mental Health Practitioner.

Jodi Field
School of Psychology
Massey University

Email: EyegazeStudy@gmail.com
Phone: (06) 350 5577
022 018 2627

Appendix K: Standardised Instructions for the Experiment: Calibration of the Eye-Gaze System

"Before we can begin, the eye-tracker needs to be calibrated to detect your eye movements. During this process, and the eye-gaze experiment, please keep your head as still as possible, moving only your eyes to shift your gaze. Once we begin, you will need to look at the centre of the camera lens and I will advise you once the eye-tracker detects your eyes. You will then need to look at the computer screen where a small dot is displayed. Please follow the dot with your eyes as it moves around the screen. Once this has been completed, I will provide you with some more instructions. During this time, it is best that you continue to keep your head still. Do you have any questions? I will begin the calibration now"

Appendix L: Standardised Instructions for the Experiment: Eye Tracking Stage

"Shortly, you will begin the eye-gaze study. Appearing on the screen in front of you will be a series of slides. You will also hear a beeping sound each time a slide appears. Each slide will depict 4 images, presented in quadrant style, like this (show trial slide)*, and will stay on screen for several seconds. At the beginning of the experiment, and in between each slide, a cross will appear in the centre of the screen, like this* (show trial cross-hair)*. Please watch the cross until the images appear and then view the images as you wish. That is, there is no requirement for you to look at each of the four images in a particular order, nor are you required to devote equal time to looking at each of the four images. Simply allow your gaze to shift to wherever you feel naturally drawn. However, please try to look at the images. Don't look away from the screen or down at the camera lens. Please keep your head as still as possible, allowing only your eyes to move. You will be shown some of these images again during the rating stage of the experiment. If at any time you do not wish to continue, please let me know and I will stop the study. Do you have any questions before we begin? OK, I will start the study now"*

Appendix M: Standardised Instructions for the Experiment: Rating Stage

"In this stage of the experiment, you will view a series of images presented individually on the screen alongside two rating scales, like this (show trial rating scale). *As you can see, this scale is labelled 'mood' and this scale is labelled 'threat'. On the mood scale, it shows 'very sad' at one end and 'very happy' at the other. On the threat scale, it shows 'very threatening' at one end and 'not threatening at all' at the other. In between each scale are several buttons with numbers on them. You are asked to rate the image at whichever point along the scale best corresponds with your feeling about the image, for both mood and threat. You have already seen these images in the eye tracking stage, and being aware of the range in image content, you are encouraged to use the full range of points along the scale, including the end points. To make your rating, use the computer mouse to click on the relevant number on each scale. You will notice that the button lights up when selected. Once you have rated both scales, click on the button that says 'next'. This will lock in your ratings for that image and the next image that requires rating will appear. If you need clarification of any of the images, please feel free to ask. During this stage, your eye movements are not recorded, so you are free to move as you wish. If at any time you do not wish to continue, please let me know and I will stop the study. Do you have any questions?"*

"Before we begin, you can practice rating some trial images. Once complete, feel free to move on to the rating task. Please remember to use the full range of ratings, including the end points."

Appendix N: Qualitative Terminology for Effect Sizes

	Cohen's d	η_p^2
Small	.2	.01
Medium	.5	.06
Large	.8	.14

Source: Field (2009).