RUNNING HEADING: Age Differences in Expectancy Bias**Title: Age Differences in Negative and Positive Expectancy Bias in Comorbid Depression and Anxiety.**

Authors: Dusanka Tadic¹, Colin MacLeod², Cindy Cabeleira³, Viviana M. Wuthrich^{4*}, Ronald M. Rapee⁵ & Romola S. Bucks⁶

* Corresponding Author

Viviana M. Wuthrich, Centre for Emotional Health, Macquarie University, Sydney, Australia. Ph: +61 2 9850 4866, Fax: +61 2 9850 8062, Email: Viviana.Wuthrich@mq.edu.au

1 Affiliation: Centre for Emotional Health, Department of Psychology, Macquarie University, Sydney, NSW, Australia, 2109, Email: v.duska@gmail.com

2 Affiliation: School of Psychology, University of Western Australia, 35 Stirling Highway, Crawley, WA, Australia, 6009, Phone: +61 8 6488 3273, Email: Colin.MacLeod@uwa.edu.au

3 Affiliation: School of Psychology, University of Western Australia, 35 Stirling Highway, Crawley, WA, Australia, 6009, Email: 10912957@student.uwa.edu.au

4 Affiliation: Centre for Emotional Health, Department of Psychology, Macquarie University, Sydney, NSW, Australia, 2109, Phone: +61 2 9850 4866, Email: Viviana.Wuthrich@mq.edu.au

5 Affiliation: Centre for Emotional Health, Department of Psychology, Macquarie University, Sydney, NSW, Australia, 2109, Phone: +61 2 9850 8032, Email: Ron.Rapee@mq.edu.au

6 Affiliation: School of Psychology, University of Western Australia, 35 Stirling Highway, Crawley, WA, Australia, 6009, Phone: +61 8 6488 3232, Email: Romola.Bucks@uwa.edu.au

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

22

2

RUNNING HEADING: Age Differences in Expectancy Bias

1 Introduction

Understanding the factors that underpin the emotional functioning of older adults has become increasingly important, due to the massive growth in the numbers of older members in society. There is evidence that emotional functioning may differ in older compared to younger age (Carstensen, Isaacowitz, & Charles, 1999; Carstensen & Mikels, 2005; Charles, 2010; Reed & Carstensen, 2012; Reed, Chan & Mikels, 2014). It is vital to know whether the mechanisms that underpin emotional dysfunction in older adults do or do not differ from those that underpin such dysfunction in younger adults, as this knowledge will inform strategies used to assist older adults to overcome emotional dysfunction.

Information processing mechanisms are known to be implicated in emotional psychopathology. For example, individuals with high trait anxiety and depression display selective biases in their processing of affectively toned information, that plausibly contribute to the development and maintenance of emotional pathology (for a review see Mathews & MacLeod, 2005; Beck & Clark, 1988; Berna, Lang, Goodwin, & Holmes, 2011; A.K. MacLeod, Tata, Kentish, Carroll, & Hunter, 1997; A.K. MacLeod, Tata, Kentish, & Jacobsen, 1997; Miranda & Mennin, 2007). There is also evidence that such differences in the selective processing of emotional information change with advancing age. Specifically, research findings suggest that older adults come to display a pattern of processing selectivity that favours attending to and remembering positive information, including pictures, faces, and words (e.g., Carstensen & Mikels, 2005; Knight, Maines, & Robinson, 2002; Leigland, Schulz, & Janowsky, 2004; Reed et al., 2014). This pattern of selective information processing may serve to improve the mood of older adults.

There are two prominent theoretical models to describe these changes in emotion processing. The first is the Socioemotional Selectivity Theory (SST: Carstensen et al. 1999;

RUNNING HEADING: Age Differences in Expectancy Bias

Reed & Carstensen, 2012), which states that motivational priorities shift across the life span as a function of future time horizons shortening, such that older adults are more motivated to seek out and maintain positive emotion. Secondly, the Strengths and Vulnerability Integration model (SAVI: Charles, 2010) extended SST to suggest that these changes in time horizons, as well as reduced physiological flexibility and increased life experience that comes with older age, motivate older adults to process information in ways that tend to attenuate negative emotion and enhance positive emotion. The SAVI model also goes on to predict that due to reduced cognitive and physiological flexibility in responding to emotion information, that when emotion regulation attempts to enhance positive emotion are unsuccessful, that negative mood is experienced and is more difficult to recover from. Therefore in older clinical populations with mental disorders, the enhanced processing of positive and negative emotionally toned information might not be as strong, or evident at all. There have been numerous studies reliably showing that older and younger adults differ in emotional processing, with older adults showing enhanced processing of positive emotionally toned information and better regulation of negative emotionally toned information (see reviews by Charles, 2010; Charles & Carstensen, 2010; Reed et al., 2014). As yet, research has not examined differences in information processing of negative and positive emotionally toned information between older and younger clinical and non-clinical samples.

There is evidence that negative expectancies concerning the future may be implicated in emotional psychopathology. The tendency disproportionately to expect that future events will be negative has been termed ‘negative expectancy bias.’ Although an anxiety-linked negative expectancy bias has been well documented, findings have been less consistent in depression, with some studies failing to find evidence of a negative expectancy bias in depressed individuals (Mogg, Bradbury, & Bradley, 2006). Methodological factors, such as

RUNNING HEADING: Age Differences in Expectancy Bias

1 the potential need to employ self-referential stimulus materials, have been suggested as
2 possible explanations for these mixed findings (Rude, Covich, Jarrold, Hedlund, & Zentner,
3 2001; Wisco & Nolen-Hoeksema, 2010).

4 Most paradigms employed to date have not identified the specific mechanisms that
5 drive the negative expectancy bias displayed by depressed and/or anxious individuals.
6 However, in two recent studies, Steinman et al. (2013) and Cabeleira et al. (2014) employed a
7 new paradigm designed to illuminate the cognitive basis of this negative expectancy bias. In
8 this approach, termed the Expectancy Bias Task, participants first processed positively
9 valenced scenarios, negatively valenced scenarios or emotionally ambiguous scenarios
10 (containing both positive and negative elements), then indicated the strength of their
11 expectancies that specified candidate positive and negative future events would likely occur
12 in these described situations. This paradigm allows the examination of three possible
13 hypotheses concerning the cognitive mechanisms that could underlie the tendency for people
14 with emotional dysfunction to display a negative expectancy bias. First, it is possible that
15 such clinical individuals may consistently exhibit a greater tendency to exhibit inflated
16 expectancy for future negative events than is exhibited by non-clinical individuals, regardless
17 of the emotional tone of the current situation, which Steinman et al. referred to as “pervasive
18 expectancy bias”. By contrast, it is possible that such an inflated expectancy for negative
19 relative to positive future events may reflect biased emotional extrapolation, with the clinical
20 individuals disproportionately inclined to assume that a currently negative situation will lead
21 to negative future events. In this case, compared to non-clinical individuals, clinical
22 individuals would exhibit disproportionately elevated expectancy that negative rather than
23 positive future events would follow on from currently presented negative scenarios, but
24 would show no such elevated relative expectancy that negative rather than positive future

RUNNING HEADING: Age Differences in Expectancy Bias

1 events would follow on from currently presented positive scenarios. Steinman et al. termed
2 this an “extrapolation bias”. Thirdly, it is possible that clinical and non-clinical individuals
3 engage equally in emotional extrapolation, expecting that negative future events will likely
4 follow from currently negative scenarios and positive future events will likely follow from
5 currently positive scenarios, but that clinical individuals are disproportionately inclined to
6 construe the emotional tone of current scenarios as being negative when the described
7 situation is emotionally ambiguous. While this would actually represent an “interpretation
8 bias,” it would give rise to disproportionately negative future expectancies relative to positive
9 future expectancies, in clinical individuals, but this differential pattern of expectancies would
10 be observed only for future events following from emotionally ambiguous scenarios.

11 Steinman et al. (2013) examined expectancy biases across the lifespan in a non-
12 clinical sample of participants aged 18 to 82 years. Participants were presented with scenarios
13 describing positive, negative or emotionally ambiguous situations. Half of the scenarios
14 concerned social situations (describing circumstances with positive, negative or emotionally
15 ambiguous social implications for the protagonist)) and half concerned situations relevant to
16 physical well-being (describing circumstances with positive, negative or emotionally
17 ambiguous implications for the health and well-being of the protagonist). After processing
18 these scenarios, participants were then required to rate the likelihood of specified candidate
19 future events that could potentially, subsequently occur in each scenario. One such candidate
20 event was emotionally negative and one was emotionally positive. An expectancy bias index
21 was calculated by subtracting average likelihood ratings for negative events from average
22 likelihood ratings for positive events, such that larger scores indicated positive expectancy,
23 while negative scores indicated negative expectancy. Steinman et al. found that heightened
24 anxiety was associated with a reduced relative expectancy for positive future events

RUNNING HEADING: Age Differences in Expectancy Bias

1 regardless of the emotional valence of the initial scenarios, consistent with a pervasive
2 expectancy bias (this was replicated in two studies by Cabeleira et al., 2014 using a young
3 sample with heightened anxiety). Older age was associated with a relatively heightened
4 expectancy for positive future events, and this age-related effect was most evident when the
5 initial scenarios described emotionally negative social situations. Thus, older adults displayed
6 a reduced tendency, compared to younger adults, to infer that negative future events were
7 likely to follow on from initially negative social scenarios, suggesting that age decreased the
8 tendency to extrapolate emotionally from initially negative events without reducing positive
9 emotional extrapolation when the initial scenarios were positive in emotional tone. The
10 authors concluded that anxiety and ageing have independent and opposing effects in terms of
11 expectancy bias. Specifically, more anxious individuals generally expect fewer positive
12 events to occur regardless of the preceding information, whereas older age is associated with
13 relatively heightened expectation of positive events due to reduced emotional extrapolation
14 from initially negative social events. The finding that, with increasing age, individuals' future
15 expectancies become less influenced by negative current situations, is consistent with SST
16 (Carstensen et al., 1999) and SAVI models (Charles, 2010).

17 While Steinman et al.'s study provided interesting evidence that age and anxiety may
18 have opposing effects on emotional expectancies, it examined only trait anxiety variation in
19 non-clinical participants. Hence, the study permits no conclusions concerning either the
20 nature of expectancy bias in clinical manifestations of emotional dysfunction, or the effects of
21 age on expectancy bias in people who experience such clinical dysfunction. Thus, the aim of
22 the current study was to extend the approach of Steinman et al. (2013) to examine expectancy
23 bias in such a clinical population, in order to resolve these issues. Furthermore, because
24 Steinman et al. calculated a bias index to express relative expectancy for future positive and

RUNNING HEADING: Age Differences in Expectancy Bias

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 negative events, their data do not reveal whether the observed expectancy biases were driven
2 by age-linked or anxiety-linked group differences in expectancy for positive future events
3 alone, or by age-linked or anxiety-linked group differences in expectancy for negative future
4 alone events, or by age-linked or anxiety-linked group differences in both types of future
5 expectancy. Hence, we separately assessed expectancy for positive and negative candidate
6 future events to overcome this limitation. Given the findings that age and anxiety have
7 independent and opposing effects on expectancy bias in a non-clinical population (Steinman
8 et al, 2013), and the predictions of the SAVI model, we hypothesised that: 1) compared to
9 younger adults, older adults would have a heightened expectancy for positive future events
10 relative to negative future events which would be driven by an extrapolation bias, reflecting
11 reduced negative emotional extrapolation from negative and ambiguous initial events than
12 from positive initial events; and 2) compared to community controls, both younger and older
13 clinical adults would exhibit a similar pervasive negative expectancy bias such that the
14 expectancy bias for positive future events relative to negative future events (from initially
15 negative and ambiguous events) would be reduced; and 3) that there would be an interaction
16 between age and clinical status where the age-linked reduction in expectancy bias of negative
17 relative to positive future events would be less in older clinical compared to older community
18 controls. The results of this study will enable us to determine not only whether negative
19 expectancy bias, reflecting heightened expectancy for negative relative to positive future
20 events, is differentially associated with emotional psychopathology in older and younger
21 adults, but also whether the mechanisms that underpin any such negative expectancy bias
22 found to be associated with emotional psychopathology differ between older and younger
23 adults.

24

RUNNING HEADING: Age Differences in Expectancy Bias

1 Method

2 *Participants*

3 A total of 125 participants took part in the study. One subset of these participants
4 made up the clinical group ($n = 67$), while the remainder made up the community control
5 group ($n = 58$). All participants in the clinical group met Diagnostic and Statistical Manual of
6 Mental Disorders 4th edition (DSM-IV; American Psychiatric Association, 2000) criteria for
7 either a mood disorder, an anxiety disorder, or both, with all but eight meeting criteria for
8 both disorders. A summary of the diagnoses is found in Table 1. The clinical group
9 comprised 37 older adults (age range = 60-78 years; $M = 66.9$; $SD = 4.3$, females = 20) and
10 30 younger adults (age range = 18-28 years; $M = 21.6$ years; $SD = 3$, females = 17). Older
11 adults in the clinical group were recruited from an intervention program designed to treat
12 comorbid depression and anxiety in older adults at the Centre for Emotional Health,
13 Macquarie University, while younger adults in the clinical group were recruited via
14 advertisements placed on the internet (i.e., Gumtree free classifieds) and in the Student
15 Counselling Service at Macquarie University, Sydney, Australia.

16 The community control group comprised 33 older adults (age range = 60-80 years; M
17 = 66.5; $SD = 5.4$, females = 22), and 25 younger adults (age range = 17-25 years; $M = 18.8$
18 years; $SD = 2.0$, females = 22). Participants were included in this group only if they scored in
19 the non-clinical or mild range on self-report measures of anxiety and depression. Older adults
20 all scored below nine on the Geriatric Anxiety Inventory (Pachana et al., 2007) and below 20
21 on the Geriatric Depression Scale (Yesavage et al., 1983). The younger participants all scored
22 below 10 on the anxiety subscale and 14 on the depression subscale of the Depression,
23 Anxiety and Stress Scale (Antony, Bieling, Cox, Enns, & Swinson, 1998). Older adults in the
24 community control group were recruited via local newspaper advertisements, and younger
25 adults were undergraduate students at Macquarie University who participated for course

RUNNING HEADING: Age Differences in Expectancy Bias

credit. All other participants in the control and clinical groups received AUS\$30 for participation.

In order to exclude participants with dementia or cognitive impairment, all older adult participants completed a cognitive screener, and older adults scoring outside the normal range were excluded.

Measures

Diagnostic Interview

Anxiety Disorders Interview Schedule for DSM-IV (ADIS-IV; Brown, Di Nardo, & Barlow, 1994) was used to diagnose depression and anxiety according to DSM-IV criteria. The ADIS-IV is scored using a clinician severity rating from 0-8, with scores of four or above indicating clinical severity. Graduate clinical psychology students, who received extensive training in making diagnostic decisions and regular supervision by trained clinical psychologists, administered the ADIS-IV. Older adults in the clinical group completed the ADIS-IV face-to-face as part of their assessment for a clinical trial (Wuthrich et al., 2016), younger participants in the clinical group completed the ADIS-IV over the phone. Only participants in the clinical samples were screened using the ADIS-IV to confirm diagnoses, and only individuals who met criteria for an anxiety and/or mood disorder were included in the clinical group. Participants in the community control sample did not complete ADIS-IV (due to time constraints); however, all scored in the normal to mild range on self-report measures of anxiety and depression (see above) and as such are unlikely to have met criteria for a mood or anxiety disorder.

Symptom Measures

RUNNING HEADING: Age Differences in Expectancy Bias

Depression Anxiety and Stress Scales (DASS; Lovibond & Lovibond, 1995) is a 42-item scale that measures the presence of depression, anxiety and stress symptoms over the past week. The depression and anxiety subscales were administered to younger adult participants in both the clinical and control groups. The DASS has been shown to exhibit good psychometric properties in both clinical and non-clinical adult populations (Brown, Korotitsch, Chorpita, & Barlow, 1997; Lovibond & Lovibond, 1995). In this sample internal consistency was adequate: anxiety (Cronbach's $\alpha = .88$), depression (Cronbach's $\alpha = .95$).

Geriatric Anxiety Inventory (GAI; Pachana et al., 2007) is a 20-item scale asking participants to rate whether they agree or disagree with experiencing a range of anxiety symptoms over the past week. This scale was developed with older adult samples and has been shown to have adequate reliability and validity in clinical and non-clinical populations (Pachana et al., 2007). This scale was administered to older adults in both the clinical and control group in the current study, and was found to have strong internal consistency ($\alpha = .94$).

Geriatric Depression Scale (GDS; Yesavage et al., 1983) is a 30-item scale measuring the severity of depression symptoms over the past week using a yes or no rating. Higher scores indicate more severe depression over the past week. The GDS has demonstrated adequate psychometric properties in clinical and non-clinical older adult samples (Dunn & Sacco, 1989; Parmelee, Lawton, & Katz, 1989). This scale was administered to older adults in both the clinical and control group in the current study, and was found to have strong internal consistency ($\alpha = .95$).

Cognitive Assessment

RUNNING HEADING: Age Differences in Expectancy Bias

Mini Mental Status Examination (MMSE; Folstein, Folstein & McHugh, 1975) is a brief cognitive screening instrument, used to determine the presence of cognitive decline in older adults. A score of 26/30 or lower is indicative of cognitive impairment (Kukull et al., 1994). All older adult participants in this study scored in the normal range (Range = 27-30; $M = 29.2$; $SD = .86$).

Assessment of Expectancy Bias

Expectancy Task: The Expectancy Task was designed to assess the relative tendency to expect that negative and positive future events will follow on from currently described scenarios (i.e., to measure ‘expectancy’). Participants were asked to imagine themselves experiencing 64 scenarios that vary in the extent to which they describe situations that are emotionally negative, emotionally positive, or emotionally ambiguous (Scenario Presentation Component, see below). Participants were then asked to judge the likelihood that specific candidate future events would occur subsequently to each described scenario (Expectancy Rating Component, see below). These candidate future events were either positive, negative or neutral in emotional tone.

In the Scenario Presentation Component of the task, participants were required to read and imagine themselves experiencing the situation described in each initial scenario. Each scenario described a situation using six statements: a Title, an Orienting Sentence, and four Event sentences. The Title remained in the centre of the computer screen during the presentation of the other five statements. Each of these five statements appeared individually, directly below the title, and remained on the screen only until the participant pressed the spacebar to signal that the statement had been read, at which point that statement was removed and the next statement was presented. The four event sentences presented in a scenario could be emotionally valenced. In emotionally positive scenarios, the only emotional

RUNNING HEADING: Age Differences in Expectancy Bias

1 event sentences were positive in valence, with the four event sentences comprising a mix of
2 two positive and two neutral events. In emotionally negative scenarios, the only emotional
3 event sentences were negative in valence, with the four event sentences comprising a mix of
4 two negative and two neutral events. In the emotionally ambiguous scenarios, two event
5 sentences were emotionally positive in valence, and two were emotional negative in valence,
6 and so this mix of four sentences do not have one predominant emotional tone. The order of
7 valenced events within individual scenarios was counterbalanced (e.g., positive followed by
8 neutral versus neutral followed by positive). Across the experimental session, 64 such
9 scenarios were presented in four blocks of 16, and each block of 16 scenarios was followed
10 by the Expectancy Rating Component.

11 In the Expectancy Rating Component, participants were asked to think about the
12 likelihood of different future events for each of the 16 scenarios they had previously read. On
13 each trial, participants were presented with the Title and Orienting Sentence from one of the
14 scenarios presented in the preceding block, with four rows of asterisks being shown in place
15 of the four events previously presented. The Title and Orienting Sentence remained on the
16 screen while participants were asked to rate the perceived likelihood that candidate future
17 events would occur subsequently within that particular scenario. The measures of interest are
18 perceived likelihood of a candidate future negative event, and a candidate future positive
19 event, which were centrally displayed beneath the Title, Orienting Sentence and rows of stars.
20 Participants were required to use a scale ranging from 1 (*“very unlikely to happen next”*) to 4
21 (*“very likely to happen next”*), displayed at the bottom of the screen, to rate the subjective
22 likelihood of each candidate future event subsequently occurring.

23 *Scenario Event Sets.* Each of the 64 scenarios presented during the task, together with
24 the candidate future events associated with that scenario, was derived from its own Scenario
25 Event Set. Each Scenario Event Set comprised 11 items: a Title, an Orienting Sentence, and

RUNNING HEADING: Age Differences in Expectancy Bias

1 nine candidate events, three of which were positive, three of which were negative, and three
2 of which were neutral. The four events included in any scenario during the Scenario
3 Presentation Component of the task were randomly selected from its Scenario Event Set, with
4 this selection being constrained as already described by the scenario condition. A positive and
5 a negative event sentence, not used in the scenario description, comprised the candidate
6 positive and negative future events employed, for that scenario, in the Expectancy Rating
7 Component of the task.

8 The Scenario Event Sets employed in this study were identical to those used by
9 Steinman et al. (2013) and Cabeleira et al. (2014). These stimuli were originally created using
10 an independent sample of 16 healthy raters (8 young, 8 old) who verified that the sentences
11 differed as required in emotional tone. Participants rated 15 possible events for each of the 75
12 scenario stimulus clusters, in terms of emotional valence and domain type. When rating
13 emotional valence, ratings ranged from -3 (“Extremely negative”) to 3 (“Extremely
14 positive”). For rating domain type, each statement was rated either as a social event
15 (indicated by “S”) or physical event (indicated by “P”). After gathering the ratings provided
16 by the independent sample of participants, a final set of 64 Scenario Stimulus Clusters were
17 selected using these rating data. These ratings also confirmed that, while negative and
18 positive emotional event sentences differed in emotional valence as intended, they were
19 equivalent in terms of their emotional intensity (see Cabeleira, 2017). See the Appendix for
20 Scenario examples.

Procedure

21
22 The Macquarie University Human Research Ethics Committee approved all study
23 procedures. The data for this study were collected as part of a larger study conducted by the
24

RUNNING HEADING: Age Differences in Expectancy Bias

authors⁷. Signed informed consent was obtained at the beginning of each experimental session. Younger adults completed the DASS at home and brought it to the experimental session, while older adults completed the GAI and GDS followed by the MMSE at the experimental session. Participants then completed eight practice trials of the Expectancy Task, followed by 64 experimental trials of this task. Participants were then debriefed before the session ended.

Results

Descriptive statistics

There was a significant difference in gender distribution between the age groups, $\chi^2(1) = 8.69, p = .033$, with a higher proportion of females in the young control group. There was also a significant difference in level of education between age groups, $\chi^2(1) = 7.36, p = .011$, with older adults having more years of education. Depression and anxiety means, standard deviations and ranges are presented in Table 2. Z scores were computed separately within each age group using means and standard deviations from the distribution obtained for each age group. This was necessary as younger and older adults completed different measures of anxiety and depression. As expected, participants in the clinical group were significantly more depressed, and more anxious than those in the control group, $F(1, 121) = 126.0, p < .001$ and $F(1, 121) = 183.07, p < .001$, respectively. Follow up comparisons showed that both younger and older adults in the clinical group were significantly more depressed, and significantly more anxious, than their counterparts in the control group (all $ps < .001$).

Evidence of Expectancy Bias

⁷ For a complete list of tasks, measures and randomisation order please contact the primary author.

RUNNING HEADING: Age Differences in Expectancy Bias

To examine whether the pattern of expectancy bias differed as a function of age and/or clinical status, we first analysed the expectancy ratings given for the candidate future events following the emotionally unambiguous scenarios, then analysed the expectancy ratings given for the candidate future events following the emotionally ambiguous passages.

Expectancy Bias Following Emotionally Unambiguous Initial Scenarios

Mean probability ratings for candidate negative and positive future events are presented in Figure 2. A mixed design analysis of variance (ANOVA) with the two between-subjects factors of Clinical Status (Control, Clinical), and Age Group (Younger, Older), and the two within-subjects factors of Initial Scenario Valence (Initial Scenario Negative, Initial Scenario Positive) and Future Event Valence (Negative Future Event, Positive Future Event) was conducted on the expectancy ratings for future events following the emotionally unambiguous (positive or negative) initial scenarios. A significant main effect of Future Event Valence was obtained, $F(1, 121) = 304.27, p < .001, \eta_p^2 = .715$, reflecting the fact that participants rated positive future events ($M = 2.8, SD = 0.4$) as more likely to occur than negative future events ($M = 2.1, SD = 0.4$). No other main effects were significant (all $ps > .05$)⁸.

As predicted the clinical populations demonstrated a pervasive expectancy bias (hypothesis 2). There was a significant interaction between Future Event Valence and Clinical Status, $F(1, 121) = 11.75, p = .001, \eta_p^2 = .09$. This reflected the fact that participants in the clinical group gave significantly higher expectancy ratings for negative future events than did participants in the control group ($M = 2.2, SD = 0.4$ vs $M = 2.0, SD = 0.4$; $F(1, 121) = 6.40, p = 0.013, \eta_p^2 = .05$), whereas participants in the clinical and control groups did not

⁸ An initial analysis including scenario type (social and physical) did not find any age group or sample group differences by scenario type, thus all further analyses were conducted collapsed across scenario type.

RUNNING HEADING: Age Differences in Expectancy Bias

1 differ in their expectancy ratings for the positive events ($M = 2.7$, $SD = 0.4$ vs $M = 2.8$, $SD =$
 2 0.3 ; $F(1, 121) = 3.22$, $p = 0.075$, $\eta_p^2 = .03$). There was also a significant interaction between
 3 Future Event Valence and Age Group, $F(1, 121) = 23.34$, $p < .001$, $\eta_p^2 = .162$. This reflected
 4 the fact that younger adults gave significantly higher expectancy ratings for future negative
 5 events than older adults ($M = 2.2$, $SD = 0.4$ vs $M = 2.0$, $SD = 0.4$; $F(1, 121) = 13.45$, $p <$
 6 $.001$, $\eta_p^2 = .10$), while giving significantly lower expectancy ratings for future positive events
 7 than older adults ($M = 2.7$, $SD = 0.4$ vs $M = 2.8$, $SD = 0.4$; $F(1, 121) = 5.79$, $p = .018$, $\eta_p^2 =$
 8 $.05$). Therefore there were age differences in the extrapolation of negative events supporting
 9 hypothesis 1. Notably, there was no significant interaction between Future Event Valence,
 10 Clinical Status and Age Group, $F(1, 121) = 1.97$, $p = .163$, $\eta_p^2 = .02$, indicating that the
 11 effects of psychopathology and age, on expectancy bias, were independent of one another
 12 (against predictions listed in hypothesis 3).

13 A significant interaction was obtained between Future Event Valence and Initial
 14 Scenario Valence, $F(1, 121) = 82.66$, $p < .001$, $\eta_p^2 = .41$, the nature of which confirmed that
 15 participants' future expectancies were influenced by emotional extrapolation from the initial
 16 scenarios. Specifically, negative future events received a higher expectancy rating when they
 17 were candidate continuations of initially negative scenarios than when they were candidate
 18 continuations of initially positive scenarios ($M = 2.3$, $SD = 0.5$ vs $M = 2.0$, $SD = 0.4$; $F(1,$
 19 $121) = 33.28$, $p < .001$, $\eta_p^2 = .22$), whereas positive future events received a higher
 20 expectancy rating when they were candidate continuations of initially positive scenarios than
 21 when they were candidate continuations of initially negative scenarios ($M = 3.0$, $SD = 0.3$ vs
 22 $M = 2.6$, $SD = 0.4$; $F(1, 121) = 452.73$, $p < .001$, $\eta_p^2 = .80$).

23 However, the relative degree to which emotional extrapolation occurred from positive
 24 and negative initial scenarios was influenced by age, as evidenced by the fact that the above
 25 two way interaction was subsumed within a significant higher order interaction involving

RUNNING HEADING: Age Differences in Expectancy Bias

Future Event Valence, Initial Scenario Valence and Age Group, $F(1, 121) = 4.72, p = .032, \eta_p^2 = .038$. Supporting hypothesis 1, follow-up, pairwise comparisons showed that negative future events were given significantly higher expectancy ratings by younger than by older adults regardless of whether the initial scenarios were negative ($M = 2.43, SD = .47$ vs $M = 2.14, SD = .43; F(1, 123) = 12.98, p < .001, \eta_p^2 = 1.00$), or positive ($M = 2.07, SD = .35$ vs $M = 1.92, SD = .41; F(1, 123) = 4.66, p = .033, \eta_p^2 = .037$). However, positive future events were given significantly lower expectancy ratings by younger adults than by older adults only when the initial scenarios were negative ($M = 2.49, SD = .40$ vs $M = 2.71, SD = .37; F(1, 123) = 9.47, p = .003, \eta_p^2 = .072$), and no such age difference in expectancy was evident when initial scenarios were positive ($M = 2.92, SD = .36$ vs $M = 2.97, SD = .33; F(1, 123) = .641, p = .425, \eta_p^2 = .005$). See Figure 2. This indicates that older participants are engaging less in emotional extrapolation when formulating their future expectancies than is the case for younger participants.

Expectancy Bias following Initial Emotionally Ambiguous Scenarios

A mixed-design analysis of variance (ANOVA) was carried out on the expectancy ratings for the future candidate events following the emotionally ambiguous initial scenarios (also shown in Figure 2). This ANOVA considered the two between-subjects factors of Clinical Status (Control, Clinical), and Age Group (Younger, Older), together with the within-subjects factors of Future Event Valence (Negative Future Event, Positive Future Event). There was a significant main effect of Age Group, $F(1, 121) = 4.38, p = .039, \eta_p^2 = .035$, reflecting the fact younger participants gave generally higher expectancy ratings than older participants (mean, SD vs mean, SD). Of greater relevance, there was again a significant main effect of Future Event Valence, $F(1, 121) = 253.88, p < .001, \eta_p^2 = .677$,

RUNNING HEADING: Age Differences in Expectancy Bias

due to higher expectancy ratings for positive future events than for negative future events ($M = 2.8, SD = 0.3$ vs $M = 2.2, SD = 0.4$).

The effect of Future Event Valence was moderated by Clinical Status, within a two way interaction of these factors, $F(1, 121) = 10.91, p = .001, \eta_p^2 = .08$. The nature of this interaction was identical to that already reported in the preceding analysis of expectancy data following the emotionally unambiguous scenarios. Specifically, participants in the clinical group gave significantly higher expectancy ratings for negative future events than participants in the control group ($M = 2.3, SD = 0.4$ vs $M = 2.1, SD = 0.4$; $F(1, 121) = 5.61, p = .019, \eta_p^2 = .04$), whereas participants in the clinical and control groups did not differ in their expectancy ratings for positive events ($M = 2.7, SD = 0.4$ vs $M = 2.8, SD = 0.4$; $F(1, 121) = 2.98, p = 0.087, \eta_p^2 = .02$). This provides further support for hypothesis 2.

There was also a significant interaction between Future Valence and Age Group, $F(1, 121) = 30.24, p < .001, \eta_p^2 = .20$, which again was identical to the effect observed when analysing expectancy ratings following emotionally unambiguous scenarios. Younger adults gave significantly higher expectancy ratings for future negative events than older adults ($M = 2.2, SD = 0.3$ vs $M = 2.0, SD = 0.4$; $F(1, 121) = 22.43, p < .001, \eta_p^2 = .16$). This provides further support for hypothesis 1.

While the above effects were also evident in the prior analysis, the final significant effects obtained in the present ANOVA was one that was not previously obtained (and provides support for hypothesis 3). This was a significant higher order interaction involving Future Event Valence, Clinical Status and Age Group, $F(1, 121) = 4.13, p = .044, \eta_p^2 = .033$. This interaction reflected the fact that the two way interaction between Future Event Valence and Clinical Status was present in older adults, $F(1, 68) = 14.32, p < .001, \eta_p^2 = .174$, but not in younger adults, $F(1, 53) = .865, p = .356, \eta_p^2 = .016$. Closer inspection of the data reveals that this effect was driven principally by an exaggeration of the general tendency to assign

RUNNING HEADING: Age Differences in Expectancy Bias

1 higher expectancy ratings to positive than to negative future events, exhibited by the older
2 adults in the control group. For younger clinical participants expectancy ratings given to
3 positive future events were only 0.4 higher than those given to negative events, which grew
4 to just 0.5 higher for younger control participants. For older clinical participants, expectancy
5 ratings given to positive future events were only 0.6 higher than those given to negative
6 events, but this increased to 1.0 for older control participants. Given that this higher order
7 interaction was observed only when the initial scenarios were emotionally ambiguous, it is
8 tempting to speculate that it may reflect an increased tendency for older adults in the control
9 group to appraise these emotionally ambiguous scenarios in a disproportionately positive
10 manner, with the emotional extrapolation process then leading to disproportionately inflated
11 expectancies for positive relative to negative future events in this group of older participants
12 without clinical dysfunction.

Discussion

15 This study investigated the effects of clinical levels of emotional dysfunction, and
16 group difference in age, on negative expectancy bias. Moreover, the Expectancy Task shed
17 light on mechanisms underlying observed expectancy bias effects. It was hypothesised that,
18 compared to younger adults, older adults would exhibit heightened expectancy for positive
19 future events, reflecting a reduced tendency to engage in negative emotional extrapolation
20 (and so being most evident when anticipating future events likely to occur in scenarios that
21 are currently negative in emotional tone). We also predicted that compared to community
22 controls, both younger and older adults with clinically significant emotional dysfunction
23 would exhibit a similar pervasive negative expectancy bias. Finally we predicted that there
24 would be an interaction between age and emotional dysfunction such that older clinical

RUNNING HEADING: Age Differences in Expectancy Bias

1 participants would have a reduced negative expectancy bias relative to positive compared to
2 older community control participants.

3 Consistent with predictions, our findings indicate that participants with emotional
4 dysfunction did indeed display a heightened tendency to expect negative events relative to
5 positive that was pervasive in the sense that this effect persisted regardless of the nature of
6 the initially described scenario. Specifically, this heightened negative expectancy bias
7 evidenced by clinical participants, relative to control participants, was unaffected by the
8 emotional tone of the initial scenarios, and remained evident when the initial scenarios were
9 emotionally ambiguous. This result indicated that the pattern of negative expectancy bias
10 previously observed in high trait anxious individuals (e.g., MacLeod et al., 1997; Miranda &
11 Mennin, 2007; Steinman et al., 2013) also operates in clinical individuals with comorbid
12 anxiety and depression.

13 Consistent with predictions, we also found evidence of an age-linked difference in
14 expectancy bias, reflecting greater positivity in older adults. The tendency for positive future
15 events to be more highly expected than negative future events was significantly inflated in
16 older adults, relative to younger adults for initial scenarios that were negatively valenced with
17 no difference between age groups for initially positively valenced scenarios. Similarly, older
18 adults were less likely than younger adults to expect negative future events regardless of
19 whether the initial scenario was positively or negatively valenced. When the initial scenarios
20 were emotionally ambiguous, then it remained the case that older adults were more inclined
21 than younger adults to expect positive future events, particularly in the absence of emotional
22 dysfunction. These observed age-linked differences in emotional extrapolation, when forming
23 expectations of the future, are consistent with the findings of Steinman et al. (2013) who also
24 observed that the tendency to extrapolate negative future expectancies from initially negative

RUNNING HEADING: Age Differences in Expectancy Bias

scenarios decreases with age, as is also consistent with predictions from the SST and SAVI models.

The association between clinical status and expectancy bias did not differ between younger and older participants, when future expectancies were assessed following the emotionally unambiguous initial scenarios, which were either negative or positive in emotional tone. Thus, the degree to which emotional pathology is characterised by the relative inflation of these negative future expectancies was equivalent for older and younger adults suffering from emotional psychopathology. Interestingly, the association between clinical status and negative expectancy bias did differ for the two age groups when future expectancies were assessed following the processing of initial scenarios that were rendered emotionally ambiguous by incorporating both negative and positive elements. However, this did not reflect any difference in the pattern of negative expectancy bias exhibited by older and younger adults with diagnosed emotional pathology. Rather, the effect was driven by the strong positive expectancy bias exhibited by the older participants in the control group, relative to the younger participants in the control group. Thus, although anxiety and depression appeared to have a more detrimental effect on the pattern of expectancies exhibited by older adults this was only because such emotional pathology served to attenuate a positive expectancy bias that was found to be particularly strong in older adults without emotional pathology. Older adults in the clinical group still had a significantly higher positive expectancy than younger adults in the clinical group.

These findings suggest that a “positive buffer” may operate in older adults with respect to their pattern of emotional expectancies, which may serve as a protective factor against the development of emotional dysfunction. This idea is consistent with SST and SAVI models, and aligns with previous research showing positivity biases in older age (Carstensen, Isaacowitz, & Charles, 1999; Carstensen & Mikels, 2005; Charles, 2010;

RUNNING HEADING: Age Differences in Expectancy Bias

Charles, 2010; Charles & Carstensen, 2010; Reed et al., 2014). This positive bias buffer may contribute to the increase in wellbeing that is observed with age, and may partly explained the lower prevalence rates of emotional disorders in older populations (Kessler et al., 2005) such that older adults might be better able to recover from negative situations, or be motivated to seek out positive information in negative situations, and expect positive solutions in the future. However, future research needs to test these causal pathways specifically (Isaacowitz & Blanchard-Fields, 2012). The specific mechanisms that go wrong in older individuals who do have anxiety and depression in later life is unknown, but may be associated with a more chronic course of stressor, or a lifetime history of anxiety and depression during which the normal age related development of enhanced positive expectancies is disrupted. More research is needed to understand differences in positive and negative expectancy biases in clinically depressed and anxious older adults with differing levels of chronicity and stressors.

Of course, the cross sectional nature of the present research does not permit us to draw conclusions concerning whether the patterns of expectancy bias we have found to be associated with emotional pathology precede or follow the development of this clinical dysfunction, or whether they are indeed related at all (Isaacowitz & Blanchard-Fields, 2012). Future studies would benefit from tracking changes in expectancy bias, and in clinical symptomatology longitudinally to more directly examine whether the temporal pattern of such changes supports the idea that negative expectancy bias may causally impact on depression and anxiety. Further, as emotion regulation has been highlighted as an important predictor of depression and anxiety (Aldao, Nolen-Hoeksema, & Schweizer, 2010; Wirtz, Hofmann, Riper, & Berking, 2013) and evidence suggests that younger and older adults employ different emotion regulation strategies (Urry & Gross, 2010), it would be useful for future research to investigate the extent to which patterns of selective expectancy contribute

RUNNING HEADING: Age Differences in Expectancy Bias

1 to emotion regulation processes and, if so, how this aspect of emotional regulation intersects
2 with individual differences in psychopathology.

3 Several limitations of the current study should be noted. First, while our results
4 suggest that the negative expectancy bias previously observed in high trait anxious
5 individuals is also evident in a clinical sample of people with comorbid depression and
6 anxiety, we cannot be certain that the mechanisms underlying this negative expectancy bias
7 are equivalent between clinical and non-clinical cohorts, or between clinical depression and
8 clinical anxiety. Future studies should seek to determine whether negative expectancy bias is
9 associated with anxiety and depression in the same way, if so, whether the expectancy biases
10 in each disorder can be dissociated. Whilst biases are likely to differ between anxiety and
11 mood disorders for threat vs non-threatening events, expectancy biases for negative vs
12 positive events are likely to be similar. However, in order to establish this, large scale studies
13 that compare pure presentations of clinical subtypes of anxiety and mood disorders are
14 needed. Nevertheless, given the common comorbidity between these disorders, in both
15 younger and older adults, the current study has ecological validity and contributes to our
16 understanding of the mechanisms underlying expectancy bias in comorbid populations.

17 A second limitation is that it is unclear the extent to which selective memory for
18 emotional information or age-linked memory differences may be implicated in these findings.
19 Given that participants viewed blocks of 16 scenarios before providing their expectancy
20 ratings of candidate future events associated with the scenarios, differences in expectancy
21 ratings could be affected by memory differences for emotional information or age-based
22 memory differences of the initial scenarios. Although our results showed a significant
23 interaction between initial valence and future valence indicating participants were generally
24 able to remember the valence of the initial scenario, and so this was unlikely a problem. Also
25 unpublished work has indicated that there were no significant differences in age-linked

RUNNING HEADING: Age Differences in Expectancy Bias

expectancy biases between presentation of 4 and 16 scenario blocks (Cabeleira, 2017). To check for memory effects more rigorously, future studies should manipulate the number of scenarios presented prior to future expectancy ratings, as well as examining the impact of the size of the blocks on the different valences of initial scenario to elucidate differences in memory biases related to positive, negative and ambiguous information.

Thirdly, we cannot state with certainty that no members of the control group were experiencing emotional dysfunction. Although our questionnaire measures provide reassurance that participants in the control group exhibited at most only mild symptoms of depression and anxiety, it would have been advantageous to have conducted full clinical interviews on control group participants, to ensure the absence of emotional dysfunction. Further, the younger control group consisted of undergraduate students, and the older adult control group were generally healthy well-educated adults from a relatively affluent geographic area. This may limit generalizability of the present findings to the broader population. Hence, future studies should seek to employ more representative participant groups drawn from the wider community. Also the scenarios used were validated in healthy participants, and also demonstrated similar results in younger samples with heightened anxiety (Cabeleira et al., 2014), further validation in clinical populations is needed. Finally, although our sample size was quite large, it would be desirable to increase experimental power in future research. Power analyses using GPower (Faul, Erdfelder & Buchner, 2007) indicate that, with our present sample size of 125 participants, we were able to detect medium sized effects with a power of 0.8 (see Murphy & Myors, 2004), will the observed effect for the interaction of interest was 0.033 and therefore our analysis was underpowered and so our results must be treated with appropriate caution. As always, replication is essential, and we hope that this current work provides a firm foundation for the future lines of research

RUNNING HEADING: Age Differences in Expectancy Bias

1 necessary to consolidate our understanding of the relationship between emotional pathology,
2 age, and negative expectancy bias.

3 For the moment, the present findings lend weight to Steinman et al.'s (2013) claim
4 that there are independent effects of anxiety and age on expectancy biases. We obtained clear
5 evidence that, relative to non-clinical control participants, individuals with comorbid
6 depression and anxiety exhibit a pervasive negative expectancy bias. Our findings indicate
7 that the negative expectancy bias associated with anxiety and depression is pervasive in
8 nature, in the sense that it is unaffected by the emotional tone of the current situations, about
9 which people generate their future expectations. We also found evidence that positive
10 expectancy bias is associated with increasing age. The heightened negative expectancy
11 associated with clinical anxiety and depression is not moderated by age, unless these involve
12 expectancies future events likely to occur within situations that are emotionally ambiguous.
13 Under such circumstances, older adults without emotional dysfunction display an especially
14 robust positive expectancy effect, which is not evident in those with clinical anxiety and/or
15 depression, meaning that the detrimental influence of such clinical dysfunction on positive
16 expectancy is greater for older adults than younger adults. The strong positive expectancy
17 bias normally exhibited by older adults may serve to protect against the development of
18 emotional dysfunction in such individuals, but further research is needed to test this
19 hypothesis (Isaacowitz & Blanchard-Fields, 2012). These findings serve to advance
20 knowledge and understanding concerning the nature of the association between age, biased
21 expectancy, and emotional pathology.

RUNNING HEADING: Age Differences in Expectancy Bias

References

- Aldao, A., Nolen-Hoeksema, S., & Schweizer, S. (2010). Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clinical Psychology Review, 30*, 217-237. doi: 10.1016/j.cpr.2009.11.004
- Antony, M. M., Bieling, P. J., Cox, B. J., Enns, M. W., & Swinson, R. P. (1998). Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales (DASS) in clinical groups and a community sample. *Psychological Assessment, 10*, 176-181. doi: 10.1037/1040-3590.10.2.176
- Beck, A. T., & Clark, D. A. (1988). Anxiety and depression: An information processing perspective. *Anxiety Research, 1*(1), 23-36. doi: 10.1080/10615808808248218
- Berna, C., Lang, T. J., Goodwin, G. M., & Holmes, E. A. (2011). Developing a measure of interpretation bias for depressed mood: An ambiguous scenarios test. *Personality and Individual Differences, 51*, 349-354. doi: <http://dx.doi.org/10.1016/j.paid.2011.04.005>
- Brown, T. A., Di Nardo, P. A., & Barlow, D. H. (1994). *Anxiety Disorders Interview Schedule for DSM-IV (ADIS-IV)*. San Antonio, TX: Psychological Corporation.
- Brown, T. A., Korotitsch, W., Chorpita, B. F., & Barlow, D. H. (1997). Psychometric properties of the Depression Anxiety Stress Scales (DASS) in clinical samples. *Behaviour Research and Therapy, 35*, 79-89. doi: 10.1016/S0005-7967(96)00068-X
- Cabeleira, C. (2017). *Exploring the Neurocognitive Basis of Age-related Differences in an Anxiety-linked Bias in Negative Expectancy*. Doctor of Philosophy thesis, University of Western Australia, Australia.
- Cabeleira, C.M., Steinman, S.A., Burgess, M.M., Bucks, R.S., MacLeod, C., Melo, W., & Teachman, B.A. (2014). Expectancy bias in anxious samples, *Emotion, 14* (3), 588-601. doi:10.1037/a0035899.

RUNNING HEADING: Age Differences in Expectancy Bias

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 Carstensen, L. L., Isaacowitz, D. M., & Charles, S. T. (1999). Taking time seriously: A
2 theory of socioemotional selectivity. *American Psychologist*, 54, 165-181. doi:
3 10.1037/0003-066X.54.3.165
4 Carstensen, L. L., & Mikels, J. A. (2005). At the intersection of emotion and cognition.
5 Aging and the positivity effect. *Current Directions in Psychological Science*, 14, 117-
6 121. doi: 10.1111/j.0963-7214.2005.00348.x
7 Charles, S. T. (2010). Strength and vulnerability integration: A model of emotional well-
8 being across adulthood. *Psychological Bulletin*, 136, 1068-1091.
9 doi:10.1037/a0021232
10 Charles, S.T. & Carstensen, L.L. (2010). Social and Emotional Aging. *Annual Review of*
11 *Psychology*, 61, 383-409. doi:10.1146/annurev.psych.093008.100448
12 Dunn, V. K., & Sacco, W. P. (1989). Psychometric evaluation of the Geriatric Depression
13 Scale and the Zung Self-Rating Depression Scale using an elderly community sample.
14 *Psychology and Aging*, 4(1), 125. doi: 10.1037/0882-7974.4.1.125
15 Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical
16 power analysis program for the social, behavioral, and biomedical sciences. *Behavior*
17 *Research Methods*, 39, 175-191. <https://doi.org/10.3758/BF03193146>
18 Folstein, M. F., Folstein, S. E., McHugh, P. R. (1975). "Mini-mental state". A practical
19 method for grading the cognitive state of patients for the clinician. *Journal of*
20 *Psychiatric Research*, 12, 189–198. doi: [http://dx.doi.org/10.1016/0022-](http://dx.doi.org/10.1016/0022-3956(75)90026-6)
21 [3956\(75\)90026-6](http://dx.doi.org/10.1016/0022-3956(75)90026-6).
22 Isaacowitz, D. M., & Blanchard-Fields, F. (2012). Linking process and outcome in the study
23 of emotion and aging. *Perspectives on Psychological Science*, 7, 3-17.
24 doi:10.1177/1745691611424750

RUNNING HEADING: Age Differences in Expectancy Bias

- 1 Kessler, R. C., Berglund, P., Demler, O., Jin, R., Merikangas, K. R., & Walters, E. E. (2005).
2 Lifetime Prevalence of Age-of-Onset Distributions of DSM-IV Disorders in the
3 National Comorbidity Survey Replication. *Archives of General Psychiatry*, 62, 593-
4 602. doi:10.1001/archpsyc.62.6.593
- 5 Knight, B. G., Maines, M. L., & Robinson, G. S. (2002). The effects of sad mood on memory
6 in older adults: A test of the mood congruence effect. *Psychology and Aging*, 17, 653-
7 661. doi: 10.1037//0882-7974.17.4.653
- 8 Kukull, W.A., Larson, E.B., Teri, L., Bowen, J., McCormick, W., & Pfanschmidt, M.L.
9 (1994). The Mini-Mental State Examination score and the clinical diagnosis of
10 dementia. *Journal of Clinical Epidemiology*, 47 (9), 1061-1067.
11 [https://doi.org/10.1016/0895-4356\(94\)90122-8](https://doi.org/10.1016/0895-4356(94)90122-8)
- 12 Leigland, L. A., Schulz, L. E., & Janowsky, J. S. (2004). Age related changes in emotional
13 memory. *Neurobiology of Aging*, 25, 1117-1124.
14 doi:10.1016/j.neurobiolaging.2003.10.015
- 15 Lovibond, S. H., & Lovibond, P. F. (1995). *Manual for the Depression Anxiety Stress Scales*.
16 (2nd. Ed.). Sydney: Psychology Foundation.
- 17 MacLeod, A. K., Tata, P., Kentish, J., Carroll, F., & Hunter, E. (1997). Anxiety, depression,
18 and explanation-based pessimism for future positive and negative events. *Clinical*
19 *Psychology and Psychotherapy*, 4(1), 15-24. doi: 10.1002/(SICI)1099-
20 0879(199703)4:1<15::AID-CPP112>3.0.CO;2-#
- 21 MacLeod, A. K., Tata, P., Kentish, J., & Jacobsen, H. (1997). Retrospective and prospective
22 cognitions in anxiety and depression. *Cognition & Emotion*, 11, 467-479.
23 doi:10.1080/026999397379881

RUNNING HEADING: Age Differences in Expectancy Bias

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 Mathews, A., & MacLeod, C. (2005). Cognitive vulnerability to emotional disorders. *Annual*
2 *Review of Clinical Psychology, 1*, 167-195.
3 doi:10.1146/annurev.clinpsy.1.102803.143916
4 Miranda, R., & Mennin, D. S. (2007). Depression, Generalized Anxiety Disorder, and
5 certainty in pessimistic predictions about the future. *Cognitive Therapy and Research,*
6 *31*(1), 71-82. doi:10.1007/s10608-006-9063-4
7 Mogg, K., Bradbury, K. E., & Bradley, B. P. (2006). Interpretation of ambiguous information
8 in clinical depression. *Behavior Research and Therapy, 44*, 1411-1419. doi:
9 10.1016/j.brat.2005.10.008
10 Murphy, K.R., & Myers, B. (2004). Statistical Power and Analysis, 2nd Edition.
11 Pachana, N. A., Byrne, G. J., Siddle, H., Koloski, N., Harley, E., & Arnold, E. (2007).
12 Development and validation of the Geriatric Anxiety Inventory. *International*
13 *Psychogeriatrics, 19*(1), 103-114. doi: 10.1017/S1041610206003504
14 Parmelee, P. A., Lawton, M. P., & Katz, I. R. (1989). Psychometric properties of the
15 Geriatric Depression Scale among the institutionalized aged. *Psychological*
16 *Assessment: A Journal of Consulting and Clinical Psychology, 1*, 331-338.
17 doi:10.1037/1040-3590.1.4.331
18 Reed, A. E., & Carstensen, L. L. (2012). The theory behind the age-related positivity effect.
19 *Frontiers in Psychology, 3*, 1-9. doi: 10.3389/fpsyg.2012.00339
20 Reed, A. E., Chan, L., & Mikels, J. A. (2014). Meta-analysis of the age-related positivity
21 effect: Age differences in preferences for positive over negative information.
22 *Psychology & Aging, 29* (1), 1-15. doi: 10.1037/a0035194
23 Rude, S. S., Covich, J., Jarrold, W., Hedlund, S., & Zentner, M. (2001). Detecting depressive
24 schemata in vulnerable individuals: Questionnaires versus laboratory tasks. *Cognitive*
25 *Therapy and Research, 25*(1), 103-116. doi: 10.1023/A:1026482917201

RUNNING HEADING: Age Differences in Expectancy Bias

- 1 Steinman, S. A., Smyth, F. L., Bucks, R. S., MacLeod, C., & Teachman, B. A. (2013).
2 Anxiety-linked expectancy bias across the adult lifespan. *Cognition and Emotion*, 27,
3 345-355. doi: 10.1080/02699931.2012.711743
- 4 Urry, H. L., & Gross, J. J. (2010). Emotion regulation in older age. *Current Directions in*
5 *Psychological Science*, 19, 352-357. doi: 10.1177/0963721410388395
- 6 Wirtz, C. M., Hofmann, S. G., Riper, H., & Berking, M. (2013). Emotion regulation predicts
7 anxiety over a five-year interval: A cross-lagged panel analysis. *Depression and*
8 *Anxiety*, 31 87-95. doi: 10.1002/da.22198
- 9 Wisco, B. E., & Nolen-Hoeksema, S. (2010). Interpretation bias and depressive symptoms:
10 The role of self-relevance. *Behaviour Research and Therapy*, 48, 1113-1122. doi:
11 10.1016/j.brat.2010.08.004
- 12 Wuthrich, V.M., Rapee, R.M., Kangas, M., & Perini, S. (2016). Randomised Controlled Trial
13 of Group Cognitive Behavioural Therapy Compared to a Discussion Group for
14 Comorbid Anxiety and Depression in Older Adults. *Psychological Medicine*, 46 (4),
15 785-795. doi:10.1017/S0033291715002251
- 16 Yesavage, J. A., Brink, T. L., Rose, T. L., Lum, O., Huang, V., Adey, M., & Leirer, V. O.
17 (1983). Development and validation of a geriatric depression screening scale: A
18 preliminary report. *Journal of Psychiatric Research*, 17(1), 37-49. doi:
19 org/10.1016/0022-3956(82)90033

Table 1. *Diagnoses for Younger and Older Clinical Groups*

	Younger	Older
Principal Diagnoses %		
Generalized Anxiety Disorder	36.7	18.9
Specific Phobia	0	5.4
Social Phobia	20.0	5.4
Obsessive Compulsive Disorder	0	2.7
Major Depressive Disorder	16.7	45.9
Dysthymic Disorder	13.3	8.1
Anxiety Disorder Not Otherwise	13.3	5.4
Mood Disorder Not Otherwise	0	8.1
Secondary Diagnoses %		
Generalized Anxiety Disorder	20.0	43.2
Specific Phobia	0	13.5
Social Phobia	6.7	16.2
Major Depressive Disorder	30.0	8.1
Dysthymic Disorder	6.7	2.7
Panic Disorder	0	5.7
Anxiety Disorder Not Otherwise	0	2.7
Mood Disorder Not Otherwise	10.0	8.1
Primary disorder clinician rated severity	$M = 5.74 (SD = 1.29)$	$M = 5.97 (SD = 0.87)$
Secondary disorder clinician rated severity	$M = 5.35 (SD = 1.23)$	$M = 5.14 (SD = 0.98)$

Table 2

Depression and Anxiety Scores by Sample Group (Clinical, Control) and Age Group (Younger, Older)

Variable	Clinical		Control	
	Younger (<i>N</i> = 30)	Older (<i>N</i> = 37)	Younger (<i>N</i> = 25)	Older (<i>N</i> = 33)
Depression				
Range	4-40	8-22	0-12	8-17
Mean (SD)	19.8 (9.4)	15.0 (2.9)	4.9 (3.4)	10.0 (1.9)
Anxiety				
Range	1-30	2-19	0-9	0-7
Mean (SD)	15.2 (7.4)	11.2 (4.1)	4.7 (3.2)	0.6 (1.3)

Note. For younger adults the Depression scores are obtained using the DASS-depression subscale, and the anxiety scores are obtained using the DASS-Anxiety subscale. For older adults the depression scores are obtained using the Geriatric Depression Scale and the anxiety scores are obtained using the Geriatric Anxiety Inventory.

RUNNING HEADING: Age Differences in Expectancy Bias

Figure 1: Age Effects on Mean Probability Ratings for Negative and Positive Future Events, with Mean Ratings Organized by Initial Passage Valence (Positive, Negative)

Note: Error Bars = Standard Error (95% Confidence Intervals)

RUNNING HEADING: Age Differences in Expectancy Bias

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

RUNNING HEADING: Age Differences in Expectancy Bias

1 Figure 2: Age and Clinical Status Effects: Mean Probability Ratings for Negative and Positive Future Events, with Mean Ratings Organized by Initial Scenario
2 Condition (Initial Scenario Negative, Initial Scenario Positive, Initial Scenario Emotionally Ambiguous), Clinical Status (Clinical, Control) and Age Group
3 (Young, Older) Note: Error Bars = Standard Error (95% Confidence Intervals)

For Peer Review Only

Appendix

Example of a Predominantly Negative Scenario

Going to the Doctor (Title)

You go to the doctor's rooms (Orienting sentence)

You find out you need a biopsy done (Negative Candidate Event A)

The doctor prescribes you medication that can have bad side effects (Negative Candidate Event B)

A bird flies past the window (Filler Candidate Event A)

The telephone rings (Filler Candidate Event B)

Example of a Predominantly Positive Scenario

Going to the Doctor (Title)

You go to the doctor's rooms (Orienting sentence)

The doctor says your heart sounds very healthy (Positive Candidate Event A)

The doctor informs you that you are at a healthy weight (Positive Candidate Event B)

A bird flies past the window (Filler Candidate Event A)

The telephone rings (Filler Candidate Event B)

Example of an Emotionally Balanced Scenario

Going to the Doctor (Title)

You go to the doctor's rooms (Orienting sentence)

You find out you need a biopsy done (Negative Candidate Event A)

The doctor prescribes you medication that can have bad side effects (Negative Candidate Event B)

The doctor says your heart sounds very healthy (Positive Candidate Event A)

The doctor informs you that you are at a healthy weight (Positive Candidate Event B)

Example of the three Future Events presented during the Expectancy Rating Trial of a Physical Scenario

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

The doctor warns you all your family is at risk of diabetes (Negative Future Event / Negative
Candidate Event C)

The doctor says she is happy with your exercise regime (Positive Future Event / Positive Candidate
Event C)

You notice a car drive by outside (Filler Future Event / Filler Candidate Event C)

For Peer Review Only