Age Differences in Anxious Responding: Older and Calmer, Unless the Trigger Is Physical

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The current study examines how the aging relevance of anxiety triggers, particularly those tied to physical threat, influences the expression of anxiety in older and younger adults. It was expected that older adults would exhibit less anxiety than younger adults in response to nonphysical triggers but that this age-related difference would diminish when faced with physical triggers. Anxiety responses were measured in older (N = 49, ages 60–85) and younger (N = 49, ages 17–34) adults in response to (a) physical and social anxiety provocations, and (b) a threat interpretation measure. Consistent with hypotheses, results for the anxiety provocations indicated less anxiety among older (vs. younger) adults on a range of anxiety measures (affective, cognitive, physiological) when triggers did not concern physical health, but this age difference diminished when physical health was threatened. Older adults actually reported more threat interpretations than younger adults to physical threat scenarios. Findings are discussed in terms of the aging relevance of anxiety triggers and theoretical accounts of age-related changes in emotional processing.

Keywords: aging, anxiety, physical arousal, threat, older

Understanding anxiety reactions among older adults is critical, given the high prevalence of anxiety symptoms in older adulthood (e.g., Schaub & Linden, 2000) and anxiety’s close tie to age-related health difficulties (e.g., Mroczek & Spiro, 2007). To better appreciate how anxious processing changes with age, the current study examines the impact of different types of anxiety triggers in older and younger adults.

Although it is true that aging is associated with declines in many domains of functioning (e.g., certain aspects of cognitive functioning, such as processing speed; Salthouse, 1991), the idea that older adulthood is defined by pervasive impairment is clearly a myth. In fact, some domains of functioning seem to maintain and perhaps even improve with age, including certain aspects of emotional processing (see Carstensen & Mikels, 2005). Socioemotional selectivity theory (Carstensen, 1993; Carstensen, Isaacowitz, & Charles, 1999), for example, proposes that as time until death becomes shorter—a characteristic associated with natural aging—people are motivated to focus on emotional goals and tend to emphasize positive relative to negative information (see also Labouvie-Vief & Medler, 2002; Mather & Johnson, 2000; but see Murphy & Isaacowitz, 2008). This focus is thought to enhance the ability to reduce negative affect and increase positive affect.

This ability to maximize positive affect and minimize negative affect has been termed affect optimization by Labouvie-Vief, Diehl, Jain, and Zhang, 2007, who suggested that the tendency to optimize affective balance increases with age. Support for enhanced affect optimization among older adults comes from numerous sources. For instance, Carstensen, Pasupathi, Mayr, and Nesselroade (2000) found that following the induction of a negative mood state, older (vs. younger) adults “were more likely to maintain highly positive states and were more likely to maintain the absence of negative emotional states” (p. 650). Other signs of healthy emotional processing among older adults include evidence that older adults report fewer negative emotional experiences and are more effective than younger adults at controlling their emotions (e.g., Gross et al., 1997). Further, findings across studies indicate that self-reported negative affect is typically lower in older adults, compared with younger or middle-aged adults (e.g., Lawton, Kleban, Rajagopal, & Dean, 1992; although this may change among octogenarians; see Teachman, 2006). Moreover, older adults tend to perceive stressors as less threatening than do younger adults (Charles & Almeida, 2005). All of these findings lead to the hypothesis in the current study that older adults will perceive many anxiety triggers as less threatening than will younger adults.

However, we expect that under certain conditions this age-related tendency to report less negative affect will be compromised among older adults. Specifically, when a trigger is especially aging relevant, it will be difficult for older adults to selectively focus on positive relative to negative information and to use this focus to optimize their affect, consistent with arguments that affect optimization requires cognitive control (e.g., Knight et al., 2007). This difficulty is expected because of the enhanced salience of the trigger (which may result in the use of additional processing resources) and because age-related triggers may activate concerns about the future. Under these conditions, older adults do not seem as able to minimize their negative affect. In particular, although...
Jackson, 1997). Supporting this idea, anxiety sensitivity predicts anxiety problems, such as panic, in older adults (Deer & Calamari, 1998). Sensitivity may play a significant role in the development of such issues as feeling frightened when one’s heart races or one becomes short of breath (Reiss & McNally, 1985), and anxiety sensitivity refers to the tendency to become concerned about signs of anxiety, such as racing heart and shortness of breath, are especially threatening for older adults, relative to other types of triggers. We expect that the lowered anxiety reactivity that older adults experience in response to nonphysical triggers (due to their enhanced affect optimization abilities) will be diminished when they are faced with physical triggers. The current work uses a set of anxiety provocations and a measure of threat interpretations to extend the exciting research by Kunzmann and Grünh (2005), which examined age differences in response to aging-relevant sad films. In addition to using provocations other than films, the current research focuses on a new emotion (anxiety) and includes measures of not only subjective affect and physiological responding (as Kunzmann & Grünh did) but also cognitive measures, including assessment of explicit threat appraisals following the anxiety provocations and a more general measure of threat interpretation biases.

Two different methodologies are used to examine age differences in reaction to anxiety triggers. First, we introduce actual anxiety provocations, including physical stressors (that elicit symptoms of anxious arousal), social stressors, and a control task. Second, we examine the tendency to interpret hypothetical, ambiguous situations as either threatening or not, depending on whether the event focuses on physical or other kinds of challenges. In each case, we expect older adults to respond with less anxiety than younger adults when triggers are not physical in nature, but this age difference is expected to diminish when the trigger is physical.

Finally, we use a variety of measures to assess anxiety responses, given that there are multiple response systems inherent in emotional reactions (see Lang, 1979). Thus, when we refer to hypotheses about anxiety reactions, we are referring not only to subjective distress but also to cognitive and physiological components of the anxiety response. Using a multimodal approach to assessment is critical, given the common finding from both the anxiety literature (e.g., Lang, 1985) and the aging and emotions literature (e.g., Kunzmann, Kupperbusch, & Levenson, 2005) of divergent responses across different modes of emotion measurement. For instance, although there is considerable evidence for reduced physiological responsivity to emotion stimuli in older adults, many studies have not found age differences in subjective experiences of emotions (see review by Levenson, 2000, and discussion in Charles & Carstensen, 2004). However, this pattern has not been observed when emotion triggers were aging relevant (e.g., Kunzmann & Grünh, 2005). By using a multimodal approach to assess anxiety and by examining responses to a range of paradigms and stressors, the current study provides a unique opportunity to evaluate age differences in the experience of anxiety as a function of the nature of the trigger and its likely relevance to aging concerns.
Method

Participants

Following Kunzmann et al. (2005), we employed an extreme groups design comparing younger and older adults for this initial evaluation of anxiety reactions to maximize the likelihood of seeing age differences. The sample included 49 younger adults (age: $M = 19.37$ years, $SD = 2.50$, range = 17–34; 69% female) and 49 older adults (age: $M = 70.02$ years, $SD = 7.27$, range = 60–85; 64% female).1 Younger adult participants who were enrolled in psychology courses participated in the study in exchange for course credit or pay. Older adult participants were recruited from the Charlottesville, Virginia, community through flyers and local newspaper advertisements that sought participants for a “research study on thoughts and feelings” and received pay in exchange for their participation. Individuals who reported a history of significantly poor vision or hearing, cardiovascular disease, epilepsy, emphysema, severe asthma, or severe motion sickness (during a prescreening phone interview for older adults or on a prescreening questionnaire for younger adults) were excluded from participation, due to concerns that these conditions would prevent full participation in the study or that the anxiety provocations could cause undue discomfort. Participants in the younger adult sample reported their race or ethnicity as 90% Caucasian, 2% Asian/Pacific Islander, and 8% other. Participants in the older adult sample reported their race or ethnicity as 98% Caucasian and 2% other. There were no age group differences in ethnicity, $\chi^2(2) = 2.80, p = .25$, or gender, $\chi^2(1) = .33, p = .56$. For those participants who chose to report their average family income per year ($n = 82$), older adults reported a lower level, $t(80) = 6.12, p < .001, d = 1.37$ (younger adults: $M = $60,000–$99,999; older adults: $M = $30,000–$39,999). More older (than younger) adults chose not to report their income or left the item blank, $\chi^2(1) = 4.78, p = .03$.

Materials

Sample Characteristics: Baseline Affect, Anxiety and Depressive Symptoms, Physical Health and Cognitive Functioning

Baseline affect. Participants completed the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988), a 20-item scale assessing positive and negative state affect. The scale presents 10 positive and 10 negative emotion words, and participants are asked to rate each word to indicate “to what extent you feel this way right now.” Items are rated using a 5-point scale ranging from very slightly or not at all to extremely. The PANAS has demonstrated good psychometric properties and has been shown to be valid and reliable in a sample ages 18 to 91 (see Crawford & Henry, 2004). Cronbach’s alpha was .89 for the positive affect subscale and .82 for the negative affect subscale.

Anxiety Sensitivity Index (ASI; Reiss, Peterson, Gursky, & McNally, 1986). The ASI is a 16-item self-report inventory that assesses fear about the negative consequences associated with various anxiety symptoms, including physiological arousal. Each of the items is rated from 0 (very little) to 4 (very much) to reflect one’s usual way of thinking and feeling e.g. “When I notice that my heart is beating rapidly, I worry that I might have had a heart attack.” This measure has adequate psychometric properties (Reiss et al., 1986) and has a similar factor structure in younger and older adults (Mohlman & Zinbarg, 2000). Cronbach’s alpha in the current study was .84.

State-Trait Anxiety Inventory

Center for Epidemiological Studies–Depression Scale (CES-D; Radloff, 1977). The CES-D is a 20-item questionnaire that has been widely used to measure symptoms of depression. The questionnaire asks respondents to endorse symptoms that they have experienced within the past week. Items are rated on a 4-point scale ranging from rarely or none of the time to most or all of the time. The measure has strong psychometric properties and has been shown to identify depressive symptoms in elderly samples (e.g., Aréan & Miranda, 1997; Hertzog, Van Alstine, Usala, Hultsch, & Dixon, 1990). Cronbach’s alpha in the current study was .89.

Health questionnaire (adapted from Belloc, Breslow, & Hochstim, 1971). Participants completed items from a self-report health questionnaire, including a question about perception of physical health compared with others of about the same age, on a 1 (excellent) to 4 (poor) scale. This item was included as a measure of perceived physical health that used the person’s age group as an anchor to help account for the expected variability of within-group health status. Participants also reported the number of current medications that a doctor had prescribed for them and whether or not they had ever seen a doctor for nerves or emotional problems or taken medicine for such problems. These items were included as somewhat more objective measures of health to check for age group differences.

Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975). Participants completed the MMSE to check for cognitive impairment. This brief, standardized interview evaluates cognitive status by assessing orientation, attention, recall, and language.

Independent Variables: Anxiety Provocations

Participants completed three tasks that were designed to evoke mild to moderate levels of anxiety (two that were physical in nature and one that represented a social stressor) and one control task that was not designed to elicit anxiety. Each of the physical anxiety provocations is a common exercise used in the evaluation of panic symptoms and involves no actual risk or danger. The tasks derive from the widely used panic control treatment manual (Barlow & Craske, 1994). Selection was based on provocations that could be completed by healthy older and younger adults (i.e., they were not prohibitively physically demanding). When receiving the instructions for each task, participants were told they could end the tasks if they became too uncomfortable; this instruction was provided to reduce the likelihood of coerced participation. Participants then completed the task for the allotted time until or unless they asked to stop. A metronome was used for provocations that required standardized of the participants’ pace.

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1 Note: This sample description does not include data from one older adult female participant who asked to have her data excluded following the conclusion of the study.
Candle blowing (Barlow & Craske, 1994). Using their index finger as an imaginary candle, participants repeatedly and rapidly blew on their finger as if blowing out a candle for 60 s. The metronome was set to 100 beats per minute, and participants were asked to blow out every time the metronome clicked. The candle-blowing task typically produces a range of sensations, including dizziness, tingling and numbness, hot flushes, and sweating.

Straw breathing (Taylor & Rachman, 1994). Participants were asked to breathe through a thin straw for 60 s, a harmless activity that produces temporary dizziness and lightheaded feelings. This provocation was designed to activate potential hypersensitivity to shortness of breath sensations.

Speech (modified from McLean & Woody, 2001). Participants were asked to stand in front of a mirror for 2 min with the experimenter watching and do an impromptu speech about what they like about their hometown. Participants were instructed to stare at themselves in the mirror to increase the likelihood of eliciting an anxiety response (due to increased self-focused attention; Carver & Scheier, 1978). The experimenter observed the speech from a chair placed approximately 1 ft (0.31 m) behind the participant and maintained a blank facial expression throughout the task (to increase concerns about potential negative evaluation). The speech, a (nonphysical) social stressor, was included to examine whether age differences in emotional vulnerability differed in response to physical versus nonphysical anxiety provocations.

Foot tapping. Participants were asked to tap their right foot every 5 s for 30 s. This task was not expected to elicit any intense physical sensations related to anxiety. Similar control tasks (e.g., breathing slowly, counting backward) have been used in previous research (e.g., Antony, Ledley, Liss, & Swinson, 2005). Foot tapping was used as the control task for the current study because it is a physical activity like the candle-blowing and straw-breathing provocations but is not expected to elicit strong physical sensations.

Dependent Variables: Responses to Provocations (Completed Following Each Provocation)

Subjective Units of Distress Scale (SUDS; self-reported anxiety). When each task was over, participants provided a rating of their peak anxiety during the task using a verbal analogue scale ranging from 0 (no anxiety) to 100 (maximum anxiety). SUDS was also rated at baseline.

Perception of heart rate change (Gordon & Teachman, 2008). This single-item questionnaire assesses participants’ perception of their heart rate (HR) change during an anxiety provocation, relative to their resting HR. Participants indicated on a 7-point Likert scale whether they felt their HR increased or decreased by an extreme, moderate, or slight amount, or whether it did not change, from 1 (My HR increased by an extreme amount during the task) to 7 (My HR increased by an extreme amount during the task). This measure was included to examine age group differences in perception of physiological arousal, a common marker of anxiety.

Bodily Sensations Questionnaire (BSQ: Chambless, Caputo, Bright, & Gallagher, 1984). The BSQ is a 17-item self-report instrument that assesses fear of bodily sensations. Each item represents an anxiety-related sensation (e.g., heart palpitations) and is rated on a 1 (not frightened or worried by this sensation) to 5 (extremely frightened by this sensation) Likert-type scale. The scale has demonstrated high internal consistency and test–retest reliability (Chambless et al., 1984). Participants completed this measure following each provocation to assess fear associated with physiological arousal during the provocations. Average Cronbach’s alpha across administrations of the BSQ was .95.

Agoraphobic Cognitions Questionnaire (ACQ; Chambless et al., 1984). The ACQ is a 14-item measure that assesses physical concerns (e.g., throwing up) and thoughts related to losing control (e.g., “going crazy”). The ACQ was included as a measure of threat appraisals. Participants indicate the extent to which they experienced each of the thoughts during the previous provocation. Responses range from 1 (thought never occurred) to 5 (thought occurred very often). Average Cronbach’s alpha across administrations of the ACQ was .88.

Physiological measure: Heart rate. HR was recorded both during a 2-min resting baseline period at the start of the study (while participants sat still in a chair and stared at a target) and during the anxiety provocations and film clips. The Polar E600 (Polar, Lake Success, NY) HR monitor uses electrodes that are enclosed in a transmitter that is worn across the chest to detect cardiac electrical impulses. The detection of the electrical impulses is transferred to a wristband receiver, which the experimenter held (out of the participant’s sight) throughout the study. The Polar monitor was programmed to sample HR values every 5 s (i.e., the interbeat interval between the impulses was recorded every 5 s), the shortest interval allowed by the equipment, to maximize the frequency of HR readings. In previous studies, Polar HR monitors have demonstrated adequate validity and reliability (e.g., Bar-Or, Bar-Or, Waters, Hirji, & Russell, 1996; Terbizan, Dolezal, & Albano, 2002).

Dependent Variables: Threat Interpretation Bias

The Brief Body Sensations Interpretation Questionnaire (BBSIQ; Clark et al., 1997) is a 14-item version of the Body Sensations Interpretation Questionnaire, which is modified from McNally and Foa’s (1987) Interpretation Questionnaire. In the present study, very minor wording modifications were made to make the measure more prototypic of American rather than British English. Participants are presented with ambiguous events and then asked to rate three alternative explanations for why the event might have occurred. One option is always negative, whereas the other two responses are either neutral or positive. Participants rate the extent to which they believe each of the explanations to be true on a 0–8 Likert scale. Half of the items refer to events tied to the threatening (mis)interpretation of bodily sensations (referred to as “physical threat” items), and the remaining items (referred to as “external threat” items) reflect other potentially threatening events, such as social rejection or a danger in the house (e.g., smelling smoke). An example of a physical threat item is, “You notice that your heart is beating quickly and pounding.” The three alternative explanations are, “because you have been physically active,” “because there is something wrong with your heart,” or “because you are feeling excited.” An example of an external threat item is, “You are introduced to someone at a party who fails to reply to a question you ask. Why?” The three alternative explanations are, “They did not hear the question,” “They think you are uninteresting and boring,” or “They were preoccupied with something else at the time.” This task was included to assess the tendency to make threatening interpretations in response to different types of ambiguous situations.
AGE DIFFERENCES IN ANXIOUS RESPONDING

Procedure

Participants were told that the study was being conducted to assess the thoughts and feelings people have in response to various tasks. Following informed consent, participants provided a baseline rating of their anxiety (SUDS) and completed the PANAS. Next, participants were provided with instructions and a demonstration of how to attach the chest transmitter of the HR monitor. To assess baseline HR, participants were asked to sit quietly and still and stare at a target that was placed on the computer screen for 2 min. Participants then completed the threat interpretation measure (BBSIQ).

Next, participants completed the four provocations (candle blowing, straw breathing, speech, foot tapping) in a randomized order. Following each provocation, participants provided a verbal rating of their peak level of anxiety during the task and completed the perception of HR change item, BSQ, and ACQ (in a fixed order). Relaxation exercises were completed between provocations whenever elevated anxiety was evident in order to minimize the effect of residual anxiety on subsequent tasks. Specifically, participants completed relaxation exercises (slow breathing) until their subjective anxiety (SUDS) was reduced by at least 75% (relative to the difference between their baseline and peak levels during the task) and their HR was reduced by at least 50% (relative to the difference between their baseline and peak levels during the task). If relaxation was not required (i.e., subjective anxiety and HR were already reduced by the requisite amount), the participant continued on to the next provocation.

Next, participants completed the health questionnaire, ASI, STAI, CES-D, and a demographics questionnaire in a randomized order, followed by the MMSE. These measures were administered at the end of the study because they were less central to the primary hypotheses, and we did not want to prime concerns about health, mood and anxiety, or cognitive functioning in advance of the provocations. Finally, participants were fully debriefed and compensated with either course credit (only relevant for the younger adults) or $20.2

Plan for Data Analysis

Age group differences in baseline affect as well as anxiety and depressive symptoms, physical health and cognitive functioning were examined to determine whether any variables needed to be controlled for in the subsequent analyses examining age differences in response to physical and nonphysical triggers. Next, age differences in response to the four provocations were examined: two provocations designed to elicit physical symptoms commonly experienced during anxiety reactions (the candle-blowing and straw-breathing tasks), one designed to activate social stress (the speech task) to serve as a nonphysical trigger, and a control task (foot tapping). To simplify analyses and increase reliability, results for the candle-blowing and straw-breathing tasks were averaged to examine overall responding to physical triggers. For each dependent variable, anxiety-relevant responding across provocations was compared using a repeated measures approach with one between-subjects factor (age group) and one within-subjects factor (provocation: physical threat, social threat, foot tapping) to test for the expected age group by provocation interaction. The dependent variables included self-reported peak anxiety (on the SUDS), perceived HR change (relative to baseline) as reported by the participants, anxious cognitions and fear of bodily sensations (on the ACQ and BSQ, respectively), and actual average HR during each task.3 The ACQ and BSQ were designed as companion measures and showed substantial correlations with one another (r = .73 on the physical tasks, r = .74 on the speech task, and r = .53 on the foot-tapping task), so these measures were combined (average of z scores was computed) to reduce the number of tests being run. For the peak anxiety and average HR during the provocations, standardized residuals were computed (after regressing the individual’s baseline anxiety and HR) so that change in responding during the tasks could be examined independent of baseline anxiety and HR (see recommendations for examining change in Hummel-Rossi & Weinberg, 1975). Finally, threat interpretations on the BBSIQ were examined by comparing age differences in average threat interpretation endorsement (following the scoring of the BBSIQ in Clark et al., 1997) for the physical and external threat scenarios.

Results

Table 1 provides the means and standard deviations for the primary study variables by age group.

Sample Characteristics

To evaluate group differences in advance of the anxiety provocations, the older and younger adults were compared on measures of baseline affect, anxiety and depressive symptoms, physical health and cognitive functioning. As expected, older (compared with younger) adults reported lower baseline subjective anxiety scores (on the SUDS), t(96) = 2.37, p = .02, d = 0.48; and reported lower negative, t(96) = 2.06, p = .04, d = 0.42, and higher positive, t(96) = −4.89, p < .001, d = −1.00, affect on the PANAS. There was no significant age group difference in baseline HR, t(94) = 1.21, p = .23, d = 0.25. With respect to emotional health, the older adults reported lower general anxiety and depressive symptoms consistent with prior literature: STAI, t(87) = 4.57, p < .001, d = 0.98; CES-D, t(96) = 3.23, p = .002, d = 0.66. On the ASI, which measures concern about anxiety symptoms (including physiological arousal), there was no significant age group difference, t(95) = −.34 p = .73, d = −0.07, in line with the hypothesis that older adults would not exhibit lower anxiety than younger adults when the trigger involved physical symptoms. On the health questionnaire, there was a significant age difference in perceived physical health compared with people of the same age, t(96) = 2.75, p = .007, d = 0.56, such that older adults reported

2 These measures and procedures are part of a larger study on aging and arousal. In particular, following the anxiety provocations, a brief manipulation was conducted that attempted to shift participants’ personal concern about their cardiovascular arousal (half of the participants were told their HR was particularly elevated; half were told it was in the normal range). Participants were then shown three film clips, and their HR and subjective distress in response to the films was measured. However, we do not have evidence that this manipulation was successful, making the data related to the films difficult to interpret. Thus, the film data are not reported here. Additionally, participants completed a single-item, exploratory measure of HR acuity.

3 Actual HR data for one participant was deleted from the speech task because this person was an extreme outlier (defined as a score that is more than 3 times the interquartile range from the rest of the scores).
better health in comparison to other older adults (relative to younger adults’ report of their health compared with other younger adults). Notably, both the younger and older adult groups reported good to excellent health on average. Not surprisingly, older adults reported taking more prescription medications than younger adults ($t(95) = -3.46, p = .001$, $d = -.71$). There were no age group differences in participants’ reports of whether they had ever received care from a doctor for nerves or emotional problems, $\chi^2(1) = 1.05, p = .31$. Finally, there were no age group differences on the MMSE, $t(96) = 1.53, p = .13$, $d = 0.31$, and all participants scored above a standard cutoff indicating a minimum level of cognitive functioning (i.e., all participants achieved a score of 24 or higher; Folstein et al., 1975).

Given the group differences on a number of the variables, five covariates were used in the subsequent analyses examining age differences. These included the PANAS positive and negative affect subscales, as well as the CES-D, STAI, and perceived physical health. Note that the baseline subjective anxiety score on the SUDS was not used as a covariate because it was used to calculate the subjective anxiety residual following the provocations.4

### Table 1

**Descriptive Statistics by Age Group (Raw Means Without Including Covariates)**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Younger adults</th>
<th>Older adults</th>
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<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
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<tr>
<td>Sample characteristics: Baseline affect, anxiety and depressive symptoms, physical health and cognitive functioning</td>
<td></td>
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<tr>
<td>Baseline PANAS—positive affect</td>
<td>24.80</td>
<td>5.93</td>
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<tr>
<td>Baseline PANAS—negative affect</td>
<td>13.06</td>
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<td>Baseline self-reported anxiety (SUDS)</td>
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<td>Baseline average HR (bpm)</td>
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<td>Center for Epidemiological Studies–Depression scale</td>
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<td>7.07</td>
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<td>Health questionnaire (perceived physical health rating, relative to same age group: 1 = excellent to 4 = poor)</td>
<td>1.84</td>
<td>0.75</td>
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<td>Mini-Mental State Examination</td>
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<tr>
<td>Physical anxiety provocation responses (average of candle-blowing and straw-breathing tasks)</td>
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<tr>
<td>Self-reported peak anxiety (SUDS z-score residual)</td>
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<td>0.90</td>
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<tr>
<td>Perceived HR change (relative to baseline)</td>
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<tr>
<td>Anxious cognitions (ACQ)</td>
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<td>Fear of bodily sensations (BSQ)</td>
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<tr>
<td>Actual average HR during task (z-score residual)</td>
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<tr>
<td>Social anxiety provocation responses (speech)</td>
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<tr>
<td>Self-reported peak anxiety (SUDS; z-score residual)</td>
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<tr>
<td>Perceived HR change (relative to baseline)</td>
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<td>Anxious cognitions (ACQ)</td>
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<tr>
<td>Actual average HR during task (z-score residual)</td>
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<td>Foot-tapping provocation responses</td>
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<tr>
<td>Self-reported peak anxiety (SUDS z-score residual)</td>
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<td>BBSIQ: External threat avg. item negative interpreters rating</td>
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<td>0.89</td>
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Note. Means for the ACQ and BSQ scales reflect total scores, rather than average item scores as is sometimes reported. PANAS = Positive and Negative Affect Scale; SUDS = Subjective Units of Distress Scale; HR = heart rate; bpm = beats per minute; ACQ = Agoraphobic Cognitions Questionnaire; BSQ = Bodily Sensations Questionnaire; BBSIQ = Brief Body Sensations Interpretation Questionnaire; avg. = average.

### Age Group Differences in Response to Anxiety Triggers

Table 2 summarizes the age group comparisons to facilitate evaluation of findings across the tasks.

**Anxiety provocations.** For each anxiety response, a multivariate analysis of covariance with age group as a between-subjects factor and type of provocation (physical, social, foot tapping) as a within-subjects factor was conducted with the five variables as covariates (baseline positive and negative affect, CES-D, STAI, and perceived physical health). As expected, on the measure of

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4 As noted in the Participants section, self-reported income also varied across the age groups. This item was not used as a covariate because of the large number of people who did not report their income ($n = 16$), resulting in missing data. However, to check that income differences were not responsible for the observed age group differences in response to anxiety triggers, the primary analyses were rerun adding annual household income as a covariate. None of the univariate tests checking for age differences changed with this covariate except the peak anxiety result for the foot-tapping control task, which no longer reached significance.
peak anxiety (SUDS residual), the age group by provocation interaction was significant, $F(2, 79) = 8.58, p < .001$, $\eta^2_p = .18$; and follow-up univariate tests (with covariates again included) indicated that older adults reported less anxiety following the speech, $F(1, 81) = 11.63, p = .001$, $\eta^2_p = .13$; but there was no significant age difference for the physical triggers, $F(1, 82) = 0.003, p = .96, \eta^2_p < .001$. Interestingly, older adults reported less anxiety on the foot-tapping control task, $F(1, 81) = 4.65, p = .03, \eta^2_p = .05$, though the magnitude of this effect was considerably smaller than the age difference in response to the speech. The pattern was identical for the measure of anxious cognitions and fear of bodily sensations (combined ACQ and BSQ). The age group by provocation interaction was significant, $F(2, 79) = 6.68, p = .002, \eta^2_p = .15$, and follow-up univariate tests (with covariates again included) indicated less anxious responding by older adults following the speech, $F(1, 81) = 22.62, p < .001, \eta^2_p = .22$, and a smaller effect on the foot tapping control task, $F(1, 81) = 8.30, p = .005, \eta^2_p = .09$, but there was no significant age difference for the physical triggers, $F(1, 82) = 2.81, p = .097, \eta^2_p = .03$. Similarly, on the measure of actual average HR, the age group by provocation interaction was significant, $F(2, 71) = 4.48, p = .02, \eta^2_p = .11$, and follow-up univariate tests (with covariates again included) indicated lower HR for older adults during the speech, $F(1, 77) = 14.92, p < .001, \eta^2_p = .16$, but not during the physical triggers, $F(1, 80) = 0.21, p = .65, \eta^2_p = .003$. In this case, there was no age difference on the foot-tapping control task, $F(1, 75) = 3.45, p = .07, \eta^2_p = .04$. Figure 1 illustrates the findings for peak anxiety as a function of age group and type of provocation (displaying estimated marginal means that take into account the covariates) as a representative example of this pattern of age differences.

The only measure not conforming to this pattern was the indicator of perceived HR change, where the age group by provocation interaction did not reach significance, $F(2, 79) = 2.65, p = .08, \eta^2_p = .06$. Notably, however, the direction of effects matched results for the other measures; the nonsignificance may be due in part

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Table 2

Summary of Age Differences in Anxiety Reactions to Different Triggers (After Including Covariates in Analyses)

<table>
<thead>
<tr>
<th>Trigger</th>
<th>Predictions</th>
<th>Age differences in anxiety response?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxiety provocations</td>
<td>Older adults less anxious than younger adults during the speech.</td>
<td>Older &lt; younger on peak anxiety (SUDS), combined ACQ/BSQ, and actual average HR.*</td>
</tr>
<tr>
<td></td>
<td>Minimal age difference during the physical tasks.</td>
<td>No significant age effect on all measures.</td>
</tr>
<tr>
<td></td>
<td>Minimal age difference during foot tapping (intended as control task).</td>
<td>No significant age effect on actual average HR and perceived HR change. Older &lt; younger on peak anxiety (SUDS) and combined ACQ/BSQ.</td>
</tr>
<tr>
<td>Threat interpretation (BBSIQ)</td>
<td>External items less threatening to older adults.</td>
<td>No significant age effect.</td>
</tr>
<tr>
<td></td>
<td>Minimal age difference on physical items.</td>
<td>Older &gt; younger.</td>
</tr>
</tbody>
</table>

Note. The Positive and Negative Affect Scale positive and negative affect subscales, as well as the Center for Epidemiological Studies–Depression scale, State-Trait Anxiety Inventory, and perceived physical health rating were used as covariates in these analyses. SUDS = Subjective Units of Distress Scale; ACQ = Agoraphobic Cognitions Questionnaire; BSQ = Bodily Sensations Questionnaire; HR = heart rate; BBSIQ = Brief Body Sensations Interpretation Questionnaire.

*Age difference (older < younger) for perceived HR change only significant when anxiety and depressive symptom and perceived physical health variables not included as covariates.

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Figure 1. Self-reported peak anxiety (using estimated marginal means of the Subjective Units of Distress Scale residuals) in response to the provocations as a function of age group and type of trigger.
part to the large number of covariates included, or the effect may be partially mediated by health. When the CES-D, STAI, and perceived physical health variables were not included as covariates (but baseline affect variables were still included), the age group by provocation interaction was significant, $F(2, 91) = 3.61, p = .03$, $\eta^2_p = .07$, and follow-up univariate tests indicated less perceived HR change by older adults following the speech triggers, $F(1, 93) = 3.97, p = .049$, $\eta^2_p = .04$, but not following the physical triggers, $F(1, 94) = 0.02, p = .90$, $\eta^2_p < .001$, or foot-tapping control task, $F(1, 93) = 0.68, p = .41$, $\eta^2_p = .01$, matching the pattern for the other anxiety responses.

Finally, correlations among the responses to the social and physical stressors are shown in Table 3. For the most part, relationships were in the small to moderate range for the various anxiety responses within a given provocation (physical or speech); the primary exception to this pattern was the general absence of relationships between the actual average HR and the other responses.

**Discussion**

The current study used a multimodal approach to evaluate age differences in anxiety reactivity as a function of the nature of the anxiety trigger and its likely relevance to aging concerns. Results from the anxiety provocations support the hypothesis that older adults would exhibit less anxiety than younger adults when triggers did not concern physical health (i.e., on the social task—giving a speech), but this age difference would diminish on the physical tasks, when physical health was threatened. This pattern holds for the measures of subjective distress (PANAS) and average HR, as well as anxious cognitions and fear of bodily sensations (combined ACQ and BSQ). The same pattern is evident for the measure of perceived HR change when the anxiety and depressive symptom and perceived physical health variables are not included as covariates, but it is not significant with all the covariates included. On the measure of interpretations, older adults actually gave higher ratings for the physical threat interpretations than did the younger adults, but there was no age difference for the nonphysical, external threat scenarios. Overall, these results are consistent with theoretical proposals suggesting that older adults tend to report less negative affect, except when demands of the situation are high (see Labouvie-Vief et al., 2007), which likely occurs when a stressor is particularly aging relevant.

**Age Differences in Response to Nonphysical Versus Physical Triggers**

Earlier ideas that aging was associated with losses in emotionality and universally dampened affect (e.g., Banham, 1951) do not seem tenable on the basis of the current results, given the clear variability in age differences depending on the trigger. As Kunzmann and Grühn (2005) noted, “There may be no simple answer to the question of whether the capacity to react to emotion-arousing events increases, declines, or remains stable over the adult years” (p. 57). The current study suggests that age relevance of triggers may be an important moderator in the ability (and perhaps motivation) to minimize anxiety.

This moderator is consistent with recent conceptualizations of the nuanced changes in emotion processing that occur in older adulthood. Theories of enhanced emotional processing in older adults do not propose that older adults are simply always going to be more positive than younger adults. Labouvie-Vief et al. (2007), for example, proposed a complicated relationship between affect optimization (expected to increase with age in general) and affect complexity skills (thought to be fairly comparable in older and younger adults). We suspect that the high personal salience of a physical stressor generates concern among older adults about

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**Table 3**

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Physical: Self-reported peak anxiety (SUDS $z$-score residual)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>2. Physical: Perceived HR change (relative to baseline)</td>
<td>.28*</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>3. Physical: Combination of ACQ and BSQ</td>
<td>.32*</td>
<td>.30*</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>4. Physical: Actual average HR during task ($z$-score residual)</td>
<td>—.11</td>
<td>.03</td>
<td>—.09</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>5. Social: Self-reported peak anxiety (SUDS $z$-score residual)</td>
<td>.63*</td>
<td>.13</td>
<td>.27*</td>
<td>—.18</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>6. Social: Perceived HR change (relative to baseline)</td>
<td>.12</td>
<td>.20</td>
<td>.08</td>
<td>.02</td>
<td>.31*</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>7. Social: Combination of ACQ and BSQ</td>
<td>.35**</td>
<td>.28*</td>
<td>.76**</td>
<td>—.13</td>
<td>.54**</td>
<td>.30*</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>8. Social: Actual average HR during task ($z$-score residual)</td>
<td>—.01</td>
<td>.12</td>
<td>—.13</td>
<td>.28*</td>
<td>.17</td>
<td>.07</td>
<td>—.01</td>
<td>—</td>
</tr>
</tbody>
</table>

*Note. SUDS = Subjective Units of Distress Scale; HR = heart rate; ACQ = Agoraphobic Cognitions Questionnaire; BSQ = Bodily Sensations Questionnaire.  
*p < .05.  **p < .001.
current and future functioning, tapping into the affect complexity domain, which involves the coordination and differentiation of current feelings with past and future ones. Under these conditions, we speculate that the demands to process the potential physical threat outweigh older adults’ enhanced ability to maintain affective balance. Directly testing whether processing physical triggers does in fact use affect complexity skills and diminish affect optimization in older adults is a critical next step.

Examining the aging relevance of emotion triggers as a moderator of anxious responding is also relevant to socioemotional selectivity theory, which posits a substantial role for motivation in determining when older adults will be biased toward positive affect (see Charles & Carstensen, 2004). We suspect that motivation may depend in part on the aging relevance of the trigger and hypothesize that this variable motivation may have benefits. Clearly, a rigid, uniformly positive affective processing style would not be adaptive. For anxiety, in particular, responding to triggers that are actual signs of danger is necessary for survival. The challenge is in recognizing which potential threats warrant our attention and the costs of an intense emotional reaction (e.g., the energy associated with preparing the body for fight or flight that occurs during intense anxiety) and which threats do not require such an excitatory response. We suspect that older adults have a higher threshold for triggering intense anxiety (relative to younger adults) for many threat domains because of their ability to process emotional information consistent with the goal of affect optimization (see Charles & Carstensen, 2004) and their flexible approach to problem solving in emotional domains (see Blanchard-Fields, 2007). However, we suspect that older adults tend to have a relatively lower threshold for responding to physical triggers, in part because they are not as motivated to reduce anxiety in response to these triggers. Declines in fitness are a realistic part of aging (see Smith & Baltes, 1997), so vigilance for physical threats makes sense. Further, there is evidence that actively trying to mitigate physical health concerns can help to reduce the negative effects of physical symptoms on declines in functioning for older adults (Wrosch & Schulz, 2008). Thus, given the realistic need for older adults to be sensitive to early signs of physical problems, responding with greater anxiety is likely an adaptive tool for older adults to recognize potential danger and mobilize for action. Accordingly, although affect optimization may reflect one aspect of helpful emotional processing skills (i.e., the ability to maximize positive affect and minimize negative affect), emotional health more broadly may also rely on the ability to adapt to different types of triggers in a flexible manner, congruent with the likely personal relevance of the threat.

At this stage, it is unclear what roles affect complexity and/or variable motivation played in the observed pattern of age differences. Future studies specifically designed to test the mechanisms that lead to more or less anxiety in older and younger adults are essential, especially because the current study does not evaluate the specific characteristics of processing an aging-relevant trigger that might explain the different levels of anxiety responding. Evaluating the time course of age differences in anxiety reactivity (i.e., obtaining assessments of affect throughout the presentation of a stressor) is also important to better understand if and when older adults are limiting their exposure to certain triggers (i.e., modifying the situation; see Charles & Carstensen, 2004) versus responding with different initial and subsequent levels of distress. This may help determine what role motivation (possibly unconscious) plays in the variable anxiety responses to different types of triggers and what role other factors, such as resource depletion due to the overwhelming of affect optimization skills, play.

Notably, both older and younger adults responded variably to the triggers. Along these lines, the age difference on the threat interpretation measure (BBSIQ) appears to be driven by the younger adults’ low threat rating on the physical items, as opposed to a difference in older adults’ threat ratings across the physical versus external items. Also, the choice to use a speech task for the nonphysical provocation is important in this regard. This task was
likely especially salient for the younger (vs. older) adults, who probably have more frequent demands to do public speaking, given that they are college students. Further, the speech task is notable because older adults seem particularly able to optimize affect in social contexts. For instance, older (vs. younger) adults tend to be less likely to fear negative evaluation by others in response to stressors (Almeida, 2005). Thus, it is important to replicate the pattern of variable age differences depending on the age relevance of the triggers using a wider variety of provocations beyond the physical and public speaking challenges.

Finally, the age differences in response to physical versus nonphysical triggers are mostly consistent, regardless of the anxiety response modality assessed. Past research has generally indicated reduced physiological responsivity to emotion stimuli in older adults and few age differences in subjective experiences of emotions (see Levenson, 2000). Yet, examination of cardiac reactivity to stress, in particular, has not consistently shown this pattern (see Jennings et al., 1997). Moreover, reduced physiological responsivity was not observed in a prior study when emotion triggers were aging relevant (Kunzmann & Grühn, 2005), matching the results of the current study. In interpreting their findings of no age differences in autonomic reactions to films featuring themes of loss, Kunzmann and Grühn (2005) suggested “that when older people are exposed to stimuli featuring themes that are relevant to their age group, they show greater subjective and physiological reactions than would be expected on the basis of past research” (p. 47). This implies that when material is especially personally salient, response modality differences may be attenuated. However, it will be important in future research to use a more comprehensive measure of self-reported anxiety (rather than SUDS) to enhance reliability of the indicator. Also, only one measure of physiological responding was used in the present study (average HR), and it will be helpful to incorporate other measures tied to cardiac arousal (e.g., reflecting autonomic flexibility) and other physiological indices (e.g., galvanic skin response).

In addition, although the pattern of age differences was reasonably consistent for the different responses to the anxiety provocations (i.e., self-reported peak anxiety, actual average HR, anxious cognitions, and fear of bodily sensations; except for a somewhat discrepant pattern for perceived HR change depending on covariates included), the threat interpretation results differed. In this case, there was no age difference for the nonphysical (external) threat scenarios, but older (compared with younger) adults gave higher threat ratings for the physical scenarios. As noted, it appeared to be variability in the younger adults’ responding that drove this effect. It is not clear why the measure of interpretation bias showed a different pattern than the anxiety provocations responses; it may be related to the different measurement modality (self-report ratings of interpretations), the hypothetical nature of the interpretation scenarios versus actual anxiety provocations, or the heterogeneity of the external threat items (compared to the social threat content of the speech task). Notably, a recent meta-analysis by Murphy and Isacowitz (2008) found only minimal evidence for differential processing of positive and negative stimuli on various information processing tasks, suggesting that many cognitive paradigms may not show age differences as reliably as actual emotional events do, although further empirical work is necessary before drawing such a conclusion.

Limitations and Conclusion

In addition to the weaknesses associated with our affect measures, other limitations of the study should be considered. With respect to the sample, only reasonably healthy younger and older adults participated in the study, limiting the generalizability somewhat, and health status was self-reported. However, given the proposed tie between health concerns and salience of physical threats, using a relatively healthy sample should make this an especially rigorous test of the hypothesized age-related effects. Along these lines, it will be helpful in future research to assess individual differences in concern about physical health to see whether this moderates or mediates the age differences. The age groups also differed in self-reported family income, which may result in a different context for the groups regarding their ability to respond to threats (but see footnote 3, indicating minimal change in results when controlling for income). In addition, the study design was cross-sectional and no middle-aged adults were included, so it is not possible to draw conclusions about changes with age or to rule out possible cohort effects.

There were also some limitations associated with the tasks and stimuli. In particular, although the social and physical anxiety provocations have been widely used in past research, further evidence specific to the age-relevance of the provocations would have been helpful. Also, the foot-tapping task had some weaknesses as a control task because it appeared to make participants somewhat self-conscious (based on anecdotal comments); it may have been a mild social stressor for some participants, which may account for the observed age differences. Interestingly, there is evidence that foot-tapping speed is reduced in older adults (e.g., Kent-Braun & Ng, 1999), so the task may have elicited some performance anxiety and been interpreted differently by the younger versus older adults, suggesting that an alternate control task would be useful for future research. Finally, we recognize the limitations associated with interpreting null results for the physical stressors. However, the consistent pattern across the anxiety provocation responses suggests the results are reliable. Further, using the effect size from Labouvie-Vief, Lumley, Jain, and Heinze’s (2003) analysis of age differences in cardiac reactivity following emotional films (e.g., $f = .27$ for a film inducing anger), our sample size had greater than 75% power to detect age differences.

Despite these limitations, results from the current study provide a unique opportunity to evaluate age differences in anxiety reactions. Findings were quite consistent for the anxiety provocations across multiple modalities of anxiety measurement in suggesting that older adults respond with less anxiety than younger adults when triggers are not physical in nature, but this age difference is diminished when the trigger is physical. These findings suggest considerable variability in responding to triggers on the basis of their aging relevance. As the population ages, it is critical that we learn more about when older adults will experience age-related enhancement of affect optimization versus when they will be at risk for anxiety problems.
References


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