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Detecting Transient Emotional Responses With Improved Self-Report Measures and Instructions

Cindy Harmon-Jones
University of New South Wales

Brock Bastian
University of Melbourne

Eddie Harmon-Jones
University of New South Wales

Psychological research often yields null results on self-reported emotion as measured by the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988), even when using manipulations that might intuitively be expected to be emotionally impactful. Three studies reported here support the hypothesis that changes in self-reported negative emotion may be detected more sensitively when discrete emotions are measured rather than by either PANAS NA or a measure created by combining discrete emotions, and when participants were instructed to report how they felt during an emotion-eliciting event versus how they felt afterward. In Study 1, emotion was manipulated with disgusting photographs, in Study 2, with recall of social exclusion/inclusion, and in Study 3, with reminders of personal mortality. Discussion focuses on implications for detecting emotional changes in psychological research, and the inadvisability of interpreting null results on an insensitive measure as indicating that emotional changes did not occur.

Keywords: discrete emotions, dimensions of emotion, measurement, self-report

Emotional changes may be difficult to detect with self-report measures. Null effects are often found even with manipulations that intuitively might be expected to be emotionally impactful, such as experiencing social exclusion (Twenge, Catanese, & Baumeister, 2003) or contemplating one's own mortality (Greenberg et al., 1990). In these and similar studies, the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988), a self-report instrument that measures general positivity and negativity, is typically used, affect is assessed immediately *after* the manipulation, and participants are asked to report how they feel "right now." Emotions are, by nature, transient phenomena, lasting from a few seconds to several minutes (Ekman, 1994). They change quickly in response to the events of the moment. Thus, even if emotion is measured immediately after a manipulation, it may decay before an individual can complete a self-report emotion scale. Furthermore, a measure of general positivity and negativity may not be sensitive to the discrete emotions produced by a particular manipulation. In the current set of studies, we tested two ideas: (a) the sensitivity of a self-report emotion measure can be improved by measuring appropriate discrete emotions rather than general PA and/or NA, and (b) the sensitivity of a self-report emotion measure can be improved by using an instruction to individuals to report how they felt during an emotional episode rather than an instruction to report how they feel "currently."

Imagine that you are giving a lecture in a packed auditorium. Suddenly a lion bursts through the door, bounds down the stairs, and knocks you to the floor. However, before the lion can do you any harm, the lion tamer appears, grabs it by the mane, and wrestles it out of the room. Immediately afterward, a psychologist hands you a questionnaire and asks you to report the positive and negative emotions you're feeling "right now, that is, at the present moment." After surviving unharmed, you might be experiencing relief, joy and euphoria, and endorse elevated positive emotions. The researcher would then conclude that lion attacks cause an increase in PA, even though the emotions you experienced *during* the attack were fear and terror.

This thought experiment may help to illustrate some of the difficulties in capturing emotions following the offset of an emotion-evoking event. Opponent process theory (Solomon & Corbit, 1974) predicts that organisms have mechanisms to cause homeostasis, so that when affect is evoked by a stimulus (primary affect), it is soon opposed by an opposite affect (opposing affect), which brings the net affect closer to baseline. If the evoking stimulus is removed, the primary affect ends, and the organism experiences the opposing affect. Returning to our original example, opponent process theory would predict that when one is exposed to a stimulus with the potential to cause physical harm (e.g., an attacking lion), fear is evoked. However, when the aversive stimulus is discontinued (the lion tamer drags the lion out of the room and shuts the door), the primary affect (fear, the negative

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Cindy Harmon-Jones, School of Psychology, University of New South Wales; Brock Bastian, School of Psychology, University of Melbourne; Eddie Harmon-Jones, School of Psychology, University of New South Wales.

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Correspondence concerning this article should be addressed to Cindy Harmon-Jones, School of Psychology, University of New South Wales, UNSW Sydney 2052, Australia. E-mail: cindyharmonjones@gmail.com

emotion) immediately ends and is replaced by its opposite (relief, the positive emotion). Opponent affective processes have been shown for both positive and negative elicitors, in humans and nonhuman animals, and are applicable to diverse emotional situations from sky diving to drug addiction (Solomon & Corbit, 1974).

In a psychological study, if a person is asked to write about a painful memory, he or she may experience sadness and anger while writing. Opponent process theory suggests that when the writing task is concluded, a pleasant opponent emotion (pleasure and relief that one is no longer required to write about the unpleasant experience) quickly begins to replace any negative emotions that were experienced during the task. Thus, a self-report measure given *after* an emotion-eliciting manipulation might capture the opponent emotion rather than the original emotion. The measure may, however, capture what appears to be a neutral affect, as the memory of the original NA blends with the opponent PA.

Another issue that may interfere with detecting emotions, beyond their transience, is the use of measures that lump discrete emotions into broad dimensions. In many studies in which self-reported affect is measured, the researchers rely on the PANAS (Watson et al., 1988). According to Google Scholar, as of April 21, 2016, the original validation paper for the PANAS had been cited over 21,000 times, which speaks to the commonness of its use. The use of this measure, which combines diverse affects into two broad categories, "positive activation" and "negative activation", may also obscure important emotion changes (Watson et al., 1988 themselves suggested that their original scales named Positive Affect (PA) and Negative Affect (NA) were more accurately referred to as positive and negative activation).

The PANAS lacks good exemplars for a number of discrete emotions, perhaps because of the factor analysis method by which the PANAS was created. The items on the PANAS NA subscale are afraid, scared, nervous, jittery, irritable, hostile, guilty, ashamed, upset, and distressed. These items do not include any synonyms for the basic emotion of disgust, and the synonyms for the basic emotion of anger (irritable, hostile) are trait-like and do not include more central anger-word exemplars such as anger or rage. The items on the PANAS PA subscale are enthusiastic, interested, determined, excited, inspired, alert, active, strong, proud, and attentive. The PA scale does not include synonyms for the basic emotion of joy, such as happy or joyful.

Why does the PANAS not include synonyms for the basic emotions of disgust, anger, or joy? These items may have been removed due to cross-loading. Watson et al. (1988) set out to create a mood measure with two independent factors, PA and NA. They began with a long list of emotion words, and eliminated those that lacked a large loading on one factor and a near-zero loading on the other factor. However, eliminating items with cross-loadings may have eliminated important sources of variance that are not subsumed in the two factors.

To illustrate the above point, consider the emotions of anger and fear. Anger and fear are both activated negative emotions. However, the situations that evoke these two emotions are very different. Fear relates to appraisals of eminent danger, whereas anger relates to appraisals of other-blame (Smith & Lazarus, 1993). In addition, fear is associated with avoidance motivation, whereas anger is associated with approach motivation (Harmon-Jones, Harmon-Jones, & Price, 2013). Thus, if an individual is angered by being treated unfairly and his or her affect is measured using the PANAS, a null result may follow because the person gives little endorsement to the fear-, anxiety- and guilt-related words that make up the majority of the PANAS NA scale. Indeed, research on situational inductions of anger found, surprisingly, that when people were induced to feel anger, they reported both more anger *and* more PANAS PA (Harmon-Jones, Harmon-Jones, Abramson, & Peterson, 2009). In this research, factor analyses of the PANAS NA revealed that fear-related words loaded on a separate factor from anger-related words. The PANAS was supplemented by additional anger-related words, and the anger words from the PANAS (irritable and hostile) loaded on this factor. The other PANAS NA words loaded on a fear factor, with the exception of upset and distressed, which cross-loaded on both the fear and anger factors. In addition, PA correlated positively with anger, whereas the five items that loaded strongly on the fear factor did not correlate with anger.

Pettersson and Turkheimer (2013) provided an explanation for this seemingly paradoxical effect: that self-reported state-anger in response to an anger manipulation correlates positively with PA, whereas angry mood (irritability) loads onto NA. They found that a large first factor they called "evaluation" confounds self-reported mood, such that individuals respond to the valence of emotion words far more than the semantic content of these words. The influence of this evaluation factor is such that individuals endorse words of opposite meaning (such as calm and excited), as long as the words have the same valence. Thus, self-reported mood does not align well with experimental results.

For the current set of studies, discrete emotions were measured with the Discrete Emotions Questionnaire (DEQ), a new instrument that made up of subscales for eight basic emotions that has been developed and validated in four studies (Harmon-Jones, Bastian, & Harmon-Jones, in press). This instrument includes subscales for five "basic" emotions that have been identified by a number of emotion theorists (Ekman & Cordaro, 2011; Izard, 1991; Panksepp, 1998; Shaver, Schwartz, Kirson, & O'Connor, 1987). These include Happiness, Anger, Disgust, Fear, and Sadness. The DEQ also includes subscales for three other discrete emotions that are of theoretical interest to psychologists who study emotion and motivation: Desire (high-approach affect), Relaxation (low-approach or postgoal affect), and Anxiety (Berridge & Kringelbach, 2008; Gray, 1987; Panksepp, 1998). The subscales of the DEQ have been shown to be sensitive to a number of commonly used emotion elicitors, including emotional photographs, recall of emotional experiences, and guided imagery to emotional scenarios (Harmon-Jones et al., in press).

Although we have taken the perspective that both discrete and dimensional models of emotion have value, we hypothesized that a discrete self-report instrument would be more sensitive to emotional changes than a dimensional instrument. We presumed that the laypersons who would constitute our participants would distinguish between discrete emotional states in response to different elicitors, and give these states distinct names. Furthermore, even researchers who take a dimensional approach may want to measure discrete emotions at the phenomenological level.

In this paper, we present a set of studies testing the idea that steps may be taken to increase the ability of self-report measures to detect changes in emotion. One hypothesis was that measuring appropriate discrete emotions with the DEQ (Harmon-Jones et al., in press) would be more sensitive than measuring general NA with the PANAS (Watson et al., 1988). The other was that instructing participants to report the emotion they were feeling during the emotion-evoking event would be more sensitive than instructing them to report how they were feeling right then (i.e., the "right now" condition, even when the emotion was measured immediately following the emotion-evoking manipulation).

In Study 1, we initially tested these ideas by eliciting emotion through photographs. Participants viewed a set of neutral and a set of disgusting photographs, and reported their emotions after each set, using both the PANAS (Watson et al., 1988) and the DEQ (Harmon-Jones et al., in press). The items on the DEQ Disgust subscale are sickened, grossed out, revulsion, and nausea. Participants completed the measures either with instruction to report how they were feeling "right now," or how they were feeling "while viewing the photographs." We predicted that reported emotions would be more intense when participants endorsed the discrete emotion of DEQ Disgust versus PANAS NA. We also predicted that reported emotions would be more intense when participants were instructed to report how they felt "while viewing the photographs" versus "right now."

Although PANAS PA and the positive emotion subscales of the DEQ (Desire, Relaxation, and Happiness) were also completed, we did not analyze them here because the manipulations in all three studies in this manuscript would theoretically be expected to increase negative emotions. Thus, examining the effects on positive emotions would produce unwieldy and theoretically uninteresting results.

Study 1

Method

Participants. Participants were 101 individuals (54 men) from the United States who participated online through Amazon's Mechanical Turk (MTurk) in exchange for $1.00. Their ages ranged from 19 to 69 years (M = 32.79, SD = 10.64). Their reported ancestries/ethnicities were White 69.3%, African/Black 13.9%, Asian 6.9%, Hispanic/Latino 7.9%, and other 2.0%. Two participants were excluded for failing the attention-check questions, leaving 99 for the analyses.

Procedure. Participants were recruited for a study on reactions to photographs. After giving informed consent, they were informed that they would view a set of photographs, which would be displayed for 4 s each before automatically advancing. The instruction stated, "As you view the set of pictures, imagine that you are physically present with and experiencing the items or events shown in the photos. As vividly as you can, try to place yourself in the scene and imagine that what is shown in the photos is actually real right now."

Participants then viewed five photographs of rocks, which have been used as neutral stimuli in past research (e.g., Gable & Harmon-Jones, 2010; used with permission). Then participants reported their emotions on the PANAS (Watson et al., 1988) and the DEQ (Harmon-Jones et al., in press), counterbalanced for order. In a between-subjects fashion, they were randomly assigned to either "right now" or "while viewing" conditions. For the "right now" condition, the prompts were, "To what extent do you feel this way right now?" (for the PANAS) and "Right now, to what extent are you experiencing these emotions?" (for the DEQ), whereas for the "while viewing" condition, the prompts were, "To what extent did you feel this way while viewing the most recent set of photos?" (for the PANAS) and "While viewing the most recent photos, to what extent did you experience these emotions?" (for the DEQ).

Participants then viewed identical instruction to those presented before the neutral photos, and then viewed five Disgust photos, each displayed for 4 s. These were pictures of dirty toilets, spoiled food, and a dead animal from the International Affective Picture System (IAPS 7359, 7380, 9300, 9320, 9570; Lang, Bradley, & Cuthbert, 2008; used with permission). Participants then reported their emotions on the counterbalanced PANAS (Watson et al., 1988) and DEQ (Harmon-Jones et al., in press) again, with instruction identical to the first rating. Participants who had been in the "right now" condition following the neutral photos were in the same condition following the Disgust photos.

Participants then completed attention-check questions (which asked what type of photographs they had viewed), gave demographic data, and were debriefed.

Data processing. Composite scores were created for PANAS NA (Watson et al., 1988) and DEQ (Harmon-Jones et al., in press) Anger, Disgust, Fear, Anxiety, and Sadness (i.e., all the negative emotion subscales of the DEQ), following both neutral and Disgust photos, by calculating the mean of the individual items on each of these subscales. To provide another measure of general NA, in addition to PANAS NA, we computed the average of all the items in all the NA subscales of the DEQ, and labeled this subscale DEQ NA. For all scales and subscales, Cronbach's αs were >.80, except for DEQ Sadness when it followed neutral photos, α = .75.

For the analysis that directly compares DEQ Disgust to PANAS NA, because the PANAS uses a 5-point scale whereas the DEQ uses a 7-point scale, a 7-point PANAS NA was created using the formula $X_2 = (X_1 - 1)(max_2 - 1)/(max_1 - 1) + 1$, where X_1 is the score on the original scale, X_2 is the corresponding rescaled score, max_1 is the maximum score on the original scale, and max_2 is the maximum score on the new scale (Card, 2011). That is, $X_{PANASNA7} = 6(X_{PANASNA} - 1)/4 + 1$.

Results and Discussion

The data were analyzed using 2 between-subjects time instruction (i.e., "report emotions 'right now' vs. 'while viewing' photos'") × 2 within-subjects picture type (i.e., neutral vs. Disgust) analyses of variance (ANOVAs). We predicted that emotions would be most intense when participants reported their emotions using the discrete emotion of DEQ Disgust versus PANAS NA. We also predicted that reported emotions would be most intense when participants received instruction to report how they felt "while viewing the photographs," versus "right now."

DEQ Disgust as a function of picture type and time instruction. For DEQ Disgust, there was a significant main effect of picture type, $F(1, 97) = 302.03$, $p < .001$, $\eta_p^2 = .76$. There was also a significant Picture Type × Time Instruction interaction, $F(1, 97) = 9.19$, $p = .003$, $\eta_p^2 = .09$. Follow-up tests showed that, for neutral photos, there was no difference in DEQ Disgust, regardless of instruction, $p = .63$. However, for disgust photos, DEQ Disgust was significantly greater when the instruction were to report the emotions experienced "while viewing" (M = 4.78, SD = 0.26) versus "right now" ($M = 3.76$, $SD = 0.25$), $p = .005$, $\eta_p^2 = .08$, 95% CI [0.31, 1.74].

PANAS NA as a function of picture type and time instruction. For PANAS NA, there was a main effect of picture type, such that participants reported more negative emotion following Disgust ($M = 1.92$, $SD = 0.84$) than neutral ($M = 1.15$, $SD = 0.42$) pictures, $F(1, 97) = 91.10$, $p < .001$, $\eta_p^2 = .48$, 95% CI [0.61, 0.93]. There was also a marginal Picture Type × Time Instruction interaction, $F(1, 97) = 3.37$, $p = .07$, $\eta_p^2 = .03$.

Comparison of DEQ Disgust and PANAS NA. To test whether the measure of the discrete emotion factor of Disgust was more sensitive to the manipulations than general NA, difference scores were created for PANAS NA and DEQ Disgust (i.e., after disgust pictures minus after neutral pictures). A repeated-measures ANOVA revealed a significant effect of emotion measure, $F(1, 97) = 187.93$, $p < .001$, $\eta_p^2 = .66$, and a significant Emotion Measure × Time Instruction interaction, $F(1, 97) = 5.04$, $p = .03$, $\eta_p^2 = .05$. Follow-up tests revealed that, in both the "right now" and the "while viewing" conditions, the change in emotions was greater for DEQ Disgust ($M = 2.52$, $SD = 0.25$, and $M = 3.61$, $SD = 0.26$, respectively) than for PANAS NA ($M = 0.91$, $SD = 0.17$, and $M = 1.41$, $SD = 0.17$, respectively; both $ps < .001$, $\eta_p^2 = .41$ and $\eta_p^2 = .57$, 95% CIs [1.24, 2.04] and [1.88, 2.69], respectively). These results support the hypothesis that DEQ Disgust is more sensitive to a disgust manipulation than PANAS NA, and they also support the hypothesis that participants would more likely report more intense disgust when they reported how they felt while exposed to the disgust stimuli rather than when they reported how they felt at that time.

Comparison of DEQ subscales as a function of conditions. We also expected the disgusting photographs to elicit greater disgust than other discrete negative emotions. In addition to the Disgust factor, the DEQ includes four other negative emotion subscales (Anger, Fear, Anxiety, and Sadness). To test this hypothesis, we conducted a 2 (between-subjects instruction: "right now" vs. "while viewing") × 10 (emotion subscales: Anger, Disgust, Fear, Anxiety, Sadness after neutral photos, and Anger, Disgust, Fear, Anxiety, Sadness after disgusting photos) ANOVA. Results showed a significant effect of emotion subscale, $F(9, 873) = 118.80$, $p < .001$, $\eta_p^2 = .55$, and a significant Emotion Subscale × Time Instruction interaction, $F(9, 873) = 4.62$, $p < .001$, $\eta_p^2 = .05$. Pairwise comparisons showed that DEQ Disgust following the disgusting photographs was significantly greater than any other DEQ subscale, in both the "right now" and "while viewing" conditions, all $ps < .001$.

Comparison of DEQ NA composite and DEQ Disgust. To further test whether the measure of the discrete emotion factor Disgust was more sensitive to the manipulations than general NA, difference scores were created for DEQ NA and DEQ Disgust (i.e., after disgusting pictures minus after neutral pictures). A repeated-measures ANOVA revealed a significant effect of emotion subscale, $F(1, 99) = 217.07$, $p < .001$, $\eta_p^2 = .69$, but not a significant Emotion Subscale × Time Instruction interaction, $F(1, 99) = 1.77$, $p = .18$, $\eta_p^2 = .02$. The change in emotions was greater for DEQ Disgust ($M = 3.06$, $SD = 1.87$) than for DEQ NA ($M = 1.30$, $SD = 1.13$, 95% CIs [1.52, 2.00]). These results support the hypothesis that DEQ Disgust would be more sensitive to a disgust manipulation than DEQ NA, lending additional support to the hypothesis that a discrete-emotion measure would be more sensitive than general NA.

Summary of Study 1's results. These results supported the hypothesis that a discrete emotions Disgust measure would be more sensitive to changes in emotion produced by viewing disgusting photographs compared with the most often used measure of general NA—the PANAS NA scale. In addition, the Disgust measure was more sensitive than a different measure of general NA created by combining the NA subscales of the DEQ. Results also supported the hypothesis that, when self-reported emotion was measured immediately following the emotion manipulation, participants reported greater emotion when the instruction were to report how they felt during the emotion induction, compared with when they were told to report the emotion they felt "right now" (See Figure 1 for summary results).

Study 2

We followed-up Study 1 by testing whether measuring discrete emotions and using instruction to report the emotions experienced during the eliciting experience would produce stronger emotion ratings in a commonly used social psychological manipulation. We chose social exclusion, because a large body of published research has failed to find emotional effects of manipulating this construct (e.g., Twenge et al., 2003).

In a representative study, Maner, DeWall, Baumeister, and Schaller (2007, Study 1) randomly assigned participants to exclusion, inclusion, or neutral conditions. Participants wrote about a time when they were either socially rejected or excluded by others, a time when they were accepted by others, or the activities of the previous day. After writing the essay, participants completed the PANAS (Watson et al., 1988) before engaging in a task to measure desire for affiliation. Results revealed no significant differences between conditions in PANAS NA or PA. Do these results indicate that participants who wrote about being socially excluded felt no differently than participants who wrote about being accepted by others? Or, instead, do they suggest problems with how self-reported emotions were measured? We suspect the latter and designed Study 2 to test whether two methodological limitations led to this null effect (and many other null effects in this long, programmatic line of research).

We predicted that, for PANAS NA, within the "right now" condition, we would replicate the null effect found in past research. However, within the "while writing" condition, social exclusion would produce more NA than social inclusion.

We also predicted that the discrete emotions affected by social exclusion would be sadness and anger, as has been found in research on ostracism using Cyberball (Peterson, Gravens, & Harmon-Jones, 2011; Williams, 2007). The DEQ includes an Anger subscale (items: anger, rage, mad, pissed off) and a Sadness subscale (items: sad, grief, lonely, empty). We predicted that DEQ (Harmon-Jones et al., in press) Anger and Sadness would be significantly greater for participants who wrote about exclusion, versus inclusion, particularly in the "while writing" condition. Furthermore, we predicted that the effects of social exclusion on DEQ Anger and Sadness would be greater than those on PANAS NA (Watson et al., 1988).

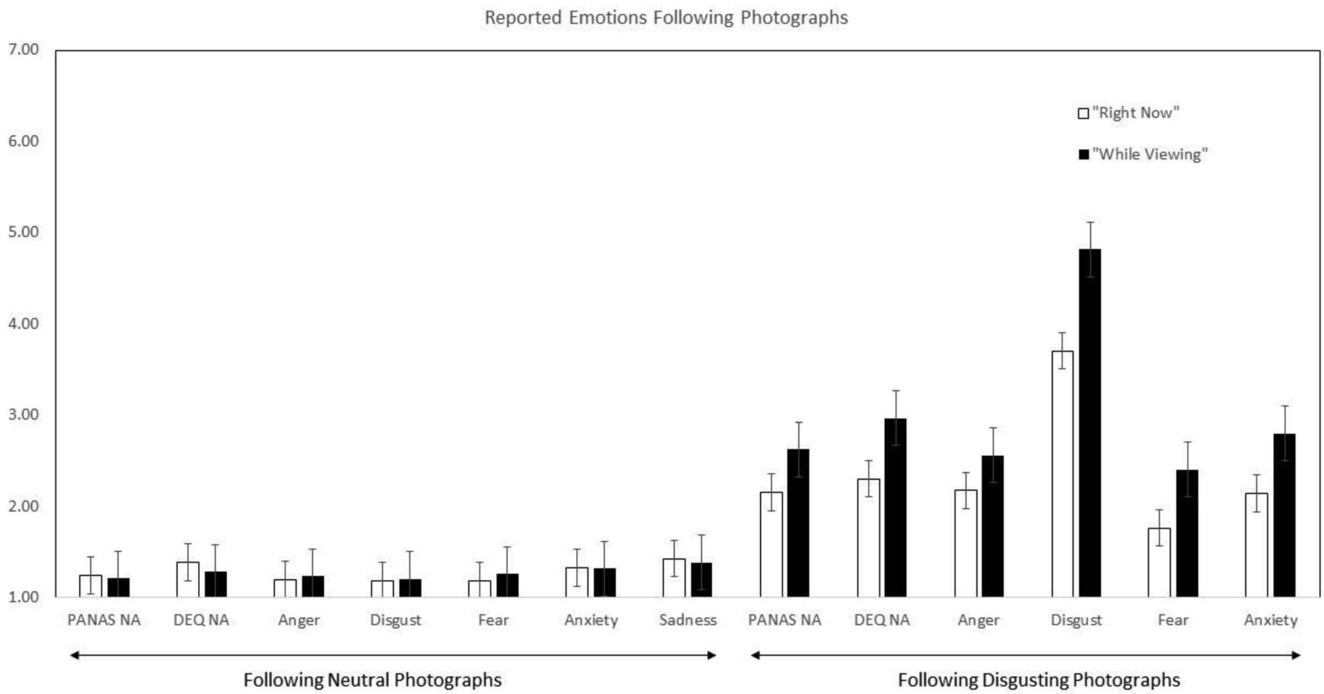

Figure 1. Negative emotions following neutral and disgusting photographs. Participants were assigned to report either the emotions they were experiencing "right now" or "while viewing" the set of photographs. Error bars are ±1 *SE*.

Method

Participants. Participants were 102 individuals (45 men) from the United States who completed the study online through MTurk for a $1.00 payment. Their ages ranged from 18 to 64 years (M = 34.92, SD = 11.02). Their reported ancestries/ethnicities were European/White 73.5%, African/Black 10.8%, Asian 7.8%, Hispanic/Latino 5.9%, Native American 1%, other 1%.

Procedure. Participants were recruited for a study on memories and emotions. After giving consent, they were randomly assigned to write, for 3 min, about either a time when they felt socially excluded or rejected by others, or about a time when they felt socially accepted by others (Maner et al., 2007). A timer was provided, and participants were able to advance to the next screen when 180 s had passed.

Similar to Study 1, participants were then randomly assigned to instruction for completing the two emotion subscales. They either reported how they felt "right now" or how they had felt "while writing." Using these instruction, they completed the PANAS (Watson et al., 1988) and DEQ (Harmon-Jones et al., in press), counterbalanced. Participants then provided demographic information and were debriefed.

Data processing. Composite scores were created for PANAS NA, DEQ NA, and DEQ Anger, Disgust, Fear, Anxiety, and Sadness by calculating the mean of the individual items on each of these subscales (all Cronbach's αs > 0.90 except DEQ Disgust, α = .89). A 7-point PANAS NA was created as in Study 1.

Results and Discussion

The data were analyzed with a 2 (social situation: inclusion vs. exclusion) × 2 (instruction: "right now" vs. "while writing") ANOVA. We predicted that social exclusion would elevate feelings of anger and sadness, and that this effect would be stronger when the emotions "while writing" were reported compared with the emotions "right now."

DEQ Anger as a function of inclusion/exclusion and time instruction. For DEQ Anger (Harmon-Jones et al., in press), there was a significant main effect of social situation, $F(1, 98) = 41.01$, $p <$ .001 $\eta_p^2 = .30$, a significant main effect of instruction, $F(1, 98) = 5.53$, $p = .02$, $\eta_p^2 = .05$, and a significant interaction, $F(1, 98) = 15.66$, $p <$ .001, $\eta_p^2 = .14$. Pairwise comparisons revealed that, in the "right now" condition, Anger was only marginally greater in the exclusion condition ($M = 2.03$, $SD = 0.22$) than in the inclusion condition ($M = 1.45$, $SD =$ 0.25, $p = .08$, $\eta_p^2 = .03$, 95% CI [−1.24, 0.08]). However, in the "while writing" condition, Anger was significantly greater in the exclusion condition ($M = 3.52$, $SD = 0.25$) than in the inclusion condition ($M = 1.07$, $SD = 0.23$, $p < .001$, $\eta_p^2 = .35$, 95% CI [1.79, 3.13]).

DEQ Sadness as a function of inclusion/exclusion and time instruction. For DEQ Sadness (Harmon-Jones et al., in press), there was a significant main effect of social situation, $F(1, 98) = 25.40$, $p < .001$, $\eta_p^2 = .21$, no significant main effect of instruction, $p = .35$, and a significant interaction, $F(1, 98) =$ 9.03, $p < .003$, $\eta_p^2 = .08$. Follow-up comparisons revealed that, in the "right now" condition, Sadness was not significantly different between inclusion and exclusion, $p = .15$. However, in the "while writing" condition, Sadness was significantly greater in the exclusion condition ($M = 3.04$, $SD = 0.25$) than in the inclusion condition ($M = 1.15$, $SD = 0.23$, $p < .001$, $\eta_p^2 = .25$, 95% CI [1.22, 2.55]).

PANAS NA as a function of inclusion/exclusion and time instruction. For PANAS NA (Watson et al., 1988), there was a significant main effect of social situation, $F(1, 98) = 14.20$, $p < .001$, $\eta_p^2 = .13$, no significant main effect of instruction, $p = .88$, and a marginally significant interaction, $F(1, 98) = 3.87$, $p = .05$, $\eta_p^2 = .04$. Although the interaction was just below the conventional level of statistical significance, follow-up tests were conducted to see whether the typically reported null effect on PANAS NA replicated in the "right now" condition. These follow-up comparisons revealed that, as expected, in the "right now" condition, NA was not significantly different in the inclusion and exclusion conditions, $p = .20$, 95% CI [−0.67, 0.14]. However, in the "while writing" condition, NA was significantly greater in the exclusion condition ($M = 1.99$, $SD = 0.15$) than in the inclusion condition ($M = 1.15$, $SD = 0.14$, $p < .001$, $\eta_p^2 = .14$, 95% CI [0.43, 1.25]).

Comparison of DEQ Anger to PANAS NA. To more specifically assess the hypothesis that discrete emotions capture affective responses to social exclusion more sensitively than does a general NA factor, a 2 (between-subjects social situation: inclusion vs. exclusion) × 2 (between-subjects instruction: "right now" vs. "while writing") × 2 (within-subjects emotion subscale: PANAS NA vs. DEQ Anger) ANOVA was conducted. Results showed a significant effect of emotion subscale, $F(1, 98) = 4.20$, $p = .04$, $\eta_p^2 = .04$, a significant Emotion Subscale × Social Situation interaction, $F(1, 98) = 24.71$, $p < .001$, $\eta_p^2 = .20$, a significant Emotion Subscale × Instruction interaction, $F(1, 98) = 18.04$, $p < .001$, $\eta_p^2 = .16$, and a significant 3-way interaction, $F(1, 98) = 13.25$, $p < .001$, $\eta_p^2 = .12$. Pairwise comparisons revealed that, in the exclusion condition, when instructions were to report how participants felt "while writing," Anger ($M = 3.52$, $SD = 0.25$) was greater than PANAS NA ($M = 2.48$, $SD = 0.23$), $p < .001$, $\eta_p^2 = .34$, 95% CI [0.75, 1.33]. In contrast, in the inclusion condition, when instructions were to report how participants felt "right now", PANAS NA ($M = 1.69$, $SD = 0.23$) was marginally greater than Anger ($M = 1.45$, $SD = 0.25$), $p = .10$, $\eta_p^2 = .03$, 95% CI [−0.04, 0.54]. Other pairwise comparisons were nonsignificant, $ps > .23$.

Comparison of DEQ Sadness to PANAS NA. A similar pattern of results was obtained for DEQ Sadness, with a significant 3-way interaction between emotion subscale, social situation, and time instruction, $F(1, 98) = 5.17$, $p = .03$, $\eta_p^2 = .05$. The only significant pairwise comparison was in the social exclusion "while writing" condition, in which Sadness ($M = 3.04$, $SD = 0.25$) was greater than PANAS NA, $p < .001$, $\eta_p^2 = .16$, 95% CI [0.21, 0.45], all other $ps > .50$. These results suggest that DEQ Anger and Sadness were more sensitive to social exclusion than PANAS NA.

Comparison of DEQ subscales as a function of conditions. We expected that social exclusion would cause a greater increase in anger and sadness than in other discrete negative emotions. To test this hypothesis, a 2 (between-subjects social situation: inclusion vs. exclusion) × 2 (between-subjects instruction: "right now" vs. "while writing") × 5 (within-subjects emotion subscale: Anger, Disgust, Fear, Anxiety, Sadness) ANOVA was conducted.

Results showed a significant effect of emotion subscale, $F(4, 392) = 28.03$, $p < .001$, $\eta_p^2 = .22$, a significant Emotion Subscale × Social Situation interaction, $F(4, 392) = 16.59$, $p < .001$, $\eta_p^2 = .15$, a significant Emotion Subscale × Instruction interaction, $F(4, 392) = 6.88$, $p < .001$, $\eta_p^2 = .07$, and a significant 3-way interaction, $F(4, 392) = 8.93$, $p < .001$, $\eta_p^2 = .08$.

This 3-way interaction was likely driven by results that emerged within the condition expected to evoke the greatest anger and sadness. That is, within the exclusion "while writing" condition, Anger had significantly higher scores than any other subscale (all $ps < .005$). Sadness was also significantly greater than all other subscales, all $ps < .05$.[1]

Comparison of DEQ NA to DEQ Anger and Sadness. To further test the hypothesis that discrete-emotion subscales are more sensitive than general NA measures, DEQ NA was compared with DEQ Anger and DEQ Sadness. For Anger, there was a significant 3-way interaction, $F(1, 98) = 20.81$, $p < .001$, $\eta_p^2 = .18$. The only significant pairwise comparison was in the social exclusion "while writing" condition, in which Anger was greater than DEQ NA, $p < .001$, $\eta_p^2 = .16$, 95% CI [0.73, 1.10], all other $ps > .07$. For Sadness, there was a significant Social Situation × Emotion Subscale interaction, $F(1, 98) = 6.96$, $p < .01$, $\eta_p^2 = .06$, with Sadness greater than DEQ NA in the exclusion condition, $p < .001$, $\eta_p^2 = .20$, 95% CI [0.64, 1.49]. These results suggest that DEQ Anger and Sadness are more sensitive to social exclusion than DEQ NA.

Summary of Study 2's results. Taken together, these results support the hypothesis that the emotion subscales would be more sensitive when participants were instructed to report how they felt during the emotion manipulation rather than after. They also support the hypothesis that the emotion subscales would be more sensitive when discrete emotions were measured rather than general positive and NA (See Figure 2 for a summary of all results).

Study 3

For Study 3, we aimed to conceptually replicate the results of Study 2, using a different commonly used social psychological manipulation that has not been found to affect self-reported emotion in past published research. We chose the mortality salience manipulation employed by researchers testing terror management theory. As terror management researchers have stated, ". . . empirical investigations of these terror management processes to date have failed to find involvement of conscious negative affect." (Arndt, Allen, & Greenberg, 2001).

As an illustration of the methods used to assess the effect of mortality salience in past research, Greenberg et al. (1995), in Study 2, assigned participants to write about either what they expected to experience at the time of death (mortality salience), what they experienced while watching TV (control), or what they expected to experience at the time of their next important exam (exam salience). Participants then completed the PANAS (Watson et al., 1988). For PANAS NA, mortality salience did not differ from the control condition, but exam salience produced more NA than both mortality salience and the control condition.

[1] Within the exclusion "right now" condition, Anger was greater than Disgust, but did not differ from Fear, Anxiety or Sadness, whereas Sadness was significantly greater than Disgust and Fear, $ps < .02$, but did not differ from Anger or Anxiety, $ps = 1.00$. In contrast, within the inclusion condition, Anger and Sadness did not differ from any other subscale, $ps > .09$, in both the "right now" and "while writing" conditions.

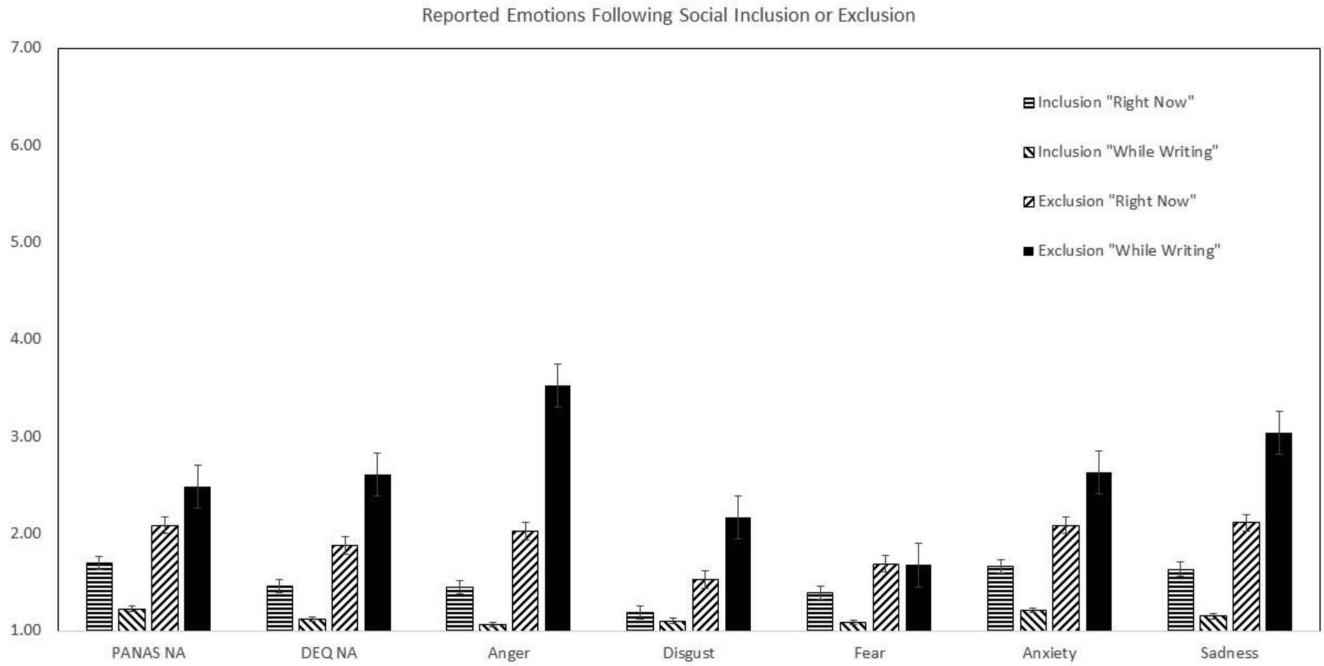

Figure 2. Negative emotions following writing about a memory of social inclusion or social exclusion. Participants were assigned to report either the emotions they were experiencing "right now" or "while writing" about the assigned memory. Error bars are ±1 *SE*.

In contrast to these past null effects of mortality salience on self-reported affect, a recently published paper revealed that reminders of one's mortality elevate ratings of the discrete emotions of fear, anxiety and sadness (Lambert et al., 2014). In Study 3, we expected to replicate this effect of mortality salience on ratings of DEQ (Harmon-Jones et al., in press) Fear (items: fear, scared, panic, terror), Anxiety (items: nervous, worry, anxiety, dread), and Sadness (items: sad, grief, lonely, empty). We also expected to replicate the past findings of null results for PANAS NA (Watson et al., 1988) after mortality salience when participants reported their emotion "right now," but find an increase in NA when participants reported how they felt "while writing" about their deaths.

Method

Participants. Participants were 101 individuals (45 men) from the United States who completed the study online through MTurk. Their ages ranged from 19 to 79 years ($M = 35.71$, $SD = 11.65$) for a $1.00 payment. Their reported ancestries/ethnicities were European/White 72.3%, African/Black 11.9%, Asian 5.9%, Hispanic/Latino 5.9%, Native American 1.0%, other 3.0%.

Procedure. The procedure was identical to Study 2, except that, instead of writing about social inclusion versus exclusion, participants were randomly assigned to write either about their own mortality or a neutral control topic. In the mortality salience condition, participants wrote, for 3 min, responses to these two questions (Greenberg et al., 1995): "Please briefly describe the emotions that the thought of your own death arouses in you," and "Jot down, as specifically as you can, what you think will happen to you as you physically die and once you are physically dead." In the control condition, participants responded to prompts that were similar, except that dying was replaced by watching TV (as in Greenberg et al., 1995).

Data processing. Composite scores were created for PANAS NA, and DEQ Anger, Disgust, Fear, Anxiety and Sadness, by calculating the mean of the individual items on each of these subscales (all Cronbach's αs > 0.80, except DEQ Disgust, α = .76). A 7-point PANAS NA subscale was also created as described in Study 1. DEQ NA was created as described in Study 1 (Cronbach's α = .87).

Results and Discussion

The data were analyzed with a 2 (salience: mortality vs. TV) × 2 (time instruction: "right now" vs. "while writing") ANOVA. We predicted that mortality salience would elevate anxiety, sadness, and fear, compared with TV salience. We also predicted that NA would be significantly greater when instruction asked participants to report how they felt "while writing" compared with "right now."

DEQ Anxiety as a function of mortality salience and time instruction. For DEQ Anxiety, there was a significant main effect of mortality salience $F(1, 96) = 19.88$, $p < .001$, $\eta_p^2 = .17$, 95% CI [0.61, 1.59]. There was no significant main effect of instruction ($p = .28$) and no significant interaction, $p = .79$. Participants who wrote about their own death reported more Anxiety ($M = 2.48$, $SD = 0.18$) than those who wrote about watching TV ($M = 1.38$, $SD = .16$).

DEQ Sadness as a function of mortality salience and time instruction. For DEQ Sadness, there was also a significant main effect of mortality salience, $F(1, 96) = 21.18$, $p < .001$,

η_p^2 = .18, 95% CI [0.51, 1.28]. There was no main effect of instruction (p = .33) and no interaction (p = .79). Participants who wrote about their own death reported more Sadness (M = 2.24, SD = 0.14) than those who wrote about watching TV (M = 1.35, SD = .14).

DEQ Fear as a function of mortality salience and time instruction. For DEQ Fear (Harmon-Jones et al., in press), the results were similar. A significant main effect of mortality salience emerged, $F(1, 96) = 14.74$, $p = .001$, $\eta_p^2 = .13$, 95% CI [0.42, 1.33], with no main effect of instruction (p = .58) and no interaction (p = .30). Participants who wrote about their own death reported more Fear (M = 2.07, SD = 0.17) than those who wrote about watching TV (M = 1.19, SD = .15). These main-effect results with the discrete emotions of anxiety, sadness, and fear replicate those of Lambert et al. (2014).

PANAS NA as a function of mortality salience and time instruction. For PANAS NA (Watson et al., 1988), there was a significant main effect of mortality salience, $F(1, 96) = 7.14$, p = .009, η_p^2 = .07, 95% CI [0.08, 0.52]. There was no main effect of instruction (p = .53) and no interaction (p = .66). Participants who wrote about their own death reported more NA (M = 1.54, SD = 0.08) than those who wrote about watching TV (M = 1.21, SD = .08). Even though the interaction was not significant, because this result contradicted past null results of mortality salience on PANAS NA, we followed up with pairwise comparisons. Replicating past research, within the "right now" condition, the difference in NA between mortality and TV salience was not significant, p = .13. However, as predicted, within the "while writing" condition, persons who wrote about their mortality reported more NA (M = 1.53, SD = .11) than those who wrote about watching TV (M = 1.18, SD = .11), p = .03, η_p^2 = .05, 95% CI [0.05, 0.65].

Comparison of DEQ Fear to PANAS NA. To more specifically assess the hypothesis that discrete emotions capture affective responses to social exclusion more sensitively than does general NA, a 2 (between-subjects mortality salience: TV vs. mortality) × 2 (between-subjects instruction: "right now" vs. "while writing") × 2 (within-subjects emotion subscale: PANAS NA vs. DEQ Fear) ANOVA was conducted. The only statistically significant result was a significant Emotion Subscale × Mortality Salience interaction, $F(1, 96) = 11.49$, $p = .001$, $\eta_p^2 = .11$. Pairwise comparisons revealed that, in the mortality salience condition, Fear (M = 2.07, SD = 0.17) was greater than PANAS NA (M = 1.81, SD = 0.12), p = .006, η_p^2 = .08, 95% CI [0.08, 0.45]. In contrast, in the TV salience condition, PANAS NA (M = 1.36, SD = 0.11) was marginally greater than Fear (M = 1.19, SD = 0.15), p = .05, ${\eta_p}^2$ = .04, 95% CI [−0.00, 0.34].

Comparison of DEQ Anxiety to PANAS NA. For DEQ Anxiety versus PANAS NA, there was a main effect of emotion subscale, $F(1, 96) = 21.12$, $p < .001$, $\eta_p^2 = .18$, and an Emotion Subscale × Mortality Salience interaction, $F(1, 96) = 18.77$, $p <$ .001, η_p^2 = .16. No other effects were significant, ps > .27. Pairwise comparisons revealed that, in the mortality salience condition, Anxiety (M = 2.48, SD = 0.18) was greater than PANAS NA (M = 1.81, SD = 0.12), $p < .001$, η_p^2 = .28, 95% CI [0.46, 0.90]. In the TV salience condition, Anxiety and PANAS NA did not differ, p = .85.

Comparison of DEQ Sadness to PANAS NA. For DEQ Sadness versus PANAS NA, there was a main effect of emotion subscale, $F(1, 96) = 8.39$, $p = .005$, $\eta_p^2 = .08$, and an Emotion Subscale × Mortality Salience interaction, $F(1, 96) = 9.52$, p = .003, η_p^2 = .09. No other effects were significant, ps > .55. Pairwise comparisons revealed that in the mortality salience condition, Sadness (M = 2.24, SD = 0.14) was greater than PANAS NA (M = 1.81, SD = 0.12), $p < .001$, 95% CI [0.22, 0.65]. In the TV salience condition, Sadness and PANAS NA did not differ, p = .89. Taken together, these results support the hypothesis that discrete-emotion subscales capture the emotional effects of mortality salience better than does general NA.

Comparison of DEQ subscales as a function of conditions. We expected that mortality salience would cause greater increases in DEQ Fear, Anxiety, and Sadness than in other discrete negative emotions. To test this hypothesis, a 2 (between-subjects salience: mortality vs. TV) × 2 (between-subjects instruction: "right now" vs. "while writing") × 5 (within-subjects emotion subscale: DEQ Anger, Disgust, Fear, Anxiety, and Sadness) ANOVA was conducted. Results showed a significant effect of emotion subscale, $F(4, 384) = 18.17$, $p < .001$, $\eta_p^2 = .16$, and a significant Emotion Subscale × Mortality Salience interaction, $F(4, 384) = 12.61$, $p <$ .001, η_p^2 = .12. Pairwise comparisons revealed that, within the mortality salience condition, Fear was greater than Anger and Disgust (ps < .002), less than Anxiety (p < .001), and equal to Sadness (p = 1.00). Anxiety was significantly greater than Anger, Disgust, and Fear (all ps < .001), and equal to Sadness (p = .60). Sadness was greater than Anger and Disgust (ps < .001) and equal to Fear and Anxiety (ps > .06). In contrast, within the TV salience condition, neither Fear, Anxiety, nor Sadness differed from any other emotion subscale (all ps > .37). These results suggest that the discrete emotions of fear, anxiety and sadness were more influenced by mortality salience than were other negative emotions.

Comparison of DEQ NA to DEQ Fear, Anxiety, and Sadness. To further test the hypothesis that discrete-emotion subscales are more sensitive than general NA subscales, DEQ NA was compared with DEQ Fear, Anxiety and Sadness. For Fear, there was a significant Emotion Subscale × Salience interaction, $F(1, 96) = 5.42$, $p < .02$, $\eta_p^2 = .05$. Pairwise comparisons showed that Fear was greater than DEQ NA in the mortality salience condition, p = .05, η_p^2 = .04. For Anxiety, there was also an Emotion Subscale × Salience interaction, $F(1, 96) = 13.68$, $p <$ .001, η_p^2 = .13, with Anxiety greater than DEQ NA in the mortality salience condition, $p < .001$, η_p^2 = .27. For Sadness, again, there was a significant also interaction, $F(1, 96) = 6.89$, $p < .01$, η_p^2 = .07, with Sadness greater than DEQ NA in the mortality salience condition, $p < .001$, η_p^2 = .16. These results suggest that DEQ Fear, Anxiety, and Sadness were more sensitive to mortality salience than DEQ NA.

Summary of Study 3's results. The pattern of these results supported predictions. When participants were asked to report the specific discrete emotions aroused by mortality salience (i.e., anxiety, sadness, and fear), mortality salience had significant effects on emotion regardless of whether participants were asked to report how they felt "right now" or while they were writing. However, when general negative mood was assessed, within the "right now" condition, the results replicated past research that showed no significant effect on PANAS NA. Within the "while writing" condition, however, mortality salience caused an increase in general NA. Moreover, mortality salience had stronger effects on measures of fear, sadness and anxiety than on a measure of NA created by combining scores on discrete NAs, further suggesting that discrete-emotion measures are more sensitive than measures of general NA (See Figure 3 for summary results).

General Discussion

The results of the three studies reported here support the hypothesis that researchers might detect emotions more accurately using participant self-reports by focusing on the discrete emotions expected to be affected by a particular manipulation, rather than measuring general PA or NA. The results also support the hypothesis that emotions may be detected more accurately via self-report through careful attention to the way the instructions are worded.

The current studies revealed stronger effects on self-reported emotions when participants were asked to report what they felt during an emotional experience, compared with what they were feeling "right now" (that is, just following the emotional experience). Some might suggest that individuals can more accurately report their current state, whereas recall of even a very recent past state may be contaminated with conjecture, stereotypes, and other sources of bias. This concern may be valid, but must also be balanced with the reality that emotional states change from moment to moment. Furthermore, the instructions for measuring state affect with the PANAS (Watson et al., 1988) specify "right now," and it is likely that researchers simply use these instructions without considering the relative importance of the duration of emotional states versus possible issues with recall. Future research could include examinations of the decay over time of emotion and to what extent, if any, recalled emotions differ from currently experienced emotions.

Too often, psychological researchers have relied on measures of general positive and negative mood, such as the PANAS (Watson et al., 1988). In the current set of studies, impactful psychological manipulations, including inducing memory of instances of social exclusion and contemplating one's own mortality, had less effect on self-reports on the PANAS than on self-reports of the specific discrete emotions, such as what the DEQ (Harmon-Jones et al., in press) measures, and that theory and past research would predict to be affected. Furthermore, these manipulations had less effect on DEQ NA, an alternative method of measuring general NA, than on DEQ subscales, which measured specific discrete emotions. Social exclusion increased reported anger and sadness, whereas mortality salience increased fear, anxiety, and sadness. The current research is consistent with past research that revealed that social rejection increases the discrete emotions of sadness, anger, hurt, anxiety, guilt, and shame (Leary, Koch, & Hechenbleikner, 2001) and that mortality salience increases fear, sadness, and anxiety (Lambert et al., 2014).

However, even in the condition most similar to past research, the "right now" instruction condition, mortality salience and social rejection caused marginally significant or significant effects on the PANAS NA scale, rather than the null effects that have been found in past research. Perhaps earlier research has been underpowered to detect emotional effects using the PANAS.

The results also suggest caution regarding researchers' claims that emotion has been "ruled out" as a part of a psychological process, using as evidence a null finding on an insensitive self-report affect measure. Studies 2 and 3 revealed significant differences in self-reported emotion due to two common social psychological manipulations that have previously been claimed not to influence self-reported affect: social exclusion (e.g., Twenge et al., 2003) and mortality salience (Arndt et al., 2001). These results serve as a reminder that a null effect on a particular measure is not

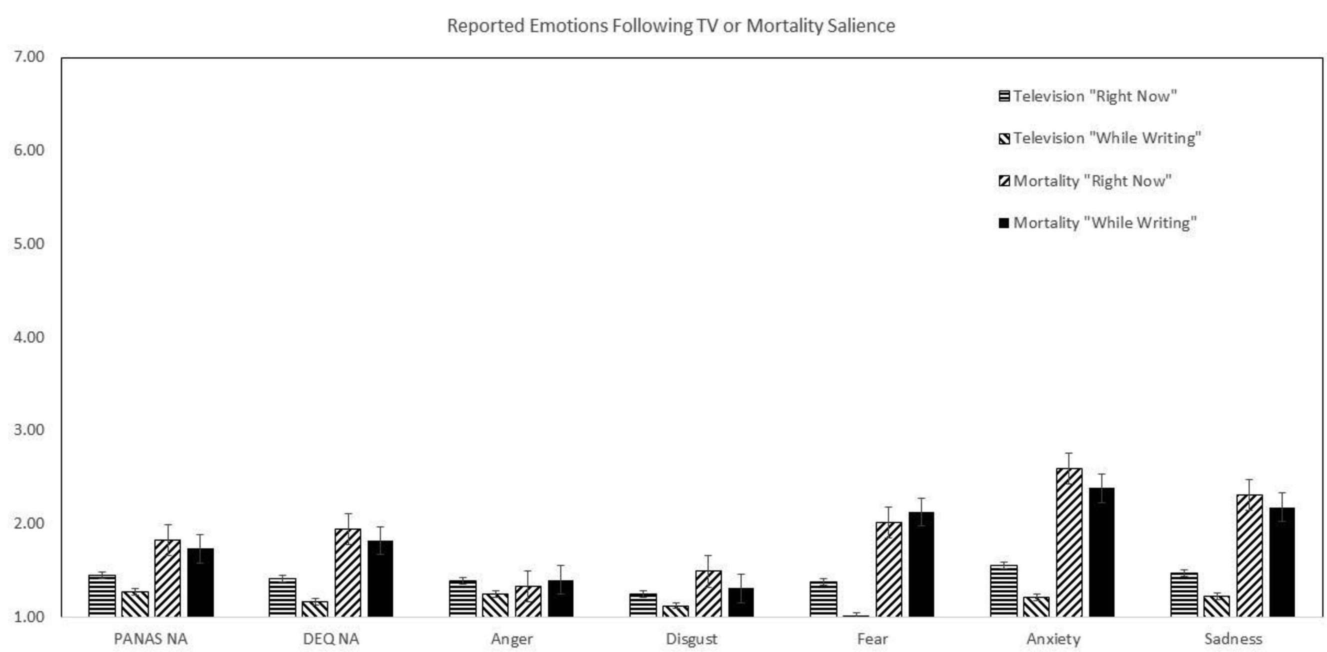

Figure 3. Negative emotions following writing about anticipating watching TV or one's own mortality. Participants were assigned to report either the emotions they experienced "right now" or "while writing" about the assigned topic. Error bars are ±1 *SE*.

good evidence that the construct under examination is absent. The problem may lie in the measure, not the absence of a given phenomenon. The measure may simply be too insensitive or presented with the wrong instructions to capture the phenomenon. Although past researchers have failed to find emotional effects of social exclusion or mortality salience, these effects easily emerged with appropriate emotion measures and instruction (see also Lambert et al., 2014).

The complex, multifaceted character of emotions also emphasizes the futility of "ruling out" emotion by administering a self-report measure. Izard (2010), through a survey of 35 distinguished emotions scientists, identified a number of components of emotion, including physiological responses, behavioral or expressive components (e.g., facial expressions), cognitive changes, appraisal tendencies, a motivational component (e.g., action impulse), and a subjective feeling component. Only one of these aspects, subjective feelings, is easily accessible to self-reporting participants. The other components of emotion are poorly accessible for self-report, but may be detected by other measures, for example psychophysiological recordings (physiological responses), facial action coding (expressive component), or reaction-time measures (cognitive changes). The components of emotion function together, but the magnitude of one component does not always directly relate to the magnitude of another. For example, physiological measures of emotional arousal correlate only weakly with the self-reported intensity of emotion (Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005).

Psychology researchers, unfortunately, often reduce emotional responses to subjective experience, the one component that is most accessible for self-report, perhaps because measuring self-reports is simple and inexpensive. However, the other components of emotional response may not involve conscious awareness, and so may not be reflected in either changes in subjective experience or the self-report data based on it.

To accurately assess emotions, the use of multiple measures is ideal, including psychophysiological (e.g., electromyography, electroencephalography) and behavioral (facial expression action coding), in addition to self-report. However, the convenience of self-report "can't be beat," and there are many situations, such as with online studies, in which self-report may be the only feasible option for measuring emotion. In this manuscript, we have offered just two suggestions for improving the accuracy of self-report measures: (a) measure the discrete emotion(s) that the manipulation would be expected to produce, and (b) ask participants to report the emotions they experienced at the time of the manipulation. These are surely not the only means of increasing the accuracy of self-report and other measures of emotion, and we look forward to other improvements developed by other researchers.

We used the DEQ (Harmon-Jones et al., in press) in the current studies because it includes subscales for the emotions that we hypothesized would be affected by the current manipulations. However, this may not always be the case. For example, a manipulation that induces participants to violate their values would be expected to evoke guilt (e.g., Amodio, Devine, & Harmon-Jones, 2007), an emotion for which the DEQ does not include a subscale. Rather than slavishly cling to a particular measure, researchers would do well to come up with items that best capture the emotion that is actually likely to be produced, based on emotion theory and past research. Similarly, we do not consider it important to administer the entire DEQ, if not all of the discrete-emotion subscales are of interest, especially because the longer it takes to complete an emotion measure, the more the emotion is likely to decay.

Research on emotion has been hampered by the fact that all measures, whether self-report, psychophysiological, or implicit, are merely proxies for emotions themselves. On self-report measures, participants vary on their awareness and willingness to disclose their emotional states. Thus, attempting to "rule out" emotion as being involved in a psychological process, by giving participants an insensitive self-report measure and finding no difference between conditions, is a fool's errand, as null results cannot be interpreted as evidence that emotion did not occur. Instead, researchers would do well to develop better and more sensitive means to detect emotions. The three studies in this manuscript are one attempt at doing so.

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