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ORIGINAL ARTICLE

Forecasting the Future, Remembering the Past: Misrepresentations of Daily Emotional Experience in Generalized Anxiety Disorder and Major Depressive Disorder

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Abstract
Studies have shown that individuals with emotional disorders expect and recall more negative and less positive information than healthy individuals. However, no study of emotional disorders has investigated affective forecasting *and* affective memory within the same individuals. Using ecological momentary assessment, we compared daily affective experiences to forecasts and memories in 145 adults with generalized anxiety disorder (GAD), major depressive disorder (MDD), comorbid GAD/MDD, or no psychopathology. All three clinical groups forecast, experienced, and remembered more negative affect than controls; positive affect showed the opposite pattern, which was especially robust for the depressed groups. All clinical groups demonstrated stronger negative forecasting and memory biases as well as a weaker positive forecasting bias than controls. However, when the independent contributions of symptom dimensions were analyzed, MDD severity was associated with a negative forecasting bias while GAD severity was associated with a negative memory bias. Cognitive representations of emotional experiences in GAD and MDD are biased in ways that may maintain the disorders and represent promising intervention targets.

Keywords Generalized anxiety disorder · Major depressive disorder · Affective forecasting · Affective memory · Ecological momentary assessment

Theorists have long recognized that a comprehensive understanding of emotion must extend beyond momentary affective experiences to include mental representations of those experiences. Individuals' expectations about (DeWall et al. 2016; Wilson and Gilbert 2005; Wilson et al. 2000) and memories of (Kardum and Tićac Daskijević 2001; Thomas and Diener 1990; Wirtz et al. 2003) emotional experiences are thought to influence attitudes and behaviors in potentially profound ways. These include, for example, diminished pursuit or active avoidance of situations in which aversive emotions are expected (Derakshan et al. 2007; Mogg et al. 2004; Singer et al. 2012) and decreased motivation to participate in activities where few pleasurable emotions are anticipated (Brinkmann et al. 2014; Henriques and Davidson 2000; Pizzagalli et al. 2008). Importantly, mental representations of emotion may influence behavior regardless of their accuracy (Levine and Safer 2002; MacLeod 2017). Indeed, one recent meta-analysis suggested that affective forecasts may have a more powerful effect on behavior than experienced affect (DeWall et al. 2016). Adverse predictions or recollections of emotional experience may result in withdrawal, decreased engagement in activities, or reduced goal-directed behaviors, which in turn may propagate emotional distress (Beck 1995; Bennett-Levy et al. 2004). If excessive and pervasive, these processes could contribute to the development and maintenance of emotional disorders, including anxiety or depressive disorders.

Surprisingly, although emotional disturbance and dysregulation are prominent features of anxiety and depressive disorders (Fairholme et al. 2013; Gross and Jazaieri 2014;

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Hofmann et al. 2012), little is known about how closely mental representations reflect actual emotional experiences in these disorders. This leaves open the question of whether the heightened negative affect (Brown et al. 1998; Campbell-Sills et al. 2006) and diminished positive affect (Bylsma et al. 2008; Rottenberg et al. 2002) typically reported by diagnosed individuals are accurate representations of the emotions they experience. Whereas accurate representations are reality-based and may adjust automatically as symptoms remit, inaccurate representations could be indicative of a separate, pathological process that contributes to symptoms and may require intervention. This is especially the case if these misrepresentations deviate markedly from the representations that are found in emotionally healthy individuals.

Determining the accuracy of affective forecasts and memories requires that expectations and recollections of affect be compared to experienced affect. Prior comparisons of this sort among emotionally healthy individuals have revealed clear biases that are evident regardless of whether the representations focus on the future or the past. Healthy individuals tend to overestimate the intensity and duration of emotional responses to a future discrete event while ignoring the potential for adjacent events to modulate responses (Wilson and Gilbert 2005). They are also poor at accurately remembering the emotions associated with particular events, often overestimating the intensity of both the negative and positive affect they have experienced (Kardum and Tićac Daskijević 2001; Thomas and Diener 1990; Wirtz et al. 2003).

There is initial evidence that these biases may be magnified or altered in emotional disorders. The evidence comes mainly from studies of affective forecasting in dysphoric or depressed samples. For example, among college students, higher levels of dysphoria (subclinical depressive symptoms) have been associated with lower overall accuracy of affective forecasts stemming particularly from an overprediction of negative affect (Hoerger et al. 2012). An advance in recent studies has been the use of ecological momentary assessment (EMA, also known as the experience sampling method) to measure emotional experiences in real time as they occur in daily life (e.g., Myin-Germeys et al. 2009; Nezlek et al. 2008; Wenze and Miller 2010). By sampling affect frequently and repeatedly, EMA provides a robust measure of experienced affect to which affective forecasts and memories can be compared; discrepancies between these momentary affect ratings and ratings of the same period made earlier or later in time allow inaccuracies to be revealed. Two recent studies used EMA to investigate inaccuracies in the affective forecasts of individuals with current (Wu et al. 2017) or remitted (Thompson et al. 2017) major depressive disorder (MDD). Both studies revealed experiences of heightened displeasure/negative affect and blunted pleasure/positive affect in the clinical groups relative to controls. However, the accuracy of affective forecasts was similar for the clinical and control groups, arguing against the possibility that forecasts are altered in depression.

These studies represent a notable advance over prior investigations which compared predicted affect in one group to experienced affect in another group, or which assessed predictions about a specific future event without later measuring experiences during that event (Wilson and Gilbert 2005; Wilson et al. 2000). Nevertheless, their focus on depression raises the question of whether the observed pattern is unique to depression or extends to other common forms of emotional disturbance such as anxiety. Furthermore, most studies asked individuals to rate affect in relation to a discrete event, either predetermined (e.g., Valentine's Day; Hoerger et al. 2012) or selected (from a pre-determined list, e.g., occupational, social, hobbies/interests, nothing, etc.; Wu et al. 2017), rather than make general predictions about the likelihood of experiencing negative or positive emotional states (Thompson et al. 2017). Key clinical features of depression (e.g., hopelessness) and anxiety (e.g., worry), however, suggest that generalized, pessimistic predictions occur spontaneously in emotional disorders and warrant further investigation.

Finally, past studies' focus on affective forecasts leaves unclear whether the pattern is exclusively future-oriented or extends to affective memories as well. Indirect support for the latter possibility comes from laboratory findings of mood-congruent memory biases in individuals with depression, who demonstrate better recall of negative than positive stimuli on experimental learning tasks, in contrast to healthy controls who show better recall of positive than negative stimuli (MacLeod et al. 1997; Matt et al. 1992). Studying affective memory is a natural extension of this work. Surprisingly, even in research with healthy individuals, affective forecasting and affective memory are usually investigated in separate studies, despite the similar patterns of inaccuracies observed across studies. The similarities are understandable, as memories form the basis for predictions about future experiences, and as the same brain regions have been implicated in future- and past-oriented thinking (Addis et al. 2007; Botzung et al. 2008). These parallels suggest, however, that a more complete understanding of affective representations may come from studying affective forecasting and memory within the same individuals, alongside measures of actual affective experiences.

We are aware of only one previous study that used EMA to investigate the accuracy of affective forecasting and affective memory within the same individuals. Wenze et al. (2012) followed a sample of 120 unselected undergraduate students for one week. The students were signaled four times per day to rate their current negative and positive affect; these ratings subsequently were aggregated and compared to affective forecasts and memories for the week. In general, individuals tended to overestimate the amount of negative

and positive affect they experienced. This overestimation was heightened for negative affect in individuals with greater self-reported symptoms of anxiety and depression and blunted for positive affect in individuals with greater symptoms of depression. The effects were stronger and more reliable for forecasts than memories, and for depression than anxiety. Importantly, this study demonstrated within a single sample that both forecasts and memories of emotions were biased and that the biases followed a similar pattern. Furthermore, both biases grew more pronounced as depression and anxiety symptoms increased.

At the same time, the Wenze et al. (2012) study had significant limitations which constrain its conclusions. First, the undergraduate sample provided limited power to detect associations with anxiety and depression measures, which have a restricted range and pronounced positive skew in unselected samples. Consequently, the many nonsignificant findings for anxiety symptoms may have been due to range restriction in this relatively high-functioning sample. A sample comprising individuals with clinically significant emotional disorders as well as those without psychopathology would offer broad coverage of the score distributions of symptom and emotion measures, including extreme scores not adequately represented in unselected samples, providing a more sensitive test for biases. A clinical sample is also needed to draw conclusions about clinically meaningful emotional disturbance, and to elicit implications for treatment.

Second, anxiety and depression were measured using self-report questionnaires that assess only a subset of relevant symptoms. Anxiety can take many forms. Wenze et al. (2012) used an anxiety scale—the Anxious Arousal scale of the Mood and Anxiety Symptom Questionnaire (Watson and Clark 1991)—that focuses on physiological sensations of fear. These sensations are the symptoms most distinguishable from depression, but do not capture the constellation of somatic, cognitive, and affective experiences associated with the construct of anxiety (Craske et al. 2009). This stacks the deck toward obtaining results different from those for depression. It also begs the question of whether disorders that are characterized more by anxiety than fear, such as generalized anxiety disorder (GAD), differ from depression in affective forecasts or memories. GAD overlaps substantially with MDD in clinical features, including affective disturbance and perseverative thinking (Ehring and Watkins 2008; Goldberg et al. 2010). However, theorists posit that thoughts in MDD tend to dwell on past negative experiences (Beck et al. 1979; Nolen-Hoeksema et al. 2008) whereas thoughts in GAD tend to take the form of catastrophic worries about possible future negative experiences (Borkovec and Inz 1990; Clark 1999; Mathews et al. 1990). Given the theorized differences in temporal focus, GAD and MDD might differ in affective forecasts and memories. Importantly, GAD frequently co-occurs with MDD (Kessler et al. 2008; Ruscio and Khazanov 2017), and comorbid cases exhibit poorer functioning and more severe, chronic, and impairing emotional disturbance than "pure" cases (Emmanuel et al. 1998; Mineka et al. 1998; Nolen-Hoeksema 2000; Ruscio et al. 2015). By using measures of anxiety and depression that exclude shared features of these constructs, and by examining anxiety and depression as separate predictors, past research could not test whether comorbid cases differ from pure (non-comorbid) cases in experiences or representations of affect.

To address these gaps, the present study used EMA to investigate forecasts and memories of emotional experience in GAD and MDD, comparing pure and comorbid cases to one another and to healthy controls with no history of psychopathology. Based on prior research, we hypothesized that all clinical groups would forecast, experience, and remember more negative affect than controls, with the added possibility that negative affect would be higher in the comorbid than the pure clinical groups given the greater symptom severity associated with comorbidity (Mineka et al. 1998). Based on theories emphasizing the specificity of positive affect deficits to MDD vis-à-vis GAD (Watson 2009), we also hypothesized that individuals with MDD—either pure or comorbid—would forecast, experience, and remember less positive affect than individuals without MDD, including those with pure GAD as well as controls. Given that thoughts in GAD (future-focused worry) and MDD (past-focused rumination) are theorized to differ in temporal focus (Nolen-Hoeksema et al. 2008), we hypothesized that the two disorders would demonstrate differences in affective forecasting and memory. Finally, as past studies have yielded inconsistent findings regarding the accuracy of affective representations in depression and anxiety (Thompson et al. 2017; Wenze et al. 2012; Wu et al. 2017), we posed competing hypotheses for group differences in accuracy, with clinical participants expected to exhibit either (a) similar forecasting and memory biases as controls or (b) altered biases that overestimate negative affect (in all clinical groups) and underestimate positive affect (in the two depressed groups) relative to the biases exhibited by controls.

Method

Participants

Participants were adults recruited from the greater Philadelphia area via flyers and advertisements in online forums. Advertisements for the clinical groups described symptoms of anxiety ("often worry about things and find it hard to stop") and depression ("feel depressed or down"; "lost interest or pleasure in your usual activities") without specifying eligibility criteria. Advertisements for the control group

sought adults with "no history of mental health problems, alcohol or drug problems, or mental health treatment" to participate in an "Emotion Research Study". Individuals first completed screening questionnaires online or by phone; those whose responses were consistent with study eligibility criteria were brought to the laboratory and administered the Anxiety Disorders Interview Schedule for DSM-IV–Lifetime Version (ADIS-IV; DiNardo et al. 1994). Inclusion criteria for the clinical groups were current, principal (most severe) *DSM-IV* diagnoses of GAD or MDD. Exclusion criteria were current suicidal intent, psychosis, or substance use disorder. Individuals were eligible for the control group if they had no current or past psychopathology. Given these stringent eligibility criteria, only a minority of those screened were enrolled in the study.

The final sample size was determined through joint consideration of statistical power and feasibility of recruitment for the four planned groups. Of 151 individuals who began the study, three withdrew due to time constraints. Data were lost from two individuals due to device malfunction, and from one individual who failed to return the device. The final sample consisted of a GAD group ($n=36$) diagnosed with current GAD but not MDD, an MDD group ($n=38$) diagnosed with current MDD but not GAD, a comorbid group ($n=38$) diagnosed with both GAD and MDD, and a control group ($n=33$) with no psychopathology. The groups did not differ in race-ethnicity, level of education, or marital status (all $\chi^2(3)<9.80$, all $p>0.133$), but did differ in age ($F(3,144)=3.18$, $p=0.026$) and sex ($\chi^2(3)=8.24$, $p=0.041$; see Table 1). Consequently, all analyses adjusted for participant age and sex.

Procedure

Participants attended three face-to-face sessions in the laboratory. During the first session, all participants provided written informed consent. Diagnostic status was assessed by a Master's- or Bachelor's-level clinical interviewer trained to a high level of reliability with the supervising licensed psychologist. Each participant was discussed by the assessment team until consensus was reached on diagnosis and clinical severity ratings. Interrater agreement was high (K = 1.00 for GAD; K = 0.88 for MDD) between these consensus diagnoses and diagnoses rendered by a blind, independent rater who listened to a randomly selected subset of recorded interviews ($n=32$).

Eligible participants returned to the laboratory and met individually with a research assistant for an orientation session. After being introduced to the EMA procedures and electronic journal (Palm Pilot Z22) and completing two full practice assessments, participants made their affective forecast ratings. During the next 7 days, participants were signaled by the electronic journal eight times per day during a 12-h period that spanned their waking hours (typically 10 am to 10 pm). A time-stratified random sampling design was employed whereby signals occurred randomly within

Table 1 Group demographics and clinical characteristics

Measure	Control ($n=33$)	GAD ($n=36$)	MDD ($n=38$)	Comorbid ($n=38$)
Age*	28.61 (10.42)$_a$	31.62 (9.24)$_{a,b}$	36.38 (12.33)$_b$	33.60 (11.35)$_{a,b}$
% Female*	66.7$_{a,b}$	83.3$_a$	71.1$_{a,b}$	52.6$_b$
% White	54.5	63.9	54.1	56.8
Marital status				
% Never married	75.0	47.2	60.5	71.1
% Married or cohabitating	15.6	44.4	26.3	18.4
% Previously married	9.4	8.3	13.2	10.5
Education				
% High school or lower	6.1	8.3	10.8	10.5
% Some college	48.5	27.8	29.7	31.6
% College degree or higher	45.5	63.9	59.5	57.9
Clinical characteristics				
ADIS GAD severity***	0.54 (0.91)$_a$	4.89 (0.66)$_b$	3.99 (1.60)$_c$	4.95 (1.02)$_b$
ADIS MDD severity***	0.18 (0.53)$_a$	2.19 (1.13)$_b$	5.16 (0.82)$_c$	5.16 (0.74)$_c$
Current comorbid disorders^***	0.00 (0.00)$_a$	0.81 (0.82)$_b$	0.90 (0.96)$_b$	1.33 (1.36)$_b$
Past comorbid disorders^**	0.00 (0.00)$_a$	0.88 (1.56)$_b$	0.77 (1.10)$_b$	1.00 (1.12)$_b$

GAD generalized anxiety disorder, *MDD* major depressive disorder, *ADIS* Anxiety Disorders Interview Schedule. *M* (*SD*) are presented for dimensional variables; all other values represent percentages. Values in the same row that do not share superscripts differ at $p<.05$

*$p<0.05$, **$p<0.01$, ***$p<0.001$

^Number of anxiety, mood, and substance-related disorders, excluding GAD and MDD

each 90-min block, separated by a minimum of 20 min. Participants were permitted to delay a signal up to 1 h at times when responding would be unsafe (e.g., while driving) or infeasible (e.g., an important meeting). Once signaled, participants were allowed up to 15 min to complete the report, with non-completed reports recorded as missing. Each report included ratings of current affect as well as ratings of other experiences that have been described elsewhere (see Ruscio et al. (2015)).

Participants were telephoned on the second day of the journaling week to confirm adherence to study procedures and address any questions. As soon as possible after the journaling week, participants returned to the laboratory to make their affective memory ratings. The median lag between the last day of the journaling week and the date on which memory ratings were provided was 1 day (interquartile range = 0–2 days). Participants returned the electronic journal, were debriefed, and were compensated for their participation ($10 per hour for the interview plus $40 for the journaling study).

Measures

Clinical Variables

The ADIS-IV-L (DiNardo et al. 1994) is a widely used, semi-structured clinical interview that is generally considered a "gold standard" measure of anxiety and mood disorders. In addition to yielding diagnoses of these and other mental disorders, it collects detailed information about symptom severity and functional impairment to arrive at an overall severity rating for each disorder. Each participant was assigned a clinical severity rating for GAD (ICC = 0.97) and MDD (ICC = 0.97) using a 9-point Likert-type scale (0 = absent, 8 = very severe), with scores of 4 or higher denoting a clinically significant severity level.

Experienced Affect

EMA was used to measure participants' actual emotional experiences during the journaling week. Each time they were signaled, participants rated the extent to which they were currently experiencing three negative emotions (anxious, sad, dissatisfied with myself) and three positive emotions (happy, determined, proud). These affect terms were drawn from the Basic Positive and Negative Emotion Scales of the expanded Positive and Negative Affect Schedule (PANAS-X; Watson and Clark 1994), with "anxious" substituted for a fear term given the greater relevance of anxiety than fear for GAD (Brown et al. 1998; Lang and McTeague 2009). Participants rated each emotion on a 5-point Likert-type scale (0 = not all, 4 = very much; e.g., "At the signal, I was feeling… HAPPY"). To obtain a robust, reliable measure of experienced affect, ratings were averaged across all signal reports submitted by the participant to yield a composite "experiences" variable for NA ($\alpha = 0.86$) and for PA ($\alpha = 0.88$) during the journaling week, consistent with previous studies (Hoerger et al. 2012; Wenze et al. 2012). NA and PA experiences were weakly negatively correlated ($r = -0.18$). Supporting the validity of these EMA affect measures, the composite variables correlated highly with trait NA ($r = 0.59$) and PA ($r = 0.62$), respectively, as assessed by the Positive and Negative Affect Schedule (PANAS; Watson et al. 1988).

Affective Forecasts and Memories

Prior to the journaling week, participants were asked to forecast the intensity of the negative and positive affect they would feel during the coming week (e.g., "In general, how HAPPY do you expect to feel this week?"). Following the journaling week, participants were asked to recall the intensity of the negative and positive affect they felt during the preceding week (e.g., "In general, during the journaling week, how HAPPY did you feel?"). To allow direct comparisons with the EMA assessment of experienced affect, the same three negative and three positive emotions were assessed for forecasts and memories, each rated on the same 5-point Likert-type scale. Ratings were averaged separately for forecasts and for memories to form NA ($\alpha = 0.77$ for both) and PA ($\alpha = 0.76$–0.79) composite variables. Affective forecasts were missing from four participants for NA and one participant for PA; these participants were still included in analyses for experiences and memories. NA and PA shared negative, moderate to large correlations for forecasts ($r = -0.57$) and memories ($r = -0.42$).

Analyses

All analyses included age and sex as covariates. Significant main effects were probed with follow-up contrasts comparing all groups (GAD, MDD, comorbid, control). Greenhouse–Geisser corrections were used for all analyses of covariance (ANCOVAs) with more than 1 df. Measures of effect size are reported for both group-based (η_p^2, Cohen's d) and dimension-based (β, ΔR^2) analyses.

Four sets of analyses were carried out. First, we performed separate ANCOVAs on absolute values of affective forecasts, experiences, and memories of NA and PA, with diagnostic group as the between-subjects variable. These analyses compared the absolute, raw levels of affect reported by the four groups.

Affective forecasting studies typically probe forecasting errors via two complementary approaches: inaccuracy and biases (Hoerger et al. 2012; Tomlinson et al. 2010; Wenze

et al. 2010; Wenze et al. 2012). For consistency, we applied these approaches to both forecasts and memories. Thus, our second set of analyses examined the *accuracy* of affective forecasts and memories using separate mixed-model ANCOVAs, with diagnostic group as the between-subjects variable and time (forecasts/memories vs. experiences) as the within-subjects variable. This analytic approach enabled us to test how much forecasts and memories deviated from actual affective experiences, regardless of the direction of those differences. Mixed-model ANCOVAs that model time as a repeated measure are a more reliable method for determining accuracy than simple difference scores (Cronbach and Furby 1970; Lord 1956), which some previous studies have used (Hoerger et al. 2012; H. Wu et al. 2017). In the third set of analyses, we tested for *biases* using separate ANCOVAs in which diagnostic group was used to predict forecasts and memories after adjusting for experienced affect (included in the model as an additional covariate), consistent with previous studies (Wenze et al. 2010, 2012). By preserving the direction in which errors were made, this approach allowed us to detect group differences in the overestimation or underestimation of particular emotional states.

Fourth and finally, we conducted hierarchical regression analyses as sensitivity analyses to probe the relationships of GAD and MDD severity with each affect variable.

Results

Preliminary Analyses

The Palm Pilots delivered a total of 7988 pre-programmed signals to the sample, of which 5724 yielded completed assessments. The mean response rate per individual of 72% (SD = 12.7, range 41–98%) was high and similar to other studies of individuals with depression or anxiety (Husky et al. 2010; Johnson et al. 2009). The rate of completed assessments was similar across the eight signals of the day (71–75%) and did not vary by day of study or by diagnostic group.

Levels of Affect

Forecasts

We began by examining group differences in absolute values of NA and PA at each time point. There was a main effect of group for negative affective forecasts, $F(3,135) = 42.86$, $p < 0.001$, $\eta_p^2 = 0.49$. Follow-up contrasts revealed, as hypothesized, that all three clinical groups expected to experience significantly more NA during the coming week than the control group, all $t > 7.02$, all $p < 0.001$. Whereas healthy participants anticipated only minimal NA ($M = 0.79$, $SD = 0.64$), clinical participants anticipated moderate levels (see Fig. 1a). In addition, the two groups with clinically significant depression, MDD ($M = 2.34$, $SD = 0.71$) and comorbid ($M = 2.39$, $SD = 0.68$), anticipated more NA than the GAD group ($M = 1.93$, $SD = 0.57$), both $t > 2.73$, both $p < 0.008$. These differences ($d = 0.65$–0.70), although reliable, were much smaller than the differences between the clinical and control groups ($d = 1.74$–2.44). The MDD and comorbid groups did not differ in their anticipated NA.

The groups also differed in their positive affective forecasts, $F(3,138) = 12.81$, $p < 0.001$, $\eta_p^2 = 0.22$. All three clinical groups expected to experience significantly less PA over the week than controls ($M = 2.56$, $SD = 0.83$), all $t > 2.76$, all $p < 0.007$. The differences between clinical and control

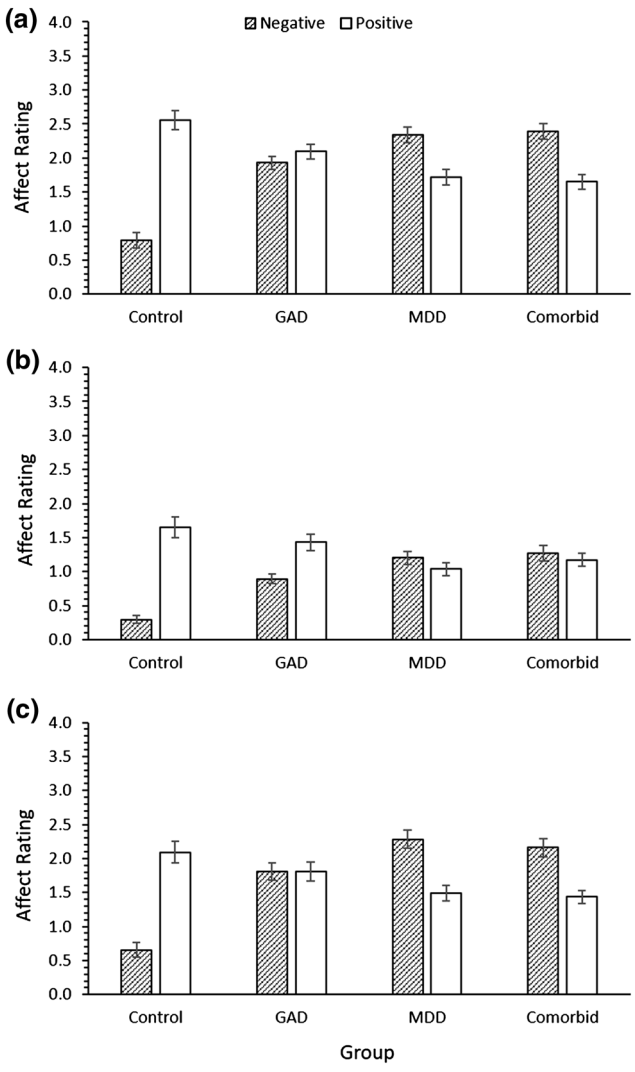

Fig. 1 Mean negative and positive affect ratings for **a** *forecasts* prior to, **b** *experiences* during, and **c** *memories* after the journaling week. Error bars represent standard errors

participants for PA ($d = 0.67$–1.32) were smaller than those observed for NA. As hypothesized, the MDD ($M = 1.72$, $SD = 0.73$) and comorbid ($M = 1.65$, $SD = 0.65$) groups also expected to experience significantly less PA than the GAD group ($M = 2.10$, $SD = 0.63$), both $t > 2.48$, both $p < 0.015$, $d = 0.58$–0.65. The two depressed groups (MDD, comorbid) did not differ in their anticipated PA.

Experiences

There was a main effect of group for negative affective experiences during the journaling week, $F(3,139) = 25.58$, $p < 0.001$, $\eta_p^2 = 0.36$. Absolute levels of NA were negligible in the healthy control group and mild in the clinical groups (see Fig. 1b). Consistent with the pattern for affective forecasts, follow-up contrasts revealed that all three clinical groups experienced significantly more NA than controls ($M = 0.30$, $SD = 0.30$), with the MDD ($M = 1.20$, $SD = 0.58$) and comorbid ($M = 1.27$, $SD = 0.71$) groups also experiencing significantly more NA than the GAD ($M = 0.89$, $SD = 0.41$) group, all $t > 2.88$, all $p < 0.005$, $d = 0.67$–1.93.

Although there was a main effect of group for positive affective experiences ($F(3,139) = 7.07$, $p < 0.001$, $\eta_p^2 = 0.13$), experiences of PA did not differ markedly between the groups, all of whom reported absolute levels in the mild to moderate range. In follow-up contrasts, the only notable differences emerged between the two groups with depression (MDD $M = 1.04$, $SD = 0.58$; comorbid $M = 1.17$, $SD = 0.56$) and the two groups without depression (GAD $M = 1.43$, $SD = 0.70$; control $M = 1.66$, $SD = 0.87$), $t = 1.95$–4.17, $p < 0.001$–0.053, $d = 0.46$–1.01 (trend difference for GAD vs. comorbid).

Memories

The pattern of results for memories of NA was very similar to the pattern for forecasts (see Fig. 1c). In follow-up contrasts probing the main effect of group ($F(3,139) = 36.18$, $p < 0.001$, $\eta_p^2 = 0.44$), all three clinical groups remembered significantly more NA than controls ($M = 0.66$, $SD = 0.59$), with the two depressed groups (MDD $M = 2.28$, $SD = 0.83$; comorbid $M = 2.16$, $SD = 0.86$) also recalling more NA than the GAD group ($M = 1.81$, $SD = 0.74$), all $t > 2.64$, all $p < 0.009$, $d = 0.62$–2.26.

For memories of PA, the absolute level and rank-ordering of means was also similar to forecasts. Once again there was a main effect of group ($F(3,139) = 6.76$, $p < 0.001$, $\eta_p^2 = 0.13$), with remembered levels of PA highest in the control group ($M = 2.09$, $SD = 0.93$), intermediate in the GAD group ($M = 1.81$, $SD = 0.84$), and lowest in the MDD ($M = 1.49$, $SD = 0.71$) and comorbid ($M = 1.43$, $SD = 0.61$) groups. However, as was found for experiences, follow-up contrasts indicated that only the two groups with depression differed reliably from the two groups without depression in their memories of PA, all $t > 2.11$, all $p < 0.037$, $d = 0.49$–0.93.

Accuracy

Forecasts

Figure 2a displays mean differences between forecast and experienced affect by group. To test for group differences in forecasting accuracy, we interpreted the interaction term from a mixed-model ANCOVA in which group was the between-subjects factor and time was the within-subjects factor. For forecasts of NA, the main effects of group ($F(3,135) = 44.46$, $p < 0.001$, $\eta_p^2 = 0.50$) and time ($F(1,135) = 42.89$, $p < 0.001$, $\eta_p^2 = 0.24$) were qualified by a significant interaction, $F(3,135) = 9.38$, $p < 0.001$, $\eta_p^2 = 0.17$. Follow-up contrasts revealed that the three clinical groups overestimated the amount of NA they would experience during the week to a greater degree than the healthy control group, all $t > 6.54$, all $p < 0.001$. In addition, the two depressed groups overestimated the amount of NA they

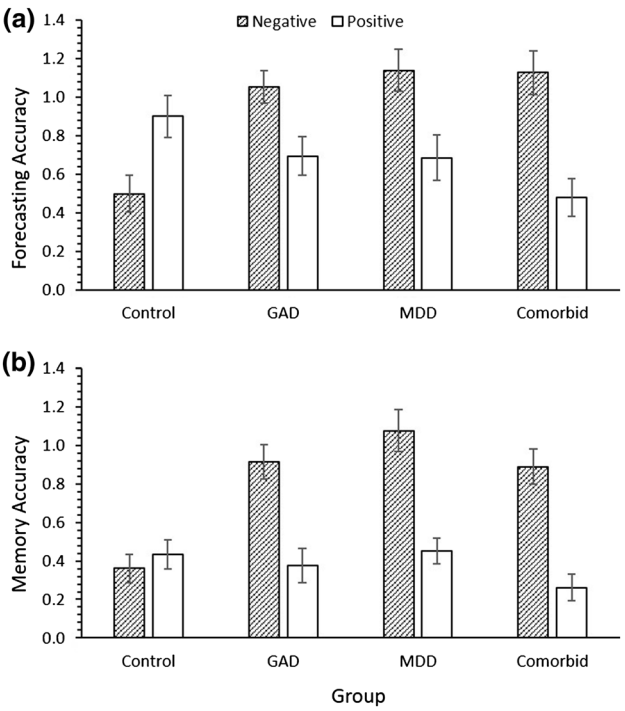

Fig. 2 Mean **a** *forecasting accuracy* (forecast affect minus experienced affect) and **b** *memory accuracy* (remembered affect minus experienced affect) for negative and positive affect. Positive values indicate a bias toward **a** overestimating the amount of affect that will be experienced, relative to what was actually experienced or **b** remembering higher affect than was experienced. Error bars represent standard errors

would experience to a greater degree than the GAD group, both $t > 3.19$, both $p < 0.002$.

The opposite pattern was observed for forecasts of PA, where the significant main effects of group ($F(3,138) = 12.24$, $p < 0.001$, $\eta_p^2 = 0.21$) and time ($F(1,138) = 4.71$, $p = 0.032$, $\eta_p^2 = 0.03$) were qualified by a trend-level interaction, $F(3,138) = 2.20$, $p = 0.09$, $\eta_p^2 = 0.05$. Although the effect was modest and only marginally significant, follow-up contrasts paralleled the findings for absolute values reported earlier: Healthy controls overestimated the PA they would experience to a greater degree than the three clinical groups (all $t > 2.48$, all $p < 0.015$), while the GAD group overestimated PA to a greater degree than the two depressed groups (both $t > 2.57$, both $p < 0.012$).

Memories

Figure 2b presents mean differences between experienced and remembered affect by group. Once again, group differences in accuracy were tested by interpreting the interaction of group by time in mixed-model ANCOVAs. Similar to the results for affective forecasting, the results for affective memory revealed significant main effects of group ($F(3,139) = 37.11$, $p < 0.001$, $\eta_p^2 = 0.45$) and time ($F(1,139) = 26.22$, $p < 0.001$, $\eta_p^2 = 0.16$) for NA that were qualified by a significant interaction, $F(3,139) = 13.06$, $p < 0.001$, $\eta_p^2 = 0.22$. Follow-up contrasts indicated that all three clinical groups over-recalled the amount of NA they experienced during the week to a greater degree than healthy controls, all $t > 5.95$, all $p < 0.001$. The two depressed groups also over-recalled the amount of NA they experienced during the week to a greater degree than the GAD group, both $t > 3.38$, both $p < 0.001$.

Memories of PA showed a different pattern. Although the main effect of group reported earlier was observed again ($F(3,139) = 7.51$, $p < 0.001$, $\eta_p^2 = 0.14$), there was neither a main effect of time ($F(1,139) = 0.02$, $p = 0.88$, $\eta_p^2 = 0.00$) nor a significant interaction of group by time ($F(3, 139) = 1.11$, $p = 0.35$, $\eta_p^2 = 0.02$), indicating that the groups did not differ in the accuracy with which they recalled PA.

Biases

Forecasts

Next, we probed misrepresentations of affective experience using a different approach, examining group status as a predictor of affective forecasts after controlling statistically for affective experiences. These tests for biases revealed a main effect of group for both NA ($F(3,134) = 15.20$, $p < 0.001$, $\eta_p^2 = 0.25$) and PA ($F(3,137) = 6.14$, $p < 0.001$, $\eta_p^2 = 0.12$). Follow-up contrasts revealed that the three clinical groups overestimated the NA they would experience during the week to a greater degree than healthy controls, all $t > 5.40$, all $p < 0.001$, $d = 1.31$–1.62. By contrast, healthy controls overestimated the PA they would experience during the week to a greater degree than all three clinical groups, all $t > 2.48$, all $p < 0.05$, $d = 0.53$–1.02. Additionally, GAD group members overestimated the PA they would experience to a greater degree than the comorbid group, $t = 2.09$, $p = 0.038$, $d = 0.50$. No other group differences were significant for either NA or PA.

Memories

Similar to the results for affective forecasting, analyses adjusting for experienced NA revealed a main effect of group for negative affective memories, $F(3,138) = 9.91$, $p < 0.001$, $\eta_p^2 = 0.18$. Follow-up contrasts indicated that all three clinical groups over-recalled the NA they experienced during the week to a greater degree than healthy controls, all $t > 3.84$, all $p < 0.001$, $d = 1.00$–1.37. There was also a trend for the MDD group to over-recall NA to a greater degree than the GAD group, $t = 1.73$, $p = 0.086$, $d = 0.41$. By contrast, after adjusting for experienced PA, there were no significant effects of group for positive affective memories, $F(3,138) = 1.36$, $p = 0.259$, $\eta_p^2 = 0.03$.

Sensitivity Analyses

Many individuals with anxiety suffer from subclinical depression, and vice versa. Examining categorical group differences alone may miss these subclinical effects. To explore this possibility, we performed sensitivity analyses in which dimensional clinical ratings of GAD and MDD severity were used to predict affective forecasts, experiences, and memories in the total sample. In separate hierarchical regression analyses, age and sex were entered on the first step, then either GAD severity or MDD severity was entered on the second step to evaluate its association with the outcome variable (see Table 2, left portion). GAD severity and MDD severity each predicted the absolute levels of NA ($\beta = 0.54$ to 0.69, all $t > 7.57$, all $p < 0.001$) and PA ($\beta = -0.22$ to -0.47, all $t > 2.62$, all $p < 0.010$) that participants forecast, experienced, and remembered. We repeated these analyses for forecasting and memory biases, entering experienced affect as well as age and sex on the first step, then entering either GAD severity or MDD severity on the second step. GAD severity and MDD severity were each associated with more biased forecasts and memories of NA, all $t > 3.21$, all $p < 0.002$. Both GAD and MDD severity also predicted forecasting biases for PA—specifically, a blunted positive forecasting bias

Table 2 Proportion of variance explained by symptom dimensions in each affect variable, over and above demographic covariates

Variable	Separate entry				Simultaneous entry		
	GAD		MDD				
	β	ΔR^2	β	ΔR^2	GAD β	MDD β	ΔR^2
Levels of affect							
Forecasts							
NA	0.57***	0.31	0.69***	0.44	0.24**	0.54***	0.48
PA	−0.32***	0.10	−0.47***	0.21	−0.05	−0.44***	0.21
Experiences							
NA	0.54***	0.28	0.63***	0.37	0.26**	0.47***	0.41
PA	−0.22**	0.05	−0.33***	0.10	−0.03	−0.31**	0.10
Memories							
NA	0.59***	0.33	0.63***	0.37	0.32***	0.43***	0.44
PA	−0.32***	0.10	−0.35***	0.11	−0.17^	−0.24*	0.13
Biases							
Forecasts							
NA	0.26***	0.05	0.38***	0.09	0.13^	0.32***	0.09
PA	−0.18**	.03	−0.29***	0.07	−0.02	−0.28**	0.07
Memories							
NA	0.21***	0.03	0.21**	0.03	0.16*	0.13^	0.04
PA	−0.14**	0.02	−0.08	0.01	−0.14*	0.01	0.02

GAD generalized anxiety disorder severity score, *MDD* major depressive disorder severity score, *NA* negative affect, *PA* positive affect. Both clinical severity scores were rated on the Anxiety Disorders Interview Schedule. Values represent the final step of hierarchical regression analyses in which age and sex were entered on the first step and GAD severity, MDD severity, or both were entered on the second step. (For biases, experienced affect was also entered on the first step.)

^$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

(both $t > 2.68$, both $p < 0.009$). However, only GAD severity was reliably associated with a blunted positive memory bias ($t = 3.01$, $p = 0.003$); the association for MDD severity only reached marginal significance ($t = 1.64$, $p = 0.103$).

In a second series of regression analyses, age and sex were entered on the first step and GAD and MDD severity were entered simultaneously on the second step to evaluate their independent association with each outcome (see Table 2, right portion). With MDD severity in the model, GAD severity remained a significant predictor of NA-related forecasts, experiences, and memories (β = 0.24 to 0.32, all $t > 2.91$, all $p < 0.005$), but no longer predicted PA-related forecasts, experiences, and memories (β = −0.03 to −0.17, all $t < 1.68$, all $p > 0.096$), suggesting that the association of GAD symptoms with PA levels was driven substantially by co-occurring MDD symptoms. Intriguingly, in analyses predicting biases, a dissociation emerged: When MDD and GAD were both in the model, only MDD severity reliably predicted biased forecasts of NA and PA (both $t > 3.31$, both $p < 0.002$), whereas only GAD severity reliably predicted biased memories of NA and PA (both $t > 2.46$, both $p < 0.016$).

Discussion

To our knowledge, this is the first study to compare *both* forecasts *and* memories of affect to in vivo measures of experienced affect in clinical anxiety and depression. Clinical participants predicted, experienced, and remembered significantly more NA and less PA than healthy controls, with effects strongest for individuals with MDD (pure or comorbid). Importantly, even accounting for the elevated levels of NA experienced by the clinical groups, these groups differed from controls in the magnitude of their overestimation when forecasting and remembering NA. By contrast, healthy individuals were distinguished by their overestimation of PA, specifically when forecasting future emotional experiences. Sensitivity analyses using clinician-rated symptom severity confirmed that GAD and MDD were each independently associated with high NA but that only MDD was associated with low PA when both symptom measures were tested simultaneously as predictors. Unexpectedly, when GAD and MDD symptoms were used simultaneously to predict biases, only MDD severity

was associated with forecasting bias, while only GAD severity was associated with memory bias, with this dissociation pattern holding across NA and PA.

Several conclusions can be drawn from these findings. First, healthy individuals are inaccurate at forecasting and remembering affect, overestimating both NA and PA. This observation aligns with past research on affective forecasting and memories in nonclinical samples (Kardum and Tićac Daskijević 2001; Thomas and Diener 1990; Wilson and Gilbert 2005; Wilson et al. 2000; Wirtz et al. 2003) and implies that inaccuracies per se are not necessarily pathological and may actually be protective. Our results add to an extensive literature linking PA (e.g., Folkman and Moskowitz 2000; Fredrickson and Levenson 1998; Tugade and Fredrickson 2004) and optimism (see Carver et al. 2010; Forgeard and Seligman 2012 for recent reviews) with well-being and mental health. At the same time, evidence that excessive PA is a vulnerability factor for other emotional disorders (e.g., bipolar disorder; Gruber 2011; Gruber et al. 2008) suggests that a predominantly optimistic outlook balanced with a small amount of "realistic pessimism" may be most adaptive psychologically (Forgeard and Seligman 2012). Further studies measuring affective experiences and representations within the same individuals, including individuals with emotional disorders not considered here, would aid in determining the optimal balance between emotional optimism and realism for mental health.

Second, the current study demonstrates that negative emotions are heightened in the daily lives of individuals with anxiety and depressive disorders and distinguish these individuals from healthy controls. This finding aligns with models proposing that anxiety and depression share a common, nonspecific factor of NA (also referred to as neuroticism or general distress; Clark and Watson 1991; Mineka et al. 1998; Watson 2009) as well as with emerging theories that identify heightened NA—and exaggerated interpretations of and responses to NA—as vulnerability and maintaining factors for all emotional disorders (Barlow et al. 2014). Importantly, by sampling actual affective experiences in real time in the natural environment, we were able to rule out several competing explanations for group differences in experienced affect, such as mood-congruent memory biases or differential reactivity to a novel assessment setting. Our results build on prior EMA studies of individuals with MDD (Bylsma et al. 2011; Peeters et al. 2003; Thompson et al. 2017) by showing that robust daily elevations in NA extend to individuals with GAD. Interestingly, individuals with pure or comorbid MDD in our sample reported more NA than those with pure GAD, which may indicate that NA is higher in depression than anxiety. A different possibility is that the terms we used to assess NA (anxious, sad, dissatisfied with myself) may have been more sensitive to affective experiences in depression than anxiety. Alternatively, although we controlled statistically for demographic characteristics, it is possible that the groups differed on other factors (e.g., life stress, specific comorbid disorders) that contributed to group differences in experienced affect. Further investigation of everyday emotional experience in GAD and other anxiety disorders would help adjudicate among these possibilities.

Third, our findings provide partial support for the hypothesis that low PA distinguishes depression from anxiety. Individuals with MDD forecast, experienced, and remembered less PA than individuals with GAD, who reported PA levels similar to healthy controls; the presence of comorbid GAD was not associated with further reductions in PA among individuals with MDD; and the severity of MDD, but not GAD, predicted PA levels when symptoms of both disorders were considered together. These effects are striking given our conservative comparison of MDD with GAD, its closest boundary condition (Goldberg et al. 2010; Kendler et al. 1992). These results are consistent with numerous theoretical models that describe and attempt to explain decreased PA in individuals with depression (Clark and Watson 1991; Davidson 1998; Gray 1994; Heller 1993; Watson 2009). A common explanation centers on blunted responsivity to reward-related stimuli, which is a core symptom of MDD (APA 2013) that is observed on behavioral (e.g., Henriques and Davidson 2000) and neural (e.g., Zhang et al. 2013) measures.

Nevertheless, some findings did not support the presumed specificity of low PA to MDD. Individuals with GAD forecast significantly less PA than controls, perhaps due to previously demonstrated deficits in the mental simulation and elaboration of positive future events (Wu et al. 2015). Although individuals with GAD did not differ reliably from controls in actual experiences or memories of PA, their mean levels on these variables fell consistently between those of the control and depressed groups. These findings add to an emerging literature suggesting that PA is not entirely spared in anxiety disorders. Although this has been recognized for some time in social anxiety disorder (Brown et al. 1998; Kashdan 2007), recent meta-analyses have indicated that positive emotionality may also be attenuated in other anxiety disorders (Bienvenu and Stein 2003; Kashdan 2007; Kotov et al. 2010) and shares longitudinal relationships of similar magnitude with depression and anxiety (Khazanov and Ruscio 2016). Few studies have examined GAD specifically, but a recent EMA study found that individuals with GAD fell between healthy controls and individuals with MDD—and generally did not differ significantly from individuals with MDD—in their emotional reactions to positive everyday events (Khazanov et al. 2018). An important caveat suggested by our sensitivity analyses is that GAD may be associated with PA because of subclinical depression symptoms. An alternative possibility is that it is only when GAD symptoms

cross a threshold of clinical significance that they become associated with PA as well as NA. Further research is needed to unpack these associations, although the smaller effects for PA than NA across the board suggest that alterations in negative emotionality are the more robust feature of these disorders.

Fourth, over and above their heightened experiences of NA, all clinical groups overestimated NA to a greater extent than controls, with overestimation evident in both forecasts and memories. Furthermore, over and above their diminished experiences of PA, all clinical groups showed an attenuated (less optimistic) bias when forecasting PA. Although our results are consistent with those reported previously in nonclinical samples (Hoerger et al. 2012; Wenze et al. 2012), they differ from the results of two prior studies with clinically depressed samples. Thompson et al. (2017) used procedures similar to those in the present study and found no differences between remitted MDD and never-depressed participants in the accuracy of positive or negative affective forecasts. Although tempered by the small size of the remitted MDD group ($n = 21$), their results suggest that the pessimistic forecasts we observed among currently depressed individuals are found only during acute episodes of illness. The implication is that these biases are better understood as cognitive features of, or maintaining factors for, the depressed state rather than as stable individual differences. Wu et al. (2017) found that both current MDD and control participants accurately predicted the amount of pleasure they would feel, and overestimated the amount of displeasure they would feel, during a specific activity they were anticipating in the next 1–2 h. The forecasts in that study—which focused on reactions to concrete, proximal events, and which measured anticipated pleasure rather than affect per se—differed from forecasts in the current study in several ways. Those differences hint that individuals with depression are more susceptible to pessimistic forecasts when making more abstract, distal, and global predictions about their emotions. An important question for future research is the extent to which individuals naturally and spontaneously make affective predictions in general (as investigated here and in a few previous studies; e.g., Thompson et al. 2017) versus in relation to specific events (as is typically investigated in the literature), as well as the frequency or temporal nature of these spontaneous forecasts (e.g., daily, weekly, yearly). The pervasive hopelessness found in MDD and the generalized apprehension found in GAD imply that affective predictions in these disorders are subtle, implicit, and automatic, and not limited to isolated events. Understanding the relative contributions of general and specific predictions across varying timeframes is important for treatment planning, as event-related predictions may be more tractable targets for testing and cognitive restructuring than are general predictions about how one will feel in the future.

Interestingly, our sensitivity analyses qualified the group-level findings: When MDD and GAD were measured dimensionally and tested simultaneously, only MDD symptoms were associated with a negative forecasting bias and only GAD symptoms were associated with a negative memory bias. This pattern runs counter to theorists' traditional emphasis on negative *expectations* in GAD (worry; Borkovec and Inz 1990; Clark 1999; Mathews et al. 1990) and negative *memories* in MDD (rumination; Beck et al. 1979; Kuyken et al. 2006; Nolen-Hoeksema 2000). The tendency of individuals with more severe depression to more strongly overestimate future NA and underestimate future PA, even when controlling for anxiety, is consistent with prior findings for subclinical dysphoria (Hoerger et al. 2012; Wenze et al. 2012). It also aligns with evidence for a negative forecasting or "prospection" bias in MDD, including reduced ability to imagine future possibilities, maladaptive evaluation of these future possibilities, and negative beliefs or hopelessness about the future (Roepke and Seligman 2016). The association of GAD symptoms with a negative memory (rather than forecasting) bias is more difficult to explain, although theories of worry—the central feature of GAD—offer possible clues. It has been suggested that worriers prefer to assume and prepare for the worst outcome rather than risk being unpleasantly surprised when things turn out worse than expected (Newman and Llera 2011). A negative memory bias that keeps past experiences of regret or disappointment "alive" in the mind may motivate persistent worry to avoid being caught off guard in the future. Additionally, the abstract, verbal-linguistic thought activity during worry has been theorized to suppress emotional reactions, particularly to perceived future threats (Borkovec et al. 2004; Borkovec and Inz 1990; Dugas et al. 1998). The resulting reduction in emotion-evoking imagery and sympathetic nervous system activity may prevent exaggerated affective forecasts. Further research is needed to replicate and explain these unexpected results, perhaps using think-aloud protocols or debriefing interviews to illuminate the steps participants followed to arrive at their forecasts and memories.

The present results illustrate the importance of studying anxiety and depression together in order to disentangle their effects. The results also underscore the value of studying affective correlates of anxiety and depression in samples with clinically meaningful emotional disturbance. Our sample offered a more sensitive test for potential affective biases than the undergraduate sample in Wenze et al. (2012), and we found far more consistent associations of anxiety with forecasts and memories than that study. The fact that differences emerged even in this stringent test provides compelling evidence that affect is experienced and represented differently in anxiety and depression. As anxiety disorders vary in their features, correlates, and hypothesized causes (Barlow 2002; Craske et al. 2009), disorders other than GAD

should also be investigated to determine the generalizability of the results described here.

The present findings have implications for the assessment and treatment of emotional disorders. Our results support the current use of behavioral activation (Martell et al. 2001; Veale 2008) and positive data logs (Fennell 1998) to increase experiences and modify expectations of PA in depression, and suggest that these and other interventions to enhance PA may also be helpful in treating anxiety (Craske et al. 2016; Taylor et al. 2017). Our findings also support the use of interventions to reduce experiences of NA, either directly (e.g., Beck 1995; Bennett-Levy et al. 2004; Clark and Beck 2010) or indirectly, by modifying maladaptive reactions to negative emotions (e.g., Barlow et al. 2011; Hayes et al. 1999; Linehan 1993) or by utilizing experiences of PA to down-regulate experiences of NA via techniques such as gratitude and savoring (Davis et al. 2016; Quoidbach et al. 2010).

The observed inaccuracies in affective forecasts and memories highlight the value of using momentary self-monitoring to collect information about affective experience, rather than relying solely on global self-reports as is typical in clinical practice. Accurate information about affect is essential for establishing a baseline from which to plan interventions and measure therapeutic change. Momentary measures also have direct intervention potential; recording emotional experience in real time could help individuals recognize that their mood is not as low as they believe and help identify activities and behaviors that are associated with better mood. These interventions could boost affect itself, as well as improving the accuracy of affective forecasts and memories. Although cognitive-behavioral therapies for anxiety and depression often require individuals to track thoughts and compare these to experiences (e.g. Beck 1995; Clark and Beck 2010), affect monitoring is less common than thought monitoring. The present findings suggest that affect monitoring may be warranted to target inaccuracies more directly.

While forecasts may be assessed using different timeframes, we argue that "the coming week" (as employed in this study) is an intuitive unit of analysis for capturing individuals' predictions about the near future, both from a logical standpoint (thinking about the week ahead is common for most people as their weekend draws to a close) and a clinical standpoint (a week is less susceptible to influence by unanticipated events and measurement error than a single day, yet more immediate and concrete than a full month). For similar reasons, standard outpatient treatment for eating disorders involves weekly, rather than daily or monthly, weigh-ins (Fairburn et al. 2008). The timeframe of "the coming week" is also directly relevant to outpatient clinical settings, where therapists typically see clients on a weekly basis. A useful clinical exercise may involve asking clients to make predictions about their affect during the coming week, then having clients rate their affect throughout the week (perhaps via a smartphone app accessible by the clinician), then assessing memory of affect during the following session. The (in)accuracy of these forecasts and memories could then be discussed and addressed in treatment. Preliminary support for the utility of incorporating EMA-based, personalized affective feedback into treatment (Kramer et al. 2014) hints at the potential value of this approach, but further research is needed. Such research could compare weekly with longer-term (e.g., next month, next year) affective forecasts to determine the optimal timescale for interventions.

It is important to recognize, though, that a strong positivity bias exists in healthy individuals and that, rather than simply striving to improve overall accuracy, interventions might aim to attain a more favorable balance between PA and NA akin to the ratio observed in healthy individuals. A cautious prediction is that it may be beneficial not only to decrease negativity bias but to increase positivity bias. The hazards of an imbalance in favor of PA (see Gruber et al. 2011 for discussion) underscore the complexity of this effort as well as the need to better understand the functions of the positivity bias and its breakdown in emotional disorders.

Several intriguing questions await further investigation. In particular, research is needed to understand the mechanisms that give rise to affective biases, such as the salience or temporal dynamics of peak emotional experiences (Phan et al. 2004; Waugh et al. 2010) or the role of cognitive processes that influence which emotional experiences are attended to or remembered (Gotlib and Joormann 2010). Frequent or even continuous (e.g., Mauss et al. 2005) sampling of affect when forecasting, experiencing, and remembering an emotionally evocative event could speak to these and other potential mechanisms. Additionally, longitudinal research is needed to determine whether these patterns of inaccuracies are a vulnerability factor or a consequence of depression and anxiety. Mixed findings from nonclinical (Wenze et al. 2012) and remitted depression (Thompson et al. 2017) samples leave open the question of whether these patterns are experienced outside major mood episodes. Research with high-risk samples or prospective designs would help establish whether these biases fluctuate with symptoms or endure at stable levels, potentially increasing risk for future episodes.

Some limitations should be noted. First, affect was sampled at random, eight times throughout the day, every day for 1 week. It is possible that significant affective experiences were missed that occurred between signals. However, as all participants were assessed in the same way, this is unlikely to account for the group differences observed here. Conversely, it is possible that the frequent sampling altered how participants experienced affect. While our sampling rate is consistent with previous studies (see Wenze and Miller 2010 for review) and reactivity to EMA has been modest

in other studies, particularly those of 2 weeks or less duration (Hufford et al. 2002), more research is needed to better understand the influence of sampling on experience. Second, NA and PA were each assessed by just three items selected for their relevance to anxiety and depression. These items formed reliable composites and correlated highly with trait NA and PA measures but captured only a small subset of possible emotions. Promising early findings reported here support the investigation of more subtle differences in NA and PA between anxiety and depression. Third, although retrospective recall biases were minimized by sampling affect in real time, affect ratings were still self-reported by participants and may have been colored by negativity biases. Future EMA studies would benefit from supplementing subjective affect ratings with more objective measures, such as ambulatory psychophysiology measures (Trull and Ebner-Priemer 2013), to gain a wider lens into emotional experience. Fourth, we aggregated emotional experiences across the week to obtain a single mean composite for NA and for PA. Although consistent with previous studies (Hoerger et al. 2012; Wenze et al. 2012), this method may be different from the way in which participants themselves aggregated across the week when generating their "in general" ratings for forecasts and memories. For example, global impressions of experienced affect may have been influenced by dynamic processes such as the magnitude or duration of fluctuations away from participants' mean affect levels (Kuppens et al. 2010). A recent synthesis of EMA studies, however, found little evidence that measures of affect dynamics predict meaningful variance over and above mean affect levels in well-being, offering little justification for more complex analyses (Dejonckheere et al. 2019). Given the reliable mean differences observed here, an important priority for future research is to explain how individuals in the different groups arrived at such different forecasts and memories.

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Compliance with Ethical Standards

Conflict of interest Danielle C. Mathersul and Ayelet Meron Ruscio have declared no conflict of interest.

Informed consent All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (national and institutional). Informed consent was obtained from all individual subjects participating in the study.

Research Involving Human Rights All procedures involving human participants were approved by the University of Pennsylvania Institutional Review Board.

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