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Predicted and Remembered Emotion:

Tomorrow's Vividness Trumps Yesterday's Accuracy

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Abstract

People rely on predicted and remembered emotion to guide important decisions. But how much can they trust their mental representations of emotion to be accurate, and how much *do* they trust them? In this investigation, participants (N = 957) reported their predicted, experienced, and remembered emotional response to the outcome of the 2016 U.S. presidential election. They also reported how accurate and vivid they perceived their predictions and memories to be, and the importance of the election. Participants remembered their emotional responses more accurately than they predicted them. But, strikingly, they perceived their predictions to be more accurate than their memories. This perception was explained by the greater importance and vividness of anticipated versus remembered experience. We also assessed whether individuals with Highly Superior Autobiographical Memory for personal and public events (N = 33) showed superior ability to predict or remember their emotional responses to events. They did not and, even for this group, predicting emotion was a more intense experience than remembering emotion. These findings reveal asymmetries in the phenomenological experience of predicting and remembering emotion. The vividness of predicted emotion serves as a powerful subjective signal of accuracy even when predictions turn out to be wrong.

Keywords: emotion; prediction; memory; phenomenology; Highly Superior Autobiographical Memory

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The present flickers by in an instant, and much of people's mental life consists of remembering past experiences and anticipating future ones. Mental representations of emotional experiences are particularly important because they inform people's decisions. To decide whether to marry, change careers, or make veggie burgers for dinner, people draw on memories of past emotion and try to predict how future experiences will make them feel. The greater the intensity of emotion they predict, the more effort and resources they invest in attaining or avoiding an outcome (Miloyan & Suddendorf, 2015). Memories and predictions are not always accurate, however, and people rely on those they perceive to be accurate to guide their decisions (Hembacher & Ghetti, 2017). This raises two questions: How much can people trust representations of emotion to be accurate, and how much do they trust them? The past and future differ in fundamental ways, so we expected the answers to these questions to differ for predicted versus remembered emotion.

To address these issues, we assessed people's predicted, experienced, and remembered emotional response to Donald Trump's victory in the 2016 presidential election. In prior research, investigators have separately examined how accurately people forecast emotion (e.g., Wilson, Wheatley, Meyers, Gilbert, & Axson, 2000) and remember emotion (e.g., Levine, 1997; Kaplan, Levine, Lench, & Safer, 2016; Robinson & Clore, 2002). A few studies examined emotion forecasts and memories concerning a single event such as an election (Wilson, Meyers, & Gilbert, 2003) or vacation (Wirtz, Kruger, Scollon, & Diener, 2003). However, these studies did not directly compare the accuracy or phenomenology of forecasts and memories. In a separate line of research, investigators have compared the phenomenological experience of imagining plausible future events and remembering past events (e.g., D'Argembeau & Van der Linden, 2004; Özbek, Bohn, & Berntsen, 2016; see Szpunar, Spreng, & Schacter, 2014, for a review and taxonomy of

prospective thought). However, investigators have not compared representations of future and past emotional responses to a specific event.

The current investigation thus extends past research by examining how predictions versus memories of emotional experience differ, and processes that may explain these differences. We directly compared the accuracy of predicted and remembered emotion, across time intervals of the same length, and compared how accurate people perceived these representations to be. We also examined potential predictors of actual and perceived accuracy: the importance of the emotion-eliciting event, the vividness of representations of emotion, the stability of semantic appraisals over time, and superior episodic memory for autobiographical events.

Similarities Between Representations of Future and Past Emotion

Mental representations of past and future experience rely on common cognitive processes. The episodic memory system retains information about the time, place, and personal context in which past experiences occurred (Tulving, 2002). Schacter and Addis (2007) proposed that this stored information is selected and recombined to simulate novel future experiences. Supporting this hypothesis, an overlapping network of brain regions is activated when people recall their past and imagine their future, including the hippocampus and parahippocampal cortex. Damage to these regions renders people amnesiac about their personal past as well as unable to anticipate personal experiences in the future (Race, Keane, & Verfaellie, 2011). Episodic memory is not comprehensive, however, and semantic memory – generalized knowledge about the world and the self – scaffolds representations of past and future experiences (Irish & Piguet, 2013; Schacter et al., 2012).

Common cognitive processes also shape memories and predictions that specifically concern emotion. When predicting or remembering their feelings, people often focus on a single event (Wilson et al., 2000), and neglect to consider how quickly they adapt to events (Wilson &

Gilbert, 2008). These cognitive biases often lead people to overestimate the overall emotional impact of both future and past events (Wilson et al., 2003). People show greater accuracy when the focus of attention is similar over time, such as when they predict or remember the peak intensity of their emotional response to events (Doré, Meksin, Mather, Hirst, & Ochsner, 2016; Kaplan et al., 2016; Levine, Lench, Kaplan, & Safer, 2012; Levine, Lench, Karnaze, & Carlson, 2018). Thus, common processes promote similar patterns of bias when people predict and remember their emotional reactions to events.

Differences between Representations of Future and Past Emotion

Despite these commonalities, the past and future differ in fundamental ways that have important implications for the accuracy and phenomenology of representations of emotion. The primary difference is that past experiences already happened, making episodic details accessible, whereas the future is uncertain. To imagine a future experience, people have to retrieve and piece together episodic memories of related experiences and rely more on semantic knowledge and appraisals concerning how experiences typically unfold (Conway & Loveday, 2015; Schacter & Addis, 2007). Consistent with this view, people commonly perceive representations of past events to be more detailed than representations of future events. For example, researchers have asked participants to imagine a plausible but novel future event, or remember a past event, in response to cues such as “telephone,” “ordering pizza,” “an encounter with a homeless person.” Participants typically rate their memories as more detailed, less vague, and more like normal vision than their representations of future events (e.g., Kane, Van Boven, & McGraw, 2012; Özbek et al., 2016). These studies compared representations of past and future events rather than representations of past and future *feelings* about events. However, given the availability of episodic detail, it seems obvious that emotion memories should be more accurate than predictions.

Less obvious is how accurate people *perceive* representations of future and past emotion to

be. People's judgments about how closely their mental representations correspond to states in the world range from high, for sensory perceptions and recent memories, to low, for dreams and fantasies. These judgements are important because they guide people's decisions. Based on perceived accuracy, people decide whether to rely on their representations and share them with others or seek out additional or alternative information (Hembacher & Ghetti, 2017; Koriat, Goldsmith, & Pansky, 2000). People often base judgments of perceived accuracy on phenomenological cues that we refer to collectively as "vividness": the ease with which representations come to mind, their intensity, and experiencing – the sense of pre- or re-living an experience (e.g., Kelley, & Jacoby, 1990; Winkielman, Schwarz, & Belli, 1998). Because remembered experiences already happened, one might expect people to perceive memories of past emotion to be more vivid, and hence more accurate, than predictions about future emotion.

Despite the plausibility of this account, we propose an alternative model: The importance of future emotional experiences may make them particularly vivid, rendering people vulnerable to misjudging their accuracy. This novel proposition bridges past findings in the research literature. People often judge future experiences, which can still be acted on and changed, as more important than past experiences, which cannot (Seligman, Railton, Baumeister, & Sripada, 2013; Van Boven & Caruso, 2015). Representations of experiences that are important or relevant for people's goals tend to be emotionally evocative (Van Boven & Ashworth, 2007) and vivid (Cole & Berntsen, 2016; Lehner & D'Argembeau, 2016). Moreover, people interpret vividness as a sign of accuracy (Benjamin, Bjork, & Schwartz, 1998; Kelley & Jacoby, 1990; Winkielman et al., 1998). Thus, Levine et al. (2018) proposed that the greater importance of the future than the past would make predicted emotion more vivid than remembered emotion. In turn, greater vividness should lead people to perceive their predictions to be more accurate than their memories.

Sources of Accuracy When Predicting and Remembering Emotion

What contributes to the actual accuracy of representations of emotion? We examined two factors: stability over time in people's semantic appraisals of the emotion-eliciting event, and accurate and detailed episodic memory for autobiographical events. People's appraisal of the valence of an outcome (i.e., how good or bad the outcome is for their goals) is a key determinant of the intensity of their initial emotional response (Lench, Flores, & Bench, 2011). Over time, however, memory for that initial emotional response becomes less accessible. When people remember how a past event made them feel, what comes to mind depends partly on episodic memory, and partly on their current semantic appraisals of the emotion-eliciting event (Kaplan et al., 2016; Levine, 1997; Levine, Prohaska, Burgess, Rice, & Laulhere, 2001; Robinson & Clore, 2002). To the extent that their appraisals have changed over time, memory for emotion tends to be inaccurate. For example, undergraduates rated how anxious they felt immediately before an exam and recalled their feelings a week later. The intensity of anxiety students recalled depended on how their appraisals of the exam had changed. Compared to students who had not yet learned their grade, those who learned that they had done well on the exam underestimated how anxious they had felt whereas those who learned that they had done poorly overestimated (Safer, Levine, & Drapalski, 2002). Thus, we hypothesized that greater stability in people's appraisals of the valence of the election outcome would be associated with greater accuracy in their predictions and memories concerning their emotional response.

People who accurately remember episodic details of their autobiographical experiences may also be more accurate at predicting and remembering their emotional experience. We had a unique opportunity to test this by assessing a group of individuals with Highly Superior Autobiographical Memory (HSAM). Fewer than 100 such individuals have been identified worldwide based on extensive testing of their memories of verifiable public and autobiographical

events and testing of the consistency of their memories over time. These individuals remember personal and public events with extraordinary detail and accuracy, including events they experienced decades ago (LePort et al., 2012, LePort, Stark, McGaugh, & Stark 2016). Emotion is a critically important component of autobiographical experience, and individuals with HSAM often describe their memories as vivid and full of emotion (e.g., Parker, Cahill, & McGaugh, 2006). However, the accuracy with which individuals with HSAM remember emotion has never been tested. Including this group allowed us to assess whether having exceptionally accurate and detailed episodic memory for autobiographical events confers greater accuracy, or alters phenomenological experience, when predicting or remembering emotional responses to events.

In summary, this investigation was designed to advance theory on mental representations of emotion by addressing the following questions: How accurately can people predict and remember their emotional responses to events? How closely do people's perceptions of the accuracy of representations of emotion map onto their actual accuracy? What factors predict perceived and actual accuracy? To address these questions, we contrasted memories, which we expected to be more accurate, with predictions, which we expected to be more compelling.

The Current Investigation

In the current investigation, participants reported their predicted, experienced, and remembered emotional response to the outcome of the 2016 U.S. presidential election. In political polls prior to the 2016 presidential election, large shares of both Democrats and Republicans reported feelings of anger and fear (Pew Research Center, 2016). In addition, most political messages in the media were negative, with anger and fear appeals being especially common (Dunn & Tedesco, 2017). Thus, we assessed happiness, anger, and fear to capture emotional responses to the election outcome likely to be common. As a measure of the subjective likelihood of a Trump victory, we also assessed predicted and current feelings of surprise.

Predicted emotion and remembered emotion were expected to differ in important ways: We expected participants to remember their emotional response to the election more accurately than they predicted it. However, we expected participants to perceive their predictions to be more vivid and accurate than their memories. What would explain this disparity between actual and perceived accuracy? We expected vividness to mediate the link between importance and perceived accuracy. That is, participants were expected to appraise Trump's victory as more important when it was a future possibility than a past certainty. Greater importance should be associated with perceiving predicted emotion as more vivid than remembered emotion. In turn, greater vividness should explain the greater perceived accuracy of predicted than remembered emotion. Finally, we hypothesized that consistency over time in participants' semantic appraisals of the election outcome, and having exceptionally detailed and accurate episodic memory for personal and public events, would be associated with greater accuracy in representations of emotion.

Method

This study was part of a larger investigation of the accuracy with which people forecast different features of their emotional experience. Hypotheses for the larger project are addressed in another paper (Lench et al., 2019). The main hypotheses for the current investigation were described in a published review (Levine et al., 2018) but analyses were not preregistered. The data are available online at https://osf.io/wh7kc/.

Participants

Participants completed three online questionnaires that assessed predicted, experienced, and remembered emotion. Data collection was planned for approximately 1,000 participants (500 community participants, 500 student participants) based on estimates that this would provide sufficient power to detect a small effect size. We oversampled due to anticipated attrition over time points. We also invited all 51 individuals with HSAM to participate who had email addresses

and had consented to participate in research at the University of California, Irvine. A total of 1,217 participants began the initial questionnaire. Participants were excluded from analyses if they did not complete all three questionnaires (n = 227).[1] The final sample included 990 participants: 451 U.S. participants recruited through Amazon Mechanical Turk, 169 undergraduates enrolled in a large public research university in Texas, 337 undergraduates enrolled in a large public research university in California, and 33 individuals with HSAM. Of the sample, 65% were women; the average age was 29.23 years (SD = 12.77, range = 18 to 70 years). They reported their ethnicity as White (56%), Hispanic (15%), East Asian (11%), South Asian (6%), African American (5%), or other (7%).

The research was carried out in accordance with Institutional Review Boards (IRB) at the University of California, Irvine and at Texas A&M University. Participants received payment (Amazon Turk and HSAM) or course credit (students). The main group of participants was invited to participate through the Amazon Mechanical Turk system or university subject pools. HSAM participants had been identified using a multi-step, IRB-approved screening process at the University of California, Irvine. They were screened based on tests of their memories of verifiable public events, dates of events, and autobiographical memories (LePort et al., 2012), and laboratory memory tests (LePort et al., 2016; LePort, Stark, McGaugh, & Stark, 2017).[2]

Procedures and Materials

Time 1: Three Weeks before the Election. Participants completed an online questionnaire three weeks before the election (October 16 - 22, 2016; M = 21.94 days pre-election, SD = 1.66 days). They predicted how happy, angry, and scared they would feel, days after the election, if Donald Trump won. Each emotion was rated from 1 *(not at all)* to 9 *(extremely)*. Participants also rated how surprised they would be if Trump won, using the same scale.

Appraised valence and importance. Participants answered two questions concerning their

appraisal of the valence of the election outcome: "If Donald Trump is elected president, would you consider this to be bad for the country or good for the country?" They also rated how much they agreed that, "It will be good for the country if Donald Trump is elected President" on a scale from 1 *(strongly disagree)* to 7 *(strongly agree)*. Participants rated, "How important is the outcome of the 2016 presidential election to you" from 1 *(not at all)* to 9 *(extremely)*.

Phenomenology and perceived accuracy. Participants answered questions concerning the phenomenological experience of imagining their future emotional response and their perceived accuracy: "Earlier, we asked you to imagine that it is an evening during the week of November 8th, just days after the presidential election, and that Donald Trump won the election and will be the next President of the United States."

a) *Intensity:* "Regardless of how you expect to feel in the future, how intensely did you experience emotion while completing this survey when you were imagining this event?" 1 *(I felt detached and not emotional)* to 9 *(I felt intensely emotional)*.
b) *Experiencing*: "When you were imagining this, how much did you feel like you were actually experiencing the event?" 1 *(it did not feel like I was experiencing it)* to 9 *(it felt just like I was actually experiencing it)*.
c) *Ease:* "How difficult was it for you to imagine your reaction?" 1 *(it was very hard to imagine my reaction)* to 9 *(it was very easy to imagine my reaction).*
d) *Detail:* "In how much detail did you imagine your reaction to this event?" 1 *(vague with no or few details)* to 9 *(vivid and highly detailed).*
e) *Perceived accuracy:* "How accurately do you think you predicted how you will feel?" 1 *(just guessing)* to 9 *(completely accurate).*

Voting behavior and demographics. Participants reported whether they planned to vote, and if so, for whom. They also reported demographic information.

Time 2: The Week of the Election. The same participants completed a second online questionnaire about two days after the election (November 9 - 14, *M* = 1.90 days post-election, *SD* = 1.21 days). Using the same prompts and scales as at Time 1, with wording altered to indicate present tense, participants reported how happy, angry, scared they were feeling about Trump's victory. They indicated their current appraisal of the valence of the election outcome (dichotomous measure and continuous measure), the importance of the election outcome, how surprised they currently were that Trump won, whether they had voted and, if so, for whom.

Time 3: Three Weeks after the Election. Participants completed a third questionnaire three weeks after the election (November 27 - December 3, *M* = 20.47 days post-election, *SD* = 1.21 days).[3] They were reminded that they had completed a questionnaire days after Trump won the election, and asked to remember how they felt at that time. Participants recalled how happy, angry, and scared they had felt using the same prompts and scales as at Time 1, with wording altered to indicate past tense. Participants also rated the phenomenological experience (intensity, experiencing, ease, detail) associated with remembering their emotional reaction, and the perceived accuracy of their memory ("How accurately do you think you remembered how you felt?"). They also reported their current appraisal of the valence and the importance of the election outcome. Participants also reported how surprised they currently were that Trump won.[4]

Emotion Measures

Participants' ratings of anger and fear were highly correlated at all three time points (*r*s > .74), and negatively correlated with happiness at all three time points (*r*s < -.60). Therefore, as is common in past studies, we computed a single index of emotion by subtracting negative from positive emotion (e.g., Hackenbracht & Gasper, 2013, p. 98; Kahneman & Krueger, 2006, p. 11). We subtracted the mean rating of anger and fear for each participant from the rating of happiness to create indices for predicted emotion, experienced emotion, and remembered emotion. Emotion

indices ranged from -8 to 8, with higher ratings indicating a more positive response.[5]

Results

Relative to the main group, the sample of HSAM participants was small. Therefore, we first present analyses conducted on the main group. We then assess predictors of accuracy for both groups. Finally, we compare the main group and HSAM participants using non-parametric tests.

Preliminary Analyses

Days after the election, participants indicated that they had voted for Clinton (48%), Trump (22%), another candidate (7%), or did not vote (18%); 5% did not indicate their vote. In response to a dichotomous question, days after the election, 30% of participants indicated that Trump's victory was good for the country (supporters) and 70% indicated that Trump's election was bad for the country (detractors). Not surprisingly, Trump supporters predicted, experienced, and remembered a more positive emotional response (all means > 2.75) than did detractors (all means < -4.50). However, including supporter/detractor status in analyses did not change the findings of comparisons between predicted and remembered emotion with respect to their actual accuracy, perceived accuracy, or phenomenology, so results are presented without this variable.

The Accuracy of Predicted and Remembered Emotion

Overall, participants predicted a more negative emotional response to President Trump's election (M = -2.82, SD = 4.83) than they later experienced (M = -2.09, SD = 5.25), $t(945) = -8.90$, $p < .001$, $d = .27$, 95% CI [-0.94, -0.60]. They remembered a less negative emotional response (M = -1.85, SD = 5.09) than they had experienced, $t(945) = -3.37$, $p < .001$, $d = .08$, 95% CI [-0.34, -0.09]. (Confidence intervals for t-tests are for the difference between means.) Analyses of the direction of bias can mask the full extent of inaccuracy if some participants overestimate emotion and others underestimate. Thus, this investigation focused on overall accuracy in predicting and remembering emotion independent of the particular direction of bias.[6]

To assess the relative accuracy of predictions and memories across individuals (e.g., Mathieu & Gosling, 2012), we first computed the correlation between predicted and experienced emotion, and between remembered and experienced emotion. Participants both predicted and remembered the intensity of their emotional reaction to Trump's victory fairly accurately but memories were more accurate, $r(946) = .93$, than predictions, $r(946) = .86$, $z = 2.85$, $p = .004$. Next, we assessed the absolute accuracy of predictions and memories for each individual. We compared the absolute value of the difference between remembered and experienced emotion ($M = 1.31$, $SD = 1.50$) and between predicted and experienced emotion ($M = 1.89$, $SD = 2.03$), $t(942) = 7.85$, $p < .001$, $d = .25$, 95% CI [0.44, 0.73]. As lower values indicate greater accuracy (less difference from experience), the results again showed that participants remembered their emotional experience more accurately than they predicted it.

The Phenomenological Experience of Predicting and Remembering Emotion

Despite the greater accuracy of remembered emotion, participants perceived their predictions to be more accurate ($M = 6.96$, $SD = 1.86$) than their memories ($M = 6.41$, $SD = 1.86$), $t(954) = 8.03$, $p < .001$, $d = .26$, 95% CI [0.41, 0.68]. Figure 1 (Panel A) shows participants' ratings of the phenomenological experience associated with predicting and remembering emotion. Compared to their memories, participants rated their predictions as more intense, $t(950) = 10.33$, $p < .001$, $d = .34$, 95% CI [0.61, 0.90], more powerfully experienced, $t(955) = 6.48$, $p < .001$, $d = .21$, 95% CI [0.36, 0.68], and easier to bring to mind, $t(955) = 4.84$, $p < .001$, $d = .16$, 95% CI [0.27, 0.64]. They rated their memories as more detailed than their predictions, $t(953) = -2.06$, $p = .04$, $d = .07$, 95% CI [-0.31, -0.01].

Thus, consistent with the view that episodic details are more accessible when remembering than predicting emotional experience, participants remembered their emotional reaction more accurately than they predicted it, and perceived their memories to be more detailed. Nevertheless,

they perceived their predictions to be more accurate than their memories. They also perceived their predictions to be more vivid than their memories, that is, more intense, powerfully experienced, and easy to bring to mind. Though effect sizes were small, ranging from d = .07 to .34, these findings reveal asymmetries in both the accuracy and phenomenological experience of predicted and remembered emotion. The high intensity and sense of experiencing that accompanied prediction further suggests that participants actively imagined their future emotional response rather than making a quick cognitive calculation to predict how they would feel.

Importance and Analyses of Indirect Effects

Why did participants perceive predicted emotion to be more accurate than remembered emotion when the reverse was the case? To find out, we first examined whether the importance of the election outcome changed over time. Participants viewed the election outcome as highly important both three weeks before the election (M = 7.06, SD = 2.08), and in the days immediately following the election (M = 7.12, SD = 2.07), $t_{T1\ vs.\ T2}(955) = -1.25$, $p = .21$, $d = .04$, 95% CI [-0.06, 0.03]. But they viewed the election outcome as less important three weeks after the election (M = 6.76, SD = 2.12), $t_{T1\ vs.\ T3}(953) = 5.90$, $p < .001$, $d = .19$, 95% CI [0.20, 0.40], $t_{T2\ vs.\ T3}(952) = 8.24$, $p < .001$ $d = .27$, 95% CI [0.28, 0.45].

Next, we examined the indirect effect of vividness on the relation between importance and perceived accuracy. Participants' ratings of intensity, experiencing, and ease were highly correlated (Cronbach's $\alpha = .80$ for predicted emotion; $\alpha = .77$ for remembered emotion). To test for indirect effects in a parsimonious manner, we used the mean of these three ratings at Time 1 as an overall measure of the vividness of predicted emotion, and the mean of these three ratings at Time 3 as an overall measure of the vividness of remembered emotion. We conducted separate analyses of indirect effects for: (a) the perceived accuracy of predicted emotion, (b) the perceived accuracy of remembered emotion, and (c) the difference in perceived accuracy between predicted

and remembered emotion. Preacher and Hayes' (2008) bootstrapping method, using 5,000 bootstrap samples, was used to estimate the indirect effect of importance on perceived accuracy through phenomenological vividness. Neither the pattern nor the significance of the results changed when including as covariates the intensity of emotion predicted or remembered, and the accuracy of predictions or memories, so the models are presented without these covariates.

Modeling the perceived accuracy of predicted emotion. For predicted emotion, the indirect effect of vividness was statistically significant, $b = .25$, 95% *CI* [.21, .30]. As Figure 2 (Panel A) shows, the more participants appraised the election outcome as important at Time 1, the more vivid their predictions were. In turn, the more vivid their predictions were, the more accurate they perceived them to be. After controlling for vividness, there remained a statistically significant relation between importance and perceived accuracy, $b = .09$, $p < .001$. Thus, vividness partially explained the association between the importance of the election outcome and the perceived accuracy of predicted emotion.

Modeling the perceived accuracy of remembered emotion. For remembered emotion, the indirect effect of vividness was statistically significant, $b = .27$, 95% *CI* [.23, .31]. As Figure 2 (Panel B) shows, the more participants appraised the election outcome as important at Time 3, the more vivid their memories were. In turn, the more vivid their memories were, the more accurate they perceived them to be. After controlling for vividness, the relation between importance and perceived memory accuracy was no longer statistically significant, $b = .03$, $p = .17$. Thus, vividness fully explained the association between the importance of the election outcome and the perceived accuracy of remembered emotion.

Modeling the difference in perceived accuracy. As noted above, the election was more important to participants before it occurred than after. We conducted a final mediation analysis to find out whether this change in importance over time, and its association with vividness, explained

the greater perceived accuracy of emotion predictions than memories. The indirect effect of vividness was statistically significant, b = .12, 95% *CI* [.06, .18]. As Figure 2 (Panel C) shows, viewing the election outcome as more important when it was in the future than the past was associated with greater vividness when predicting emotion than when remembering emotion. In turn, the greater vividness of prediction than memory was associated with perceiving predicted emotion to be more accurate than remembered emotion. After controlling for the difference in vividness, the association between the difference in importance and the difference in perceived accuracy was no longer significant (b = .01, SE = .04, p = .81). Thus, the greater vividness of emotion predictions fully explained the link between viewing the election as more important before it occurred and perceiving predictions to be more accurate than memories.

These data are correlational, limiting inferences about causal direction. However, we also tested reverse mediation models. We assessed whether having a vivid representation of future or past emotion predicted the perceived importance of the election outcome, which in turn predicted the perceived accuracy of representations of emotion. A much poorer fit was found for all three reverse mediation models. Specifically, for the model of the perceived accuracy of predicted emotion, the indirect effect of importance was statistically significant, b = .04, 95% CI [.02, .07], but was a much poorer fit than the original model. The indirect effect of importance was not significant for the model of the perceived accuracy of remembered emotion, b = .02, 95% CI [-.01, .05], or for the model of the difference in perceived accuracy, b = .00, 95% CI [-.01, .01].

Associations between phenomenological experience and accuracy. As the models above show, vividness was strongly associated with the perceived accuracy of predicted emotion, $r(954) = .67$, $p < .001$, and remembered emotion, $r(950) = .66$, $p < .001$. We examined whether phenomenological experience (i.e., vividness and perceived accuracy) provided a reliable guide to the actual accuracy of representations of emotion. For predicted emotion, statistically significant

but relatively weak associations were found between vividness and actual accuracy (i.e., greater vividness was associated with less deviation between predicted and experienced emotion), $r(943) = -.07$, $p = .04$, and between perceived accuracy and actual accuracy, $r(946) = -.10$, $p = .003$. Similarly, for memory, statistically significant but relatively weak associations were found between vividness and actual accuracy, $r(941) = -.09$, $p = .005$, and between perceived accuracy and actual accuracy, $r(944) = -.17$, $p < .001$. Thus, vividness was strongly associated with the perceived accuracy of representations of emotion but weakly associated with their actual accuracy.

What Predicts the Actual Accuracy of Representations of Emotion?

Next, we examined whether greater accuracy in representations of emotion would be found for participants who: (a) showed greater stability in their semantic appraisals of the valence of the election outcome, or (b) had superior episodic memory for autobiographical events (HSAM). These analyses included both groups of participants.

Stability of semantic appraisals. Stability in appraisals refers to consistency over time in participants' beliefs about how good Trump's victory would be for the country. Three weeks before the election, participants as a group did not appraise Trump's election as good for the country ($M_{Time1} = 2.34$, $SD = 1.90$), with mean ratings significantly below the midpoint of 4 on the 7-point scale, $t(988) = -27.41$, $p < .001$. Appraisals became more positive days after the election ($M_{Time2} = 2.82$, $SD = 2.07$), $t(987) = -12.99$, $p < .001$, $d = .42$, 95% CI [-0.47, -0.54]. Three weeks later, a tendency toward even more positive appraisals was found ($M_{Time3} = 2.87$, $SD = 2.10$), $t(987) = -1.95$, $p = .052$, $d = .06$, 95% CI [-2.60, -0.37].

We conducted a regression analysis on the accuracy of emotion predictions. The dependent measure was the absolute value of the difference between predicted and experienced emotion. As a reminder, lower values represent greater accuracy. The model included the stability of semantic appraisals over time (that is, the absolute value of the difference between appraised valence at

Time 1 versus Time 2; lower values represent greater stability), HSAM status (main group = 0, HSAM = 1), and their interaction. The model was significant, R^2 = .17, F(3, 973) = 66.53, MSE = 3.41, p < .001. The more stable participants' appraisals were concerning the valence of the election outcome, the more accurately they predicted their emotional response, b =.82, SE = .06, β = .41, t = 14.01, p < .001. HSAM status, and the interaction between appraisal stability and HSAM status, were not significant predictors of accuracy (β = .03 and -.02, respectively, ps > .49).

We conducted the same regression analysis with memory accuracy as the dependent variable. The model included appraisal stability (Time 2 vs. Time 3), HSAM status, and their interaction. The model was significant, R^2 = .02, F(3, 973) = 7.78, MSE = 2.18, p < .001. The more stable participants' appraisals were concerning the valence of the election outcome, the more accurately they remembered their emotional response, b =.30, SE = .06, β = .15, t = 4.69, p < .001. HSAM status and the interaction were not significant predictors (β = -.03 and .00, ps > .47). Thus, as hypothesized, greater consistency over time in participants' semantic appraisals was associated with greater accuracy in both predicting and remembering emotion. In contrast to hypotheses, HSAM participants did not show greater accuracy in predicting or remembering emotion.

Superior memory for autobiographical events. We also compared the emotion predictions and memories of participants with HSAM versus the main group using non-parametric tests (two-tailed Mann-Whitney z-tests). Preliminary analyses revealed that HSAM participants did not differ from the main group in the intensity of forecast, experienced, or remembered emotion (ps > .22), nor did they differ from the main group in their ratings of the importance of the election outcome at any time point (ps > .50).

Correlations of predicted and remembered emotion with experience showed that HSAM participants tended to be more accurate when remembering, r(32) = .95, than predicting emotion, r(32) = .86. These correlations were almost identical to those found for the main group. HSAM

participants also did not differ from the main group in the absolute accuracy of predicted emotion, z = -0.97, p = .33, or remembered emotion, z = 0.42, p = .67. Like the main group, HSAM participants remembered their emotional response (M = 1.09, SD = 1.04) more accurately than they predicted it (M = 2.11, SD = 1.86), t(32) = 3.37, p = .002, d = .25, 95% CI [1.39, 2.29].

Finally, we assessed HSAM participants' phenomenological experience. For HSAM participants, perceived accuracy did not differ for predicted emotion (M = 6.63, SD = 2.37) and remembered emotion (M = 6.61, SD = 2.03), t(31) = 0.11, p = .91, d = .01, 95% CI [-1.24, 1.11]. Figure 1 (Panel B) shows HSAM participants' ratings of the phenomenological experience of predicting and remembering emotion. Like the main group, HSAM participants rated the experience of predicting emotion as more intense than the experience of remembering emotion, t(32) = 2.71, p = .01, d = .44, 95% CI [0.25, 1.75]. Like the main group, HSAM participants perceived their memories to be more detailed than their predictions, t(32) = -2.72, p = .01, d = .49, 95% CI [-2.60, -0.37]. No other differences between predictions and memories were found for participants with HSAM. Comparing HSAM participants with the main group revealed no difference in the perceived accuracy of predicted emotion, z = -0.49, p = .63, or remembered emotion, z = 0.89, p = .37. HSAM participants differed from the main group only in rating their memories as more detailed than the main group, z = 2.74, p = .006. In summary, individuals with exceptionally accurate and detailed memory for personal and public events did not show superior ability to predict or remember their emotional response to an important public event.

Discussion

People rely on representations of future and past emotion to guide choices in their daily lives (e.g., Miloyan & Suddendorf, 2015). But fundamental differences between yesterday and tomorrow have implications for the accuracy of these representations, and for how accurate and compelling people perceive them to be. Remembering emotion is rooted in experience whereas

predicting emotion is an inherently uncertain business. People lack episodic detail concerning their future emotional reactions, semantic appraisals of upcoming events change, and events themselves rarely turn out precisely as envisioned. Thus, comparing predictions and memories reveals how the vividness and perceived accuracy of mental representations of emotion map onto their actual accuracy. This investigation assessed participants' emotional response to Donald Trump's victory in the 2016 U.S. presidential election. This was the first investigation to directly compare predicted and remembered emotion concerning a highly-emotional real world event with respect to accuracy, perceived accuracy, and phenomenological experience. Assessing a politically diverse group of participants, as well as individuals with Highly Superior Autobiographical Memory, provided a strong test of the generalizability of the findings and yielded new insights about the abilities and limitations of a unique group.

The results revealed asymmetries between representations of future and past emotion. Participants remembered their emotional response to President Trump's election more accurately than they predicted it, and perceived their memories to be more detailed. Strikingly, however, they perceived their predictions to be more accurate and more vivid than their memories. This perception was explained by the greater importance of the election outcome when it was a future possibility than a past certainty. Even for individuals with HSAM, predicting emotion was a more intense experience than remembering emotion. Stability over time in participants' semantic appraisals of the election outcome was associated with accuracy in their representations of emotion. Having superior episodic memory for autobiographical events was not associated with greater accuracy.

Similarities found between Predicted and Remembered Emotion

Emotion predictions and memories were similar in two notable ways. First, participants both predicted and remembered the intensity of their feelings about Trump's election fairly

accurately. Past research has also shown high accuracy when people predict or remember the intensity of their feelings about events (e.g., Doré et al., 2016; Kaplan et al., 2016; Lench et al., 2019; Levine et al., 2012). Far less accuracy is found when people predict or remember their general emotional experience, a judgment that encompasses multiple features of emotion including intensity, duration, and mood (e.g., Wilson et al., 2000). Second, participants' perceptions of the accuracy of their predictions and memories were strongly related to their vividness but weakly related to their actual accuracy. The phenomenological cues of vividness and fluency can render people poor judges of how much they have learned and will later remember (Benjamin et al., 1998; Kruger & Dunning, 1999). We found that vividness was not a particularly reliable guide to the actual accuracy of predicted and remembered emotion.

Remembered Emotion is More Trustworthy, Predicted Emotion is More Trusted

Predicted and remembered emotion also differed in important ways. Participants remembered their emotional response to Trump's victory more accurately than they predicted it. They also perceived their memories to be more detailed than their predictions. Bringing to mind past experiences and imagining future ones both involve drawing from a complex body of knowledge (Conway & Lovejoy, 2015). However, imagining future experiences requires more cognitive acrobatics, including extracting details from past experiences and flexibly recombining them into a novel experience (Schacter & Addis, 2007; Schacter et al., 2012). To simulate how they would feel in the future if Trump won the election, participants had to piece together episodic memories of related past experiences and draw on semantic knowledge and appraisals. In contrast, episodic detail about their actual emotional response to Trump's victory was available to participants after the election. This likely explains why participants remembered their emotional experience more accurately than they predicted it. Despite the greater accuracy of memory than prediction, the main group of participants perceived their predictions to be more accurate. They

also perceived their predictions to be more vivid than their memories, even adjusting for the extremity of emotion predicted and remembered. Specifically, compared to remembering their feelings, participants perceived the experience of predicting their feelings to be more intense, accompanied by a greater sense of experiencing the event, and easier to bring to mind.

Why did participants perceive predicted emotion to be more accurate than remembered emotion when the reverse was the case? Emotions likely evolved to motivate action (Miloyan & Suddendorf, 2015). Future events can be acted on and changed but past events cannot, so people accommodate to them (Frederick & Loewenstein, 1999; Wilson & Gilbert, 2008). This inherent asymmetry endows the future with greater importance than the past (Van Boven & Caruso, 2015). Extending this view, we proposed that the greater importance of future emotional experiences makes predictions particularly vivid, rendering people vulnerable to misjudging their accuracy. Consistent with this proposal, participants viewed the outcome of the 2016 presidential election as more important when it was a future possibility than a past certainty. Greater importance was associated with perceiving representations of emotion to be more accurate. Analyses of indirect effects further showed that the association between greater importance and perceived accuracy was fully explained by participants' more vivid phenomenological experience when predicting than remembering emotion. These findings suggest that viewing an event as more important before it occurs than afterwards imbues predicted emotion with greater vividness than remembered emotion, which in turn is linked to perceiving emotion predictions to be more accurate than memories.

Researchers often use the term "vividness" to refer to the clarity and detail of visual imagery when people remember past experiences or imagine future ones (e.g., D'Argembeau & Van der Linden, 2004; Rubin & Kozin, 1984). Retrospection is typically associated with greater visual clarity and detail than prospection (e.g., Cole & Berntsen, 2016). However,

phenomenological properties other than detailed imagery contribute to the vividness of mental representations (Habermas & Diel, 2013; Kensinger, Addis, & Atapattu, 2011; Van Boven & Ashworth, 2007). For example, a person's memory of their recent drive to the grocery store might be clear and detailed but lackluster. A person's memory of their recent near miss on the freeway might lack clarity and detail but be vivid. Core features of an experience can come to mind with ease, as if they were happening in the moment, and accompanied by intense emotion, even if a representation is not especially detailed (Kensinger et al., 2011). In the current investigation, these properties of ease, experiencing, and intensity, rather than detail, characterized anticipated emotion more than remembered emotion.

Factors Associated with the Accuracy of Emotion Predictions and Memories

We also examined two factors that we expected to be associated with greater accuracy in representations of emotion. Past research shows that, as episodic memory for emotion fades, people rely on their current semantic appraisals of the emotion-eliciting event (e.g., "How good or bad is this event for my goals?") to reconstruct how they must have felt. The more people's appraisals change over time, the less accurately they remember how they felt (e.g., Kaplan et al., 2016; Levine, 1997; Robinson & Clore, 2002). In the current investigation, greater stability in participants' appraisals of whether Trump's election was good for the country was associated with greater accuracy in their memory for how they had felt. Extending past research, greater stability in appraisals was also associated with greater accuracy in predicting emotion. These findings suggest that people draw on their semantic appraisals of events both to remember how they felt in the past and to simulate how they will feel in the future.

We also examined whether people with detailed and accurate episodic memories of autobiographical experiences were better than others at remembering or predicting emotional responses to experiences. Individuals with Highly Superior Autobiographical Memory perform

similarly to controls on many standard cognitive tests (e.g., mental imagery, attention; LePort et al., 2017). They also show similar susceptibility to memory bias when presented with misleading post-event information (Patihis et al. 2013). Thus, these individuals do not appear to encode personal or public events in a unique way but they retain representations of the events they experienced in greater detail and for far longer than controls, suggesting unusually efficient memory consolidation and retrieval (Le Port et al., 2012, 2016, 2017). Emotion is an important part of autobiographical experience but memory for emotion had never been tested in this group.

We found that participants with HSAM did not differ from other participants in the accuracy with which they predicted or remembered emotion. They also did not differ from others in the perceived accuracy of emotion predictions or memories, though they did perceive their memories to be more detailed. Like the main group, participants with HSAM found predicting emotion to be a more intense experience than remembering emotion. Taken together, these findings highlight differences between remembering the "what," "where," and "when" of events (Tulving, 2002), which individuals with HSAM do with extraordinary accuracy and detail, and predicting or remembering feelings about events. These findings again highlight the important contribution of semantic appraisals to representation of emotion. The consistency of semantic appraisals (e.g., how good or bad is this outcome for my goals) was associated with greater accuracy in representations of emotion; having superior episodic memory for events that may evoke emotion was not. The exceptional abilities of individuals with HSAM do not appear to extend to this type of semantic knowledge about the self.

Researchers have speculated that experiencing events with heightened emotional intensity may be one mechanism underlying the ability of individuals with HSAM to retain details of autobiographical and public events (McGaugh, 2017). However, HSAM participants did not experience more intense emotion in response to the election compared to the main group of

participants at any time point. These individuals also remember neutral information more accurately than controls, such as conversations about their day during a lab session the previous week (LePort et al., 2017). Thus, heightened emotional arousal is not likely to be a primary mechanism underlying this group's superior memory for autobiographical events. In summary, superior memory for personal and public events did not confer superior ability to predict or remember emotion. These findings refine our understanding of the abilities and limitations of a unique group, and suggest that emotional intensity is not the mechanism underlying their abilities. The findings also point to important differences between remembering episodic details of autobiographical events versus emotions, and underscore the compelling nature of anticipated emotion.

Limitations and Directions for Future Research

This investigation examined representations of emotion in the context of a real world event of significance, but limitations should be noted. The correlational nature of the data limits causal conclusions. In future laboratory studies, researchers should vary the importance of events and assess the effects on the accuracy, perceived accuracy, and vividness of predicted and remembered emotion. Using a repeated measures design had the benefits of allowing us to compare emotion predictions and memories while controlling for participants' emotional reactivity, cognitive ability, and political orientation. However, such designs can be susceptible to order effects. Memory is more constrained than prediction by the need to adhere to prior experience (Kane et al., 2012). Beyond this inherent temporal asymmetry, however, past research makes it unlikely that order effects account for our findings. In the absence of explicit interventions, making repeated emotion judgments has not been shown to increase their accuracy (e.g., Ayton, Pott, & Elwakili, 2007; Wilson et al., 2003). Making repeated emotion judgments also does not decrease perceived accuracy. Indeed, research shows that participants often misremember their past judgments as

more accurate than they really were. For example, after mispredicting their emotional response to an election outcome, participants misremembered their predictions as having been consistent with their experience (Meyvis, Ratner, & Levav, 2010). Finally, order effects cannot explain the finding that, for prediction as well as memory, vividness accounted for the association between importance and perceived accuracy.

MTurk workers differ from the general population in meaningful ways, including having higher rates of social anxiety and depression (e.g., Arditte et al., 2016). In the current study, however, both students and MTurk participants remembered their emotional response to the election outcome more accurately than they predicted it, yet perceived their predictions to be more accurate and vivid than their memories (all *p*s < .002). Thus, including MTurk participants did not appear to limit the generalizability of the current findings.

Finally, an issue of growing interest in the literature is the extent to which simulations of future experiences inform planning and action (Barsics, Van der Linden, & D'Argembeau, 2016). This study assessed both anticipated emotion (emotion expected to occur in the future), and anticipatory emotion (whether the prospect of a future outcome was accompanied by emotion in the present). Future research should assess the extent to which these differing emotional components of future thinking motivate goal pursuit (e.g., Barsics et al., 2016). In addition, beliefs about the accuracy of emotion predictions are likely to interact with belief in occurrence to motivate goal pursuit (Ernst, Scoboria, & D'Argembeau, 2019). That is, people may believe that they have accurately represented how a possible future event would make them feel. This belief is most likely to guide their actions if they also believe the event will actually occur. Recent research shows that belief in accuracy and belief in occurrence have both overlapping and distinct determinants. The personal importance of an event and the vividness of mental representations contribute to both judgments, consistent with our findings on perceived accuracy. However, belief

that an event will occur also depends on the extent to which that event is integrated in a broader autobiographical context (e.g., links with other events, personal plausibility; Ernst et al., 2019). Future research should examine how belief in the accuracy of predicted emotion, and belief that emotion-eliciting events will occur, interact to predict people's actions.

Conclusions

In conclusion, when emotion comes to mind, tomorrow's vividness trumps yesterday's accuracy. Anticipated emotion has a powerful influence on behavior (Miloyan & Suddendorf, 2015; Seligman et al., 2013). This investigation advances past research by helping to explain why. The results showed asymmetries in both the accuracy and phenomenological experience of anticipated and remembered emotion. People remembered their feelings more accurately than they predicted them yet they perceived their predictions to be more accurate and vivid than their memories. The vividness of mental representations often serves as a reliable cue to their accuracy (Koriat et al., 2000) and their usefulness as a guide to behavior (Hembacher & Ghetti, 2017). But when people predicted how they would feel about a future event that they considered important, phenomenological cues pointed powerfully to accuracy irrespective of whether their predictions were right or wrong.

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Footnotes

[1]To allow us to directly compare predicted, experienced, and remembered emotion for each participant, we excluded data from participants who did not complete all three questionnaires. Participants who did not complete all three questionnaires did not differ from those who did with respect to the intensity of emotions predicted, the importance of the election, whether they planned to vote, or for whom they planned to vote (all *p*s > .11).

[2]Following publication of a case study (Parker et al., 2006) and media reports, individuals who contacted the researchers claiming to have HSAM underwent two screening procedures (LePort et al., 2012). The Public Events Quiz asked individuals to provide the date and day of the week when prompted with significant public events during their lifetime, and to provide the significant public event and day when prompted with dates during their lifetime. Those who scored 50% correct or more completed the 10 Dates Quiz. This quiz asked individuals to describe a verifiable public event, and an autobiographical event, that occurred within ± one month of 10 randomly generated dates, and indicate the day of the week for all events. Researchers classified those who scored 65% or above as having HSAM. Individuals with HSAM scored an average of 85% on the 10 Dates Quiz, compared to an average of 8.2% for age- and sex-matched controls (see LePort et al., 2012, for a detailed description of the screening method).

[3]On average, there was a three-week interval between ratings of predicted and experienced emotion, and between ratings of experienced and remembered emotion. To account for minor differences in interval length, preliminary analyses included as a covariate the difference in days between the prediction interval and the retention interval. This did not change the pattern or significance of any of the findings so results are presented without this covariate.

[4]Participants viewed Trump's victory as very surprising at Time 1 (M = 6.89, SD = 2.28), Time 2 (M = 7.16, SD = 2.20), and Time 3 (M = 6.99, SD = 2.22). Including the difference in

surprise at the time of prediction versus memory did not change the pattern or significance of any of the findings, so results are presented without this covariate.

[5]Happiness, anger, and fear differ along many dimensions other than valence (e.g., Kragel & LaBar, 2015). Thus, we also compared the accuracy of predictions and memories for each individual emotion. The results were consistent with those reported in the text, and are available online in Supplemental Figure S1 (direction of bias), and Figure S2 (overall magnitude of inaccuracy). Specifically, memories were more accurate than for predictions for all three emotions, and for both Trump supporters and detractors, with one exception: Happiness ratings were quite low for Trump detractors (all means < 1.59), thus predicted and remembered happiness did not differ in accuracy for this group.

[6]Results for the direction of bias are available online in Supplemental Figure S1.

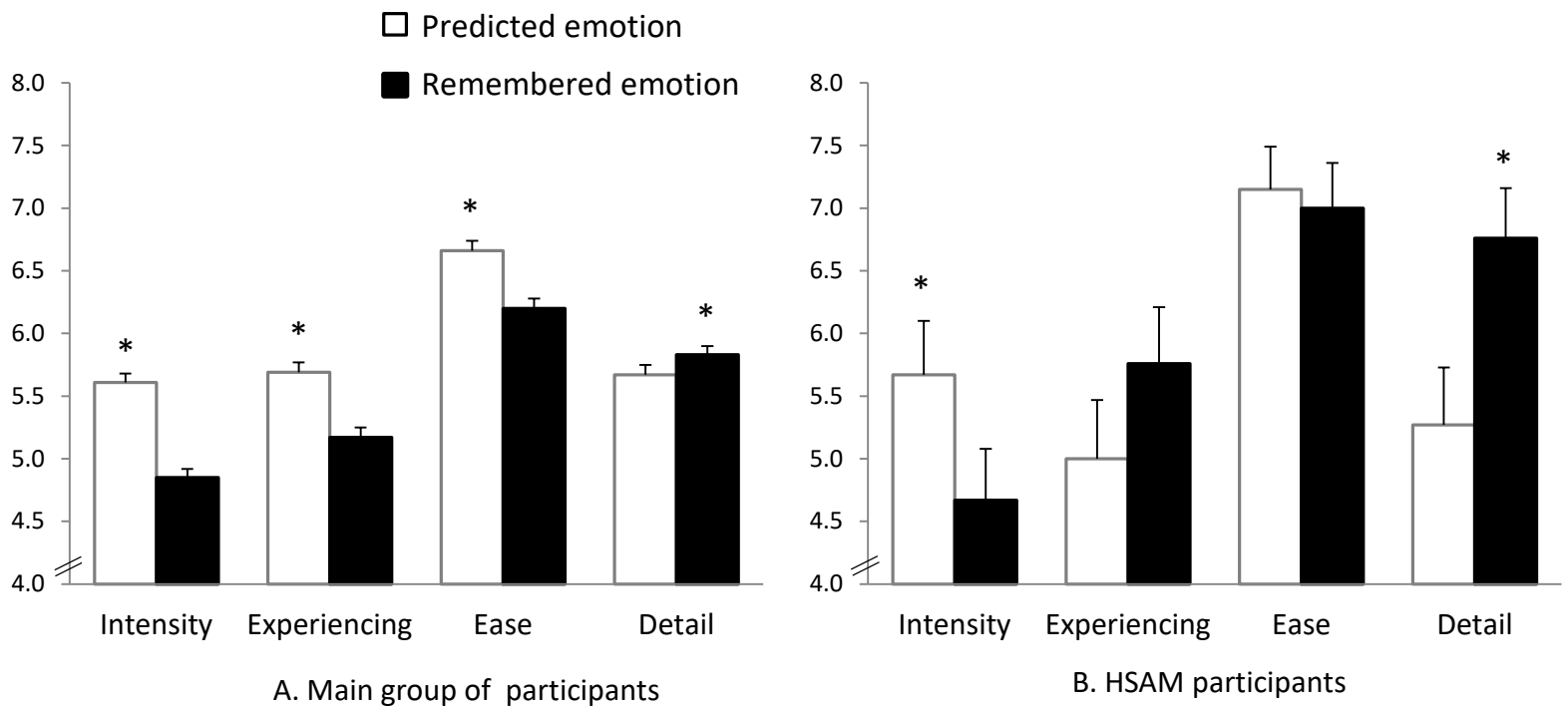
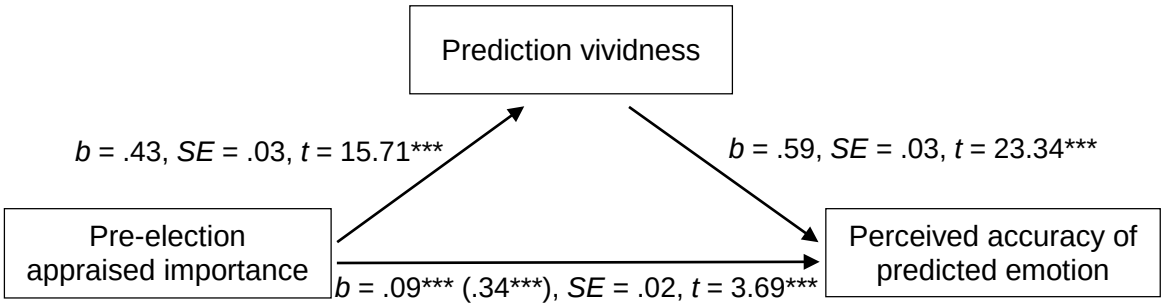
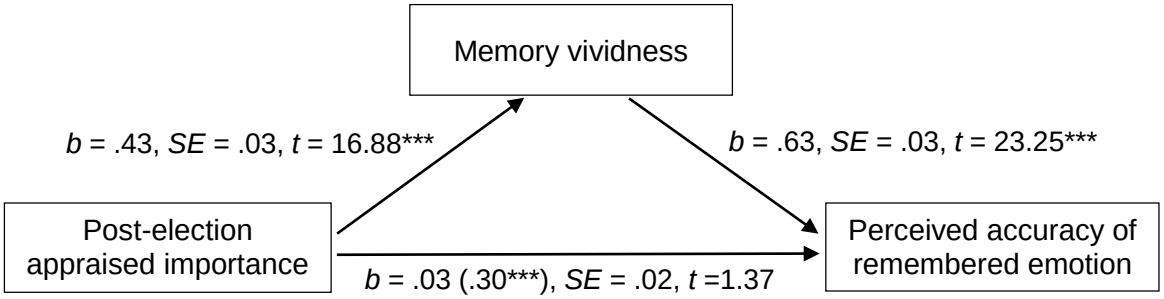


Figure 1. Mean ratings of the phenomenological experience associated with predicting emotion (3 weeks pre-election) and remembering emotion (3 weeks post-election) for the main group of participants (N = 957) and HSAM participants (N = 33). Error bars represent +1 standard error. Asterisks represent statistically significant comparisons ($p < .05$).

A. Predicted emotion



B. Remembered emotion



C. Predicted vs. remembered emotion

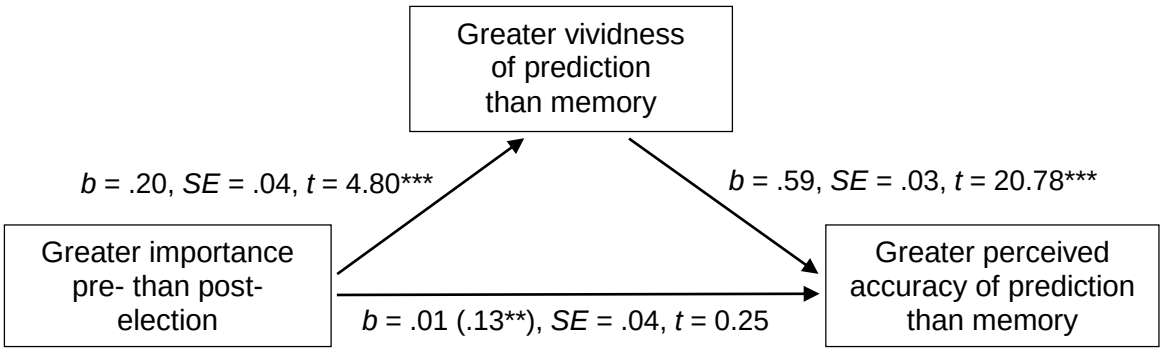
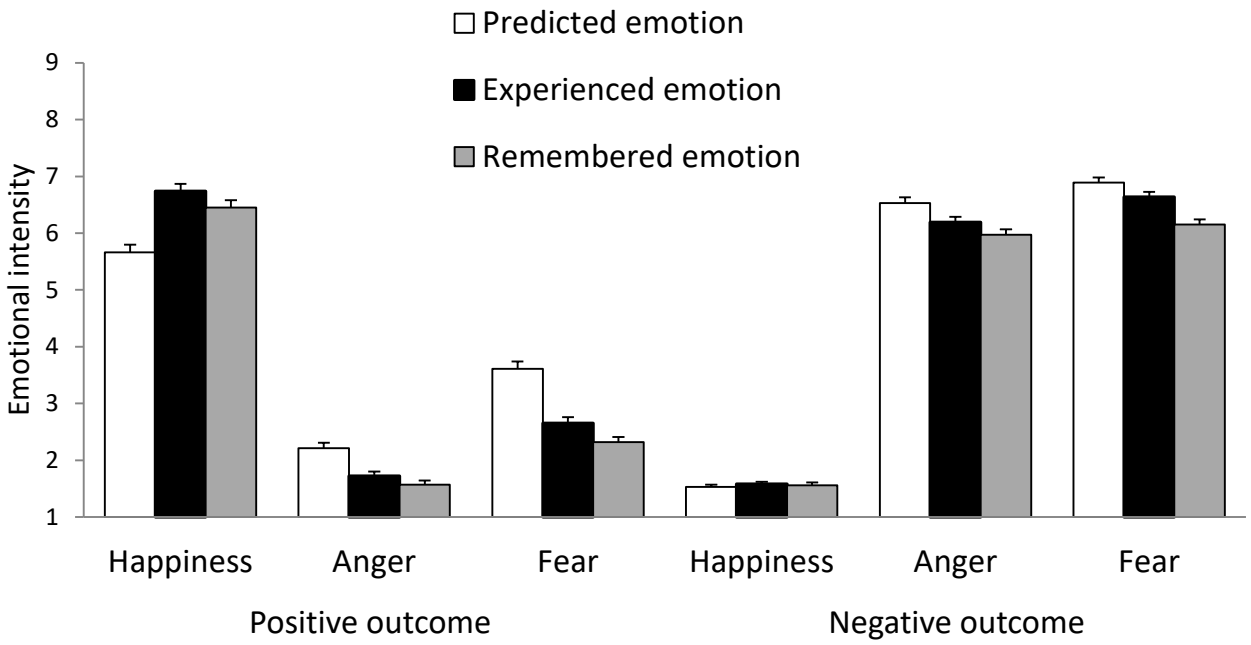


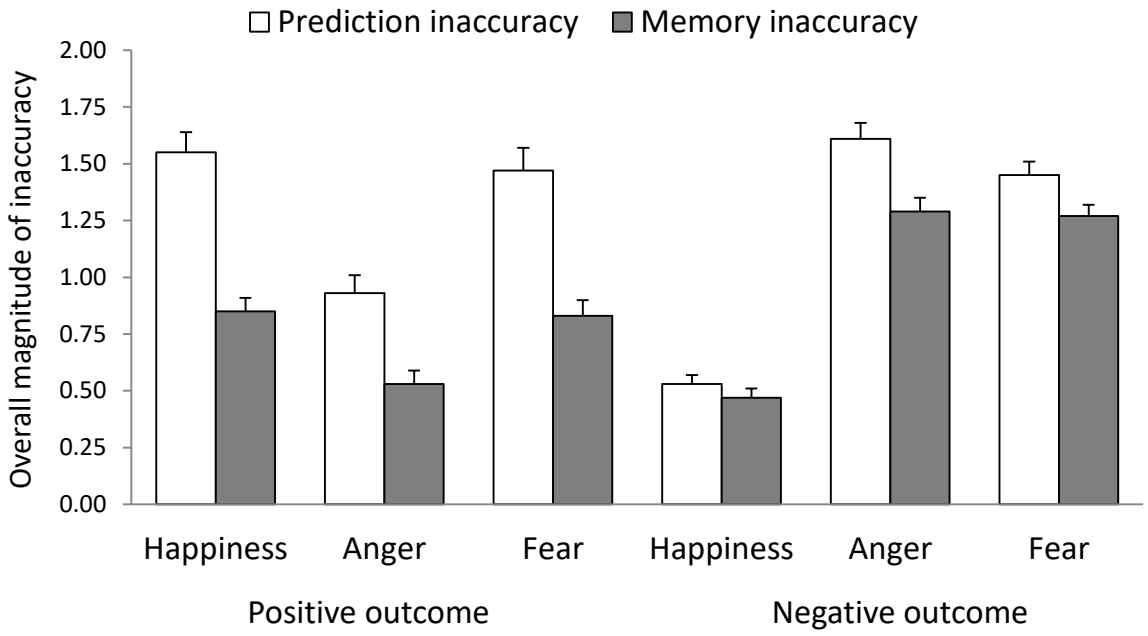
Figure 2. Phenomenological vividness explained the association between appraising the election outcome as more important and perceiving emotion representations to be more accurate. Unstandardized coefficients are presented. Total effects of importance predicting perceived accuracy are shown in parentheses. Panel A: For predicted emotion, *Adj.* R^2 = .46***; Mediated effect = .25, *SE* = .02, 95% *CI* [.21, .30]. Panel B: For remembered emotion, *Adj.* R^2 = .44***; Mediated effect = .27, *SE* = .02, 95% *CI* [.23, .31]. Panel C: For the difference between predicted and remembered emotion, *Adj* R^2 = .32; Mediated effect = .12, SE = .03, 95% *CI* [.06, .18]. **p < .01. ***p < .001.

Supplemental Material: Figure S1



Supplemental Figure S1. Mean intensity of predicted, experienced, and remembered emotion for participants who viewed the election outcome as positive (n = 295) or negative (n = 695). Participants rated the intensities of happiness, anger, and fear from 1 *(not at all)* to 9 *(extremely)*. Error bars represent +1 standard error.

Supplemental Material: Figure S2



Supplemental Figure S2. Overall magnitude of inaccuracy (independent of direction), for participants who viewed the election outcome as positive (n = 295) or negative (n = 695). Overall magnitude of inaccuracy refers to the absolute value of the difference between predicted and experienced emotion, or between remembered and experienced emotion. Error bars represent +1 standard error.