

## Bias in predicted and remembered emotion

Linda J Levine<sup>1</sup>, Heather C Lench<sup>2</sup>, Melissa M Karnaze<sup>1</sup> and Steven J Carlson<sup>1</sup>

Predicting and remembering emotion both rely on the episodic memory system which is constructive and subject to bias. In keeping with the common cognitive processes underlying prospection and retrospection, people show similar strengths and weaknesses when they predict how they will feel in the future and remember how they felt in the past. Recent findings reveal that people predict and remember the intensity of emotion more accurately than their overall or general emotional response, and whether emotion is overestimated or underestimated depends on how people's attention to, and appraisals about, events change over time. People's phenomenological experience differs markedly when they are predicting versus remembering emotion, however. Phenomenological cues, such as intensity and autothetic experience, make predicted emotion a more compelling guide for decisions, even when inaccurate.

### Addresses

<sup>1</sup> Department of Psychology and Social Behavior, 4201 Social & Behavioral Sciences Gateway, University of California, Irvine, Irvine, CA 92697-7085, United States

<sup>2</sup> Department of Psychology, 4235 TAMU Psychology Building, Texas A & M University, College Station, TX 77843, United States

Corresponding author: Levine, Linda J ([llevine@uci.edu](mailto:llevine@uci.edu))

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People base decisions, large and small, on predicted emotion. Whether deciding if they should have children, change careers, or have pasta for dinner, people try to predict how future outcomes will make them feel so they can pursue those that will make them happy. These predictions, in turn, are based on their memories of how they felt in related circumstances in the past. So predicted and remembered emotion serve as a mental road map or GPS directing people toward decisions that should enhance their wellbeing. Problems arise because these representations can be inaccurate. To understand

when and why our mental GPS goes awry, we review research demonstrating strengths and weaknesses in people's ability to predict and remember emotion, processes that contribute to those strengths and weaknesses, and consequences for decision making. Finally, we raise issues in need of further research.

### Common processes underlie predicting and remembering emotion

A growing body of evidence indicates that imagining future experience relies on the episodic memory system which supports people's ability to represent the time, place, and personal context in which events occurred. Neuroimaging studies show that bringing to mind past experiences and imagining future ones activate an overlapping network of brain regions including the hippocampus and parahippocampal cortex within the medial temporal lobes [1,2]. Amnesic patients with damage to these regions are unable to recollect past experiences and also draw a blank when asked to imagine their personal future [3]. In nonclinical populations, retrospection and prospection are affected by similar experimental manipulations [4] and have similar developmental trajectories [5].

Schacter and Addis [6] proposed that a key function of the episodic memory system is to permit simulation of future experience. Although episodic memory is constructive and error prone [7], being able to pull apart and update representations of past experiences allows people to piece them together in novel ways to simulate and prepare for the future. Semantic knowledge also scaffolds episodic representations of both past and future experiences [8]. As temporal distance from events increases, and relevant episodic details become less accessible, memories and predictions increasingly rely on semantic knowledge such as appraisals of the importance of events for personal goals [9].

### Similar sources and patterns of bias when predicting and remembering emotion Overestimation of emotion

Consistent with evidence of common underlying cognitive processes, similar biases have been found when people predict and remember emotion. The fundamental source of inaccuracy is that people extrapolate from beliefs, memories, and feelings that are currently salient to predict how they will feel in the future or remember how they felt in the past. Errors occur when salient information is unrepresentative of actual emotional

experience. Gilbert and Wilson have demonstrated that relying on salient but unrepresentative information often leads people to overestimate the overall emotional impact of future events [10]. For example, when predicting how an event will make them feel, people often focus on salient features of the event and neglect to consider the broader context in which the event will occur. Failing to consider mundane events that will also occupy their attention in the future leads people to overestimate their overall emotional experience [11]. To predict emotion, people also rely on memories of how they felt in similar circumstances in the past [12<sup>\*\*</sup>]. The most accessible memories often concern experiences that were particularly emotionally intense [13]. Basing predictions on these unrepresentative memories can lead to overestimating future emotion [14]. People also tend to predict the peak intensity of emotion they will feel rather than how they will adapt to events over time [15,16]. Similarly, when people remember how they felt in the past, focusing on salient but unrepresentative moments, such as the peak and end of an experience, leads people to overestimate their average or overall emotional response [17,18].

Overestimating emotion sometimes leads to poor decisions. People who anticipated feeling more devastated if they learned they were at risk of developing a serious, but medically actionable, disease were less willing to obtain results of genetic tests [19]. In another study, women who anticipated greater stress if they took recommended medication to reduce their high risk of breast cancer were more likely to refuse those medications [20]. Compared to prior research showing hedonic adaptation to physical injuries, laypeople and rehabilitation specialists overestimated how long injury victims would suffer. This bias may result in excessive damage awards in court to compensate victims for hedonic loss [21]. Yet, overestimating emotion also boosts motivation [22,23]. Participants who could influence future outcomes overestimated more when predicting emotion, and experimentally increasing overestimation led participants to try harder to pass a memory test [24]. Similarly, when remembering past emotion, the more students overestimated their pre-exam anxiety, the harder they planned to study for the next exam [25]. Thus, overestimating emotion may be the price of a potent source of motivation.

#### Variation in the direction and magnitude of bias

People do not always overestimate in predicting and remembering emotion, however. Recent research reveals underestimation [26<sup>\*\*</sup>,27,28], and accuracy [12<sup>\*\*</sup>,29<sup>\*</sup>,30<sup>\*\*</sup>], as well as overestimation [31,32,33<sup>\*</sup>]. To account for this variation, Buechel, Zhang, and Morwedge [26<sup>\*\*</sup>] proposed that emotional experiences are more attention absorbing and richly detailed than forecasts. As a result, forecasters attend more than experiencers to characteristics of events that are typically diagnostic of an event's hedonic impact. For example,

participants overestimated when asked to predict how happy they would feel after getting a large, unexpected prize but underestimated how happy they would feel after getting a small, expected prize. The researchers argue that, because only a few hedonically diagnostic characteristics of events are salient when predicting emotion, people overestimate their reactions to major events but are often taken aback by the power of their reactions to more subtle losses and gains.

The direction of bias in predicting and remembering emotion can also vary for a single event (e.g. a romantic break-up, receiving an exam grade) depending on how people's attention to, and appraisals of, that event change over time. For example, focusing attention on salient events, and neglecting the broader context in which those events will occur, does not always lead to overestimating future emotion. People underestimate their emotional response when the context in which events are experienced, such as public holidays, media attention, or sharing experiences with others, heightens their focus on those events. In one study, participants were invited in January to predict how they would be feeling on February 14, or on February 7, if their current romantic relationship were to end before that time. Those whose relationships later did end had underestimated in predicting their distress if they reported their emotional experience on Valentine's Day when having a romantic partner was the focus of their attention and viewed as important, but overestimated their distress if they reported their feelings on an ordinary day one week earlier [28].

Relatively few studies have examined how changes in people's appraisals of events bias their predictions, but it is well-documented that remembered emotion shifts in directions consistent with people's current appraisals of emotion-eliciting events [34–36]. Compared to undergraduates who had not yet received their grade on an exam, students who learned that they had done well on the exam underestimated their pre-exam anxiety whereas those who learned that they had done poorly overestimated. Thus, the direction of memory bias depended on how students' appraisals of the exam had changed [25]. Inaccuracy resulting from changing appraisals is particularly likely as temporal distance from events increases, relevant episodic details fade, and people rely more on semantic knowledge or appraisals concerning events to scaffold memories and predictions of emotion [36,37].

Finally, people are better at predicting and remembering some features of their emotional experience than others. People show greater accuracy when they predict emotional intensity than when they predict their general emotional response, a judgment commonly assessed in the research literature which encompasses emotional intensity, duration, and mood. For example, participants were highly accurate in predicting the intensity of their

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