Title
Bias in predicted and remembered emotion

Authors
Levine, LJ
Lench, HC
Karnaze, MM
et al.

Publication Date
2018-02-01

DOI
10.1016/j.cobeha.2017.10.008

Peer reviewed

Levine, L. J., Lench, H. C., Karnaze, M. M., & Carlson, S. J. (2018). Bias in predicted and remembered emotion. *Current Opinion in Behavioral Sciences*, *19*, 73-77. https://doi.org/10.1016/j.cobeha.2017.10.008

Bias in Predicted and Remembered Emotion

Linda J. Levine[1]

Heather C. Lench[2]

Melissa M. Karnaze[1]

Steven J. Carlson[1]

Affiliation

[1]University of California, Irvine

[2]Texas A & M University

Addresses

[1]Department of Psychology and Social Behavior, 4201 Social & Behavioral Sciences Gateway, University of California, Irvine, Irvine, CA 92697-7085

[2]Department of Psychology, 4235 TAMU Psychology Building, Texas A & M University, College Station, TX 77843

Corresponding author

Levine, Linda J., (llevine@uci.edu)

Abstract

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 over- 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 autonoetic experience, make predicted emotion a more compelling guide for decisions, even when inaccurate.

Highlights:

- The episodic memory system supports predicting and remembering emotional experience
- Similar patterns of accuracy and bias characterize predicted and remembered emotion
- Intensity is represented more accurately than overall emotional experience
- The direction of bias depends on how attention and event appraisals shift over time
- Phenomenological experience differs markedly for predicted and remembered emotion

Bias in Predicted and Remembered Emotion

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]. The most accessible memories often concern experiences that were particularly emotionally intense [13]. Basing predictions 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,

summarize the previous part of this paragraph: ppl tent to overestiamte!

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 [26–28], and accuracy [12,29,30], as well as overestimation [31–33]. To account for this variation, Buechel, Zhang, and Morewedge [26] 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]. kind like misattribution? cant really tell it is the experienced emotion changes, or the predicted emotion changes

Relatively few studies have examined how changes in peoples' 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 feelings about Obama's election in 2008 but overestimated when asked to predict and later report their feelings in general [30]. Undergraduates showed high accuracy when predicting the intensity of their feelings about receiving a better or worse exam grade than expected, but overestimated when asked to predict and later report their feelings in general [30]. Dore and colleagues [12] also document accuracy in predicting emotional intensity. They asked people to predict the intensity of emotion they would feel about the September 11, 2001, terrorist attacks 1, 2, or 7 years in the future. People showed striking accuracy in predicting the intensities of sadness, fear and anger. The pattern of greater accuracy for intensity than for feelings in general is also found for memory. A month after Obama's victories in the 2008 and 2012 presidential elections, participants remembered the intensity of their feelings about the election outcome far more accurately than they remembered their feelings in general [7]. These findings suggest that inaccuracy and overestimation are found most reliably for judgments that encompass the impact of events on the duration of emotion and overall mood.

Several factors likely contribute to people's relative strength in predicting and remembering emotional intensity [7,30]. When experiencing intense emotion, attention narrows to central or salient features of events at the expense of more peripheral features [13]. Thus, the features of events that come to mind when people are predicting or remembering emotion are also likely to be salient when people are experiencing the peak intensity of emotion, promoting accuracy. In addition, greater accuracy in remembering the peak intensity than the duration of past emotional episodes [17] provides a better basis for predicting the intensity of future emotion. Finally, predictions and memories about emotional intensity draw on semantic knowledge about the importance of events for personal goals. Stability over time in people's goals would contribute to accuracy in predicting and remembering emotional intensity [29].

Asymmetries between Predicting and Remembering Emotion

The research reviewed above and summarized in Figure 1 shows substantial commonalities in the function, cognitive processes, and patterns of accuracy and bias, associated with predicting and remembering emotion. But important differences have also been documented [38,39]. The most obvious difference is that remembered emotional experiences already happened. When people remember how they felt in the past, they do not need to retrieve, select, and piece together representations to simulate an uncertain future. As a result, memories of past experiences are more detailed, idiosyncratic, and include more contextual information than predictions about the same experiences [40,41]. Predictions are simpler and more prototypical than memories [38,42]. Thus, remembered emotion should be truer to actual experience than predicted emotion.

Paradoxically, other asymmetries should make predictions more plausible and compelling than memories. Van Boven and Caruso [39] argue that a key function of emotion is to motivate

action but past experiences cannot be changed. Moreover, remembered events become more distant as time passes, and people accommodate to them and regulate their emotional response. In contrast, future experiences can be changed and become increasingly imminent as time passes. These differences may explain why people report that they feel more intense emotion when anticipating future emotional experiences (e.g., Thanksgiving Day, annoying noises) than when remembering the same experiences in the past, even adjusting for the intensity predicted and remembered [43]. Imagining future emotional experience is also accompanied by stronger "autonoetic" experience, the sense of pre- or reliving an event [44] (also see [45]). Predicted emotional experiences are perceived to be more motivating [46,47], personally important [48], and psychologically closer [39] than comparable memories. Direct comparisons are needed but these differing phenomenological cues should affect the perceived accuracy of predicted and remembered emotion and their impact on behavior [49,50].

Recalculating ....

In conclusion, it is widely assumed that people overestimate the intensity and duration of emotion [11,23,33]. Recent findings show that our mental GPS is not that bad. People often show striking accuracy when predicting the intensity of their feelings [12,29,30]. Predictions diverge most from experience when they encompass emotion duration or mood. Changing appraisals of events, and attending to salient but unrepresentative features of events, can result in either over- or underestimating emotion [25,26,28]. Consistent with evidence that common cognitive processes underlie prospection and retrospection, similar patterns of accuracy and bias, and similar sources of bias, are found when people predict and remember emotion. To shed further light on people's strengths and weakness in representing emotion, future research should

directly compare people's ability to bring to mind different features of their emotional experience including intensity, duration, and mood.

Although GPS devices usually get people where they want to go, they occasionally give directions that are wildly wrong. Lacking reliable cues to accuracy can lead people to make bad driving decisions. People rely on cues such as intensity and autonoetic experience to judge the plausibility of their representations [49]. When predicting emotion, these phenomenological cues point powerfully to accuracy irrespective of whether predictions are right or wrong. Thus, future research should also explore asymmetries in processes that would account for the marked phenomenological differences between prediction and memory [38]. Addressing these issues is essential, not only for a theoretical understanding of how people think about their pasts and futures, but also for understanding how to intervene so people make informed decisions with implications for the quality of their lives.

Acknowledgements

We acknowledge the support of the National Science Foundation (Award # 1451214 to Linda J. Levine and Award #1451297 to Heather C. Lench).

References and recommended reading

Papers of particular interest, published within the period of review,
have been highlighted as:
* of special interest
** of outstanding interest

1. Benoit RG, Schacter DL: **Specifying the core network supporting episodic simulation and episodic memory by activation likelihood estimation.** *Neuropsychologia.* 2015, **75**:450–457.

2. Mullally, SL, Maguire, EA: **Memory, imagination, and predicting the future: A common brain mechanism?** The Neuroscientist. 2014, **20**:220-234.

3. Race E, Keane MM, Verfaellie M: **Medial temporal lobe damage causes deficits in episodic memory and episodic future thinking not attributable to deficits in narrative construction**. *J. Neurosci.* 2011, **31**:10262–10269.

4. Jing HG, Madore KP, Schacter DL: **Worrying about the future: An episodic specificity induction impacts problem solving, reappraisal, and well-being**. *J. Exp. Psychol. Gen.* 2016, **145**:402–418.

5. Suddendorf T: **The emergence of episodic foresight and its consequences**. *Child Dev. Perspect.* 2017, **0**:1–5.

6. Schacter D, Addis DR: **The cognitive neuroscience of constructive memory: remembering the past and imagining the future**. *Philos. Trans. R. Soc. B Biol. Sci.* 2007, **362**:773–786.

7. Kaplan RL, Van Damme I, Levine LJ, Loftus EF: **Emotion and false memory**. *Emot. Rev.* 2015, **8**:8-13.

8. Irish M, Piguet O: **The pivotal role of semantic memory in remembering the past and imagining the future.** *Front. Behav. Neurosci.* 2013, **7**:27. doi:10.3389/fnbeh.2013.00027.

9. Szpunar KK, Spreng RN, Schacter DL: **A taxonomy of prospection: Introducing an organizational framework for future-oriented cognition.** *Proc. Natl. Acad. Sci.* 2014, **111**:18414–18421.

10. Gilbert DT, Wilson TD: **Prospection: Experiencing the future**. *Science.* 2007, **317**:1351–1354.

11. Wilson TD, Wheatley T, Meyers JM, Gilbert DT, Axsom D: **Focalism: A source of durability bias in affective forecasting.** *J. Pers. Soc. Psychol.* 2000, **78**:821–836.

12. Doré BP, Meksin R, Mather M, Hirst W, Ochsner KN: **Highly accurate prediction of emotions surrounding the attacks of September 11 , 2001 over 1- , 2- , and 7-year prediction intervals**. 2016, **145**:788–795. (**)

Participants showed striking accuracy in their predictions of how sad, angry, and fearful they would feel about the September 11 terrorist attacks 1, 2, or 7 years in the future, and sensitivity to how their feelings would diminish over time.

13. Yonelinas AP, Ritchey M: **The slow forgetting of emotional episodic memories: An emotional binding account**. *Trends Cogn. Sci.* 2015, **19**:259–267.

14. Morewedge CK, Gilbert DT, Wilson TD: **The least likely of times: How remembering the past biases forecasts of the future.** *Psychol. Sci.* 2005, **16**:626–630.

15. van Dijk WW, van Dillen LF, Rotteveel M, Seip EC: **Looking into the crystal ball of our emotional lives: Emotion regulation and the overestimation of future guilt and shame**. *Cogn. Emot.* 2015, **9931**:1–9.

16. Wilson TD, Gilbert DT: **Explaining away: A model of affective adaptation**. *Perspect. Psychol. Sci.* 2008, **3**:370–386.

17. Geng X, Chen Z, Lam W, Zheng Q: **Hedonic evaluation over short and long retention intervals: The mechanism of the peak-end rule**. *J. Behav. Decis. Mak.* 2013, **26**:225–236.

18. Chajut E, Caspi A, Chen R, Hod M, Ariely D: **In pain thou shalt bring forth children**. *Psychol. Sci.* 2014, **25**:2266–2271.

19. Ferrer RA, Taber JM, Klein WMP, Harris PR, Lewis KL, Biesecker LG: **The role of current affect, anticipated affect and spontaneous self-affirmation in decisions to receive self-threatening genetic risk information.** *Cogn. Emot.* 2015, **29**:1456–1465.

20. Hoerger M, Scherer LD, Fagerlin A: **Affective forecasting and medication decision making in breast-cancer prevention.** *Heal. Psychol.* 2016, **35**:594–603.

21. Greene E, Sturm K, Evelo A: **Affective forecasting about hedonic loss and adaptation: Implications for damage awards.** *Law Hum. Behav.* 2016, **40**:244–256.

22. Leder S, Florack A, Keller J: **Self-regulation and protective health behaviour: How regulatory focus and anticipated regret are related to vaccination decisions**. *Psychol. Health* 2015, **30**:165–188.

23. Miloyan B, Suddendorf T: **Feelings of the future**. *Trends Cogn. Sci.* 2015, **19**:196–200.

24. Morewedge CK, Buechel EC: **Motivated underpinnings of the impact bias in affective forecasts.** *Emotion* 2013, **13**:1023–9.

25. Safer MA, Levine LJ, Drapalski AL: **Distortion in memory for emotions: the contributions of personality and post-event knowledge**. *Personal. Soc. Psychol. Bull.* 2002, **28**:1495–1507.

26. Buechel EC, Zhang J, Morewedge CK: **Impact bias or underestimation? Outcome specifications predict the direction of affective forecasting errors.** *J. Exp. Psychol. Gen.* 2017, **146**:746–761. (**)

Presents evidence that, because affective forecasters are more sensitive to outcome specifications of events than experiencers, the outcome specification values of an event (e.g., duration, magnitude, probability) can be used to predict whether forecasters will over- or underestimate the event's hedonic impact.

27. Ebert JEJ, Meyvis T: **Reading fictional stories and winning delayed prizes: The surprising emotional impact of distant events**. *J. Consum. Res.* 2014, **41**:794–809.

28. Lench HC, Safer MA, Levine LJ: **Focalism and the underestimation of future emotion: When it's worse than imagined.** *Emotion* 2011, **11**:278–285.

29. Kaplan RL, Levine LJ, Lench HC, Safer MA: **Forgetting feelings: Opposite biases in reports of the intensity of past emotion and mood.** *Emotion* 2015, **16**:309-319. (*)

This research contrasts the accuracy with which people remember different features of emotional experience. Participants remembered the intensity of their feelings about the outcomes of the 2008 and 2012 U. S. presidential elections far more accurately than their feelings in general or mood. Intensity bias was predicted by changes in the appraised importance of the election.

30. Levine LJ, Lench HC, Kaplan RL, Safer MA: **Accuracy and artifact: Reexamining the intensity bias in affective forecasting.** *J. Pers. Soc. Psychol.* 2012, **103**:584-605. (**)

Empirical studies and a meta-analysis show greater accuracy when people predict and later report the intensity of their feelings about an event than when the more typical affective forecasting procedure used, in which people predict how they would feel in general if an event were to occur, and later report their feelings in general without reference to that event.

31. Charpentier CJ, De Neve J-E, Li X, Roiser JP, Sharot T: **Models of affective decision making: How do feelings predict choice?** *Psychol. Sci.* 2016, **27**:763 – 775.

32. Cooney G, Gilbert DT, Wilson TD: **When fairness matters less than we expect**. *Proc. Natl. Acad. Sci.* 2016, **113**:11168–11171.

33. Coteț CD, David D: **The truth about predictions and emotions: Two meta-analyses of their relationship.** Pers. Individ. Dif. 2016, **94**:82–91. (*)

This paper presents a meta-analysis of affective forecasting research showing that people can accurately anticipate whether their reaction will be relatively mild or strong but, on average, tend to overestimate the emotional impact of future events.

34. Levine LJ, Lench HC, Safer MA: **Functions of remembering and misremembering emotion.** *Appl. Cogn. Psychol.* 2009, **23**:1059–1075.

35. Levine LJ: **Reconstructing memory for emotions.** J. Exp. Psychol. Gen. 1997, **126**:165–177.

36. Robinson MD, Clore GL: **Episodic and semantic knowledge in emotional self-report: Evidence for two judgment processes.** J. Pers. Soc. Psychol. 2002, **83:**198–215.

37. La Corte V, Piolino P: **On the role of personal semantic memory and temporal distance in episodic future thinking: The TEDIFT Model**. *Front. Hum. Neurosci.* 2016, **10**:1–5.

38. Özbek M, Bohn A, Berntsen D: **Imagining the personal past: Episodic counterfactuals compared to episodic memories and episodic future projections**. *Mem. Cognit.* 2016, **45**:375–389.

39. Van Boven L, Caruso EM: **The tripartite foundations of temporal psychological distance: metaphors, ecology, and teleology**. *Soc. Personal. Psychol. Compass* 2015, **9**:593–605. (**)

The authors propose a model describing asymmetries between prospection and retrospection which explains people's tendency to feel more intense emotion when anticipating future experiences than when remembering past experiences.

40. De Brigard F, Giovanello K: **Influence of outcome valence in the subjective experience of episodic past, future, and counterfactual thinking**. *Conscious. Cogn.* 2012, **21**:1085-1096.

41. MacLeod AK: **Prospection, well-being and memory**. *Mem. Stud.* 2016, **9**:266–274.

42. Kane J, Van Boven L, Mcgraw AP: **Prototypical prospection: Future events are more prototypically represented and simulated than past events**. *Eur. J. Soc. Psychol.* 2012, **42**:354–362.

43. Van Boven L, Ashworth L: **Looking forward, looking back: Anticipation is more evocative than retrospection.** *J. Exp. Psychol. Gen.* 2007, **136**:289–300.

44. Caruso EM, Van Boven L, Chin M, Ward A: **The temporal Doppler effect: When the future feels closer than the past.** *Psychol. Sci.* 2013, **24**:530–6.

45. Lehner E, D'Argembeau A: **The role of personal goals in autonoetic experience when imagining future events**. *Conscious. Cogn.* 2016, **42**:267–276.

46. Barsics C, Van der Linden M, D'Argembeau A: **Frequency, characteristics, and perceived functions of emotional future thinking in daily life.** *Q. J. Exp. Psychol.*. 2015, **218**:1–17.

47. Seligman MEP, Railton P, Baumeister RF, Sripada C: **Navigating into the future or driven by the past**. *Perspect. Psychol. Sci.* 2013, **8**:119–141.

48. Cole SN, Berntsen D: **Do future thoughts reflect personal goals? Current concerns and mental time travel into the past and future**. *Q. J. Exp. Psychol.* 2016, **69**:273–284.

49. Schwarz N, Strack F: **Beyond 'what comes to mind': Experiential and conversational determinants of information use.** Curr. Opin. Psychol. 2016, **12**:89–93.

50. DeWall CN, Baumeister RF, Chester DS, Bushman BJ: **How often does currently felt emotion predict social behavior and judgment? A meta-analytic test of two theories.** *Emot. Rev.* 2016, **8**:136–143.

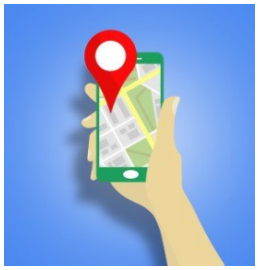
Predicted and remembered emotion …			
guide people's decisions	**rely on common cognitive processes**	**are subject to common biases**	**but differ in phenomenology**
Like a mental roadmap or GPS, predicted and remembered emotion guide people's decisions [20,24,34,50] 	Both types of representations rely on: ● episodic memory [1-3,6] ● semantic knowledge and appraisals [8,9] 	Changes in semantic appraisals over time promote bias in both predicted and remembered emotion [16,25,28,35,36] 	Remembered emotion is more detailed than predicted emotion [40,41] Predicted emotion is often experienced as more intense and compelling than remembered emotion, even when predictions are wrong [39,43,44,48,50]

Figure 1. Research shows substantial commonalities in the function, cognitive processes, and patterns of accuracy and bias associated with predicting and remembering emotional experience. However, the phenomenological experience associated with the two types of representations differs.

Conflicts of interest: none