American Psychological Association
Journal of Personality and Social Psychology: Attitudes and Social Cognition

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0022-3514/19/$12.00
2019, Vol. 116, No. 2, 193–214
http://dx.doi.org/10.1037/pspa0000136

Does the Future Look Bright? Processing Style Determines the Impact of Valence Weighting Biases and Self-Beliefs on Expectations

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People regularly form expectations about their future, and whether those expectations are positive or negative can have important consequences. So, what determines the valence of people's expectations? Research seeking to answer this question by using an individual-differences approach has established that trait biases in optimistic/pessimistic self-beliefs and, more recently, trait biases in behavioral tendencies to weight one's past positive versus negative experiences more heavily each predict the valence of people's typical expectations. However, these two biases do not correlate, suggesting limits on a purely individual-differences approach to predicting people's expectations. We hypothesize that, because these two biases appear to operate via distinct processes (with self-beliefs operating top-down and valence weighting bias operating bottom-up), to predict a person's expectations on a given occasion, it is also critical to consider situational factors influencing processing style. To test this hypothesis, we investigated how an integral part of future thinking that influences processing style—mental imagery—determines each bias's influence. Two experiments measured valence weighting biases and optimistic/pessimistic self-beliefs, then manipulated whether participants formed expectations using their own first-person visual perspective (which facilitates bottom-up processes) or an external third-person visual perspective (which facilitates top-down processes). Expectations corresponded more with valence weighting biases from the first-person (vs. third-person) but more with self-beliefs from the third-person (vs. first-person). Two additional experiments manipulated valence weighting bias, demonstrating its causal role in shaping expectations (and behaviors) with first-person, but not third-person, imagery. These results suggest the two biases operate via distinct processes, holding implications for interventions to increase optimism.

Keywords: optimism, valence weighting bias, expectation formation, imagery perspective, mental simulation

Supplemental materials: http://dx.doi.org/10.1037/pspa0000136.supp

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The future is inherently ambiguous and uncertain. Yet, despite this fact, people often think about their futures and form expectations for what is to come. Indeed, when faced with an upcoming event, forming expectations about how it will unfold seems like a natural and almost unavoidable response. How many people could be told by their boss to "Come by my office before leaving work today," and not instantly begin to think about what might happen at the impending meeting? Forming expectations in the face of an uncertain future is part of the human experience. Further, the expectations people form are not idle musings: expecting a bad grade on a test can fill a student with dread, expecting success can spur a smitten romantic to ask out her love interest, and fearing losses can lead people to underinvest their money and earn significantly less over time (e.g., Mehra & Prescott, 1985). That is, people's expectations—and, in particular, whether those expectations are positive or negative—have consequences for people's emotions, behaviors, and outcomes (Feather, 1966). In fact, whether people chronically tend to form positive or negative expectations may even impact the length of their lives (e.g., Kim et al., 2017). Thus, understanding how people form expectations, and what factors determine the valence of those expectations, is a critically important pursuit.

One way to approach this question is to identify types of people who tend to form positive or negative expectations. Traditionally,

This article was published Online First October 25, 2018.

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This research was supported by a grant from the John Templeton Foundation (Grant 52462) and the National Science Foundation (Grant BCS-1729482).

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research has done so using self-report measures of optimism. These measures show that people endorse reliable propositional beliefs about the general positivity or negativity of their futures (Scheier, Carver, & Bridges, 1994). More recently, research has employed a behavioral measure of people's tendency to weight past positive (or negative) learning more heavily when forming expectations about ambiguous future events. This measure shows that people exhibit reliable biases in their valence weighting (Fazio, Pietri, Rocklage, & Shook, 2015). Interestingly, while self-beliefs and valence weighting biases can each reliably predict people's expectations, on average, people's biases on these two dimensions are not necessarily consistent (Fazio et al., 2015). So, a person who appears optimistic on one dimension may not necessarily appear optimistic on the other. Together, these facts suggest that valence weighting tendencies represent a chronic bias in expectation formation that is distinct from people's chronic bias in their self-beliefs about the future. As such, one might conclude that simply taking into account people's level of bias on both dimensions should improve our ability to predict the valence of their expectations on a given occasion. However, we propose that considering an additional, situationally varying factor is also critical.

In particular, we hypothesize that self-beliefs and valence weighting tendencies operate via qualitatively distinct processes. Specifically, we hypothesize that, whereas self-beliefs bias expectations via top-down processes, valence weighting tendencies bias expectations via bottom-up processes. And, because the extent to which people rely on top-down and bottom-up processes can shift based on situational influences (e.g., Gawronski & Bodenhausen, 2007; Olson & Fazio, 2008; Rydell & McConnell, 2006), predicting the valence of people's expectations on any given occasion requires not only considering their chronic biases in self-beliefs and valence weighting, but also considering the extent to which people are relying on top-down and bottom-up processes to generate their expectations.

The present research investigates how variation in a common aspect of future-thinking, mental imagery, might cause people to form expectations in line with one type of chronic bias or the other by differentially facilitating top-down or bottom-up processing. On a theoretical level, this research sheds light on the expectation formation process and the underlying mechanisms that bias whether people tend to form positive or negative expectations. It also helps clarify the cognitive functions of the processing styles evoked by mental imagery. Finally, on a practical level, this research offers insights for interventions aimed at helping people form more adaptive expectations for the future.

Chronic Biases in Expectation Formation

Past efforts to predict the valence of people's expectations have attempted to identify different types of people that are more likely to form positive or negative expectations—that is, optimists or pessimists. Traditionally, this approach employed self-report measures to assess the positivity or negativity of people's propositional belief systems regarding their personal future. For example, the most widely used scale for optimism measures the extent to which respondents endorse statements such as "Overall, I expect more good things to happen to me than bad" (Scheier et al., 1994). Trait hope, a similar construct that focuses on the extent to which people believe there are pathways to achieving their goals and that they are able to achieve their goals, is measured much the same way (Snyder et al., 1991). To the extent that the logic of these propositional belief systems guides people's expectations, those who endorse more positive beliefs should form more positive expectations. For instance, following the logic that "more good things than bad things happen to me" should bias a worker who has been called into his boss's office to be more likely to expect praise than censure. Indeed, a vast amount of research shows that, on average, the positivity of people's self-beliefs about the future predict their expectations and behaviors across a variety of domains (e.g., Scheier et al., 1994; Snyder et al., 1991).

More recent research has taken a different approach to identify whether a given individual is more likely to form positive or negative expectations (Fazio et al., 2015). In particular, this research uses an implicit, performance-based measure to assess stable individual differences in the extent to which people overgeneralize their past positive or negative experiences when thinking about future events. A tendency to weight past positive (or negative) experiences more heavily is believed to shape people's reactions to ambiguous future events. And, to the extent that these reactions guide people's expectations, those with more positive weighting biases should form more positive expectations. For instance, a worker with negative valence weighting tendencies should be biased to have a negative reaction to being called into his boss's office and, therefore, be more likely to expect censure than praise.

Indeed, a growing body of work shows that individual differences in people's valence weighting tendencies predict their expectations across a variety of domains (Fazio et al., 2015): when considering hypothetical events in their lives, people with negative valence weighting biases are more rejection sensitive, report greater fear of novel situations, and are more risk averse (Pietri, Fazio, & Shook, 2013b). Further, valence weighting biases not only affect people's reports about hypothetical events in their lives, but also guide actual behavior. For instance, people with positive valence weighting biases are more willing to take risks to earn rewards (Pietri et al., 2013b). Further, building from the evidence that valence weighting tendencies predict rejection sensitivity and willingness to approach novel situations, a prospective real-world study found that first-year college students with more positive valence weighting biases made more friends over the course of their first few months on campus (Rocklage, Pietri, & Fazio, 2017).

However, despite the fact that self-beliefs about the future and valence weighting biases each predict people's expectations on average, evidence suggests that these two biases are sometimes discrepant within individuals. People seem unable to accurately self-report their valence weighting bias (Pietri et al., 2013b), and valence weighting biases do not tend to correlate with people's positive or negative self-beliefs about the future (Fazio et al., 2015). As such, a person who appears optimistic on one dimension may not necessarily appear optimistic on the other. This fact suggests that considering people's chronic bias on both dimensions should improve predictions about the valence of their expectations on any given occasion. However, we hypothesize that considering an additional, situationally varying factor is essential: the process by which people form their expectations on that particular occasion.

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Top-Down and Bottom-Up Processes in the Context of Expectation Formation

We propose that a critical difference between the two trait biases is that they operate via qualitatively distinct processes. Specifically, we hypothesize that people's propositional beliefs about the positivity of their future bias expectations through a top-down mechanism that structures their interpretation of a future event according to the logic of their belief systems. In contrast, we hypothesize that people's valence weighting tendencies bias expectations through a bottom-up mechanism that shapes their interpretation of a future event by influencing their experiential reactions to it. The idea that the two trait biases operate via qualitatively distinct processes helps make sense of why the two biases are not correlated and, critically, holds important implications for predicting when one bias or the other is more likely to shape a person's expectations on a given occasion.

Unlike traditional measures of optimism that reflect a person's self-reported beliefs about the future, valence weighting biases reflect a person's implicit, behaviorally measured tendency to form positive or negative expectations. As such, the lack of correspondence between self-beliefs and valence weighting bias is analogous to discrepancies between other explicitly and implicitly measured constructs (e.g., attitudes) which have been explained by dual processes underlying people's judgments (Gawronski & Bodenhausen, 2007; Olson & Fazio, 2008; Rydell & McConnell, 2006). Applying the logic of these explanations, people's valence weighting bias and self-beliefs may not align if other factors make it difficult for people to accurately identify biases in their valence weighting tendencies or if people are motivated to hold particular beliefs about their optimism. Indeed, both of these possibilities appear to contribute to the discrepancy. First, people may be unable to report their valence weighting biases (Pietri et al., 2013b) because, in the real world, valence is often confounded with other variables such as distinctiveness and diagnosticity (e.g., Kanouse & Hanson, 1972; Skowronski & Carlston, 1987), making it difficult for people to identify and learn about asymmetries in their valence weighting tendencies per se (Fazio et al., 2015). Second, people may be motivated to hold particular beliefs about whether they are an optimist or a pessimist. For instance, the social desirability of "positive thinking" appears to motivate many people to hold the self-belief that they are the type of person who tends to form positive expectations about the future (Rauch, Schweizer, & Moosbrugger, 2007; Schweizer, Beck-Seyffer, & Schneider, 1999). Alternatively, some people strategically adopt pessimistic beliefs as a self-protective mechanism to reduce their emotional reactions in the face of negative outcomes (Norem & Cantor, 1986a, 1986b). Thus, many people can (and do) hold propositional beliefs about their future that conflict with their valence weighting tendencies.

Beyond making sense of why valence weighting bias does not correlate with people's self-beliefs about the future, the insight that these two biases operate via qualitatively distinct processes has important implications for predicting the valence of a person's expectations on a given occasion. Because a person's reliance on top-down and bottom-up processes can vary depending on situational influences, in addition to considering a person's level of chronic bias on each dimension, it should be critical to consider the processes driving their expectations in any particular instance. If the two chronic biases are based in different processes as we propose, then variables that influence people's reliance on top-down versus bottom-up processes should moderate each bias's influence on expectation formation. That is, increasing reliance on bottom-up (vs. top-down) processing should cause people to form expectations more in line with their valence weighting biases, and less in line with their self-beliefs about the future. In the present research, we explore one such moderating variable that is integrally involved in thinking about the future: visual perspective in mental imagery.

How Mental Imagery Influences Reliance on Top-Down Versus Bottom-Up Processing

People use mental imagery to simulate the future and make predictions about how it will unfold (Schacter, Addis, & Buckner, 2007; Wheeler, Stuss, & Tulving, 1997). Critically, this visual imagery is not merely epiphenomenal, but rather, plays a functional role in supporting cognition (Moulton & Kosslyn, 2011). We are interested in the role that a particular inherent feature of mental imagery—its visual perspective—may play in determining the basis for people's expectations about imagined events by shifting people's reliance on top-down and bottom-up processing.

Visual images necessarily have a perspective, and visual images of events involving the self can be constructed from either one's own first-person visual perspective, or an external third-person visual perspective (Nigro & Neisser, 1983). The vast majority of people report spontaneously using each perspective and are able to vary which perspective they use at will (Nigro & Neisser, 1983; Rice & Rubin, 2009). And, as is the case with other features of mental imagery, this feature serves a cognitive function. The two perspectives appear to facilitate two qualitatively distinct processing styles (Libby & Eibach, 2011). Specifically, third-person imagery facilitates a conceptual processing style in which people achieve a coherent understanding of an event in terms of their broader abstract belief systems, whereas first-person imagery facilitates an experiential processing style in which people understand an event based on the phenomenology evoked by the concrete features of the pictured scene.

Consistent with this account, imagery perspective affects how people construe and interpret events (Libby, Shaeffer, & Eibach, 2009; Shaeffer, Libby, & Eibach, 2015): the third-person perspective (vs. first-person) causes people to construe pictured actions, such as "locking the door," more abstractly (e.g., as "securing the house" vs. "turning a key"). Further, mentally simulating personal events from the third-person perspective (vs. first-person) increases reliance on top-down processing, causing people to coherently integrate events with their abstract belief systems (Libby & Eibach, 2011). As such, people's reactions to imaged events from the third-person perspective (vs. first-person) more closely correspond with their propositional beliefs pertaining to a variety of domains including their self-reported personality traits, values, preferences, and developmental trajectories (Libby & Eibach, 2011; Libby, Valenti, Hines, & Eibach, 2014; Marigold, Eibach, Libby, Ross, & Holmes, 2015).

In addition to reducing reliance on top-down processes, mentally simulating personal events from the first-person perspective (vs. third-person) increases reliance on bottom-up processes (Libby & Eibach, 2011). Evidence supporting this idea comes

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from research in which people's reactions to imagined events from the first-person perspective (vs. third-person) corresponded less with their propositional self-beliefs, and corresponded more with their experiential reactions to concrete features of the pictured scene (Libby et al., 2014; Niese, Libby, Eibach, & Carlisle, 2018). For instance, in one experiment, when participants imagined how they would vote in an upcoming election, first-person imagery (vs. third-person) caused their behavioral intentions to align more with their implicitly measured preference for one candidate or the other (assessed via the personalized Implicit Association Test; Olson & Fazio, 2004) and align less with their explicitly measured preference (assessed via self-report).

Evidence corroborating the processing style mechanism for such effects comes from other experiments that manipulated imagery perspective (first-person vs. third-person) using photographs of everyday actions unrelated to target judgments (e.g., Niese et al., 2018; Shaeffer et al., 2015); varying perspective via action photographs unrelated to the target judgment replicates the effects of varying perspective via instructions for mentally visualizing a scene directly related to the target judgment. As such, these results support the notion that perspective operates by shifting processing style, rather than by merely changing the salience of information that is only relevant to the pictured scene. Thus, a variety of past research suggests that, by shifting processing style, imagery perspective differentially facilitates reliance on top-down or bottom-up processes.

The present research seeks to build from the evidence that each imagery perspective differentially facilitates reliance on top-down or bottom-up processes in order to test the hypothesis that people's valence weighting biases influence expectation formation through a distinct mechanism from people's self-beliefs about the future. That is, if self-beliefs operate via top-down processes, then expectations should align more with people's self-beliefs about the future with third-person imagery (vs. first-person imagery). In contrast, if valence weighting biases operate via bottom-up processes, then people should form expectations that align more with their valence weighting biases with first-person imagery (vs. third-person imagery). As such, this approach uses a variable that is integrally involved in thinking about the future—visual perspective in mental imagery—that influences reliance on top-down versus bottom-up processes to help understand the conditions under which valence weighting biases, as opposed to self-beliefs about the future, guide expectations.

The Present Research

Four experiments manipulated imagery perspective as individuals formed expectations about ambiguous future events in their lives. Beforehand, we used traditional self-report measures of trait optimism and hope to index biases in people's self-beliefs about the future (Scheier et al., 1994; Snyder et al., 1991), and we used the performance-based measure BeanFest to index people's valence weighting biases (Pietri et al., 2013b). If these two biases operate via different processing styles as we propose, then imagery perspective should influence the extent to which each bias shapes people's expectations for the future.

Based on previous work, we expected that by facilitating top-down influences, third-person imagery (vs. first-person) would cause people to make predictions about ambiguous future events more in line with their self-reported trait optimism and hope. Additionally, we expected that by facilitating bottom-up processes, first-person imagery (vs. third-person) would cause people to make predictions about ambiguous future events more in line with their valence weighting biases. Thus, Experiments 1 and 2 sought to provide evidence that valence weighting biases better predict people's expectations when another variable (i.e., first-person imagery) facilitates the influence of bottom-up processes, whereas traditional measures of people's self-beliefs better predict their expectations when another variable (i.e., third-person imagery) facilities the influence of top-down processes. This predicted result would provide novel, converging evidence that valence weighting biases operate via a qualitatively distinct process from people's self-beliefs about the future, and by extension, allow us to better predict when valence weighting biases, as opposed to self-beliefs, are likely to guide expectations.

Experiments 3 and 4 sought to provide stronger evidence that people's valence weighting biases *causally* shape their expectations via a bottom-up process. To do so, Experiments 3 and 4 manipulated, rather than measured, people's valence weighting bias before manipulating imagery perspective as people formed expectations. We predicted that manipulating valence weighting biases would shape people's expectations with the bottom-up processing style evoked by first-person imagery, but not with the top-down processing style evoked by third-person imagery.

Experiment 4 also sought to provide additional convergent evidence for the role of processing style in producing the current effects. To do so, Experiment 4 used a different, previously validated method of manipulating imagery perspective to induce the processing style differences observed with mental imagery instruction (Shaeffer et al., 2015). Finally, Experiment 4 sought to extend Experiments 1 through 3 by investigating the consequences of shifting the basis for people's expectations. In particular, rather than measure people's reports of their expectations to hypothetical scenarios, Experiment 4 used a behavioral measure that assessed people's actual risk-taking behavior in a task with real monetary consequences. Together, the present experiments offer insight into the mechanisms underlying two distinct trait biases that influence people's expectations, with implications for improving interventions to help people reap the benefits of seeing their futures in a more positive light.

Experiments 1 and 2

In Experiments 1 and 2, we indexed biases in people's self-beliefs about the future by measuring their self-reported optimism and hope (Scheier et al., 1994; Snyder et al., 1991), and we indexed their valence weighting biases via the performance-based measure BeanFest (Pietri et al., 2013b). In a separate session, we manipulated the imagery perspective that participants used to visualize events happening in their lives and make predictions about how positively or negatively they would turn out.

The only difference between Experiments 1 and 2 was how we measured participants' expectations. Following past procedure (Pietri et al., 2013b), Experiment 1 provided participants with three possible explanations for each scenario they visualized (1 positive, 1 negative, and 1 neutral) and asked them to rank order these explanations from most to least likely. Experiment 2 instead asked participants to generate up to seven of their own explanations for each scenario before rating how positive and how negative each of their explanations would be for them. Thus, the procedure for Experiment 2 replicated Experiment 1 with the exception of using a conceptually identical dependent measure that better represents the full range of possible expectations people might form when imagining the scenarios and captures idiosyncrasies across participants in how positive or negative each outcome would be for them personally.

In both experiments, we expected imagery perspective to moderate the extent to which participants' expectations corresponded with their valence weighting bias versus their self-beliefs about the positivity of the future. Specifically, first-person imagery (vs. third-person) should cause expectations to correspond more closely with valence weighting biases and less closely with self-beliefs about the future.

Method

Participants. We posted ample experiment sessions using an online sign-up tool with the goal of obtaining a minimum of 60 participants per perspective condition.[1] Using this recruitment method, 162 undergraduates participated in Experiment 1 for course credit. Analyses excluded a participant who did not follow instructions during the BeanFest game ($n = 1$) and participants who failed a self-report attention check at the end of the visualization task ($n = 15$),[2] leaving data from 146 participants (79 female, 67 male; 72 first-person). Sensitivity analyses indicate that this experiment is adequately powered to detect a small effect ($f^2 = 0.05$) at 80% power (Faul, Erdfelder, Lang, & Buchner, 2007).

Experiment 2 used the same recruitment strategy as Experiment 1. One hundred thirty-one undergraduates participated in Experiment 2 for course credit. Analyses excluded participants whose computers crashed during the BeanFest game ($n = 3$), a participant who did not complete both sessions ($n = 1$), and participants who failed the self-report attention check at the end of the online session ($n = 5$), leaving data from 122 participants (48 female, 74 male; 61 first-person). Sensitivity analyses indicate that this experiment is adequately powered to detect a small effect ($f^2 = 0.07$) at 80% power (Faul et al., 2007).

Procedure and materials. Session 1 (in lab): Measuring chronic biases in expectation formation.

Self-Beliefs Questionnaire. Participants entered the lab and sat at computers in individual cubicles. Participants first completed a computerized questionnaire containing a battery of individual difference measures of their self-beliefs about the positivity of the future.

Life Orientation Test—Revised. Participants completed an individual difference measure assessing the extent to which they endorsed a positive or negative system of beliefs regarding their future (Scheier et al., 1994). The measure consists of six scored items such as, "In uncertain times, I usually expect the best" and "If something can go wrong for me, it will" (reverse scored), as well as four filler items. Participants responded to each item on a scale ranging from 1 (*I strongly disagree*) to 9 (*I strongly agree*). Participants' responses to the six scored items were reverse scored where appropriate and then averaged, with higher numbers reflecting higher general optimistic self-beliefs (Experiment 1: $M = 6.03$, $SD = 1.23$, $\alpha = 0.78$; Experiment 2: $M = 6.00$, $SD = 1.27$, $\alpha = 0.83$).

Adult Trait Hope Scale. Participants also completed an individual difference measure assessing the extent to which they endorsed a set of beliefs indicating hope for the future (Snyder et al., 1991). The measure consists of eight scored items such as, "I meet the goals that I set for myself" and "Even when others get discouraged, I know I can find a way to solve the problem," as well as four filler items. Participants responded to each item on a scale ranging from 1 (*Definitely false*) to 8 (*Definitely true*). Participants' responses to the eight scored items were averaged, with higher numbers reflecting higher trait hope (Experiment 1: $M = 5.95$, $SD = 0.79$, $\alpha = 0.82$; Experiment 2: $M = 6.29$, $SD = 0.87$, $\alpha = 0.88$).

Additional measures. In addition to answering questions indexing self-beliefs about the future, participants completed a few other self-report measures for exploratory purposes. Participants completed the Weighting Bias Questionnaire (Pietri et al., 2013b), which assessed their ability (or lack thereof) to explicitly report their valence weighting bias. The measure consists of four items such as, "If you see something that appears equally negative and equally positive, how would you tend to categorize it?" answered on 7-point scales (e.g., 1 = *Always categorize it as negative* to 7 = *Always categorize it as positive*). Participants' responses to the four items were reverse-scored where appropriate and then averaged, with higher scores indicating beliefs about weighting positive information more heavily (Experiment 1: $M = 4.43$, $SD = 0.94$, $\alpha = 0.79$; Experiment 2: $M = 4.67$, $SD = 0.84$, $\alpha = 0.92$). Finally, for exploratory purposes, participants also completed individual difference measures of their self-esteem (Rosenberg, 1965) and, in Experiment 1 only, rejection sensitivity (Downey & Feldman, 1996).

Performance-based measure of valence weighting bias. After finishing the questionnaires, participants completed the game, BeanFest (following the procedure in Pietri et al., 2013b). This game provided a performance-based measure of valence weighting bias.

BeanFest. Participants first read instructions about how to play the game (Fazio, Eiser, & Shook, 2004). Participants were told they would be viewing beans one at a time and would need to decide whether to select each bean or not. The beans varied in their shape (10 levels from circular to oblong) and their number of speckles (1 to 10), creating a 10×10 matrix of 100 beans. During the game, participants saw 36 out of the 100 total beans. The 36

[1] We aimed to collect at least 60 participants per imagery perspective condition because this number is consistent with the sample sizes of other similar experiments investigating imagery perspective's moderating role on implicitly- vs. explicitly-measured constructs (e.g., Libby et al., 2014).

[2] Participants completed the visualization task in Experiments 1 through 3 in a separate session online. Because it is important for our manipulation that they were actively engaged in the task and imagining the scenarios, we asked participants to self-report how much attention they paid to the task and informed them that their answers would in no way affect their course credit. We excluded participants who indicated that they engaged in one or more of the following behaviors during the online portion of the experiment: "I did not pay much attention to the task," "I did not visualize the scenarios," "I did not understand the instructions," or "I was doing other things on my computer while completing the task." The number of participants excluded did not differ by perspective condition in any of the three experiments ($ps > .37$).

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game beans were selected from six different regions of the matrix that were assigned to be positive or negative. When participants selected a positive bean, their score increased by 10 points; when they selected a negative bean, their score decreased by 10 points. If participants decided not to select a bean, they were still shown its value but saw no change in their points; this ensured that participants would receive information about the valence of each bean regardless of whether they chose to select it or not. The participants' goal was to learn which types of beans were positive and which types were negative so that they could earn as many points as possible.

Participants began by completing six practice trials so that they could become familiar with the buttons and screen displays. They then completed three game-phase blocks, each consisting of the 36 beans that had been assigned as positive or negative. The 36 game beans were presented in random order and retained their value across all three game-phase blocks. Participants started each game with 50 points and their total score could range from 0 to 100 points. If their score reached 0, they were told they lost, and if it reached 100, they were told they won. After winning or losing a game, their score was reset to 50 and they continued playing. Regardless of the number of times participants won or lost during each game-phase block, they still viewed all 36 game beans and the beans' values did not change.

After completing the game-phase blocks, participants continued on to the test phase. In the test phase, participants viewed all 100 beans from the matrix individually in random order and categorized each one as "harmful" or "helpful" with no score or feedback. Participants' responses to the 36 game beans allowed us to assess how well they learned the values of positive and negative beans. Additionally, the remaining 64 beans were novel stimuli that were visually similar to the game-phase beans. Critically, many of these beans were similar to a region that was positive in the game phase as well as similar to a region that was negative in the game phase, forcing participants to weight either their previous positive or negative learning more heavily in order to classify the novel bean. For instance, some participants may have learned during the game phase that circular beans with few speckles were positive, but circular beans with many speckles were negative. Then, at test, when these participants saw a novel circular bean with a *medium* amount of speckles, they had to classify it as harmful or helpful. People with negative valence weighting biases are more likely to have negative reactions to this bean and classify it as harmful, whereas people with positive valence weighting biases are more likely to have positive reactions and classify it as helpful. In this way, BeanFest indexes individual differences in people's experiential expectations about the valence of ambiguous information.

Session 2 (online): Manipulating imagery perspective and measuring expectations.

Manipulating imagery perspective. Two days after participants completed the self-report questionnaires and behavioral game BeanFest, we emailed them a link to complete the second part of the experiment online.[3] In the online portion, participants completed a modified version of the Interpretation Questionnaire (Pietri, Fazio, & Shook, 2013a) in which they visually imagined 13 ambiguous future scenarios happening in their own lives. The original questionnaire directs respondents to imagine 13 ambiguous future scenarios (e.g., "Your boss calls you into their office," "You walk into a room and someone looks in your direction," "You reach for your wallet/pocketbook and cannot find it," etc.), which we modified by explicitly instructing participants to visualize each scenario. Additionally, we randomly assigned participants to complete one of two versions of the questionnaire that only differed in the imagery perspective they were instructed to use while visualizing the scenarios. Participants in the first-person condition were instructed for all the scenarios to "Imagine the scene from your own visual perspective, in other words, you are looking out at your surroundings through your own eyes," whereas those in the third-person condition were instructed for all the scenarios to "Imagine the scene from an observer's visual perspective, in other words, you can see yourself in the image, as well as your surroundings." After imagining each scenario, participants used a scale ranging from 0 (*No image at all*) to 4 (*Perfectly clear and vivid*) to rate how vivid their mental imagery was and a scale ranging from −3 (*Very difficult*) to 3 (*Very easy*) to rate how easy it was for them to imagine the scenario.[4]

Measuring expectations.

Experiment 1. Participants in Experiment 1 visualized each scenario using the specified imagery perspective and then, as in the original Interpretation Questionnaire (Pietri et al., 2013a), received three possible explanations for the ambiguous event. For each scenario, one of the explanations was positive (e.g., "Your boss is going to promote you"), one was negative (e.g., "Your boss is going to fire you"), and one was neutral (e.g., "Your boss has a question for you"). Instructions directed participants to order the explanations from most to least likely.

Following past procedure (Pietri et al., 2013a), we scored the Interpretation Questionnaire by first calculating "positive" and "negative" scores. For each scenario, participants received a positive score of 3 when they ranked the positive interpretation as most likely, a positive score of 2 when they ranked it second most likely, and a positive score of 1 when they ranked it least likely. The same method was used to calculate a negative score for each scenario. Then, we calculated a difference score for each participant between the means of their positive and negative scores across the 13 scenarios ($M = -0.04$, $SD = 0.48$) to serve as an index of the average valence of participants' expectations about the future events.

Experiment 2. Experiment 2 sought to replicate Experiment 1 using a more ecologically valid version of our dependent measure. Rather than rank ordering three possible interpretations, participants visualized each scenario using the specified imagery per-

[3] We chose to split the procedure into two sessions based on pilot data suggesting that completing the entire experiment in a single session was too fatiguing for participants to remain fully engaged (see the online supplemental materials for more details).

[4] Average reports of imagery vividness were not significantly different across perspective in either experiment or when combined and analyzed together (combined: $F(1, 266) = 2.19$, $p = .23$; first-person: $M = 1.81$, $SD = 0.61$; third-person: $M = 2.10$, $SD = 0.56$). Average reports of how easy it was to imagine the scenarios were also not significantly different across perspective for either experiment or when combined and analyzed together, although there was a trend for first-person imagery to be reported as slightly easier (combined: $F(1, 266) = 3.19$, $p = .08$; first-person: $M = 5.97$, $SD = 0.89$; third-person: $M = 5.78$, $SD = 0.92$). Nonetheless, controlling for ease and its interactions with valence weighting bias and the self-beliefs composite did not change the significance of our results in any of the experiments.

spective and then came up with their own explanations for how they expected the event to unfold. First, participants were asked to generate up to seven explanations for each ambiguous event (e.g., "Why does your boss want to see you?"). Then, after imagining all the scenarios and generating explanations, participants were re-shown each explanation[5] so they could rate how positive it would be for them on a scale from 0 (*Not at all positive*) to 4 (*Extremely positive*) and how negative it would be for them on a scale from 0 (*Not at all negative*) to 4 (*Extremely negative*).[6]

Next, following an analogous procedure to that in Experiment 1, we created a composite score indexing how positively or negatively participants tended to expect the scenarios to unfold. We created a total positivity score by summing the participants' ratings for how positive each of the explanations would be for them; we also created a total negativity score by summing participants' ratings for how negative each of the explanations would be for them. Finally, we calculated a difference score for each participant by subtracting the negativity score from the positivity score ($M = -17.61$, $SD = 21.19$) to index the valence of participants' expectations about the future events.

Results

We predicted that the imagery perspective participants used would determine the extent to which their expectations corresponded with their valence weighting bias versus their self-beliefs about the future. Specifically, first-person (vs. third-person) imagery should cause expectations to correspond more closely with valence weighting biases and less closely with self-beliefs.

To test these predictions, we first created a composite index of participants' self-beliefs about the future from their trait optimism and trait hope scores, and we calculated individual differences in valence weighting bias from the performance-based measure, BeanFest. Then, we conducted a single linear regression analysis to predict responses to the Interpretation Questionnaire from participants' valence weighting biases and self-beliefs, as well as imagery perspective and its interaction with each of these chronic biases in expectation formation.

Preparatory creation of indices.

Self-beliefs composite. We created a composite of participants' self-beliefs about the future by averaging each participant's *z* scores on the Life Orientation Test—Revised (optimism), and the Adult Trait Hope Scale (Experiment 1: $SD = 0.81$, $r(144) = 0.31$, $p < .001$; Experiment 2: $SD = 0.89$, $r(120) = 0.60$, $p < .001$).

Valence weighting bias. Following past procedure (Pietri et al., 2013b), we calculated participants' valence weighting biases by evaluating their responses to novel beans during the test phase of BeanFest while controlling for how well they learned the positive and negative game beans. To do this, we first calculated each participant's average response to novel beans by coding helpful categorizations as $+1$ and harmful categorizations as -1. We also measured how well participants learned the game beans by coding correct categorization as $+1$ and incorrect categorizations as 0 and then calculating average positive and negative game-bean learning scores. Then, to control for how past learning influenced responses to the novel beans, we used a linear regression model predicting participants' average responses to novel beans from their positive and negative game-bean learning scores. In order to obtain a regression equation that was more stable and less likely to vary based on irregularities in any given experiment, we followed past procedure (Fazio et al., 2015) of running the regression by aggregating the data from the present experiments with a much larger set of over 2,000 similar participants that have completed BeanFest in the past. Doing so allowed us to calculate valence weighting bias scores for each participant that were less likely to fluctuate based on the sample of other participants who happen to be in any given experiment. The resulting multiple regression equation was:

$$\text{Novel response} = 0.59(\text{Positive correct}) - 0.83(\text{Negative correct}) + 0.08.$$

From the coefficients in this equation, we can see that participants tend to weight their past negative learning more strongly, on average, than their past positive learning when classifying novel beans. That is, we can expect participants who learned both positive and negative game beans equally well to weight their negative learning more heavily than their positive learning and classify more of the novel beans as negative. However, there is also variability across individuals in the extent to which this effect occurs, indicating that some participants have particularly negative valence weighting biases, whereas others show this bias less strongly (or even show a positive valence weighting bias).

In order to capture this variability, we entered each participant's past positive and negative learning into the regression equation to determine what the participant's average response to the novel beans normatively should have been. Then, we compared this value with each participant's actual average response to the novel beans as a way of capturing the extent to which each participant's valence weighting tendency was more positive or negative than would be expected based on past learning. Thus, the residual of this regression served as our measure of valence weighting bias because it captures the extent to which a participant tended to expect novel game beans to be negative (or positive) over and above what we would expect based on the participant's previous learning.[7]

Testing imagery perspective's moderating effect on the role of two chronic biases in expectation formation. For each experiment, we used a single linear regression model to predict

[5] A computer glitch prevented participants from rating the explanations they generated for one of the scenarios ("Your phone rings at 3:00 A.M.")

[6] Some of the responses that participants provided were not an explanation or reason for the ambiguous event (e.g. "I see my boss," "I don't know," "I am nervous"). Because we only wanted to analyze participants' ratings for responses that were explanations or reasons for the ambiguous event, two undergraduate research assistants read all the responses in order to exclude inappropriate responses. The research assistants agreed 96% of the time whether or not to exclude a response and a third independent research assistant served as the tiebreaker for discrepancies. Approximately 7.87% of responses were excluded. There were no differences by perspective condition on the total number of responses participants provided $F(1, 120) = 0.27$, $p = .61$, the number of responses excluded $F(1, 120) = 0.64$, $p = .43$, or the final number of responses included in the analyses $F(1, 120) = 0.01$, $p = .92$.

[7] Our composite of participants' self-beliefs did not significantly correlate with their valence weighting biases (Experiment 1: $r(144) = -0.01$, $p = .93$; Experiment 2: $r(120) = 0.17$, $p = .07$). Additionally, replicating past findings, participants' explicit reports of their valence weighting biases, as measured by the Weighting Bias Questionnaire, did not significantly correlate with their actual valence weighting biases (Experiment 1: $r(144) = 0.06$, $p = .46$; Experiment 2: $r(120) = 0.06$, $p = .49$).

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participants' expectations on the Interpretation Questionnaire from their valence weighting bias (sample mean centered) and their self-beliefs composite, as well as imagery perspective (-1 = *first-person*, 1 = *third-person*) and its interactions with the other two measures. We also included the number of explanations that participants self-generated as a covariate in Experiment 2. Tables 1 and 2 display the regression statistics in each experiment.

Primary analyses.

Experiment 1. As hypothesized, imagery perspective moderated the role of valence weighting biases in forming expectations about ambiguous future events ($b = -0.39$, $\beta = -0.15$, $t(140) = -1.95$, $p = .05$). Expectations significantly corresponded with the valence weighting biases when participants used the first-person perspective ($b = 0.64$, $\beta = 0.25$, $t(140) = 2.46$, $p = .02$), but not the third-person perspective ($b = -0.14$, $\beta = -0.05$, $t(140) = -0.45$, $p = .65$). Additionally, as predicted, imagery perspective had the opposite effect in moderating the role of self-beliefs ($b = 0.12$, $\beta = 0.21$, $t(140) = 2.69$, $p = .01$). Expectations significantly corresponded with the self-beliefs composite when participants used the third-person perspective ($b = 0.30$, $\beta = 0.51$, $t(140) = 4.73$, $p < .01$), but not the first-person perspective ($b = 0.05$, $\beta = 0.09$, $t(140) = 0.80$, $p = .42$; Figure 1).

Experiment 2. Using an open-ended version of the dependent measure, Experiment 2 replicated the results from Experiment 1. Imagery perspective again moderated the role of valence weighting biases in forming expectations about ambiguous future events ($b = -22.56$, $\beta = -0.19$, $t(115) = -2.16$, $p = .03$). Expectations significantly corresponded with valence weighting biases when participants used the first-person perspective ($b = 46.85$, $\beta = 0.40$, $t(115) = 3.14$, $p < .01$), but not the third-person perspective ($b = 1.73$, $\beta = 0.02$, $t(115) = 0.12$, $p = 0.91$). Additionally replicating Experiment 1, imagery perspective had the opposite effect in moderating the role of self-beliefs ($b = 4.25$, $\beta = 0.18$, $t(115) = 2.02$, $p = .05$). Expectations significantly corresponded with the self-beliefs composite when participants used the third-person perspective ($b = 7.86$, $\beta = 0.33$, $t(115) = 2.67$, $p = .01$), but not the first-person perspective ($b = -0.64$, $\beta = -0.03$, $t(115) = -0.21$, $p = .83$; Figure 2).

Secondary analyses. We constructed our primary dependent measure as a difference score because the two chronic biases (i.e., valence weighting and self-beliefs) are measured on a single negative-positive continuum. As such, constructing the dependent measure by subtracting negative scores from positive scores creates a single negative-positive continuum that best matches what each of these two trait biases are theorized to predict. Nonetheless, one may wonder if the effects on the difference score are driven by primarily influencing positive or negative interpretation scores. We did not have theoretical grounds a priori to predict that either of the trait biases would uniquely influence negative interpretations but not positive interpretations (or vice versa). Indeed, analyzing the positive and negative scores separately does not suggest clear patterns across experiments that one or the other is consistently driving the effects. Instead, the results were directionally consistent with the primary analyses, such that both positive and negative expectations appeared to correspond more closely with valence weighting bias and less closely with self-beliefs with first-person imagery (vs. third-person).

The interactions for positive expectations were all directionally consistent with the primary analyses, although the strength and significance of these effects varied across experiments. Imagery perspective did not significantly moderate the role of valence weighting biases on positive expectations in Experiment 1 ($b = -0.14$, $\beta = -0.11$, $t(140) = -1.35$, $p = .18$) or Experiment 2 ($b = -13.38$, $\beta = -0.12$, $t(115) = -1.45$, $p = .15$). Imagery perspective did significantly moderate the role of self-beliefs on positive expectations in Experiment 1 ($b = 0.08$, $\beta = 0.25$, $t(140) = 3.11$, $p < .01$) but not in Experiment 2 ($b = 1.77$, $\beta = 0.08$, $t(115) = 0.95$, $p = .34$).

The interactions for negative expectations were also all directionally consistent with the primary analyses, although the strength and significance of these effects also varied across experiments. Imagery perspective significantly moderated role of valence weighting biases on negative expectations in Experiment 1 ($b = 0.25$, $\beta = 0.16$, $t(140) = 2.04$, $p = .04$) but not in Experiment 2 ($b = 9.19$, $\beta = 0.08$, $t(115) = 1.04$, $p = .30$). Imagery perspective did not significantly moderate the role of self-beliefs on negative expectations in Experiment 1 ($b = -0.05$, $\beta = -0.14$, $t(140) = -1.74$, $p = .08$) or Experiment 2 ($b = -2.48$, $\beta = -0.10$, $t(115) = -1.40$, $p = .17$).

Table 1
Statistics From a Single Linear Regression in Experiment 1 Predicting Valence of Expectations Based on Participants' Valence Weighting Bias (Sample-Mean Centered) and Self-Beliefs About the Future, as Well as Imagery Perspective (−1 = First-Person, 1 = Third-Person) and Its Interaction With Each of the Other Two Measures

Predictor	b	β	$t(140)$	p
Perspective	−.003	−.01	−.08	.94
Self-beliefs	.18	.30	3.85	<.01
Perspective × Self-beliefs	.12	.21	2.69	.01
Valence weighting bias	.25	.10	1.27	.21
Perspective × Valence weighting bias	−.39	−.15	−1.95	.05

Table 2
Statistics From a Single Linear Regression in Experiment 2 Predicting Valence of Expectations Based on Participants' Valence Weighting Bias (Sample-Mean Centered) and Self-Beliefs About the Future, as Well as Imagery Perspective (−1 = First-Person, 1 = Third-Person) and Its Interaction With Each of the Other Two Measures

Predictor	b	β	$t(115)$	p
Number of responses	−.22	−.17	−1.92	.06
Perspective	−1.55	−.07	−.86	.39
Self-beliefs	3.61	.15	1.73	.09
Perspective × Self-beliefs	4.25	.18	2.02	.05
Valence weighting bias	24.29	.21	2.33	.02
Perspective × Valence weighting bias	−22.56	−.19	−2.16	.03

Discussion

In two experiments, we found that the imagery perspective people used to visualize ambiguous future events differentially modulated the role of two distinct chronic biases in expectation

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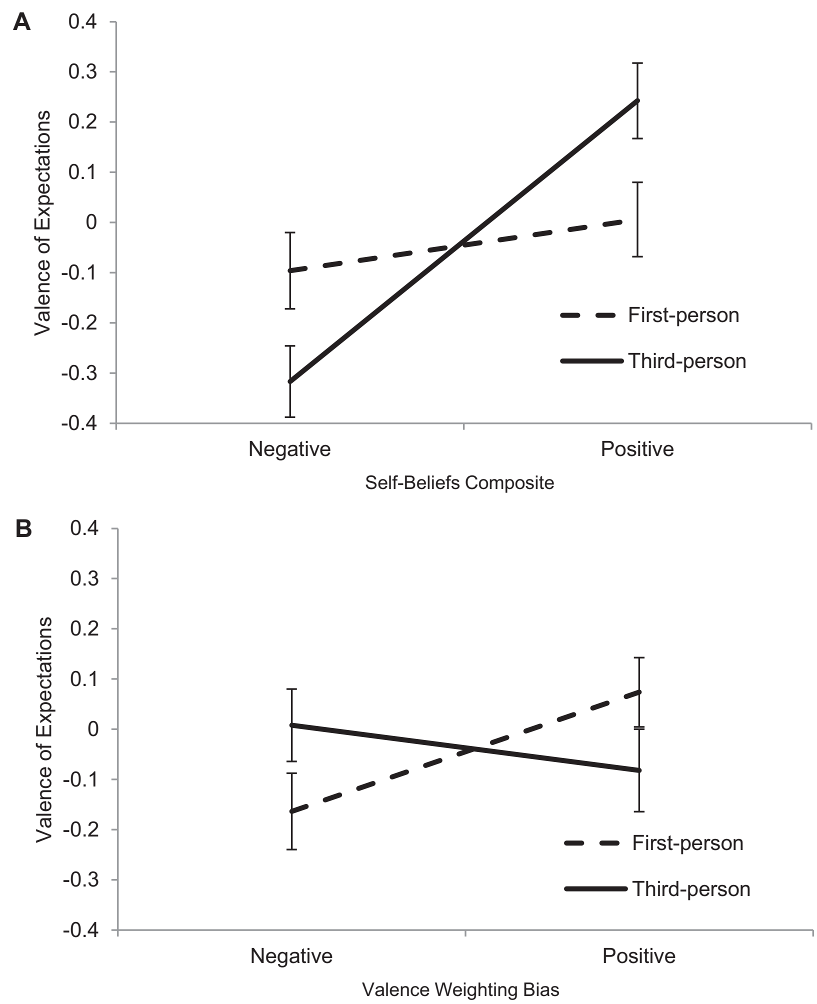

Figure 1. Valence of participants' expectations in Experiment 1 as assessed by a closed-ended measure, depending on imagery perspective and self-beliefs composite (A) and imagery perspective and valence weighting bias (B). Values are plotted within each perspective condition at one standard deviation above and below sample means of the self-beliefs composite and valence weighting bias, with standard error bars. Both interaction effects come from a single model predicting the valence of participants' expectations from their self-beliefs composite score and their valence weighting bias, as well as imagery perspective and its interaction with each of the other two measures.

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formation. First-person imagery (vs. third-person) caused people to form expectations for the future in line with their valence weighting biases. In contrast, third-person imagery (vs. first-person) caused people to form expectations for the future in line with their self-beliefs about the future. These results are consistent with the notion that valence weighting biases influence expectations via bottom-up processes, whereas self-beliefs about the positivity of the future influence expectations via top-down processes. Further, this pattern appeared not only when participants judged the likelihood of a controlled set of possible alternatives in Experiment 1, but also when they had the opportunity in Experiment 2 to generate and rate their own explanations for the scenarios they visualized.

Thus, Experiments 1 and 2 provide initial evidence that valence weighting tendencies represent a chronic bias in expectation formation that operates via a qualitatively distinct process from that by which people's chronic bias in their self-beliefs about the future operates. As such, in order to predict whether a person will form positive or negative expectations on any given occasion, it is critical to understand when valence weighting biases, as opposed to self-beliefs, are more likely to operate. Experiments 1 and 2 provided initial evidence for the hypothesis that unlike self-beliefs about the future that operate via top-down processes, valence weighting biases operate through bottom-up processes, and therefore, better predict expectations when another variable increases reliance on bottom-up processing.

Of course, while these findings demonstrate that imagery perspective causally determines the extent to which valence weighting biases, as opposed to self-beliefs, predict people's expectations, the findings are silent on whether valence weighting biases causally guide expectations via bottom-up processing. That is, would experimentally manipulated valence weighting exert a greater influence on expectations under the bottom-up processing style

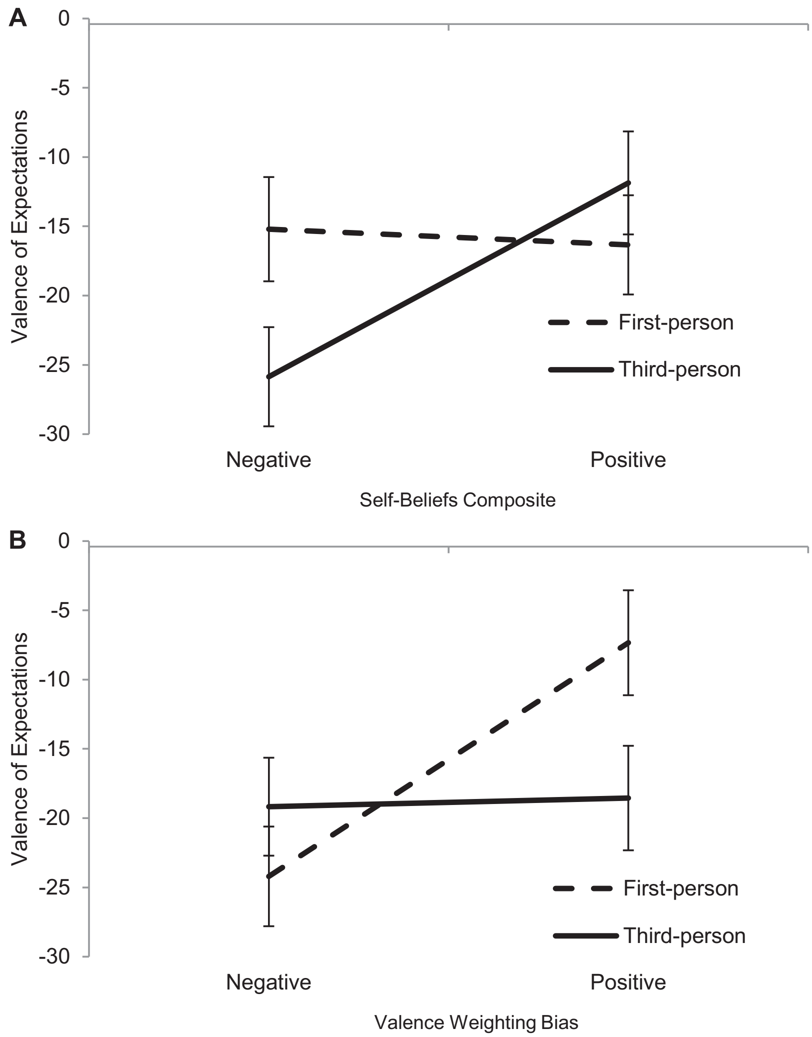

Figure 2. Valence of participants' expectations in Experiment 2 as assessed by an open-ended measure, depending on imagery perspective and self-beliefs composite (A) and imagery perspective and valence weighting bias (B). Values are plotted within each perspective condition at one standard deviation above and below sample means of the self-beliefs composite and valence weighting bias, with standard error bars. Both interaction effects come from a single model predicting the valence of participants' expectations from their self-beliefs composite score and their valence weighting bias, as well as imagery perspective and its interaction with each of the other two measures.

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promoted by first-person imagery than the top-down processing style promoted by third-person imagery? To address this question, we turned our attention to the consequences of an experimental manipulation of valence weighting biases on the judgments that individuals form when guided by first-person imagery (vs. third-person). In this way, Experiments 3 and 4 sought to demonstrate that valence weighting biases causally guide expectations via bottom-up processing.

Experiment 3

Experiment 3 sought to manipulate people's valence weighting bias in order to provide stronger evidence of its causal role in guiding expectations with bottom-up processing. If valence weighting tendencies bias expectations via bottom-up processing, then manipulations of people's valence weighting biases should influence the expectations they form with first-person imagery, which facilitates a bottom-up processing style. In contrast, these manipulations should be attenuated or even eliminated with third-person imagery, which facilitates a top-down processing style.

To manipulate valence weighting tendencies, we used a previously validated method of recalibrating people's valence weighting biases to be more neutral using a modified version of the game BeanFest (Pietri et al., 2013a). In this method, people are given clear and immediate feedback about each of the expectations they form about novel beans during the test phase of the game. As such, if participants have a negative valence weighting tendency and routinely expect novel beans that more closely resemble known positives to be negative, they receive feedback about their incor-

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rect expectations, serving to recalibrate their valence weighting bias toward a more balanced and objectively appropriate direction.

Importantly, this procedure provides people with immediate and clear feedback they rarely receive in their real lives—for instance, outcomes in real life may themselves be ambiguous, allowing people to interpret the outcome in line with the expectations they formed (e.g., Crocker, Fiske, & Taylor, 1984; Darley & Gross, 1983); additionally, forming negative expectations may lead individuals to avoid situations and therefore never learn if their expectations were incorrect (e.g., Fazio et al., 2004). Moreover, the recalibration procedure provides feedback regarding the appropriate weighting of resemblance to known positives and negatives per se, unconfounded by all the natural correlates of valence in the real world (e.g., distinctiveness and diagnosticity). Thus, although this procedure is relatively simple, previous research demonstrates that giving people clear and immediate feedback about their valence weighting decisions appears to be a highly effective means of recalibrating their valence weighting biases (Fazio et al., 2015).

As a consequence, people with initially negative valence weighting biases who are recalibrated (vs. control) form more positive expectations about future events in their lives, are more willing to take behavioral risks, are less rejection sensitive, and more (Fazio et al., 2015; Pietri et al., 2013a). Further, this recalibration procedure appears to produce durable changes in people's valence weighting biases that can have long-lasting effects (Pietri & Fazio, 2017). For example, one experiment found that first-year college students with negative valence weighting biases who underwent the recalibration procedure (vs. control) at the start of a semester became less rejection sensitive and formed more friendships over the course of the semester (Rocklage et al., 2017). Experiment 3 capitalized on this simple yet effective procedure of manipulating people's valence weighting biases.

We first recruited a sample of participants expected to have relatively negative valence weighting biases at baseline (Pietri et al., 2013b). Then, we randomly assigned participants to complete either a recalibration or control version of BeanFest. Thus, this paradigm gave us experimental control of people's valence weighting biases by recalibrating them to be more positive (vs. control). Later on, participants completed the same ambiguous scenario interpretation task as in Experiment 1. As in Experiment 1, we manipulated the imagery perspective participants used to visualize scenarios as they ranked the likelihood of positive and negative outcomes. Again, we hypothesized that first-person imagery (vs. third-person) would increase people's reliance on their valence weighting bias when forming expectations. Thus, in Experiment 3, participants' expectations should benefit from the valence weighting bias recalibration procedure when using the first-person perspective to visualize the scenarios, but should benefit less or not at all when using the third-person perspective.

Method

Participants. In order to identify a sample of participants who could be expected to have relatively negative valence weighting biases, we recruited undergraduates who scored in the top half of the distribution on the Rejection Sensitivity Questionnaire (Downey & Feldman, 1996) during a mass prescreening administered to the undergraduate participant pool (Pietri et al., 2013b). In it, respondents read 18 possible-rejection scenarios such as, "You ask someone in one of your classes to coffee." For each scenario, respondents rated how anxious or concerned they would feel about making the request on a scale ranging from 1 (*Very unconcerned*) to 6 (*Very concerned*) and rated how likely the other person would be to oblige the request on a scale ranging from 1 (*Very unlikely*) to 6 (*Very likely*). We computed an index of rejection sensitivity following the standard convention. Following past recalibration procedures (Pietri & Fazio, 2017; Rocklage et al., 2017) that have capitalized on the fact that individuals who score higher in rejection sensitivity are characterized by more negative valence weighting tendencies (e.g., Pietri et al., 2013a, 2013b), we invited those who scored in the top half of the distribution to participate in the experiment. We recruited as many such eligible participants as possible within the timeframe of the academic year.

One hundred thirteen undergraduates participated for course credit. Analyses excluded participants whose computers crashed during the BeanFest game ($n = 7$) and participants who failed the self-report attention check at the end of the online session ($n = 5$), leaving data from 101 undergraduates (74 female, 27 male; 24 first-person and control, 25 first-person and recalibration, 26 third-person and control, 26 third-person and recalibration). Sensitivity analyses indicate that this experiment is adequately powered to detect a small effect ($f^2 = 0.08$) at 80% power (Faul et al., 2007).

Procedure and materials.

Session 1 (in lab): Manipulating valence weighting biases. Upon entering the lab, participants sat in individual cubicles and completed a battery of self-report questionnaires assessing individual differences in trait optimism (Life Orientation Test—Revised: $M = 5.41$, $SD = 1.07$, $\alpha = 0.78$), hope (Adult Hope Scale: $M = 5.99$, $SD = 0.75$, $\alpha = 0.80$), the Weighting Bias Questionnaire ($M = 3.99$, $SD = 0.95$, $\alpha = 0.81$), and self-esteem (Rosenberg Self-Esteem Scale: $M = 4.16$, $SD = 0.73$ $\alpha = 0.90$).

BeanFest recalibration. After finishing the questionnaire, participants completed one of two versions of the BeanFest game (Pietri et al., 2013a). We randomly assigned half of the participants to complete a control version of the game, in which they classified novel beans during the test phase as positive or negative without any feedback, just like the traditional BeanFest game. The other half of the participants completed the recalibration version of the game (following the procedure reported in Pietri et al., 2013a), in which they were given feedback after every classification they made during the test phase, allowing them to learn from their errors and retrain their valence weighting biases.

Participants in both conditions first read instructions about how to play the game. As in the traditional version of the BeanFest game, they were told they would be viewing beans one at a time and would need to decide whether to select each bean or not. Selecting a positive bean would increase their score by 10 points whereas selecting a negative bean would decrease their score by 10 points. If they did not select a bean, they would see no change in their score but would still receive information about the bean's value. Thus, their goal was to learn which beans were positive and which were negative so that they could earn as many points as possible.

The beans varied in their shape (10 levels from circular to oblong) and their number of speckles (1 to 10), creating the same 10×10 matrix of 100 beans used in the traditional BeanFest

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game. However, unlike the traditional BeanFest game that presented 36 game beans from various pockets of the matrix, this version of the game presented 40 total game beans from the corners of the matrix. This difference has two important consequences. First, this version of the game is much easier, helping to ensure that participants learn which game beans are positive and which are negative. Second, dividing the matrix in this way means that each of the 60 novel test beans is objectively closer to one of the four corners, creating a correct answer as to whether each novel test bean should be labeled positive or negative.

After reading the instructions, participants began a practice game in which they viewed all 40 of the game beans. After the practice game, participants completed a classification training task to further help facilitate their learning of the game beans. During the training task, participants saw the game beans one at a time and had to classify each one as positive or negative. When participants correctly classified a bean, they moved on to the next one. However, when participants incorrectly classified a bean, they received the following message: "Error! This was *not* a Positive (Negative)." After the classification training task, participants played through two more blocks of the BeanFest game that each consisted of 40 beans randomly selected from the four corner sections of the matrix.

After completing the second game block, participants continued on to either the control or recalibration version of the test phase. In both versions, participants saw all 100 beans from the matrix and had to classify each one as positive or negative. Although each of the 60 novel beans was objectively more similar to one of the regions of positive or negative learned game beans, biases in valence weighting can cause people to overgeneralize their past positive or negative learning and misclassify the beans. For instance, because we recruited a population expected to have particularly negative valence weighting biases, participants were likely to overgeneralize their negative learning and misclassify some of the positive novel beans as negative.

Participants in the control condition simply classified the test beans without any feedback about their performance. In contrast, participants in the recalibration condition received immediate, clear feedback about their decisions for every single bean during the test phase. When participants in the recalibration condition correctly classified a bean during the test phase, a message appeared saying, "Correct! This was a Positive (Negative)!!"And, when participants in the recalibration condition incorrectly classified a bean, a message appeared saying, "Error! This was a Positive (Negative)!!" As such, the recalibration procedure provided people an opportunity to learn from their performance in order to retrain their valence weighting tendencies to be more neutral and accurate.

Session 2 (online): Manipulating imagery perspective and measuring expectations. That evening, we emailed participants a link to complete the second part of the experiment online, which used the modified Interpretation Questionnaire (Pietri et al., 2013a) from Experiment 1 to manipulate imagery perspective and measure expectations. As in Experiment 1, we randomly assigned participants to use the first-person or third-person perspective to imagine themselves in ambiguous future scenarios and rank order three possible explanations for each scenario from most to least likely.[8]

Results

Recalibration manipulation check. We first examined participants' responses to the novel beans during the test phase to verify that the recalibration procedure (vs. control) successfully retrained participants' valence weighting biases. To do so, we calculated participants' average performance to the novel test beans by coding correct responses as +1 and incorrect responses as 0. As expected, participants in the recalibration condition performed significantly better ($M = 0.69$, $SD = 0.10$) than participants in the control condition ($M = 0.62$, $SD = 0.07$; $F(1, 99) = 13.70$, $p < .001$).

However, we would predict that this effect should appear gradually over time as the participants completed the recalibration procedure. That is, we would not expect differences between recalibration and control at the start of the procedure and should expect the strongest effects at the end. To test this, we compared participants' performance on the first 20 novel beans to their performance on the last 20 novel beans in a 2 (time point: first 20 vs. last 20) × 2 (BeanFest condition: recalibration vs. control) mixed analysis of variance (ANOVA). The interaction between time point and condition was significant $F(1, 99) = 3.86$, $p = .05$. There was no difference between recalibration and control condition performance for the first 20 novel trials $F(1, 99) = 0.28$, $p = .60$, but participants in the recalibration condition significantly outperformed participants in the control condition during the last 20 novel trials $F(1, 99) = 7.78$, $p = .01$.

Testing imagery perspective's role in moderating recalibration's effect on expectations.

Primary analysis. We predicted that the imagery perspective participants used while imagining ambiguous future scenarios on the Interpretation Questionnaire would moderate the effects of recalibrating valence weighting bias. Specifically, the benefits of recalibration should be evident when participants used first-person imagery but should be attenuated or eliminated when they used third-person imagery. To test this prediction, we scored participants' responses to the Interpretation Questionnaire the same way as in Experiment 1 by subtracting their average negative scores from their positive scores to serve as an index of their expectations in each scenario ($M = -0.28$, $SD = 0.53$). Then, we predicted participants' scores using a 2 (BeanFest condition: recalibration vs. control) × 2 (perspective: first-person vs. third-person) ANOVA.

Replicating past research (Pietri et al., 2013a), there was a main effect of recalibration condition $F(1, 97) = 5.79$, $p = .02$ such that recalibrated participants formed more positive interpretations ($M = -0.16$, $SD = 0.52$) than did control participants ($M = -0.40$, $SD = 0.52$).[9] Critically however, as hypothesized, this effect was moderated such that recalibration's effect on expectation formation was completely dependent upon imagery perspective, $F(1, 97) = 4.23$, $p = .04$. The first-person perspective caused participants to rely on their valence weighting biases, such that recalibration ($M = -0.06$, $SD = 0.46$) caused them to form more

[8] Also, as in Experiment 1, participants rated how vivid their imagery was and how easy it was to imagine each scenario. Neither vividness nor ease ratings differed significantly across perspective (vividness: $F(1, 100) = 0.77$, $p = .38$; ease: $F(1, 100) = 0.53$, $p = .47$).

[9] There was no main effect of imagery perspective $F(1, 97) = 0.10$, $p = .76$.

positive expectations than control ($M = -0.52$, $SD = 0.58$), $t(47) = 3.04$, $p < .01$. In contrast, the third-person perspective caused participants not to rely on their valence weighting biases, resulting in no difference between recalibration ($M = -0.24$, $SD = 0.55$) and control ($M = -0.28$, $SD = 0.44$), $t(50) = 0.26$, $p = .80$; Figure 3).[10]

Secondary analysis. As in Experiments 1 and 2, we calculated our primary dependent measure as a difference score between positive and negative interpretations and did not have theoretical reasons a priori to predict that the effects in the primary analyses would be driven by effects on either negative or positive expectations alone. Analyzing the effects for positive and negative interpretations separately, we found that the strength (and significance) of the effects varied, but all of the effects were directionally consistent with the primary analyses. Expectations reflected recalibration condition more in the first-person condition (vs. third-person condition), although the moderating effect of perspective was significant only for negative expectations, $F(1, 97) = 5.23$, $p = .02$ and not positive, $F(1, 97) = 2.36$, $p = .13$.

Discussion

As hypothesized, the patterns of data suggest that recalibration (vs. control) appears to have caused participants to form more positive expectations only when using the first-person perspective to visualize events. By attuning people to their recalibrated valence weighting biases, first-person imagery (but not third-person imagery) appears to have caused people to form more positive expectations (vs. control). As such, these results provide experimental evidence consistent with the possibility that manipulating (rather than simply measuring) valence weighting biases produces effects with the bottom-up processing style evoked by first-person imagery, whereas the effect is not present with the top-down processing style evoked by third-person imagery.

Experiment 4

Experiment 4 served several purposes: replicate the effects from the previous experiments with a larger more diverse sample, demonstrate behavioral consequences of the effects, and provide convergent evidence for the proposed mechanism. Experiment 4 used a sample of participants recruited from a different population (Amazon Mechanical Turk [MTurk] workers vs. undergraduates). As did Experiment 3, Experiment 4 recalibrated participants with negative valence weighting biases to be more neutral. The procedure also measured participants' self-beliefs about the future and then manipulated imagery perspective before participants formed expectations about an uncertain outcome. We expected to replicate the results from Experiment 3 such that first-person imagery (vs. third-person) would increase people's reliance on their valence weighting bias when forming expectations, thereby causing participants who were recalibrated (vs. control) to form more positive expectations. Additionally, because Experiment 4 was more highly powered than Experiment 3, we also expected to conceptually replicate the effects from Experiments 1 and 2 such that third-person imagery (vs. first-person) would cause people's expectations to align with their self-beliefs about the future.

Experiment 4 also included some important modifications aimed at extending the effects observed in Experiments 1 through 3. First, Experiment 4 sought to extend the current findings by employing a behavioral dependent measure—one that captures the momentary expectations participants formed about anticipated outcomes in an actual task that had real monetary consequences. Participants in Experiment 4 played a game that was designed to mirror the real-world decisions people face when deciding how to invest their money. People often display risk aversion when making investment decisions, which leads them to overinvest in risk-free options (e.g., bonds) and underinvest in somewhat riskier options that are more lucrative over time (e.g., stocks; Thaler,

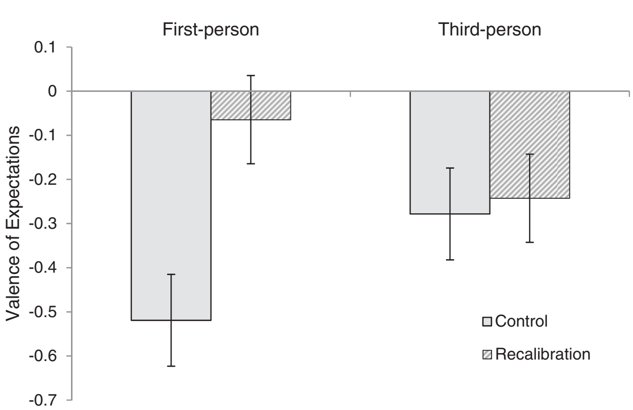

Figure 3. Valence of participants' expectations in Experiment 3 as assessed by a closed-ended measure, depending on imagery perspective and valence weighting bias recalibration condition. Values are plotted at the cell means with standard error bars.

[10] Because we also measured self-beliefs about the future in this experiment, it was possible to test the effect of imagery perspective in moderating their role in the expectations participants formed. However, compared with Experiments 1 and 2, the design of Experiment 3 made detecting the effect of perspective on the role of self-beliefs more difficult. The primary goal of Experiment 3 was to test whether perspective moderated the effect of valence weighting bias recalibration. In order to detect mean level effects of the recalibration procedure, it is necessary that the direction of recalibration be the same for all participants. Thus, following protocol from research that developed the recalibration procedure, we recruited participants that were expected to have negative valence weighting biases and recalibrated half of them to be more accurate. While this restriction of range in our sample was necessary to test perspective's role in moderating reliance on valence weighting biases, it naturally interfered with the ability to test perspective's role in moderating reliance on self-beliefs. Indeed, while the moderating effect of imagery perspective on self-beliefs was directionally consistent with Experiments 1 and 2, it was not significant ($b = 0.07$, $\beta = 0.11$, $t(95) = 1.12$, $p = .27$). However, simple slope analyses do show that, consistent with our account, the self-beliefs composite significantly predicted participants' expectations in the third-person perspective ($b = 0.21$, $\beta = 0.33$, $t(95) = 2.58$, $p = .01$) but not in the first-person perspective ($b = 0.07$, $\beta = 0.10$, $t(95) = 0.76$, $p = .45$). Experiment 4 sought to address this issue by running a more highly-powered conceptual replication of Experiment 3. Additionally, meta-analyzing the interaction across all four experiments using Fisher's method of combining independent p values (as described in Borenstein, Hedges, Higgins, & Rothstein, 2011; Goh, Hall, & Rosenthal, 2016) still yields a significant effect of imagery perspective in moderating the role of self-beliefs ($Z = 3.85$, $p < .001$, Cohen's $d = 0.30$). Similarly, using this method to meta-analyze the interaction between imagery perspective and valence weighting (measured, as in Experiments 1 and 2, or manipulated, as in Experiments 3 and 4) also yields a highly significant effect ($Z = 3.98$ $p < .001$, Cohen's $d = 0.30$).

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Tversky, Kahneman, & Schwartz, 1997). Further, people who are more likely to expect and fear negative outcomes are particularly likely to make these suboptimal investment decisions (Riley & Chow, 1992), and as such, helping them overcome this tendency can improve their long-term financial well-being (Mehra & Prescott, 1985).

Experiment 4 used a procedure (modeled after Thaler et al., 1997) that mirrors this real-world issue. Participants played an investment game in which they needed to decide how to invest their funds across two options: one option was always a no-risk/low-reward option (mirroring the typical performance of bonds), whereas the other was riskier but, on average, provided greater returns (mirroring the typical performance of stocks). Thus, for each trial, participants had to form expectations about whether the high-risk/high-reward option would perform well (or poorly) in order to decide how to best invest their funds. To the extent that participants relied on their valence weighting biases, those who were recalibrated from an initially negative tendency toward a more balanced weighting (vs. control) should expect more positive outcomes from the high-risk/high-reward option and decide to invest in it more. Similarly, to the extent that participants relied on their self-beliefs about the future, those with more positive (vs. negative) self-beliefs should expect more positive outcomes from the high-risk/high-reward option and decide to invest in it more.

Further, not only was the task designed to reflect the types of investing decisions that people make in the real world, but participants also earned bonus pay at the end of the experiment based on the outcome of their performance in the investment game. As such, participants' investment decisions in the game held consequences for a real outcome in their lives—that is, how much money they earned.

Finally, Experiment 4 sought to provide convergent evidence of the proposed mechanism responsible for the moderating effects of imagery perspective across the previous experiments—specifically, that the effects of imagery perspective reflect a shift in processing styles. To do so, Experiment 4 used a different, previously validated method of manipulating imagery perspective—a mindset manipulation that replicates the processing style differences observed with mental imagery instructions (Shaeffer et al., 2015). Specifically, before completing the investment game, participants viewed photographs that depicted a series of actions either from the first-person or third-person perspective. Importantly, the actions in the photographs were unrelated to the investing game. Previous research demonstrates that this method of manipulating perspective produces effects on subsequent judgments that replicate the effects observed when manipulating perspective in mental imagery relevant to the target judgment (e.g., Niese et al., 2018; Shaeffer et al., 2015). Such results support the notion that perspective is operating by shifting processing style rather than by merely changing salience of information that is only relevant to the pictured scene. Thus, if manipulating imagery perspective this way in Experiment 4 changes the expectation formation process in the subsequent investing task (i.e., causing expectations to align more with valence weighting tendencies with first-person imagery or self-beliefs with third-person imagery), it would support the idea that processing style is a critical determinant of the extent to which biases in self-beliefs and valence weighting shape expectations on any given occasion.

Method

Participants. In order to identify participants with a negative valence weighting bias, we first created a pool of participants who completed the Rejection Sensitivity Questionnaire (Downey & Feldman, 1996) by paying 700 MTurk workers $0.25 to complete the questionnaire. Separately, we then invited participants who scored in approximately[11] the top half of the distribution to participate in the main experiment online. We aimed to recruit at least 299 participants in order for the experiment to be well-powered to detect a small effect. Specifically, the experiment can detect a minimum effect size of $f^2 = 0.05$ at 95% power (Faul et al., 2007). Three hundred one MTurk workers participated in the main experiment in exchange for $4.00 and an opportunity to earn up to $2.00 bonus depending on their performance in the investment game (164 female, 135 male, 2 preferred not to say; 77 first-person and control, 72 first-person and recalibration; 75 third-person and control, 77 third-person and recalibration).

Procedure and materials.

Manipulating valence weighting biases.

BeanFest recalibration. Participants read that they would be completing a variety of different tasks during the study. For the first task, participants completed an in-browser version of the BeanFest game (Pietri et al., 2013a). We randomly assigned participants to complete the control or recalibration version of the task. Following the procedure as in Experiment 3, participants in the control condition classified novel beans during the test phase as positive or negative without any feedback, whereas participants in the recalibration condition were given feedback after every classification they made during the test phase, allowing them to learn from their errors and retrain their valence weighting biases.

Measuring self-beliefs. After completing the BeanFest game, participants completed a battery of self-report questionnaires assessing individual differences in trait optimism (Life Orientation Test—Revised: $M = 5.51$, $SD = 1.62$, $\alpha = 0.89$), hope (Adult Hope Scale: $M = 5.72$, $SD = 1.24$, $\alpha = 0.92$), the Weighting Bias Questionnaire ($M = 4.38$, $SD = 1.19$, $\alpha = 0.86$), and self-esteem (Rosenberg Self-Esteem Scale: $M = 4.32$, $SD = 1.01$, $\alpha = 0.93$). We combined z scores of participants' trait optimism and hope ($r(301) = 0.67$, $p < .001$) to create a composite index of participants' propositional beliefs about their future ($SD = 0.91$).

Manipulating imagery perspective and measuring expectations. Participants then read that they would be alternating between two tasks in the final portion of the study: forming impressions of images and playing an investment game. Participants read the instructions for each task before beginning. The tasks were blocked such that participants viewed 12 images, completed 12 trials of the investment game, viewed the 12 images again, and then completed another 12 trials of the investment game.

Manipulating imagery perspective. The procedure manipulated imagery perspective using action photographs unrelated to the investment game (Libby et al., 2009). The photographs depicted hands performing simple common actions (e.g., wiping a

[11] The study was completed in waves over the course of a week until we hit our target sample size for the main study. Thus, the exact midpoint of the rejection sensitivity distribution shifted as more participants were added to the pool.

spill). For each action there were two photographs that differed only in whether they were taken from the first-person or third-person perspective; the objects in the image and distance to the action remained constant (for example stimuli, see Libby et al., 2009). Participants were randomly assigned either to view the first-person or the third-person versions of the action photographs. The procedure informed participants that they would be viewing a series of images one at a time and that they should pay attention to each one and try to form an impression of it in their mind. For each block, participants viewed a series of 12 images one at a time for 3.5 s each.

Measuring expectations in the investment game. Participants read that they would also be playing an investment game (modeled after Thaler et al., 1997) in which they would need to make decisions about how to invest a set amount of money. Participants earned (or lost) points based on their decisions in each trial. Importantly, participants earned bonus pay based on their final summed score across all the trials. The procedure informed participants that performing at average would earn them about $1.00 bonus, and that performing below average would earn them less (minimum $0.00) while performing above average would earn them more (maximum $2.00). Thus, participants were encouraged to perform as well as they could because their decisions would have direct consequences for how much bonus pay they actually earned at the end of the study.

We created a payout scheme in which participants earned a bonus of $0.00 if they scored less than 20 points in the game and at least $0.20 if they scored 20 points or more. For every 35 points beyond the first 20 points, participants earned an additional $0.20 bonus (i.e., $0.40 total for scoring above 55 points, $0.60 total for scoring above 90 points, $0.80 total for scoring above 125 points, etc.) up to a maximum of $2.00 for scoring 335 points or more (M = $0.89, SD = $0.33).

For each trial in the game, participants were given 1,000 shares to invest between two options, split however they like. In order to inform their decision on each trial, participants were shown line graphs depicting how each of the two options had performed over the last 6 months. In each trial, one of the options was more volatile, but overall showed greater growth (specifically, it increased in value by an average of 1.25% per month with a standard deviation of ±3%). The other option was more stable and never decreased, but showed less growth (specifically, it increased in value by an average of 0.25% per month with a standard deviation of ±0.17%, truncated at 0). Thus, similar to the real-world decision that people face between investing their money in stocks and bonds, for each trial, participants needed to decide how much to invest in an option that earned more over time (but also had the chance of losing money on any given trial) or a less lucrative option that was safer. As such, the average amount of shares participants chose to invest in the high-risk/high-reward option (out of 1,000) across the 24 trials served as our behavioral index of the extent to which participants formed positive (vs. negative) expectations about an uncertain outcome ($M = 440.11$, $SD = 135.84$).

After making their decision for each trial, participants were shown how the two options performed in the next month of the game. The outcomes of the final month of each trial followed the same rules as the previous 6 months (i.e., across trials, the high risk/high reward options increased in the final month by an average of 1.25% with a standard deviation of ±3%, while the safe option increased in the final month by an average of 0.25% with a standard deviation of ±0.17%, truncated at zero). Participants earned points as a function of each option's performance and the amount they chose to invest in each option.

Results

Recalibration manipulation check. We first examined participants' responses to the novel beans during the test phase of the BeanFest game to verify that the recalibration procedure (vs. control) successfully retrained participants' valence weighting biases. To do so, we calculated participants' average performance on the novel test beans by coding correct responses as +1 and incorrect responses as 0. As expected, participants in the recalibration condition performed significantly better ($M = 0.63$, $SD = 0.12$) than participants in the control condition ($M = 0.57$, $SD = 0.07$; $t(278) = -4.58$, $p < .001$).[12] Further, comparing participants' performance on the first versus last 20 novel trials showed a significant interaction between recalibration condition and time $F(1, 277) = 11.40$, $p < .01$). There was no difference between recalibration and control for the first 20 novel trials $F(1, 277) = 0.28$, $p = .59$, but participants in the recalibration condition significantly outperformed participants in the control condition during the last 20 novel trials $F(1, 277) = 18.30$, $p < .001$.

Testing imagery perspective's role in moderating recalibration's effect on expectations and performance. We predicted that the imagery perspective manipulation would differentially facilitate reliance on valence weighting biases and self-beliefs about the future, thereby influencing the basis for participants' decisions to invest in the high risk/high reward option. Specifically, the benefits of recalibrating people's valence weighting biases should be evident with first-person imagery, but should be attenuated or eliminated with third-person imagery. In contrast, participants' decisions to invest in the high-risk/high-reward option should correspond more with their self-beliefs about the future with third-person imagery (vs. first-person). To test these predictions, we used a single linear-regression model to predict the average amount participants invested in the high-risk/high-reward option from their recalibration condition (−1 = *control*, 1 = *recalibration*) and their self-beliefs composite, as well as imagery perspective (−1 = *first-person*, 1 = *third-person*) and its interaction with the other two measures. Table 3 displays the regression statistics.

As hypothesized, the effect of valence weighting bias recalibration depended on the imagery perspective manipulation ($b = -16.79$, $\beta = -0.12$, $t(295) = -2.17$, $p = .03$). Recalibration (vs. control) caused participants to invest more in the high-risk/high-reward option with first-person imagery ($b = 33.15$, $\beta = 0.24$, $t(295) = 3.01$, $p < .01$), but not third-person ($b = -0.43$, $\beta \leq -0.01$, $t(295) = -0.04$, $p = .97$). Additionally, as predicted,

[12] Due to a program malfunction, BeanFest performance data were not logged for twenty-two of the participants (11 = control condition, 11 = recalibration condition). Because these participants clearly received the manipulation, we chose to include them in the primary analysis on expectations (presented below). However, choosing to instead exclude these participants from the primary analyses does not change the significance of the interaction between imagery perspective and recalibration condition or the interaction between imagery perspective and self-beliefs.

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Table 3
Statistics From a Single Linear Regression in Experiment 4 Predicting Valence of Expectations Based on Valence Weighting Bias Recalibration Condition (−1 = Control, 1 = Recalibration) and Participants' Self-Beliefs About the Future, as Well as Imagery Perspective (−1 = First-Person, 1 = Third-Person) and Its Interaction With Each of the Other Two Measures

Predictor	b	β	t(295)	p
Perspective	5.79	.04	.75	.45
Self-beliefs	9.44	.06	1.11	.27
Perspective × Self-beliefs	17.75	.12	2.09	.04
Recalibration condition	16.36	.12	2.12	.04
Perspective × Recalibration condition	−16.79	−.12	−2.17	.03

imagery perspective had the opposite effect in determining the role of self-beliefs (b = 17.75, β = 0.12, $t(295)$ = 2.09, p = .04). Participants' decisions to invest in the high-risk/high-reward option significantly corresponded with their self-beliefs about the future with third-person imagery (b = 27.19, β = 0.18, $t(295)$ = 2.23, p = .03), but not first-person imagery (b = −8.30, β = −0.06, $t(295)$ = −0.70, p = .48; Figure 4).

Downstream consequences. Participants were paid a bonus depending on their performance in the investing game. Because the game was designed to mirror the real world in which people's risk aversion causes them to earn less over time, we expected that deciding to invest more in the high-risk/high-reward option would increase participants' final performance-based pay. We predicted that participants' pay would reflect valence weighting bias recalibration (as a function of investment decisions) with first-person imagery and that participants' pay would reflect their self-beliefs about the future (as a function of investment decisions) with third-person imagery. We used the computational tool PROCESS (Model 10; Hayes, 2017) to calculate bias-corrected bootstrap confidence intervals (CIs) with 10,000 samples to test if the indirect effects of valence weighting bias recalibration (−1 = *control*, 1 = *recalibration*) and the indirect effects of self-beliefs (low = −1 *SD*, high = +1 *SD*) differed across imagery perspective condition (−1 = *first-person*, 1 = *third-person*) and if each was significantly different from zero. Doing so revealed that the two predicted moderated mediation pathways were significant.

The indirect effect of valence weighting bias recalibration (through investment choice) on participants' pay depended on imagery perspective (point estimate = −0.05, *SE* = 0.02, 95% CI [−0.10, −0.01]). Valence weighting bias recalibration (vs. control) indirectly increased participants' final pay by increasing high-risk/high-reward choices after participants viewed first-person imagery (point estimate = 0.05, *SE* = 0.02, 95% CI [0.02, 0.09]), but not after they viewed third-person imagery (point estimate = −0.001, *SE* = 0.02, 95% CI [−0.03, 0.03]).

The indirect effect of self-beliefs about the future (through investment choice) on participants' pay also depended on imagery perspective (point estimate = 0.03, *SE* = 0.01, 95% CI [0.001, 0.05]). More (vs. less) positive self-beliefs indirectly increased participants' final pay by increasing high-risk/high-reward choices after participants viewed third-person imagery (point estimate = 0.04, *SE* = 0.02, 95% CI [0.01, 0.08]), but not after they viewed first-person imagery (point estimate = −0.01, *SE* = 0.02, 95% CI [−0.05, 0.02]).

Discussion

Experiment 4 conceptually replicated Experiments 1 through 3 using a larger and more diverse sample. Imagery perspective determined whether valence weighting bias recalibration influenced the amount that participants decided to invest in a high-risk/high-reward investment option. Recalibration (vs. control) only caused participants to form more positive expectations and invest in the high risk/high reward option with first-person imagery (and not with third-person imagery). Additionally, imagery perspective determined whether the amount that participants decided to invest in the high-risk/high-reward option aligned with their self-beliefs about the future. Participants formed expectations in line with their self-beliefs with third-person imagery (but not first-person imagery). Further, these effects on participants' decisions to invest in the high-risk/high-reward option held consequences for their final performance, producing differences in the actual amount of bonus pay they earned in the game.

As such, Experiment 4 extended the findings from Experiments 1 through 3 by using a behavioral dependent measure that captures the momentary expectations people formed about anticipated outcomes in an actual task with real monetary consequences. This task was designed to mirror the real-world decision that people face about whether to invest their money in riskier options that have the potential for greater returns (such as stocks) or low-risk options with low returns (such as bonds). Importantly, many people tend to form overly negative expectations when making these decisions and overinvest in low-risk options, which is a costly mistake: for instance, a dollar invested in the stock market in 1926 would be worth over $1,100 fifty years later; but that same dollar invested in government bonds in 1926 would only be worth about $13 fifty years later (Mehra & Prescott, 1985; Thaler et al., 1997). As such, not only did Experiment 4 demonstrate that processing style shifted the extent to which people's decisions reflected their valence weighting tendencies, as opposed to their self-beliefs about the future, but also demonstrated a way to improve people's decisions in this context. In particular, Experiment 4 specifically recruited participants that were expected to have negative valence weighting tendencies, and found that recalibrating them caused them to invest more in the high-risk/high-reward option. However, this effect only occurred when another variable (i.e., first-person vs. third-person imagery) caused participants to use bottom-up processing. Thus, Experiment 4 provides empirical support for the implications of the current findings. In particular, because people's valence weighting bias and self-beliefs about the future operate via distinct processes, processing style shapes whether the people's expectations and behavioral decisions are based in one chronic bias or the other.

Finally, Experiment 4 provided converging evidence for the role of processing style in shifting reliance on valence weighting biases versus self-beliefs. Experiment 4 manipulated imagery perspective with action photographs that were unrelated to the measure of expectations (i.e., the investing game) and only differed in whether they were taken from the first-person or third-person perspective. The fact that this manipulation produced carryover effects on participants' subsequent behavior in the investing game implicates

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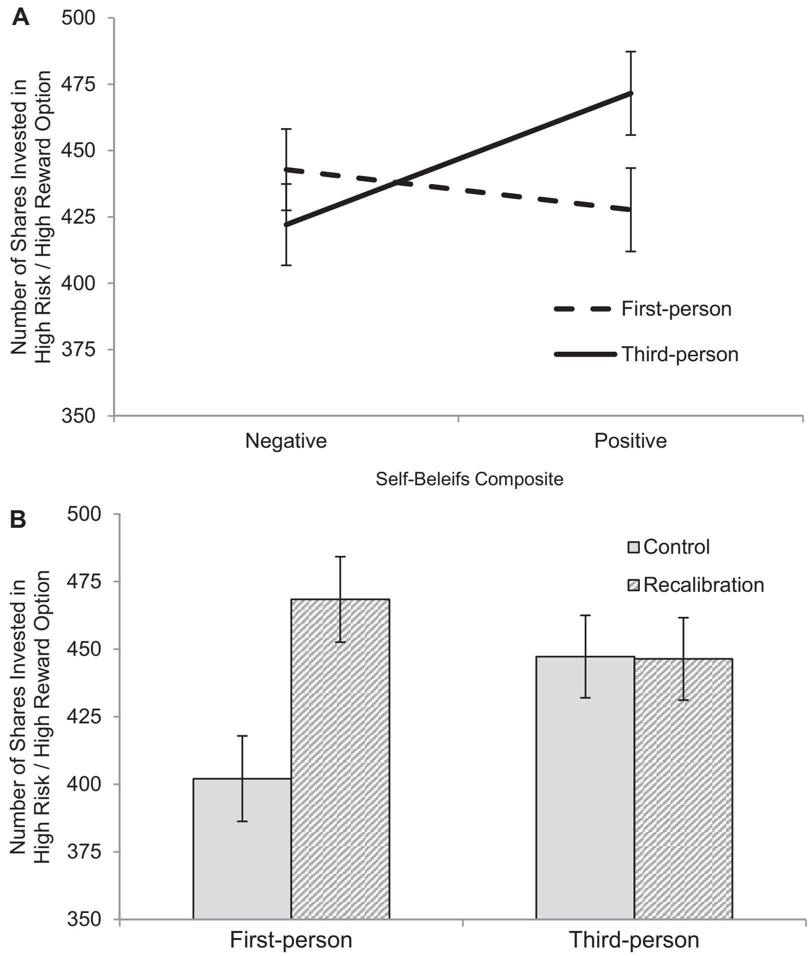

Figure 4. Average number of shares invested in the high risk/high reward option (out of 1,000) depending on imagery perspective and self-beliefs, as indexed by composite scores of trait optimism and hope (values are plotted within perspective condition one standard deviation above and below sample means with standard error bars [A]), and imagery perspective and valence weighting bias recalibration condition (values are plotted at the adjusted cell means with standard error bars [B]). Both interaction effects come from a single model predicting the number of shares participants invested in the risky option from their self-beliefs composite score and valence weighting bias recalibration condition, as well as imagery perspective and its interaction with each of the other two variables.

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processing style as the mechanism by which perspective exerts its effects on the basis for individuals' expectations.

General Discussion

Across four experiments, imagery perspective determined whether participants' expectations aligned with individual differences in their valence weighting bias, as opposed to their self-beliefs about the future. By evoking a processing style that privileges bottom-up influences, first-person imagery (vs. third-person) caused people's expectations to correspond more with individual differences in their valence weighting biases, and less with their propositional beliefs about the positivity of their future. Further, two experiments manipulated people's valence weighting bias, providing stronger evidence for its causal role in expectation formation with the bottom-up processing style evoked by first-person imagery, but not the top-down processing style evoked by third-person imagery. Additionally, as demonstrated in a final experiment, these effects not only changed people's reports of their expectations about hypothetical scenarios, but also influenced their actual risk-taking behavior in a task with real monetary consequences.

Implications for Chronic Biases in Expectation Formation

A good deal of past research has demonstrated that people exhibit trait biases in their self-beliefs about the future, which predict the expectations they tend to form (Scheier et al., 1994). More recent research has demonstrated that people also exhibit chronic biases in their valence weighting tendencies, which also predict the expectations they tend to form (Fazio et al., 2015). However, as in previous research (Fazio et al., 2015), our partic-

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ipants' valence weighting biases were not necessarily consistent with their self-beliefs (see Footnote 7). Although this may suggest that one simply needs to take into account chronic biases on both dimensions to most accurately predict the valence of a person's expectations on a given occasion, the current research highlights that it is also necessary to take into account the process by which people form their expectations on that particular occasion. That is, in order to accurately estimate whether people are likely to form positive or negative expectations on any given occasion, it is necessary to go beyond simply considering chronic individual differences and identify the factors that make people more likely to form expectations in line with one bias or the other.

The present research sheds light on this issue by identifying a crucial distinction in the operation of these two trait biases in expectation formation. Specifically, people's valence weighting biases and self-beliefs about the future appear to shape expectations via qualitatively distinct processes. The present experiments tested this idea by employing a manipulation (i.e., visual perspective) that is an integral element of the mental imagery people sometimes use when forming expectations and that has been shown in the past to differentially evoke processing styles that either privilege top-down or bottom-up processes (Libby & Eibach, 2011). Accordingly, the present experiments found that increasing the effects of top-down processes via third-person imagery (vs. first-person) made people more likely to form expectations in line with their self-beliefs. In contrast, increasing the effects of bottom-up processes via first-person imagery (vs. third-person) made people more likely to form expectations in line with their valence weighting biases. Further, Experiment 4 provided more direct evidence that these effects reflect a shift in processing style by manipulating imagery perspective using photographs unrelated to the target judgment. Thus, these results provide evidence that, whereas self-beliefs about the future operate via top-down processes that structure people's expectations to align with their broader belief systems, valence weighting biases operate as a bottom-up process that shapes people's expectations by influencing their reactions to ambiguous information.

As such, the current findings connect with the broader literature of theoretical and empirical work aimed at identifying distinct processing styles and the implications of adopting each (Gawronski & Bodenhausen, 2007; Olson & Fazio, 2008; Rydell & McConnell, 2006). That is, the evidence in the current studies that these two biases operate via qualitatively distinct processes suggests that other variables that influence processing style should also shift whether people form expectations in line with one type of bias or the other. For instance, manipulating construal level by asking people to think about themselves in the distant (vs. near) future causes them to make more stable judgments that more consistently align with their self-beliefs (Wakslak, Nussbaum, Liberman, & Trope, 2008). Additionally, guiding people to think concretely (vs. abstractly) can reduce the impact of their negative self-beliefs—and this effect has been demonstrated using standard manipulations of construal level, as well as manipulations of imagery perspective (Kille, Eibach, Wood, & Holmes, 2017). Paired with the current findings, this suggests people might naturally form expectations more in line with their self-beliefs about the future when thinking about the distant (vs. near) future, or when other situational variables encourage people to engage in abstract (vs. concrete) thinking (e.g., Zunick, Fazio, & Vasey, 2015).

In contrast, situational factors that encourage people not to reason through their decisions (e.g., Gawronski & LeBel, 2008; Wilson et al., 1993) might increase the bottom-up influence of people's valence weighting biases. For instance, directly instructing people to simply trust their intuitions (e.g., Jordan, Whitfield, & Zeigler-Hill, 2007), "go with their gut" (e.g., Kendrick & Olson, 2012), or focus attention on their immediate experience without elaboration (e.g., Koole, Govorun, Cheng, & Gallucci, 2009) might cause people to form expectations in line with their valence weighting biases and less with their self-beliefs about the future. Consistent with this possibility, there is some evidence that both encouraging intuitive responding and speeding people's decisions in a behavioral task increase reliance on their valence weighting biases (Rocklage & Fazio, 2014).

Finally, individual differences that predict whether people tend to engage in one type of processing style or the other (e.g., Epstein, Pacini, Denes-Raj, & Heier, 1996) might also predict which trait bias in expectation formation typically predicts a given person's expectations. Exploring these possible connections and developing a fuller understanding of the conditions that evoke one type of processing style or the other is an important direction for future theory and research.

Future research could also benefit from further exploring the types of situations that naturally cause people to rely on their self-beliefs, rather than experiential processes, to inform their judgments and behavior. That is, beyond experimental manipulations that can direct people to rely more on their self-beliefs by evoking a top-down processing style, what naturally occurring cues in the immediate situation lead people to rely on their self-beliefs? Certainly, self-beliefs seem likely to guide people's behavior more in some situations than others. For instance, an intermediate skier deciding whether to attempt the challenge involved in a black diamond run, one that is classified as expert in nature, should be particularly likely to use his self-beliefs (e.g., about his skill level, how well things turn out for him generally, etc.) to inform his decision. However, those self-beliefs may be irrelevant to the same skier's decision to try, once again, a favored intermediate run. That decision is likely to rest on an in-the-moment appraisal of factors such as his current state of fatigue or the current snow conditions. Thus, given that people seem likely to differentially rely on their self-beliefs and experiential processes in different situations, it is important to explore the cues that cause them to do so. Ultimately, a theoretical framework that incorporates these naturally occurring cues will better allow us to predict whether people's self-beliefs about the future or valence weighting biases are more likely to shape the expectations they form on a given occasion.

Implications for Visual Imagery Perspective

The present findings are consistent with, and uniquely contribute to, previous evidence documenting the processing function of imagery perspective. Specifically, the present findings replicate previous work establishing that imagery perspective differentially facilitates distinct processing styles while adding nuance and depth to our understanding in a few theoretically important ways.

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First, previous research shows that third-person imagery shapes people's reactions in line with a host of relevant propositional beliefs such as their traits, values, preferences, and developmental trajectories (Libby & Eibach, 2011; Libby et al., 2014; Marigold et al., 2015). Such findings support the idea that third-person imagery evokes a processing style that facilitates the influence of top-down processes, causing people to understand simulated events in relation to their explicitly endorsed belief systems and propositional self-beliefs (Libby & Eibach, 2011). The present experiments provide convergent evidence for this account by conceptually replicating these effects in a new domain: self-beliefs about the positivity of the future.

Further, the present findings offer discriminant validity to the processing function of third-person imagery. Past research has demonstrated a causal link between people's propositional self-beliefs and their reactions to a pictured scene with third-person imagery (Libby, Eibach, & Gilovich, 2005; Niese et al., 2018). By demonstrating third-person imagery's ability to attenuate the effects of manipulations that do not appear to operate via top-down processes, Experiments 3 and 4 demonstrate that third-person imagery does not make people indiscriminately more sensitive to any manipulation. Rather, consistent with the processing style account, while manipulations of the top-down effects of people's belief systems prove effective with third-person imagery (as demonstrated in past research), manipulations of bottom-up processes are not effective with third-person imagery (as demonstrated in the present Experiments 3 and 4).

The present set of experiments also offers convergent validity for the processing function of first-person imagery. Previous work has found that first-person (vs. third-person) imagery causes people to respond more in line with their implicitly measured reactions to features of a pictured scene (Libby et al., 2014) or manipulations of its concrete features (Niese et al., 2018). The present finding that first-person imagery caused people to respond more in line with their valence weighting bias is consistent with the previous work and also provides more direct evidence that such effects reflect an effect of perspective on processing style. More specifically, because valence weighting bias is a domain-general bottom-up process that is not bound to the specific content of any of the visualized scenes, the current experiments rule out the alternative possibility that imagery perspective's effects are driven by merely changing the salience of different content in the visualized image. Instead, by finding that first-person imagery caused people to form expectations in line with this domain-general bottom-up process, the current experiments provide stronger converging evidence for the processing style account. Further, because Experiments 3 and 4 manipulated valence weighting bias through recalibration, these experiments offer novel evidence for the causal role of bottom-up processes with first-person imagery.

Additionally, Experiment 4 manipulated perspective in photographs unrelated to the events about which participants formed expectations and replicated the patterns from Experiments 1 through 3 that manipulated, via instruction, perspective in mental imagery concerning the very events about which participants formed expectations. This result is consistent with other research that replicates effects of perspective in mental imagery by varying perspective in photographs (Niese et al., 2018; Shaeffer et al., 2015), thereby providing convergent evidence for the role of processing style in producing perspective's effects.

Thus, the present findings provide converging evidence with previous research for the processing function of imagery perspective with first-person facilitating bottom-up processes and third-person imagery facilitating top-down processes. However, like the previous research, the current experiments relied exclusively on North American individuals, raising the question of whether the effects of the present experiments would generalize to other cultural contexts (Henrich, Heine, & Norenzayan, 2010). As such, this is an important area for future investigation. Considering the current empirical evidence at this point, we speculate that the processing function of perspective may be constant across cultures, although the implications of evoking one processing style or the other may differ.

For example, there is evidence of cross-cultural differences in East Asian and North American individuals' tendencies to use first-person versus third-person imagery (Cohen & Gunz, 2002; Cohen, Hoshino-Browne, & Leung, 2006). However, across cultures, third-person imagery may still serve the common function of causing people to make sense of an event in relation to their broader belief systems—although important differences may arise based on the divergent top-down belief systems that the members of each culture tend to rely on (Libby & Eibach, 2011). For instance, East Asians' tendency to view the self as interdependent (Markus & Kitayama, 1991) may make them more likely to incorporate others' opinions of the self with third-person imagery, whereas North Americans' tendency to view the self as independent may make them more likely to incorporate their own opinions of the self with third-person imagery. Thus, researching these types of questions on imagery perspective's functional role in cognition across cultures is one promising area of future research that will be useful for understanding the generalizability of the present effects.

Practical Implications

Finally, these results hold implications for interventions designed to change people's outlooks on life so that they can experience the beneficial outcomes associated with forming positive expectations. For instance, clinical psychologists have a long tradition of working to improve lives by reducing their patients' pessimistic thoughts and self-views (Beck, 1967) and, more recently, by increasing their patients' optimistic thoughts and self-views (Riskind, Sarampote, & Mercier, 1996). Further, the value of making one's propositional self-beliefs more positive has also taken hold in popular culture—one only need browse a self-help section for a few minutes to find numerous books that provide tips on how to be an optimist, offer suggestions on how to increase one's self-confidence, and extol the importance of positive thinking (e.g., Seligman, 1991). However, while these approaches may be beneficial, the current experiments highlight the fact that people do not always use their self-beliefs to inform their expectations. As such, approaches that focus solely on helping people restructure these beliefs to be more positive may miss part of the problem. For instance, even if individuals come to adopt propositional beliefs that their futures are positive, they may still find themselves forming negative expectations if they possess a negative valence weighting bias and rely on bottom-up processes rather than top-down processes when faced with ambiguous events in the real world.

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Thus, the current experiments suggest that interventions aimed at improving self-beliefs about the positivity of one's future could be more beneficial if they were also paired with manipulations that encourage people to rely on those newly improved beliefs. For example, mental imagery is a common tool in therapeutic interventions (e.g., Holmes, Arntz, & Smucker, 2007; Stopa, 2009), and visual perspective is an inherent aspect of imagery that people are able to vary at will with minimal training. Given the role of perspective in shaping processing style, the present experiments suggest the promise of leveraging the power of imagery perspective to improve the effectiveness of interventions. Additionally, the current experiments suggest that to create a positive change that is not constrained by the processing style a person is using in any given moment, it may be effective to complement techniques for changing people's self-beliefs with interventions that are designed to improve biases in people's valence weighting tendencies (or other relevant bottom-up processes, e.g., Dandeneau & Baldwin, 2004).

Conclusion

The future is inherently ambiguous, and yet, people make predictions about it that can influence their current feelings, motivations, behaviors, and outcomes in life. While trait differences in people's self-beliefs about the future and their valence weighting tendencies each reliably predict the valence of the expectations they form, the two biases are not necessarily consistent (Fazio et al., 2015). By manipulating an integral element of future thinking—visual perspective in mental imagery—that plays a functional role in cognition (Libby & Eibach, 2011), the present experiments support the notion that these two biases operate via qualitatively distinct processes. By differentially invoking a processing style that privileges bottom-up or top-down processes, first- and third-person imagery differentially caused people to form expectations that aligned with their valence weighting bias or self-beliefs about their future. Thus, by providing evidence that a crucial difference between the two biases is that they operate via different processes, the present experiments provide insight into the types of situational influences that make one bias or the other more likely to exert its influence on expectation formation. As such, the present experiments improve our ability to know how positive or negative a person's expectations will be on any given occasion and suggest a novel tool for helping to modify those expectations in desired ways.

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Received September 15, 2017
Revision received August 21, 2018
Accepted August 25, 2018 ■

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