Asymmetric Hedonic Contrast: Pain Is More Contrast Dependent Than Pleasure

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Abstract

Research has shown that hedonic-contrast effects are a ubiquitous and important phenomenon. In eight studies (N=4,999) and four supplemental studies (N=1,809), we found that hedonic-contrast effects were stronger for negative outcomes than for positive outcomes. This *asymmetric-contrast effect* held for both anticipated and experienced affect. The effect makes risks that include gains and losses more attractive in the presence of high reference points because contrast diminishes the hedonic impact of losses more than gains. We demonstrated that the effect occurs because people are generally more attentive to reference points when evaluating negative outcomes, so drawing attention to reference points eliminates the asymmetric-contrast effect.

Statement of Relevance

Judgment is often comparative: research has shown that the pain or pleasure people obtain from an experience can depend on the surrounding environment as much as on the experience itself. The taste of food, beauty of paintings, hardships of illness and victimization, and satisfaction with possessions can all depend on how they compare with other foods, paintings, hardships, or possessions. Such comparisons often induce *hedonic contrast*, an effect that occurs when something feels better or worse by virtue of being compared with a reference point that is worse or better, respectively. Here, we show that contrast effects are larger for negative than positive experiences. We also show that risky propositions that may result in either negative or positive outcomes become more attractive when evaluated next to reference points that can make those outcomes seem less significant in comparison, because contrast reduces the affective impact of negative outcomes more than the affective impact of positive outcomes.

Introduction

The pain and pleasure associated with outcomes guide choices with personal, financial, political, medical, and other implications (Blumenthal, 2005; Ditto et al., 2005; Halpern & Arnold, 2008; Marroquín et al., 2013; Mellers & McGraw, 2001). For instance, people are more likely to deem 'enhanced interrogation' unacceptable, intervene on behalf of an abused child, or donate money to the hungry if they can appreciate the suffering caused by torture and abuse or the relief brought by donations (Christy & Voigt, 1994; Harel & Kogut, 2015; Nordgren et al., 2011).

One of the factors that determines how much pain or pleasure people associate with an outcome is how it compares with salient standards of comparison, or *reference points* (Kahneman & Miller, 1986; Novemsky & Ratner, 2003). The taste of food, beauty of paintings, hardships of illness and victimization, and satisfaction with possessions can all depend on how they compare with other foods, paintings, hardships, or possessions (Carter & Gilovich, 2010; Cogan et al., 2013; Huh et al., 2016; Taylor et al., 1983; Wood et al., 1985). *Hedonic contrast* often occurs when an outcome seems better or worse by virtue of being evaluated in the presence of a reference point (Morewedge et al., 2019).

For people to experience contrast effects, they need to compare a stimulus with a salient reference point (Buechel et al., 2014), and research suggests that such comparisons are spontaneous (Gilbert et al., 1995; Mussweiler et al., 2004; Petty & Wegener, 1993; Raghunathan & Irwin, 2001). On the basis of this research, it may be reasonable to assume that hedonic contrast occurs spontaneously as well (Carter & Gilovich, 2010). Indeed, most of the findings in this research area are consistent with the idea that the intensity of hedonic contrast is largely determined by the salience of the difference between an outcome and a reference point. For

instance, hedonic contrast is stronger when differences are easily quantifiable (Carter & Gilovich, 2010) and when outcomes and reference points are evaluated consecutively (Novemsky & Ratner, 2003) or belong in the same category (Huh et al., 2016; Zellner et al., 2003).

Here, we examined another factor that may influence how intensely people experience hedonic contrast: the valence of the outcome. People process negative stimuli more thoroughly than positive stimuli (Baumeister et al., 2001; Öhman, 2007; Pratto & John, 1991; Puig & Szpunar, 2017; Taylor, 1991). For instance, people think longer about losses than about gains (Gilovich, 1983). Consequently, representations of negative stimuli are more complex, and people are more attuned to their variations (Baumeister et al., 2001; Claeys & Timmers, 1993; Puig & Szpunar, 2017; Rozin & Royzman, 2001).

Although past work shows that people are more attentive to negative than positive stimuli, it is unclear whether people pay different amounts of attention to reference points when evaluating negative and positive outcomes. Past research has not compared the intensity of hedonic contrast in the negative and positive domains, leaving open the question of whether people experience stronger hedonic contrast for negative outcomes than for positive outcomes. To illustrate, compare people who find a parking ticket under their windshield wiper with people who receive a winning scratch-off lottery ticket. The people who found the parking ticket may be highly attentive to the fine given to another car, whereas the people with the winning lottery ticket may pay no attention to how much someone else won. Therefore, the hedonic impact of a $100 parking ticket may depend more on whether the neighboring car has a $50 or a $150 ticket than the hedonic impact of winning $100 on a scratch-off lottery ticket depends on whether another person won $50 or $150.

Across eight studies, we explored the possibility that people experience stronger hedonic contrast when evaluating negative rather than positive outcomes. In Studies 1a and 1b, we demonstrated an asymmetric contrast effect in two domains: When anticipating the hedonic impact of gaining or losing money (Study 1a) or time (Study 1b), people expect weaker contrast effects for gains than for losses. Studies 2a, 2b, and 2c show that the asymmetric-contrast effect is reflected in choice: People experience stronger hedonic contrast for negative than positive outcomes, so risky prospects that involve potential negative and positive outcomes more attractive when evaluated in the presence of high reference points. Studies 3a and 3b suggest that the asymmetric-contrast effect occurs because people pay less attention to reference points when evaluating positive outcomes. In these studies, we drew participants' attention to reference points and showed that this leads them to experience the same contrast effect when evaluating negative and positive outcomes. Study 4 shows that the asymmetric-contrast effect is reflected not only in choice and anticipated affect but also in experienced affect following realized outcomes.

Sample sizes were determined prior to data collection, and we aimed to have at least 100 participants in each experimental condition to ensure reasonable statistical power to identify small- to medium-sized effects. We report all manipulations and all measures, and we did not deviate from any of our preregistrations or exclude any participant who completed a study. Participants were prevented from participating in more than one study on the same recruitment platform. A summary of participants' nationalities appears in section S3 in the Supplemental Material available online. Study materials, data, and R code for reproducing our analysis are publicly available on OSF at https://osf.io/hm7cw/?view_only=71a7b9466c544298b885fffc7fbab177.

Studies 1a and 1b

Studies 1a and 1b tested whether contrast effects are asymmetric for positive and negative outcomes. In Study 1a, participants estimated how they would feel about gaining or losing money in the presence of different reference points. In Study 1b, participants estimated how someone else would feel about saving or losing time in the presence of different reference points. We expected to find stronger hedonic contrast for negative than positive outcomes.

Study 1a

Method. We opened Study 1A to 600 participants on TurkPrime[1] (Litman, Robinson, & Abberbock, 2017). In a 2 (outcome valence: negative, positive) × 3 (reference point: low, high, control) between-participants design, participants were asked to imagine that they flipped a coin to gain or lose $20. Each participant was then asked to estimate either how painful it would be to lose the coin flip (negative valence) or how enjoyable it would be to win the coin flip (positive valence), on a scale ranging from 1, *not at all*, to 7, *extremely*. To manipulate the reference point, we asked each participant to imagine that some of the other participants could win or lose either $2 (low reference point), $100 (high reference point), or $20 (control). Study 1A was preregistered (https://aspredicted.org/blind.php?x=y2yu2s).

[1] In all TurkPrime studies, participants were assigned to a condition only if they responded correctly to several attention checks.

***Results*.** Six hundred six participants completed the study (53% female; age: M = 35.85 years, SD = 11.14.). An analysis of variance (ANOVA) revealed a significant Valence × Reference Point interaction, demonstrating that participants experienced stronger hedonic contrast for losing money than for winning money, $F(2, 600) = 10.17$, $p < .001$, $\eta_G^2 = .033$ (see Fig. 1). Follow-up ANOVAs showed that the reference point influenced the anticipated pain from losing money, $F(2, 299) = 26.07$, $p < .001$, $\eta_G^2 = .149$, but had no significant effect on enjoyment from gaining money, $F(2, 301) = .7$, $p = .497$, $\eta_G^2 = .005$. For additional analysis, see section S2 in the Supplemental Material.

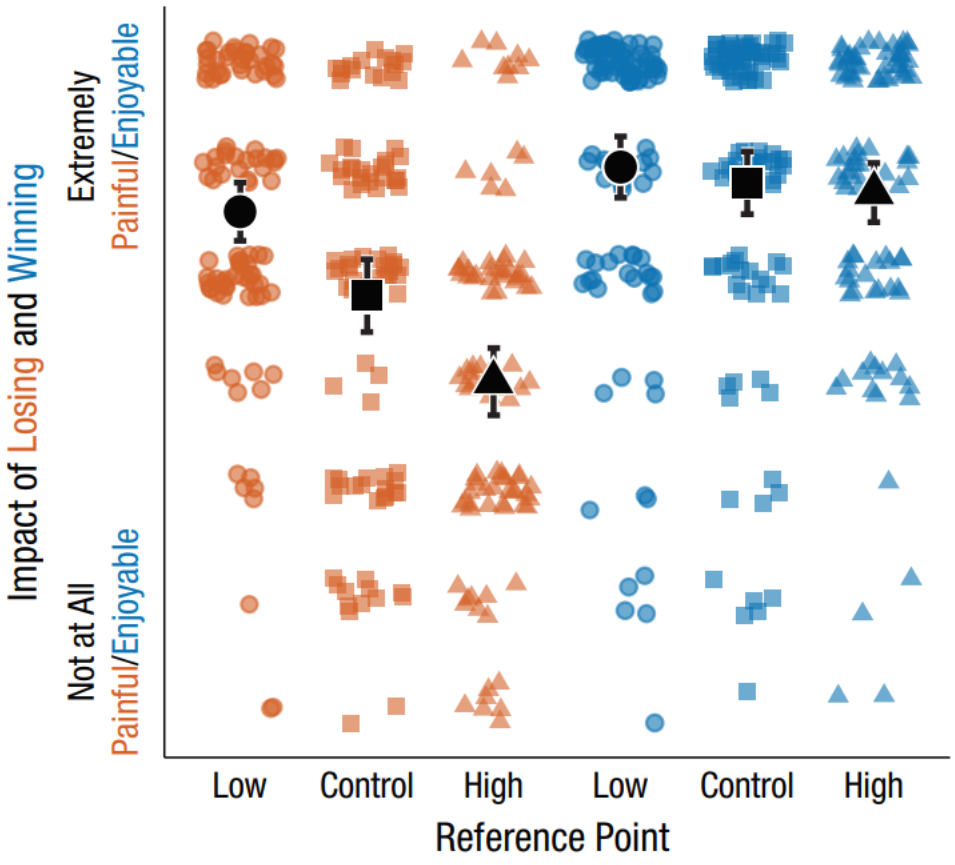

Fig. 1. Results of Study 1a: anticipated impact of negative outcomes (orange) and positive outcomes (blue) as a function of reference point. Small shapes indicate individual data points, and large shapes indicate group means. Error bars represent 95% confidence intervals.

Study 1b

Method. We opened Study 1b to 400 participants on Prolific (www.prolific.co). In a 2 (outcome valence: negative, positive) × 2 (reference point: low, high) between-participants design, participants read that Alice and Bob live together and work in different offices, and for their daily commute, they can either take the train or drive. All participants read that if Bob decides to drive, he may save or lose 10 min relative to his train ride, depending on whether traffic is light or heavy. Each participant was asked to indicate either how Bob would feel if he drives and traffic is light (positive valence) or how Bob would feel if he drives and traffic is heavy (negative valence), on a scale ranging from -10, *extremely unhappy*, to 10, e*xtremely happy*. To provide a reference point, we had participants read about Alice prior to reading about Bob. They were told that if Alice decides to drive, she could also save or lose time relative to her train ride, depending on traffic. We manipulated the reference point by varying how much time Alice could save or lose: either 5 min (low reference point) or 50 min (high reference point).

Results. Four hundred participants completed the study (53% female; age: M = 29.93 years, SD = 10.44). For our analysis, we reverse-coded responses for participants in the negative-valence condition. An ANOVA revealed a significant Valence × Reference Point interaction, showing that participants experienced stronger hedonic contrast for losing time than for saving time, $F(1, 396) = 11.27$, $p = .001$, $\eta_G^2 = .028$. Follow-up t tests showed that the reference point influenced the anticipated hedonic impact of both losing time - low reference point: M = 5.76, 95% confidence interval (CI) = [5.15, 6.37], SD = 3.1; high reference point: M = 2.14, 95% CI = [1.45, 2.83], SD = 3.47; $t(199) = 7.81$, $p < .001$, d = 1.10, 95% CI = [.80, 1.40] - and saving time - low reference point: M = 7.29, 95% CI = [6.66, 7.92], SD = 3.16; high reference point: M = 5.86, 95% CI = [5.20, 6.52], SD = 3.31; $t(197) = 3.12$, $p = .002$, d = .44, 95% CI = [.16, .73].

Studies 2a, 2b, and 2c

Studies 1A and 1B found an asymmetric-contrast effect for negative and positive outcomes. One important implication of this finding is that risky prospects with potential positive and negative outcomes should be more appealing in the presence of high reference points. The asymmetric-contrast effect implies that when a risky prospect is evaluated in the presence of a high reference point, the anticipated impact of the potential negative outcome decreases more than the impact of the potential positive outcome, thereby increasing the overall appeal of the risky prospect.

Studies 2a and 2b tested whether introducing high reference points increases the likelihood that people will recommend a risky experimental drug or accept a monetary gamble. In Study 2c, to directly test whether the contrast effect on affective forecasts mediates the effect of reference points on choice, we measured how introducing a high reference point affects both participants' willingness to take a risk and the anticipated impact of its outcomes..

Study 2a

Method. We opened Study 2A to 400 participants on Prolific. In a two-condition between-participants design (reference point: low, high), participants read that Hospital B is dealing with an outbreak of a deadly disease and is debating whether to continue using a known drug or switch to an experimental drug that would either increase or decrease the mortality rate by 10%. We asked participants whether they would recommend that Hospital B continue to use the known drug or switch to the experimental drug. To provide a reference point, we had participants read about another hospital - Hospital A - that is also debating whether to continue treating the

outbreak with the known drug or to switch to another experimental drug. We manipulated the reference point by varying by how much the mortality rate at Hospital A would increase or decrease if it switches to its experimental drug: either 5% (low reference point) or 50% (high reference point). Study 2A was preregistered (http://aspredicted.org/blind.php?x=qs2j4d).

Results. Three-hundred ninety-nine participants completed the study (46% female; age: M = 28.35 years, SD = 10.00). Participants were more likely to recommend that Hospital B use the experimental drug in the high-reference point condition than in the low-reference point condition (53% vs. 36%), $X^2(1) = 11.49$, $p < .001$.

Study 2b

Method. We opened Study 2b to 400 participants on Turkprime. Each participant was randomly assigned to one of two conditions (reference point: low, high). Participants were asked whether they would be willing to bet $20 on the flip of a coin to either double or lose their money. Participants were informed that one participant would be chosen at random. That participant either would receive $20 if they chose not to gamble or would receive the outcome of the gamble (either $0 or $40) if they decided to gamble. To manipulate the reference point, we told participants that the maximum amount that was allocated to any participant in this study was either $25 (low reference point) or $100 (high reference point).[2]

[2] This study was replicated in Study S2, except that the gamble was smaller ($0.20), and all participants received the outcome of their choice. The results were similar to those of Study 2b (see Section S1 in the Supplemental Material).

Results. Four hundred one participants completed the study (51% female; age: M = 28.96 years, SD = 9.20). Participants were more likely to gamble in the high-reference-point condition than in the low-reference-point condition (42% vs. 31%), $X^2(1) = 5.28$, $p = .022$.

Study 2c

Method. We opened Study 2c to 400 participants on Prolific. In a 2 (outcome valence: negative, positive) × 2 (reference point: low, high) between-participants, we asked each participant to imagine that they were walking with either $10 (low reference point) or $50 (high reference point) in their pocket. Then we asked participants whether they would be willing to bet $8 on the flip of a coin. Finally, we asked some participants to indicate how emotionally impactful it would be for them to lose $8 (negative valence) and asked other participants to indicate how emotionally impactful it would be to gain $8 (positive valence). Both ratings were made on a continuous unnumbered scale ranging from *not at all* to *extremely*.[3]

Results. Four hundred participants completed the study (47% female; age: M = 31.69 years, SD = 11.15). Participants in the high-reference-point condition were more likely to accept the gamble than participants in the low-reference-point condition (50% vs. 17%), $\chi^2(1) = 47.51$, $p < .001$. For our analysis of how emotionally impactful participants anticipated gaining or losing

[3] This study was replicated in Study S3, except that participants made the affective forecast before deciding whether to gamble. Study S4 replicated Study 2c in a different context. The results of both studies were similar to those of Study 2c (see section S1 in the Supplemental Material).

money would be, we scored participants' responses using a scale ranging from 1, *not at all*, to 100, *extremely*. An ANOVA revealed a significant Valence × Reference Point interaction: The reference point had a stronger effect on the anticipated impact of losing money than on the anticipated impact of gaining money, $F(1, 396) = 9.661$, $p = .002$, $\eta_G^2 = .024$. Follow-up t tests showed that the reference point influenced the anticipated hedonic impact of losing money - low reference point: $M = 53.68$, 95% CI = [47.85, 59.51], $SD = 29.39$; high reference point: $M = 34.75$, 95% CI = [29.84, 39.57], $SD = 24.91$; $t(199) = 4.93$, $p < .001$, $d = .70$, 95% CI = [.41, .98] - but had no significant impact on the anticipated hedonic impact of gaining money - low reference point: $M = 48.74$, 95% CI = [43.18, 54.30], $SD = 28.01$; high reference point: $M = 47.26$, 95% CI = [41.33, 53.20], $SD = 29.76$; $t(197) = .36$, $p = .719$, $d = .05$, 95% CI = [-.23, .33].

Finally, we investigated whether the anticipated hedonic impact mediated the effect of the reference point on the likelihood of accepting the gamble. We tested for mediation separately in the negative-valence and positive-valence conditions with 10,000 bootstrapped samples each. Reference point was the independent variable, willingness to gamble was the dependent variable, and anticipated hedonic impact of the outcome was the mediator. Willingness to accept the bet was mediated by the anticipated hedonic impact of a loss - indirect effect = .08, 95% CI = [.03, .14], proportion mediated = .27. The high reference point reduced participants' anticipated hedonic impact of losing money, $b = -18.93$, $SD = 3.84$, $p < .001$, which in turn made them more likely to accept the bet, $b = -.02$, $SD = .00$, $p < .001$. A sensitivity analysis (Imai et al., 2010) indicated that at ρ of -.29, the average causal mediation effect was .00, 95% CI = [-.04, .03]. This relationship did not hold for the anticipated hedonic impact of a gain - indirect effect = -.003, 95% CI = [-.03, .02], $p = .710$. In sum, the presence of a high reference point led participants to

believe that losing money would hurt less. The sense that a loss would be less painful in turn promoted risk taking.

Studies 3a and 3b

Our previous studies found an asymmetric-contrast effect. We argue that the asymmetry occurs because people are less attentive to reference points when evaluating positive outcomes. If so, drawing people's attention to a reference point as they evaluate a positive outcome should lead them to experience as much contrast as people who evaluate a negative outcome. In the following studies, we tested whether drawing attention to reference points explicitly (Study 3a) or implicitly (Study 3b) weakens the asymmetric-contrast effect.

In Study 3a, participants evaluated an outcome in the presence of a reference-- another outcome that they themselves experienced. We explicitly manipulated attention to the reference point by asking some of the participants to attend to it when making their evaluation. We predicted that those participants would not experience an asymmetric-contrast effect.

In Study 3b, we manipulated attention to the reference point implicitly. When people attend to a reference point while making an evaluation, that reference point may remain salient in evaluations made shortly afterwards (Zellner et al., 2003). Therefore, if evaluating a negative outcome draws people's attention to a reference point, this reference point should be more likely to influence evaluations they make immediately afterward. It follows that people who evaluate a positive outcome would experience stronger contrast if they first evaluated a negative outcome that made the reference point salient. In Study 3b, participants evaluated both a negative and a positive outcome in the presence of a reference point. Some participants first evaluated the

negative outcome and then evaluated the positive outcome, whereas other participants evaluated the positive outcome first. We predicted that the asymmetric contrast effect would be more pronounced in the first evaluations participants made than in the second evaluations participants made.

Study 3a

Method. We opened Study 3a to 1,600 participants on Prolific. In a 2 (outcome valence: negative, positive) × 2 (reference point: low, high) × 2 (attention: manipulated, control) between-participants design, we asked participants to imagine that they invested in two start-ups: Start-Up A and Start-Up B. All participants imagined that they invested $1,000 in Start-Up B. To manipulate the reference point, we asked each participant to imagine that they invested either $100 (low reference point) or $10,000 (high reference point) in Start-Up A. In the negative-valence condition, participants read that they lost both their investments and estimated how painful it would be to lose $1,000 with Start-Up B. Estimates were made using an unnumbered continuous scale ranging from *not at all* to *extremely*. In the positive-valence condition, participants read that they doubled both their investments and estimated how pleasurable it would be to gain $1,000 with Start-Up B. Estimates were made using the same unnumbered scale. To manipulate attention to the reference point, we either (a) asked participants to consider how much money they had gained or lost with Start-Up A while rating their feeling about Start-Up B (manipulated attention) or (b) did not ask participants to consider anything while making that rating (control).

***Results*.** This study was completed by 1,601 participants (57% female; age: M = 33.26 years, SD = 13.06). For our analysis of how emotionally impactful participants anticipated gaining or losing money would be, we scored their responses using a continuous scale ranging from 0, *not at all*, to 100, *extremely*. Although an ANOVA did not find a significant Valence × Reference Point × attention interaction, $F(1, 1593) = 2.64$, $p = .105$, $\eta_G^2 = .002$ (see Fig. 2), separate ANOVAs for participants in the control and manipulated-attention conditions found a significant Valence × Reference Point interaction for participants in the control conditions, $F(1, 800) = 9.69$, $p = .002$, $\eta_G^2 = .012$, but not for participants in the manipulated-attention condition, $F(1, 793) = .69$, $p = .407$, $\eta_G^2 < .001$, suggesting that explicitly drawing participants' attention to a reference point eliminated the asymmetric-contrast effect. For simple-effects analysis, see section S2 in Supplemental Material.

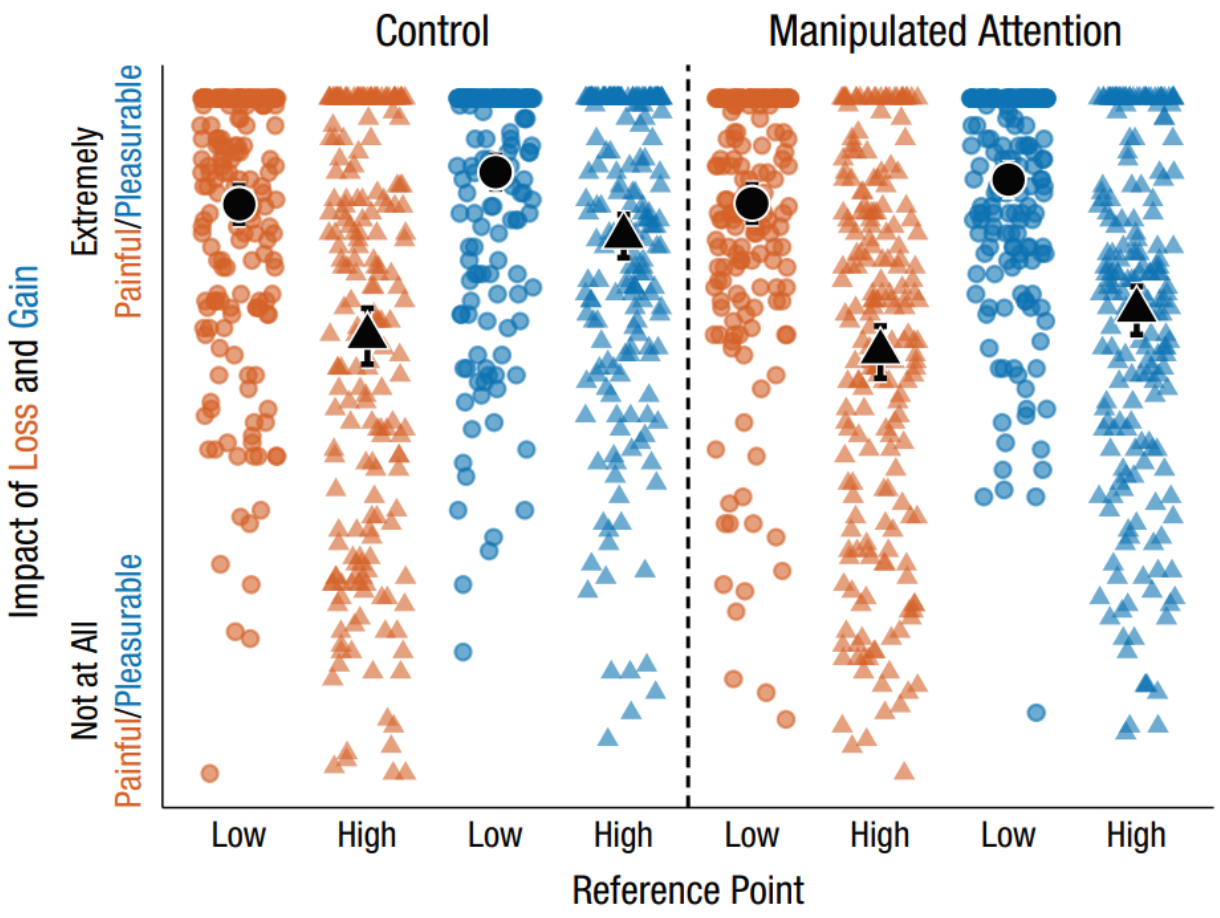

Fig 2. Results of Study 3a: anticipated impact of negative outcomes (orange) and positive outcomes (blue) as a function of reference point and attention manipulation. Small shapes indicate individual data points, and large shapes indicate group means. Error bars represent 95% confidence intervals.

Study 3b

Method. We opened Study 3b to 800 participants on Prolific. In a 2 (reference point: low, high) × 2 (evaluation order: negative outcome first, positive outcome first) between-participants design, we asked participants to imagine that they are walking with either $10 (low reference point) or $100 (high reference point) in their pocket. Then we asked participants to indicate both how it would feel to lose $8 and how it would feel to find $8, using unnumbered scales ranging

from *extremely unhappy* to *extremely happy*. Participants made each affective forecast on a separate page, and question order was randomized for each participant. Study 3b was preregistered (https://aspredicted.org/blind.php?x=gi3xj7).

Results. This study was completed by 798 participants (51% female; age: M = 31.2 years, SD = 11.72). For our analysis of how emotionally impactful participants anticipated finding money would be, we analyzed responses using a scale ranging from 0, *extremely unhappy*, to 100, *extremely happy*. For losing money, we reverse-coded evaluations (*extremely happy* = 0 and *extremely unhappy* = 100). An ANOVA found a significant Valence × Reference Point × Evaluation Order interaction, showing that the asymmetric-contrast effect was stronger in the first evaluation participants made than in the second evaluation they made, $F(1, 1588) = 9.29$, $p = .002$, $\eta_G^2 = .006$ (see Fig. 3). Separate ANOVAs for the first and second evaluations participants made found a significant Valence × Reference Point interaction for the first evaluations participants made, $F(1, 794) = 26.07$, $p < .001$, $\eta_G^2 = .032$, but not for the second evaluations participants made, $F(1, 794) = .11$, $p = .740$, $\eta_G^2 < .001$, suggesting that implicitly drawing participants' attention to a reference point eliminated the asymmetric contrast effect in later evaluations. [4] For simple-effects analysis, see section S2 in the Supplemental Material.

[4] In Section S2 in the Supplemental Material, we report analyses of combined data from Study 3a, Study 3b, and Study S1 (which used another attention manipulation), and we found the same pattern as in Study 3b: the Valence × Reference Point × Attention Manipulation interaction was significant ($p = .001$, $\eta_G^2 = .003$), and the Valence × Reference Point interaction was significant when attention to the reference point was not experimentally manipulated (control: $p < .001$, $\eta_G^2 = .018$) and not significant when attention was manipulated ($p = .237$, $\eta_G^2 = .001$).

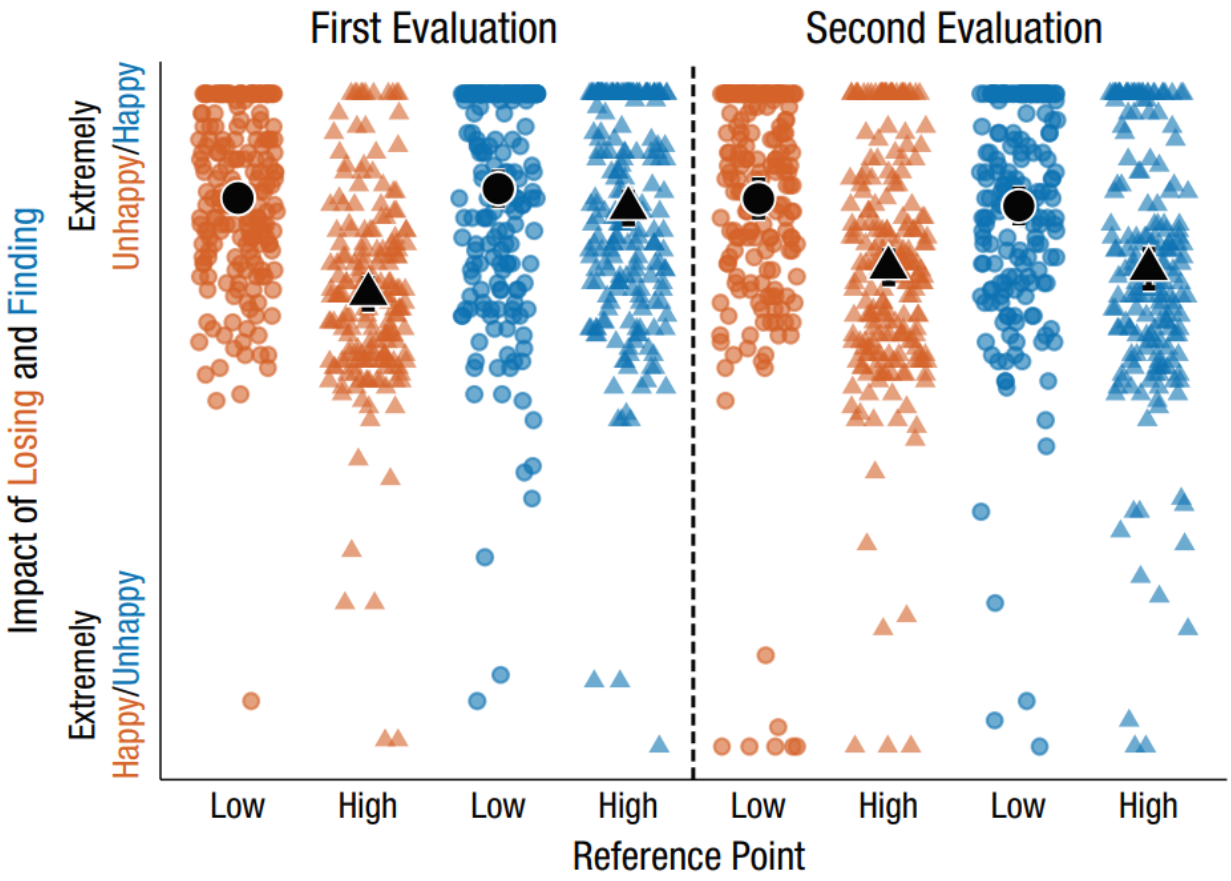

Fig 3. Results of Study 3b: anticipated impact of negative outcomes (orange) and positive outcomes (blue) as a function of reference point and evaluation order. Small shapes indicate individual data points, and large shapes indicate group means. Error bars represent 95% confidence intervals.

Study 4

Thus far, our work demonstrates a stronger hedonic-contrast effect on negative than positive outcomes, reflected in affective forecasts and choices. However, affective forecasts are often misguided (Gilbert & Ebert, 2002; Read & Loewenstein, 1995; Snell et al., 1995), and it is not clear whether this asymmetric contrast will be reflected in experiences. Next, we tested whether people actually experience an asymmetric-contrast effect when they realize negative and positive

outcomes. In Study 4, participants played a real gamble in the presence of a reference point and then reported how they felt about the outcome of the gamble.

Method

We opened Study 4 to 400 participants on TurkPrime. In a 2 (outcome valence: negative, positive) × 2 (reference point: low, high) between-participants design, we informed participants that they were about to be allocated an amount between $0.01 and a certain maximum value and that they would be required to bet this money a coin flip that would either lose or double it. The maximum amount they could be allocated was either $0.50 (low reference point) or $5.00 (high reference point). Next, all participants were allocated $0.40, picked heads or tails, flipped a virtual coin, and learned whether they had lost or doubled their $0.40. They then reported how painful it was to lose the coin flip or how pleasurable it was to win it, using a scale ranging from 1,*not at all*, to 7, *extremely*.

Results

Three hundred ninety-four participants completed the study (56% female; age: M = 41.52 years, SD = 13.37). An ANOVA revealed a significant Valence × Reference Point interaction, showing that participants experienced stronger hedonic contrast for negative than for positive outcomes, $F(1, 390) = 10.00$, $p = .002$, $\eta_G^2 = .025$. Although the pain of losing $0.40 was greater when the maximum bet was $0.50 than when it was $5.00 - low reference point: M = 3.93, 95% CI = [3.54, 4.33], SD = 2.01; high reference point: M = 2.77, 95% CI = [2.44, 3.11], SD = 1.75; $t(205) = 4.43$, $p < .001$, $d = .62$, 95% CI = [.34, .90] - the pleasure of winning was not significantly influenced by the reference point - low reference point: M = 6.09, 95% CI = [5.89,

6.30], *SD* = 1.01; high reference point: *M* = 5.91, 95% CI = [5.70, 6.12], *SD* = 1.01; *t*(185) = 1.23, *p* = .219, *d* = .18, 95% CI = [-.11, .47].

General Discussion

Contrast influences the hedonic impact of negative outcomes more than that of positive outcomes, and this is reflected in anticipated and experienced affect as well as risky choices. The asymmetric-contrast effect occurs because people are more attentive to reference points when evaluating negative outcomes.

Our findings advance work that identified antecedents of hedonic-contrast effects. Complementing this past work, which mostly focused on the factors that influence how salient comparisons are or how easy they are to make (Carter & Gilovich, 2010; Cogan et al., 2013; Gilbert et al., 1995; Huh et al., 2016; Rota & Zellner, 2007), our studies focused on how the valence of outcomes determines how strongly people experience hedonic contrast. Furthermore, although much research shows that the same amount can be evaluated differently depending on whether it is lost or gained, this has generally been reflected in losses being more impactful than gains (Kahneman & Tversky, 1979). The present research suggests that in the right context, gains may loom larger than corresponding losses. This may explain why people routinely reject gambles in the laboratory but accept them in environments where great wealth is made salient, such as casinos.

Our findings do not imply that people do not experience hedonic contrast for positive outcomes. Indeed, two of our studies (Studies 1b and 3a) found hedonic contrast for positive outcomes, even when attention was not experimentally drawn to a reference point. Our findings

suggest only that people experience stronger hedonic contrast for negative than for positive outcomes.

We designed our studies to test whether contrast is stronger for negative outcomes than for positive outcomes, all else being equal. To that end, we asked participants to evaluate comparable negative and positive outcomes (i.e., of the same type and magnitude). However, our results have potential implications for any decision that requires consideration of positive and negative consequences. Consider, for example, the decision to reopen an economy during a pandemic (with potential financial benefits but also with increased infections and casualties) or to vote for a political candidate (which may depend on the positive and negative aspects of the candidate's party platform). In future work, researchers should investigate how asymmetric-contrast effects may influence such decisions.

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Supplemental Material for Asymmetric Hedonic Contrast: Pain is more Contrast-Dependent Than Pleasure

1. Additional studies

Supplemental Study 1

In Supplemental Study 1, participants evaluated either a negative or a positive outcome. Prior to evaluating a positive outcome, we asked some participants about the reference point to draw their attention to it. We predicted that participants who evaluate a positive outcome would not experience weaker contrast than participants who evaluate a negative outcome if their attention is first drawn to the reference point.

Method. We opened the study to 600 participants on Prolific. In a 3X2 (outcome: negative, positive, positive-manipulated attention; reference point: low, high) between-participants design, participants were asked to imagine that they flipped a coin for $20, and to estimate either how painful it would be to lose the coin flip (negative outcome) or how pleasurable it would be to win the coin flip (positive outcome), on a scale from 1 (*Not at all*) to 7 (*Extremely*). To manipulate the reference point, we asked participants to imagine that some of the other participants could lose or win either $2 (low reference point) or $100 (high reference point). To manipulate attention to the reference point in the positive outcome condition, we asked some of the participants in the positive outcome condition to indicate what is the highest or lowest amount that participants bet in the study, in the low reference point and high reference point conditions, respectively, prior to estimating how they would feel if they were to win $20 (positive outcome – manipulation attention).

Results. Five-hundred ninety-nine participants completed the study (51% female; age: M = 28.82 years, SD = 10.14). An ANOVA with participants in the positive outcome and negative outcome conditions revealed a significant outcome valence by reference point interaction (F(1, 397) = 5.70, p = .017, η_G^2 = .014), but an ANOVA with participants in the positive outcome – manipulated attention and negative outcome conditions did not (F(1, 395) = .30, p = .583, η_G^2 < .001), suggesting that participants who evaluated a positive outcome experienced weaker hedonic contrast than those who evaluated a negative outcome only if their attention was not experimentally drawn to the reference point. Follow-up t-tests found that the high reference point reduced the expected emotional impact of negative outcomes (low reference point: M = 5.17, 95% CI = [4.86, 5.47], SD = 1.46 vs. high reference point: M = 4.43, 95% CI = [4.16, 4.69], SD = 1.39; t(199) = 3.59, p < .001, d = .51, 95% CI = [.22, .79]) and of positive outcomes when attention was manipulated (low reference point: M = 6.10, 95% CI = [5.86, 6.33], SD = 1.26 vs. high reference point: M = 5.53, 95% CI = [5.16, 5.90], SD = 1.68; t(196) = 2.71, p = .007, d = .39, 95% CI = [.10, .68]), but not for positive outcomes without an attention manipulation (low reference point: M = 5.77, 95% CI = [5.45, 6.10], SD = 1.58 vs. high reference point: M = 5.74, 95% CI = [5.48, 6.00], SD = 1.34; t(198) = .17, p = .862, d = .02, 95% CI = [-.25, .30]).

Supplemental Study 2

Supplemental Study 2 was very similar to Study 2B. The differences were that all participants in Supplemental Study 2 received the outcome of their choice, and that the gamble was for a smaller amount of money.

Method. We opened the study to 400 participants on Prolific. In a 2 condition between-participants design (reference point: low, high), participants read that they are allocated $0.40 that they could either keep or use to bet on a coin flip where they will either lose or double their money. To provide a reference point, participants read what is the maximum amount of money that could be allocated in the study. The maximum amount was either $0.50 (low reference point) or $5.00 (high reference point). Finally, participants who chose to bet picked Heads or Tails, flipped a virtual coin (the outcome of the coin flip was determined randomly), and learned whether they lost or doubled their $0.40. We paid participants according to their choice and outcome of the bet.

Results. Four-hundred participants completed the study (53% female; age: M = 31.16 years, SD = 11.27). Participants were more likely to gamble with real money in the high reference point condition than in the low reference point condition (80% vs. 57%; $X^2(1) = 24.62$, $p < .001$).

Supplemental Study 3

Supplemental Study 3 was very similar to Study 2C, except that participants made an affective forecast prior to making a gambling decision, and the high reference point was $100.

Method. We opened the study to 400 participants on Prolific. In a 2x2 (valence: negative, positive; reference point: low, high) between-participants design, we asked participants to imagine that they are walking with either $10 (low reference point) or $100 (high reference point) in their pocket. Then, we asked participants to indicate either how emotionally impactful would it be for them to lose $8 (negative valence) or how emotionally impactful it would be to

gain $8 (positive valence) on an unnumbered scale from ‘Not at all’ to ‘Extremely’. Finally, we asked participants if they would be willing to bet $8 on the flip of a coin.

Results. Four-hundred three participants completed the study (57% female; age: M = 31.42 years, SD = 12.25). Participants in the high reference point condition were more likely to accept the gamble than participants in the low reference point condition (55% vs. 28%; $\chi^2(1) = 29.26$, $p < .001$). For our analysis of how emotionally impactful participants anticipated losing or gaining money would be, we coded ‘Not al all’ as 0 and ‘Extremely ‘as 10. An ANOVA revealed a significant valence by reference point interaction ($F(1, 399) = 31.47$, $p < .001$, $\eta_G^2 = .073$), such that the reference point had a stronger effect on the anticipated impact of losing money than on the anticipated impact of gaining money. Follow-up t-tests showed that the reference point influenced the anticipated hedonic impact of losing money (low reference point: M = 8.73, 95% CI = [8.50, 8.96], SD = 1.17; high reference point: M = 6.75, 95% CI = [6.43, 7.08], SD = 1.63; $t(200) = 9.95$, $p < .001$, d = 1.40, 95% CI = [1.09, 1.71]), but had no significant impact on the anticipated hedonic impact of gaining money (low reference point: M = 8.28, 95% CI = [7.86, 8.71], SD = 2.14; high reference point: M = 8.24, 95% CI = [7.87, 8.60], SD = 1.85; $t(199) = .15$, $p = .881$, d = .02, 95% CI = [-.26, .30]).

Finally, we investigated whether anticipated hedonic impact mediated the effect of the reference point on likelihood to accept a gamble. We tested for mediation with participants in the negative valence and in the positive valence conditions with 10,000 bootstrapped samples each, with reference point as the independent variable, willingness to gamble as the dependent variable, and anticipated hedonic impact of the outcome as the mediator. Willingness to accept the bet was mediated by the anticipated hedonic impact of a loss, indirect effect = .11, 95% CI = [.02, .21], proportion mediated = .42. High reference point reduced participants’ anticipated

hedonic impact of losing money, b = -1.98, SD = .20, p < .001, which in turn made them more likely to accept the bet, b = -.15, SD = .07, p = .020. A sensitivity analysis indicated that at rho = -.18, the average causal mediation effect was -.00, 95% CI = [-.08, .06]. This relationship did not hold for the anticipated hedonic impact of a gain (indirect effect = .00, 95% CI = [-.01, .01], p = .922). In sum, the presence of a high reference point led participants to believe that losing money would hurt less. The sense that a loss would be less painful in turn promoted risk-taking.

Supplemental Study 4

Similarly to Study 2C, in Supplemental Study 4 we measured how introducing a high reference point affects both willingness to take a risk and the anticipated impact of its outcomes, to directly test whether the contrast in affective forecasts mediates the effect of reference points on choice.

Method. We opened the study to 400 participants on TurkPrime. In a 2x2 (valence: negative, positive; reference point: low, high), participants were asked to imagine that they were offered to flip a coin for $20, and to estimate either how painful it would be to lose the coin flip (negative outcome) or how enjoyable it would be to win the coin flip (positive valence), on a scale from 1 (*Not at all*) to 7 (*Extremely*). Then, we asked participants whether they would be willing to bet $20 on the flip of a coin. To manipulate the reference point, we asked participants to imagine that the maximum amount that can be bet was either $25 (low reference point) or $100 (high reference point).

Results. Four-hundred seven participants completed the study (49% female; age: M = 39.71 years, SD = 12.94). Participants in the high reference point condition were more likely to accept

the gamble than participants in the low reference point condition (60% vs. 40%; $\chi^2(1) = 14.57$, $p < .001$). An ANOVA revealed a significant valence by reference point interaction ($F(1, 403) = 4.43$, $p = .036$, $\eta_G^2 = .011$), such that the reference point had a stronger effect on the anticipated impact of losing money than on the anticipated impact of gaining money. Follow-up t-tests showed that the reference point influenced the anticipated hedonic impact of losing money (low reference point: $M = 5.10$, 95% CI = [4.79, 5.41], $SD = 1.57$; high reference point: $M = 4.36$, 95% CI = [4.09, 4.63], $SD = 1.37$; $t(202) = 3.56$, $p < .001$, $d = .50$, 95% CI = [.22, .78]), but had no significant impact on the anticipated hedonic impact of gaining money (low reference point: $M = 5.91$, 95% CI = [5.64, 6.18], $SD = 1.35$; high reference point: $M = 5.77$, 95% CI = [5.49, 6.06], $SD = 1.44$; $t(201) = .70$, $p = .487$, $d = .10$, 95% CI = [-.18, .38]).

Finally, we investigated whether anticipated hedonic impact mediated the effect of the reference point on likelihood to accept a gamble. We tested for mediation separately in the negative valence and in the positive valence conditions with 10,000 bootstrapped samples each, with reference point as the independent variable, willingness to gamble as the dependent variable, and anticipated hedonic impact of the outcome as the mediator. Willingness to accept the bet was mediated by the anticipated hedonic impact of a loss, indirect effect = .05, 95% CI = [.01, .10], proportion mediated = .21. High reference point reduced participants' anticipated hedonic impact of losing money, $b = -.74$, $SD = .21$, $p < .001$, which in turn made them more likely to accept the bet, $b = -.19$, $SD = .06$, $p = .002$. A sensitivity analysis indicated that at rho = -.22, the average causal mediation effect was -.00, 95% CI = [-.03, .02]. This relationship did not hold for the anticipated hedonic impact of a gain (indirect effect = -.004, 95% CI = [-.02, .01], $p = .584$). In sum, the presence of a high reference point led participants to believe that losing money would hurt less. The sense that a loss would be less painful in turn promoted risk-taking.

2. Additional analyses

Study 1A

We conducted an ANOVA for participants in the low reference point and control conditions and an ANOVA for participants in the high reference point and control conditions. Both ANOVAs revealed significant valence by reference point interactions (low reference point and control: $F(1, 400) = 4.53$, $p = .034$, $\eta_G^2 = .011$; high reference point and control: $F(1, 400) = 5.31$, $p = .022$, $\eta_G^2 = .013$). Follow-up t-tests found that the low reference point made a loss appear more painful (low reference point: $M = 5.59$, 95% CI = [5.32, 5.86], $SD = 1.37$ vs. control: $M = 4.81$, 95% CI = [4.47, 5.15], $SD = 1.70$; $t(199) = 3.60$, $p < .001$, $d = .51$, 95% CI = [.23, .79]), but had no significant effect on expected enjoyment from a gain (low reference point: $M = 6.01$, 95% CI = [5.73, 6.29], $SD = 1.44$, vs. control: $M = 5.86$, 95% CI = [5.57, 6.16], $SD = 1.49$; $t(201) = .72$, $p = .475$, $d = .10$, 95% CI = [-.18, .38]), and that a high reference point made a loss appear less painful (high reference point: $M = 4.01$, 95% CI = [3.70, 4.32], $SD = 1.59$; $t(199) = 3.44$, $p < .001$, $d = .49$, 95% CI = [.20, .77]) but had no significant effect on the anticipated enjoyment from a gain (high contrast: $M = 5.77$, 95% CI = [5.50, 6.05], $SD = 1.39$; $t(201) = .45$, $p = .655$, $d = .06$, 95% CI = [-.21, .34]).

Study 3A

Simple effects: control. T-tests showed that the reference point influenced the anticipated hedonic impact of both losing money (low reference point: $M = 84.31$, 95% CI = [81.56, 87.07], $SD = 19.86$; high reference point: $M = 64.76$, 95% CI = [60.60, 68.91], $SD = 29.86$; $t(401) = 7.75$, $p < .001$, $d = .77$, 95% CI = [.57, .97]) and gaining money (low reference point: $M = 89.06$, 95% CI = [86.61, 91.50], $SD = 17.55$; high reference point: $M = 79.60$, 95% CI = [76.42, 82.78], $SD = 22.88$; $t(399) = 4.64$, $p < .001$, $d = .46$, 95% CI = [.26, .66]).

Simple effects: manipulated attention. T-tests showed that the reference point influenced the anticipated hedonic impact of both losing money (low reference point: $M = 84.46$, 95% CI = [81.71, 87.22], $SD = 19.70$; high reference point: $M = 62.44$, 95% CI = [58.59, 66.30], $SD = 27.58$; $t(396) = 9.17$, $p < .001$, $d = .92$, 95% CI = [.71, 1.13]) and gaining money (low reference point: $M = 87.956$, 95% CI = [85.70, 90.21], $SD = 16.11$; high reference point: $M = 68.61$, 95% CI = [65.03, 72.19], $SD = 25.67$; $t(397) = 9.01$, $p < .001$, $d = .90$, 95% CI = [.70, 1.11]).

Study 3B

Simple effects: first evaluation. T-tests showed that the reference point influenced the anticipated hedonic impact of losing money (low reference point: $M = 84.04$, 95% CI = [82.15, 85.93], $SD = 13.41$; high reference point: $M = 69.34$, 95% CI = [67.05, 71.63], $SD = 15.81$; $t(380) = 9.82$, $p < .001$, $d = 1.00$, 95% CI = [.79, 1.22]), and had a marginal effect on the anticipated hedonic impact of gaining money (low reference point: $M = 85.48$, 95% CI = [83.05, 87.91], $SD = 17.50$; high reference point: $M = 82.49$, 95% CI = [80.14, 84.84], $SD = 17.43$; $t(414) = 1.75$, $p = .081$, $d = .17$, 95% CI = [-.02, .36]).

Simple effects: second evaluation. Follow-up t-tests showed that the reference point influenced the anticipated hedonic impact of both losing money (low reference point: M = 83.95, 95% CI = [81.16, 86.74], SD = 20.10; high reference point: M = 73.42 95% CI = [70.95, 75.89], SD = 18.31; $t(414) = 5.59$, $p < .001$, $d = .55$, 95% CI = [.35, .74]) and gaining money (low reference point: M = 82.84, 95% CI = [80.33, 85.34], SD = 17.78; high reference point: M = 73.20, 95% CI = [70.29, 76.11], SD = 20.12; $t(380) = 4.96$, $p < .001$, $d = .51$, 95% CI = [.30, .71]).

Combined analysis – Studies 3A, 3B, and Supplemental Study 1

To test whether the attention manipulation effects are significant across the three attention manipulation studies, we analyzed the combined data from Studies 3A, 3B, and Supplemental Study 1. Converting all forecasting measures to a 1-7 scale, an ANOVA found a significant valence by reference point by attention manipulation 3-way interaction ($F(1, 3788) = 10.61$, $p = .001$, $\eta_G^2 = .003$). Separate 2-way ANOVAs found a significant valence by reference point interaction when attention was not manipulated ($F(1, 1999) = 36.94$, $p < .001$, $\eta_G^2 = .018$), but not when attention was manipulated ($F(1, 1789) = 1.40$, $p = .237$, $\eta_G^2 < .001$).

Simple effects: non-manipulated attention. T-tests showed that the reference point influenced the anticipated hedonic impact of negative outcomes (low reference point: M = 5.89, 95% CI = [5.78, 5.99], SD = 1.16; high reference point: M = 4.89, 95% CI = [4.76, 5.02], SD = 1.46; $t(984) = 11.87$, $p < .001$, $d = .76$, 95% CI = [.63, .89]) and, to a lesser but significant extent,6.15, 95% CI = [6.04, 6.25], SD = 1.18; high reference point: M = 5.84, 95% CI = [5.73, 5.95], SD = 1.24; $t(1015) = 4.06$, $p < .001$, $d = .25$, 95% CI = [.13, .38]).

Simple effects: manipulated attention. T-tests showed that the reference point influenced the anticipated hedonic impact of negative outcomes (low reference point: $M = 6.05$, 95% CI = [5.94, 6.17], $SD = 1.19$; high reference point: $M = 5.09$, 95% CI = [4.95, 5.23], $SD = 1.43$; $t(812) = 10.43$, $p < .001$, $d = .73$, 95% CI = [.59, .87]) and positive outcomes (low reference point: $M = 6.12$, 95% CI = [6.02, 6.21], $SD = 1.08$; high reference point: $M = 5.30$, 95% CI = [5.17, 5.43], $SD = 1.45$; $t(977) = 10.06$, $p < .001$, $d = .64$, 95% CI = [.51, .77]).

3. Summary of participants' nationalities

Within each study we coded nationalities that constituted less than 1% of the sample as 'other'.

Study	Nationality	% sample
1A	United States	100%
1B	Greece	1%
	Netherlands	2%
	Portugal	2%
	Canada	4%
	Germany	4%
	Poland	4%
	other	8%
	United Kingdom	35%
	United States	42%
2A	India	1%
	Belgium	1%
	Hungary	1%
	Germany	2%
	Mexico	2%
	South Africa	2%
	Ireland	2%
	France	2%
	Australia	3%
	United States	3%
	Greece	4%
	Netherlands	4%
	Canada	4%
	other	7%
	Spain	7%
	Italy	8%
	Portugal	9%
	Poland	17%
	United Kingdom	24%
2B	France	1%
	Canada	2%
	Germany	2%
	Hungary	2%
	Ireland	2%
	South Africa	2%
	Spain	2%
	Mexico	3%
	Italy	6%
	Portugal	7%

Study	Nationality	% sample
2B, cont.	Poland	8%
	United States	28%
	United Kingdom	37%
2C	Czech Republic	1%
	Germany	1%
	Israel	2%
	Spain	2%
	Greece	2%
	Hungary	2%
	Netherlands	2%
	South Africa	3%
	Italy	5%
	Portugal	9%
	Poland	9%
	United States	12%
	United Kingdom	50%
3A	Mexico	2%
	Portugal	2%
	Germany	3%
	Italy	3%
	Canada	3%
	Poland	3%
	other	12%
	United States	19%
	United Kingdom	54%
3B	Greece	1%
	Germany	2%
	Portugal	2%
	Italy	3%
	Canada	3%
	Poland	5%
	other	14%
	United Kingdom	33%
	United States	36%
4	United States	100%
Sup. 1	Ireland	1%
	Netherlands	1%
	Spain	2%
	France	2%

Study	Nationality	% sample
Sup. 1, cont.	Germany	2%
	Greece	3%
	Italy	3%
	Mexico	3%
	Canada	4%
	Portugal	6%
	Poland	8%
	other	11%
	United States	15%
	United Kingdom	40%
Sup. 2	Hungary	1%
	Germany	1%
	Canada	2%
	Ireland	2%
	Greece	2%
	South Africa	3%
	Netherlands	3%
	Spain	3%
	Portugal	4%
	Italy	5%
	Poland	7%
	United States	8%
	other	9%
	United Kingdom	51%
Sup. 3	Germany	1%
	Mexico	1%
	South Africa	2%
	Italy	2%
	France	2%
	Greece	2%
	Portugal	3%
	Canada	3%
	Poland	4%
	other	12%
	United States	14%
	United Kingdom	52%
Sup. 4	United States	100%