Associations of fear, anger, happiness, and hope with risk judgments: Revisiting appraisal-tendency framework with a replication and extensions Registered Report of Lerner and Keltner (2001)

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## Authorship declaration:

Sirui Lu conducted the replication for her thesis and led this through PCIRR Stage 1 peer review to in-principle acceptance, followed by data analysis and writing the first draft for her thesis.

Emir Efendić joined in Stage 2, verified all analyses, revised and improved, prepared the PCIRR Stage 2 submission, and addressed Stage 2 peer review.

Gilad Feldman was the supervisor for the thesis and guided the project, supervised each step, ran data collection, conducted the pre-registration, and edited all versions of the manuscript for submission in both stages.

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**Important links and information**

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## Contributor Roles Taxonomy

|  |  |  |  |
| --- | --- | --- | --- |
| **Role** | **Sirui Lu** | **Emir Efendić** | **Gilad Feldman** |
| Conceptualization | X |  | X |
| Pre-registration | X |  |  |
| Data curation |  |  | X |
| Formal analysis | X |  |  |
| Funding acquisition |  |  | X |
| Investigation | X |  |  |
| Pre-registration peer review / verification |  |  | X |
| Data analysis peer review / verification |  | X | X |
| Methodology | X |  |  |
| Project administration |  |  | X |
| Resources |  |  | X |
| Software | X |  |  |
| Supervision |  |  | X |
| Validation |  |  | X |
| Visualization | X | X |  |
| Writing-original draft | X |  |  |
| Writing-review and editing |  | X | X |

# Abstract

The appraisal-tendency framework proposed that specific emotions predispose individuals to appraise future events corresponding to the core appraisal themes of the emotions. In a Registered Report with a US American online Amazon Mechanical Turk CloudResearch sample (*N* = 780), we conducted an independent close replication of Experiments 1, 2, and 3 in Lerner and Keltner (2001). We found support for the appraisal-tendency framework for risk optimism in general, risk optimism for positive events, and risk optimism for ambiguous events, but not for risk preference and risk optimism for negative events. Extending the replication, we added hope as one dispositional emotion and failed to find support for the assumptions of the appraisal-tendency framework. Materials, data, and code are available on: <https://osf.io/t5kz9/> .

*Keywords:* Appraisal-tendency framework, judgment and decision making, registered replication, affect, anger, fear, hope, risk preference, optimism

# PCIRR-Study Design Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Hypothesis | Analysis performed in the target article | Analysis plan in the current study | Description of the change | Theory that could be shown wrong by the outcomes |
| Trait fear is negatively associated with risk seeking.  Trait anger is positively associated with risk seeking. | Multiple regression | Correlations  Multiple regression | Trait happiness and trait hope are added to the analysis. Additional hypotheses: 1) Trait happiness is positively associated with risk seeking; 2) Trait hope is negatively associated with risk seeking. | Appraisal-tendency framework |
| Fear and anger traits are negatively associated with trait happiness.  Trait fear is negatively associated with optimistic risk assessment.  Trait happiness and trait anger are positively associated with optimistic risk assessment. | Correlations  Multiple regression | Correlations  Multiple regression | Trait hope is added to the analysis. Additional hypothesis: Trait hope is negatively associated with optimistic risk assessment. | Valence theory  Appraisal-tendency framework |
| Ambiguity of events moderates the relationship between dispositional emotions and risk optimism.  For ambiguous events, fear is negatively associated with optimistic risk assessment, while happiness and anger are positively associated with optimistic risk assessment.  For unambiguous events, anger and fear are negatively associated with optimistic risk assessment, while happiness is positively associated with optimistic risk assessment. | Factorial ANOVA | Correlations  Multiple regression | The design was changed from dichotomized between-subject design to continual within-subject design.  Trait hope was added to the analysis. Additional hypotheses: 1) For ambiguous events, hope is negatively associated with optimistic risk assessment; 2) For unambiguous events, hope is positively associated with optimistic risk assessment. | Valence theory  Appraisal-tendency framework |

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## Background

That emotions have a strong impact on decision making is by now considered a robust and well-accepted finding. Early approaches to studying affect’s role on people’s cognitions were mostly valence-based, categorizing affect into positive and negative emotions (DeSteno et al., 2000; Lerner & Keltner, 2000). In the valence-based approach, affect was thought of as having broad generalized associations with cognition, arguing that people make judgments and decisions congruent with the valence of the affect experienced. In this way, different emotions such as fear and anger would be viewed similarly, having a negatively valenced impact (Johnson & Tversky, 1983; Mayer et al., 1992). An alternative, more nuanced view proposed that specific emotions, even if they are of the same valence, are associated with judgment and decision-making in different ways (DeSteno et al., 2000). Lerner and Keltner (2000) proposed an appraisal-tendency framework, that the perception of events is consistent with the tendency of the cognitive-appraisal dimensions of the specific emotions. They demonstrated that people higher on trait anger tend to make more optimistic future judgments and prefer risk-seeking decisions, whereas those higher on trait fear tend to make more pessimistic judgments and prefer risk-aversive decisions (Lerner & Keltner, 2000, 2001). Further consistent with an appraisal tendency framework, they demonstrated that the associations between trait emotions and optimism were especially relevant for ambiguous events, whereas the valence-based approach matched better with unambiguous events (Lerner & Keltner, 2001).

We conducted a close replication of Lerner and Keltner (2001) with the following goals. Our first goal was to conduct an independent replication with design improvements of the findings that provided initial support for the appraisal-tendency framework. Our second goal was to examine extensions of the original findings, adding other specific emotions to complement the original findings.

We begin by introducing the literature on the appraisal-tendency framework and the chosen article for replication - Lerner and Keltner (2001). We then present the motivation for the current replication study, then introduce the original's hypotheses and design, and our replication’s adjustments and extensions.

## Appraisal-tendency framework

The appraisal-tendency framework (ATF) is based on the cognitive-appraisal theories of emotion (Smith & Ellsworth, 1985). Rather than the simple categorization of emotions based on valence, cognitive-appraisal theories suggest that emotions are related to cognitive appraisals of the environment (Smith & Ellsworth, 1985). ATF relies on six cognitive dimensions of emotions: pleasantness, anticipated effort, attentional activity, control, certainty, and responsibility (Lerner & Keltner, 2000).

Based on the cognitive-appraisal theories, Lerner and Keltner (2000) proposed that specific emotions predispose individuals to appraise events in accordance with the appraisal themes of the emotions. This appraisal tendency persists until the problem that elicited the emotions is no longer present (Lerner & Keltner, 2000).

## Choice of study for replication: Lerner and Keltner (2001)

We chose the Lerner and Keltner (2001) study based on three factors: absence of direct replications, theoretical impact, and the potential for improving on their methodology as well as drawing new insights using the same design. To the best of our knowledge, there are currently no published direct replications of this study. The article has had a significant impact on scholarly research in the area of judgment, decision-making, and emotion. At the time of writing (March 2022), there were 4983 Google Scholar citations of the article and many important follow-up theoretical and empirical articles, such as Lerner and Tiedens (2006) on how anger uniquely differs from other negative emotions in its impact on decision making.

Lerner and Keltner (2001)'s work is noted for its substantial theoretical development. The ATF has spurned a plethora of research and their contributions also have important practical implications with extensions to other domains such as economic decisions (Lerner et al., 2004), moral judgments (Horberg et al., 2011), and consumer choice and assessments of risk and monetary value (Achar et al., 2016; Cavanaugh et al., 2007; Han et al., 2007; Lerner et al., 2007).

Given the significance of the work, we took a detailed look at the methodological and design decisions implemented in the original paper. Some of the choices made in the paper may now, with current improved methodological and statistical insights, appear limited. As such, we felt it important to revisit and reassess the methodological decisions in the design of the study. In their Study 2, Lerner and Keltner (2001) measured trait emotions, but in Study 3 the authors created groups of participants that scored more than one standard deviation above the mean on the target emotion and less than one standard deviation above the mean on the other two emotions. This ostensibly allowed them to create groups of e.g., a purely anger-prone group or a purely fear-prone group. However, such dichotomizing and grouping may have led to suboptimal analyses and conclusions. Additionally, in Studies 1 and 3 of the target article, some of the reported *p* values were just above .05 (0.055 and 0.08) claiming in a footnote that “t-tests were one-tailed: hypotheses and comparisons were planned” which may indicate both insufficiently powered studies and potentially premature conclusions based on multiple testing to achieve signal threshold. Given those, we identified a need for follow-up on these findings with a well-powered replication employing analyses appropriate that do not artificially categorize participants into groups but treat emotion dispositions as a continuous measure, hoping to obtain even stronger evidence in support of the impactful findings.

Therefore, we aimed to revisit the classic phenomenon to examine the reproducibility and replicability of the findings with an independent replication. Following the recent growing recognition of the importance of reproducibility and replicability in psychological science (e.g., Brandt et al., 2014; Open Science Collaboration, 2015; van‘t Veer & Giner-Sorolla, 2016; Zwaan et al., 2018), we embarked on a well-powered pre-registered close replication of Lerner and Keltner (2001) (See Table 8 for the classification of close replication).

We summarized the main hypotheses of the target article in Table 1 and provided a detailed description of the methods and the results of the studies in the “Analysis of the original article” section in the supplementary.

## Overview of replication and extension

Lerner and Keltner (2001) ran four experiments, and the current replication focused on Studies 1 to 3. Study 4 involved inducing specific emotions in participants to try and determine causality, which we felt was more appropriate for a follow-up study after reconfirming the associations in Studies 1 to 3 with a replication, and then preferably executed in a well-controlled lab setting with careful attention to the possible impact on the participants.

Study 1 adopted the “Asian disease problem” (Tversky & Kahneman, 1981), a widely used framing question, to test individuals’ risk-seeking preferences. Numerous studies found that framing influences risk preferences, suggesting that people tend to be risk-seeking under the loss frame, while being risk-aversive under the gain frame (Ruggeri et al., 2020). Study 1 showed that while the framing effect was observed for the whole sample, fearful people tended to avoid uncertainty (risk averse) whereas angry people were more likely to embrace risk, regardless of positive or negative framing.

Studies 2 and 3 measured participants’ risk optimism by their estimates of the comparative chance of future life events. Study 2 showed that the angrier and happier tended to be more optimistic, whereas the more fearful tended to be more pessimistic. Study 3 showed that ambiguity moderated the effects of Study 2 in that the differences in associations between the angry and fearful were much weaker for unambiguous events compared to ambiguous events.

Given the similar design of the three target studies measuring trait emotions and various outcomes, we combined the studies into a single survey design. We first assessed trait anger, fear, happiness, and hope as the independent variables, presented in random order, and then the outcome dependent variables of risk preferences and optimism, presented in random order, with the assessment of controllability and certainty in random order at the very end. This design allowed us to replicate designs of each of the original studies and then compare the effects of the different studies. We successfully employed a similar approach in previous replications in our team (e.g., Chan & Feldman, 2022).

###### Table 1 *Summary of main hypotheses of the target article*

|  |  |  |
| --- | --- | --- |
| Study | Hypothesis | |
| 1 | Hypothesis 1: | Trait fear is negatively associated with risk seeking. |
| Hypothesis 2: | Trait anger is positively associated with risk seeking. |
| 2 | Hypothesis 3: | Trait fear is negatively associated with optimistic risk assessment. |
| Hypothesis 4: | Trait happiness is positively associated with optimistic risk assessment. |
| Hypothesis 5: | Trait anger is positively associated with optimistic risk assessment. |
| 3 | Hypothesis 6: | For ambiguous events, trait fear is negatively associated with optimistic risk assessment, whereas trait happiness and trait anger are positively associated with optimistic risk assessment. |
| Hypothesis 7: | For unambiguous events, trait fear and trait anger are negatively associated with optimistic risk assessment, whereas trait happiness is positively associated with optimistic risk assessment. |

*Note*. We deduced these hypotheses from the target’s findings, and adjusted those to hypotheses about associations fitting with continuous measures rather than group comparisons. We note that additional hypotheses can be drawn by combinations of Hypotheses 1 and 2 (fear is more strongly negatively associated with risk seeking than anger), Hypotheses 3, 4, and 5 (fear is more strongly negatively associated with optimistic risk assessment than anger or happiness), and Hypotheses 6 and 7 (ambiguity more strongly moderates trait anger than trait fear or trait happiness). We address those in our conclusions of the effects and confidence intervals.

## Extension: Dispositional hope

We aimed to extend the replication by adding hope to the measured dispositional emotions. In the target article, the authors started by focusing on fear and anger, two negative-valenced emotions with different appraisals of certainty and control. Studies 2 and 3 added happiness to the investigation, a positive-valenced emotion with high certainty and control. Their results suggested that while fear and anger (two negative emotions of differing appraisals) differ in their effect, anger and happiness (two emotions of different valence but similar appraisals) showed similar effects (Lerner & Keltner, 2001). Given that trait hope is regarded as a positive-valenced emotion with low certainty and control (Smith & Ellsworth, 1985) it ought to have similar effects as fear. More specifically, following the conclusions of the target article, we expected that hope would show a pattern similar to that of happiness in predicting unambiguous events (Hypothesis 8), while showing a similar pattern to fear in predicting ambiguous events (Hypothesis 9). Such a finding would further strengthen the theoretical and practical underpinnings of the ATF.

Hope is commonly defined as a positive motivational/emotional state derived from a sense of agency or planning in attaining goals (Snyder, 2000). There is still very little research on the relationship between hope and risk preferences or perceptions. Hope may lead to perceiving less risk and therefore stronger tendency to take risks, given that hope can shift emphasis from the negatives to the positives (Wong & Yang, 2021), as well as increase perceptions of efficacy in controlling the situation and addressing risks (Li & Monroe, 2018).

By comparing the four emotions, we sought to explore the role of different appraisal themes for events with different levels of ambiguity (see Table 2 for the emotions mapped onto valence and certainty/control, and Table 4 for our extension design). Following the conclusions of the target article, we expected that hope would show a pattern similar to that of happiness in predicting unambiguous events, while showing a similar pattern to fear in predicting ambiguous events.

###### Table 2 *Four emotions mapped onto valence and certainty/control appraisal themes*

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  | |
|  |  | **High certainty/control** | **Low certainty/control** |
| **Valence** | **Positive** | Happiness | Hope |
| **Negative** | Anger | Fear |

*Note*. Hope complements the three other trait emotions, by checking the missing box of positive valence with low certainty/control.

## Exploratory directions: Ambiguity - embedding the pre-test into the main test

In the target study, authors conducted a pretest measuring the ambiguity of events by examining controllability and certainty, which was then used in the main study’s analyses with a tertiary split on this composite index of the two. In our main replication analyses, we used the categorization reported in the target article as is. However, in an effort to improve on the methods of the original we also opted to directly assess participants’ perceived controllability and certainty of the events. With these measurements we sought to revisit the ambiguity categorization of the target article and also conduct analyses of ambiguity as the two continuous measures rather than a dichotomous split of an aggregate.

## Pre-registration and open-science

The project is part of a larger replications project that received ethical approval from the University of Hong Kong Human Research Ethics Committee (EA210265). We provided all materials, data, and code on: <https://osf.io/t5kz9/> . This project received Peer Community in Registered Reports Stage 1 in-principle acceptance (<https://rr.peercommunityin.org/articles/rec?id=162>; <https://osf.io/8yu2x/>) after which we created a frozen pre-registration version of the entire Stage 1 packet (<https://osf.io/ctfwq/>) and proceeded to data collection. [To be updated after Stage 2 endorsement:] It has then gone through peer review and officially endorsed by Peer Community in Registered Reports ([Endorsement citation will be provided after Stage 2 endorsement]; [Endorsement link will be provided after Stage 2 endorsement]). All measures, manipulations, exclusions conducted for this investigation are reported, and data collection was completed before analyses. There are no other unreported/unlinked pre-registrations for this project. This Registered Report was written using the Registered Report template by Feldman (2023).

# Method

## Power and sensitivity analyses

Given the methodological issues discussed in the introduction and our plan to conduct different analyses from the original’s focusing on continuous measures and associations between the variables, we decided not to use the original’s effect sizes (ES) as a basis for our power analysis. We instead aimed for a sample size of 770 participants taking into account a 10% exclusion rate with a final sample of 700, aiming to go beyond the largest study in the original (Study 2 had 601 participants) to allow for exclusions and additional analyses. Our sensitivity analysis indicated this sample would allow for the detection of *r* = .12 and Cohen’s *f* = 0.06 for the interaction (4 predictors, 2 groups; both 95% power, alpha = 5%, one-tail), effects that are considered weak in social psychology (Jané et al., 2024). Therefore, we set these very conservative effect estimates as our Smallest Effect Size of Interest (SESOI) that we considered would serve as a fair test for detecting the target phenomenon.

## Participants

A total of 826 US American participants were recruited from Amazon Mechanical Turk (MTurk) using TurkPrime.com/CloudResearch (Litman et al., 2017). To ensure high quality data collection, we employed the following CloudResearch options: Duplicate IP Block. Duplicate Geocode Block, Suspicious Geocode Block, Verify Worker Country Location, Enhanced Privacy, CloudResearch Approved Participants, and Block Low Quality Participants. Among them, 780 fulfilled the consent requirements, passed the verifications, and finished the survey, thus are regarded as valid participants (*Mage* = 43.41, *SD* = 12.87; 411 females), slightly higher than targeted. We compared the target article sample and the replication samples in Table 3.

Assignment pay is based on the federal wage of 7.25USD/hour, so for example - 5-8 minutes survey would be paid 1 USD per participant. We first pretested survey duration with 30 participants to make sure our time run estimate was accurate and then adjusted pay as needed. The pretest indicated the time duration as 8 minutes, thus 1.1USD was paid per participant in the full run, and the pretest participants were paid a bonus as pay adjustment. The data of the 30 participants was not analyzed separately from the rest of the sample other than to assess survey completion duration and needed pay adjustments.

###### Table 3 *Difference and similarities between original study and replication*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Lerner and Keltner (2001)  Study 1 | Lerner and Keltner (2001)  Study 2 | Lerner and Keltner (2001)  Study 3 | US MTurk workers using CloudResearch |
| Sample size | 75 | 601 | 118 | 780 | |
| Geographic origin | Not reported | Not reported | Not reported | US American | |
| Gender | 20 males, 55 females | 281 males, 320 females | Not reported | 360 males, 411 females, 9 other/did not disclose | |
| Median age (years) | Not reported | Not reported | Not reported | 40 | |
| Average age (years) | Not reported | Not reported | Not reported | 43.41 | |
| Standard deviation age (years) | Not reported | Not reported | Not reported | 12.87 | |
| Age range (years) | Not reported | Not reported | Not reported | 20-84 | |
| Medium (location) | Classroom | Home | Lab | Computer (online) | |
| Compensation | Course credits | Course credits | Not reported | Nominal payment | |
| Year | 2001 | 2001 | 2001 | 2022 | |

*Note*. Replication sample is filled in using randomly simulated data before data collection. The row Year for Study 1 to 3 in Lerner and Keltner (2001) refers to the time of publication.

## Design and procedure: Replication

We summarized the experimental design in Table 4: a four (dispositional emotions: anger, fear, happiness, and hope) by two (ambiguity of events: ambiguous events and unambiguous events) within-subject design. Display of measures was counterbalanced by randomizing the order of scales of dispositional emotions (with randomization of items within each scale), randomizing the order of risk optimism scale and risk preference questions.

Participants first read the basic information about the study and gave consent. After reading the study outline and answering several verifications, participants answered a randomized sequence of measures of dispositional anger, fear, and happiness as part of the replication, and trait hope as our extension. Participants then rated events optimism and indicated risk preferences in randomized order, with a follow-up section examining either their perceived controllability or certainty of the same events. Overall, each participant provided risk optimism estimates for each of the 23 events (7 ambiguous and 16 unambiguous as per the target article classification) and risk preferences for both the gain and loss frame. Finally, there were funneling, demographics information, and debriefing sections. We provided further details and all measures in the supplementary materials (section “Materials and scales used in the replication and extension experiment”).

###### Table 4 *Replication and extension experimental design*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IV1: Dispositional emotions [within]  IV2: Ambiguity of events [within] | **IV1: Trait Anger**  Spielberger’s (1983) Trait-Anger Scale | **IV1: Trait Fear**  Fear Survey Schedule-II (Behl, 1997) and Spielberger’s (1983) Trait Anxiety Scale | **IV1: Trait Happiness**  Underwood & Froming’s (1980) Mood Survey | **IV1: Trait Hope [Extension]**  Adult Trait Hope Scale (Snyder et al., 1991) |
| **IV2: Ambiguous events**  7 items | (The dependent variables were measured for each of the IV2 ambiguity 23 items:)  **DV1: Risk optimism**  Please estimate your own chances of experiencing these future events relative to the average chances of other MTurk workers of the same gender and age as you  -4 (*Very much less likely*) to 4 (*Very much more likely*).  **DV2: Risk preference**  Which of the two programs would you favor?  1 (*Very much prefer Program A/C*) to 6 (*Very much prefer Program B/D*).  **Exploratory variables: Perceived ambiguity of events**  Randomly assigned to rate one of the following two factors - controllability or certainty:  Certainty: “For each of the items below, we would like you to indicate the extent to which the event seems to be certain”  1 (*Not at all certain*) to 6 (*Completely certain*).  Controllability: “For each of the items below, we would like you to indicate the extent to which the event seems to be controllable”  1 (*Not at all controllable*) to 6 (*Completely controllable*). | | | |
| **IV2: Unambiguous events**  16 items |

*Note*. The ambiguity of events is based on the target article’s categorization. Please refer to Table 12 for the full list and categorization of the events.

## 

## Measures

We provided all measures in the supplementary materials (“Instructions and experimental material” section). The specific items chosen and used from each scale were not reported in the original article, and we therefore used the scales as is based on reported items in other studies. We included the Cronbach alpha level reported in the target article and aimed to compare it with the reliability of the measures in the current study, summarized in Table 5. Given current discussions on the limitations of Cronbach’s alpha we also include reliability estimates obtained with McDonald’s omega (cf., Hayes & Coutts, 2020). We summarized adjustments and deviations in Table 6.

###### 

###### Table 5 *Comparison of Cronbach alpha of the measures*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Lerner and Keltner (2001)  Study 1 | Lerner and Keltner (2001)  Study 2 | Lerner and Keltner (2001)  Study 3 | Current Study |
| Fear measure(s) | 12-item version of Fear Survey Schedule-II (Suls & Wan, 1987) and Speilberger’s (1983) 20-item trait anxiety scale | 12-item version of Fear Survey Schedule-II (Suls & Wan, 1987) and Speilberger’s (1983) 20-item trait anxiety scale | 12-item version of Fear Survey Schedule-II (Suls & Wan, 1987) and Speilberger’s (1983) 20-item trait anxiety scale | 14-item Fear Survey Schedule-II (Behl, 1997) and Spielberger’s (1983) 20-item trait-anxiety scale | |
| *Cronbach alpha*  *McDonald’s omega* | (composite) .91 | (composite) .89 | Not reported | (composite) .95  ωh = .80 | |
| Anger measures | Spielberger’s (1996) 10-item trait-anger scale and a 10-item face-valid anger scale (Lerner & Keltner, 2000) | Spielberger’s (1996) 10-item trait-anger scale | Spielberger’s (1996) 10-item trait-anger scale | Spielberger’s 10-item trait-anger scale (Spielberger et al., 1983) | |
| *Cronbach alpha*  *McDonald’s omega* | (composite) .84 | .84 | Not reported | .89  ωh = .78 | |
| Happiness measure | N/A | Abbreviated version of Underwood and Froming’s (1980) mood survey | Abbreviated version of Underwood and Froming’s (1980) mood survey | 16 items chosen from Underwood and Froming’s (1980) mood survey | |
| *Cronbach alpha*  *McDonald’s omega* | N/A | .81 | Not reported | .92  ωh = .57 | |

### Trait anger

Dispositional anger was measured using Spielberger’s 10-item trait-anger scale (Spielberger et al., 1983) (1 = *Almost never*, 4 = *Almost always*; Cronbach alpha = .89; ωh = .78).

### Trait fear

Dispositional fear was measured using Fear Survey Schedule-II (FSS-II; Behl, 1997) (1 = *None*, 7 = *Terror*; Cronbach alpha = .93; ωh = .75), and Spielberger’s 20-item trait-anxiety scale (Spielberger, 1983) (1 = *Almost never*, 4 = *Almost always*; Cronbach alpha = .96; ωh = .81). We were not able to identify the exact items used in the target article, and we therefore chose 14 items from FSS-II that were high on the social evaluation fear factor (Behl, 1997). Given the high Pearson correlation reported in the original between the two scales (*r* = .54), we followed the pre-registered plan to follow the original’s method in combining the two scales into an aggregate score if the correlation is higher than *r* = 0.3. In the current study, the two scales had a strong correlation (*r* = .62).

### Trait happiness

Dispositional happiness predictor was measured using the Mood Survey (Underwood & Froming, 1980) (1 = *Strongly disagree*, 6 = *Strongly agree*; Cronbach alpha = .92; ωh = .57). As we were not able to determine the specified items used in the target study, we chose 16 items with a factor loading above .40 on at least one out of the two primary factors of the mood survey (Underwood & Froming, 1980).

### Dispositional hope rating (extension)

Dispositional hope predictor was measured using 12-item Adult Trait Hope Scale (Snyder et al., 1991) (1 = *Definitely false*, 8 = *Definitely true*; Cronbach alpha = .94; ωh = .85). We provided details of the measure in the supplementary materials (“Dispositional hope: Adult Trait Hope Scale (Snyder et al., 1991)” subsection).

### Risk optimism

Risk optimism was assessed using Weinstein’s (1980) optimism measure. Participants rated the likelihood of encountering the events in the future compared with other MTurk workers of the same gender and age. Among the 26 items used in the target article, one was not specified, thus omitted (Lerner & Keltner, 2001). The items “I graduated in the top third of my class” and “I could not find a job for 6 months” were also removed from the survey, as they might not show a good fit with our target sample. The remaining 23 items were adjusted to better represent the target population of varying age groups (Wong et al., 2019). For example, the item “heart attack before age 50” was adjusted to “heart attack within the next 10 years”. We summarized the specific item adjustments in the supplementary materials (“Instructions and experimental material” subsection).

Our analysis of the categorization of the ambiguity of events is based on the target article’s dichotomy (Table 12). In addition, we added an extension measure after all the other dependent measures, to test the perceived ambiguity of the events as an exploratory direction. Participants rated the same items as in the risk optimism measure either on perceived certainty or perceived controllability of each event (1 = *Not at all controllable/certain*; 6 = *Completely controllable/certain*).

### Risk preference

We renamed the “Asian Disease Problem” (Tversky & Kahneman, 1981) used in the target article to a generalized “Pandemic Problem”. We also adjusted the original estimates of people saved or killed by 1000 times, given that under the COVID pandemic the original estimate of 600 people killed may not be regarded by our participants to be a true pandemic-related decision. The adapted version of Asian Disease Problem has been used in other studies and was found to yield framing effect in the same direction as the original version (e.g., Dylman & Champoux-Larsson, 2020; Feldman et al., 2016; Miozzo et al., 2020). Larger framing effects were reported when more people were affected in the problem (Diederich et al., 2018). Thus, our modification of the problem was meant to compensate for the potential weak effect of framing due to the likely impact of the pandemic in the decreased sensitivity to the loss of hundreds of lives.

Participants indicated their preference for two programs with different risk levels under the positive and negative frames, presented in random order. Given the possible popularity of this question and framing effects on MTurk, we also asked participants to rate their familiarity with the materials by inquiring whether they had encountered similar questions before. We planned to exclude participants from the analysis of this problem if participants indicated familiarity.

## Deviations

We summarized our adjustments and deviations from the original study in Table 6.

## Evaluation criteria for replication findings

We aimed to compare the replication with the original findings in the target article. Given the adjusted methods we would not be able to compare effect sizes, and will instead indicate whether we found a signal in support of the effects and whether it was in the same direction as in the original study (see our similar implementation in Ziano et al., 2021). We summarized our replication based on the criteria in Table 7.

## 

###### 

###### Table 6 *Comparing original and replication with a list of adjustments*

|  |  |  |
| --- | --- | --- |
| **Category** | **Lerner and Keltner (2001)** | **Current study** |
| Sample | Undergraduate students | MTurk workers |
| Setting | Classroom (Study 1), home (Study 2), lab (Study 3) | Online |
| Design | Study 1: 2 (dispositional emotions: anger, fear; within-subjects) x 2 (framing: loss domain, gain domain; within-subjects) | For risk preference: 4 (dispositional emotions: anger, fear, happiness, hope; within-subjects) |
| Study 2: 3 (dispositional emotions: anger, fear, happiness; within-subjects) | For risk optimism: 4 (dispositional emotions: anger, fear, happiness, hope; within-subjects) x 2 (ambiguity of events: ambiguous, unambiguous; within-subjects) |
| Study 3: 2 (ambiguity of events: ambiguous, unambiguous; within-subjects) x 2 (order: ambiguous first, unambiguous first; within-subjects) x 3 (dispositional emotions: anger, fear, happiness; between-subjects) | Randomized order |
| Procedures | 1. Conducted as three studies | 1. Combined as one study |
|  | 2. In Study 3, participants were selected and grouped based on the prescreening results of dispositional emotions; pretest was used for categorizing the ambiguity of events  3. In Study 3, face-to-face interview was used to test the potential social reality factor | 2. No pretest or pre-screening was used; ambiguity of events was measured at the end of the survey  3. The survey is completed anonymously online |
| Materials | 1. Selected items from respective scales to measure dispositional fear, anger, and happiness | 1. Reselected items as we were not able to identify the items used in the target article; added the scale to test dispositional hope as an extension |
|  | 2. “Asian disease problem (Tversky & Kahneman, 1981)” to assess participants’ risk preference | 2. Adjusted the problem to “pandemic problem” and increased the estimated number by 1000 times |
|  | 3. Selected 26 items from Weinstein’s (1980) optimism measure to rate participants’ risk optimism | 3. Excluded one item that was not specified in the target article and two items that didn’t fit the current population; adjusted some of the rest items to better fit the current population |
| Analysis | Study 1: mixed design regression | For risk preference: correlations and mixed design regression |
| Study 2: linear regression  Study 3: one-way ANOVA and planned contrast | For risk optimism: correlations and linear regression |
|  |  |  |

###### Table 7 *Criteria for evaluating the replication*

Overall

|  |  |
| --- | --- |
| **Conclusion** | **Criteria** |
| Fully successful replication | Finding support for all studies |
| Mostly successful replication | Successful replication (all hypotheses supported) of two of the three studies |
|
| Mixed findings | One study out of the three or two studies out of the three with some but not all hypothesis supported |
| Failed replication | Failure to find support for all three studies |

Analysis based on ambiguity of events

|  |  |
| --- | --- |
| **Conclusion** | **Criteria** |
| Robust phenomenon | Both found support |
| Successful replication, with robustness challenge | Original’s methods succeeded in finding support yet we failed to find support using our method |
| An update to the target and/or a need to reframe the target’s theory and conclusions | Original’s methods failed to find support yet we found support using our method |
|
| Failed replication | Both failed to find support |

###### 

###### Table 8 *Classification of the replication, based on LeBel et al. (2018)*

|  |  |  |
| --- | --- | --- |
| **Design facet** | **Replication** | **Details of deviation** |
| Effect/hypothesis | Same |  |
| IV construct | Same |  |
| DV construct | Same |  |
| IV operationalization | Similar | The IV in the current study adopted a within-design with continuous measures. |
| DV operationalization | Same |  |
| Population (e.g. age) | Different | In the target article, the participants were undergraduate students. In the current study, the participants were online MTurk workers of a wider demographic range. |
| IV stimuli | Similar | 1. For emotion measures: as we were not able to identify the specific items used in the target article, we chose items from the scales according to the nature of the measures.  2. For ambiguity of events: we used the categorization in the target article without pretesting; the scale measuring ambiguity of events was added in the survey for exploratory analysis. |
| DV stimuli | Similar | 1. For risk preference: 1) renamed “Asian disease” to “pandemic”; 2) made the estimated numbers to 1000 times as large.  2. For risk optimism: 1) excluded 3 items that were not able to specify or not applicable to the current participants; 2) adjusted some of the items to better fit the current population. |
| Procedural details | Different | Studies 1-3 in the target article were combined into a single survey. We did not conduct pretests or pre-screening and used a randomized design. |
| Physical settings | Different | In the target article, the surveys were completed in class (Study 1), at home (Study 2), and at the lab (Study 3). In the current study, the participants completed the Qualtrics survey online. |
| Contextual variables | Same |  |
| Replication classification | Close replication |  |

## 

## 

## Data analysis strategy

### Replication: Original’s analyses

As preliminary analyses, we examined the Pearson correlations between all four trait emotions and all dependent variables, supplemented with Spearman’s Rho as an alternative in case the statistical assumptions are violated.

For risk preference, we performed multiple regression analysis as in the original’s Study 1 examining the associations between dispositional emotions and risk preferences. We reported the regression for the gain frame, the loss frame, and then the difference between two frames (1/2 x [loss frame - gain frame]).

For risk optimism, we performed multiple regression analysis as in the original’s Study 2 examining the associations between dispositional emotions and optimism estimates. We reported the regression for the positive events, the negative events (reversed), and then combined for positive events and negative events (reversed).

### Replication: Additional analyses

As the replication of Study 3 of the target article, and to supplement the correlations, we also performed multiple regression examining associations between emotion dispositions and optimism for both ambiguous events, unambiguous events, and all events combined. We summarized the regression coefficients in Tables 10 and 11. The ambiguity of events was based on the categorization in the target article, summarized in Table 12.

### Extensions

As our extension was adding hope as a dispositional emotion, our data analysis for hope would be the same as it was for the other three emotions, as stated in the previous section. For each regression analysis, we conducted it both for three emotional predictors and four emotional predictors, namely with and without trait hope.

### Exclusions

Our generalized exclusion criteria are detailed in the “exclusion criteria” subsection of the supplementary materials. In addition, we added a question checking participants’ familiarity with the framing effect question, and we excluded those indicating previous experience from analyses on that question.

Given that the survey is fairly long and somewhat repetitive, and given the target sample, we included five attention checks throughout the survey in the form of “Check: Please answer X”. Even attentive participants may occasionally answer one or two attention checks wrong, while three or more wrong answers probably indicate a pattern of random responding. Therefore, we excluded participants who answered three or more of the five attention checks incorrectly. We focused our main report on the full sample, and the same analyses with exclusions are reported in the supplementary (see subsection “pre-exclusions versus post-exclusions”).

# Results

## Replication and extension

We summarized descriptive statistics and correlation tests of all measures in Table 9, and statistical tests of the hypotheses in Tables 10 and 11.

Consistent with the expected valence of emotions, we found support for positive correlations between two of the the negative emotions, anger and fear (*r* = .54, *p* < .001), between two of the positive emotions, happiness and hope (*r* = .69, *p* < .001), and for negative correlations between each negative emotion and each positive emotion (anger and happiness: *r* = -.47, *p* < .001; anger and hope: *r* = -.27, *p* < .001; fear and happiness: *r* = -.68, *p* < .001; fear and hope: *r* = -.52, *p* < .001).

###### Table 9 *Summary of descriptive statistics and correlations*

|  | *M* | *SD* | Statistics | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 - Anger | 1.61 | 0.53 | Pearson's r | **α =** .89 |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | p-value | — |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | 95% CI Upper | — |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | 95% CI Lower | — |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | Spearman's rho | — |  |  |  |  |  |  |  |  |  |  |  |
| 2 - Fear | 2.79 | 0.83 | Pearson's r | 0.54 | **α =** .95 |  |  |  |  |  |  |  |  |  |  |
|  |  |  | p-value | < .001 | — |  |  |  |  |  |  |  |  |  |  |
|  |  |  | 95% CI Upper | 0.59 | — |  |  |  |  |  |  |  |  |  |  |
|  |  |  | 95% CI Lower | 0.49 | — |  |  |  |  |  |  |  |  |  |  |
|  |  |  | Spearman's rho | 0.55 | — |  |  |  |  |  |  |  |  |  |  |
| 3 - Happiness | 3.99 | 1.00 | Pearson's r | -0.47 | -0.68 | **α =** .92 |  |  |  |  |  |  |  |  |  |
|  |  |  | p-value | < .001 | < .001 | — |  |  |  |  |  |  |  |  |  |
|  |  |  | 95% CI Upper | -0.41 | -0.64 | — |  |  |  |  |  |  |  |  |  |
|  |  |  | 95% CI Lower | -0.52 | -0.71 | — |  |  |  |  |  |  |  |  |  |
|  |  |  | Spearman's rho | -0.48 | -0.66 | — |  |  |  |  |  |  |  |  |  |
| 4 - Hope | 5.82 | 1.41 | Pearson's r | -0.27 | -0.52 | 0.69 | **α =** .94 |  |  |  |  |  |  |  |  |
|  |  |  | p-value | < .001 | < .001 | < .001 | — |  |  |  |  |  |  |  |  |
|  |  |  | 95% CI Upper | -0.21 | -0.46 | 0.72 | — |  |  |  |  |  |  |  |  |
|  |  |  | 95% CI Lower | -0.34 | -0.57 | 0.65 | — |  |  |  |  |  |  |  |  |
|  |  |  | Spearman's rho | -0.29 | -0.53 | 0.68 | — |  |  |  |  |  |  |  |  |
| 5 -Risk optimism | 0.26 | 0.87 | Pearson's r | -0.15 | -0.39 | 0.46 | 0.48 | **α =** .81 |  |  |  |  |  |  |  |
|  |  |  | p-value | < .001 | < .001 | < .001 | < .001 | — |  |  |  |  |  |  |  |
|  |  |  | 95% CI Upper | -0.08 | -0.32 | 0.51 | 0.53 | — |  |  |  |  |  |  |  |
|  |  |  | 95% CI Lower | -0.22 | -0.44 | 0.40 | 0.42 | — |  |  |  |  |  |  |  |
|  |  |  | Spearman's rho | -0.17 | -0.39 | 0.45 | 0.47 | — |  |  |  |  |  |  |  |
| 6- Risk optimism (ambiguous) | -0.47 | 1.18 | Pearson's r | -0.05 | -0.33 | 0.36 | 0.43 | 0.85 | **α =** .64 |  |  |  |  |  |  |
|  |  |  | p-value | .178 | < .001 | < .001 | < .001 | < .001 | — |  |  |  |  |  |  |
|  |  |  | 95% CI Upper | 0.02 | -0.27 | 0.42 | 0.48 | 0.87 | — |  |  |  |  |  |  |
|  |  |  | 95% CI Lower | -0.12 | -0.39 | 0.30 | 0.37 | 0.83 | — |  |  |  |  |  |  |
|  |  |  | Spearman's rho | -0.09 | -0.33 | 0.34 | 0.41 | 0.80 | — |  |  |  |  |  |  |
| 7- Risk optimism (unambiguous) | 0.58 | 0.86 | Pearson's r | -0.19 | -0.36 | 0.45 | 0.44 | 0.95 | 0.63 | **α =** .72 |  |  |  |  |  |
|  |  |  | p-value | < .001 | < .001 | < .001 | < .001 | < .001 | < .001 | — |  |  |  |  |  |
|  |  |  | 95% CI Upper | -0.13 | -0.30 | 0.50 | 0.49 | 0.95 | 0.67 | — |  |  |  |  |  |
|  |  |  | 95% CI Lower | -0.26 | -0.42 | 0.39 | 0.38 | 0.94 | 0.59 | — |  |  |  |  |  |
|  |  |  | Spearman's rho | -0.20 | -0.35 | 0.44 | 0.44 | 0.93 | 0.56 | — |  |  |  |  |  |
| 8- Risk optimism (positive) | -0.85 | 1.33 | Pearson's r | 0.06 | -0.18 | 0.26 | 0.42 | 0.72 | 0.79 | 0.57 | **α =** .84 |  |  |  |  |
|  |  |  | p-value | .083 | < .001 | < .001 | < .001 | < .001 | < .001 | < .001 | — |  |  |  |  |
|  |  |  | 95% CI Upper | 0.13 | -0.11 | 0.32 | 0.47 | 0.75 | 0.81 | 0.62 | — |  |  |  |  |
|  |  |  | 95% CI Lower | -0.01 | -0.25 | 0.19 | 0.36 | 0.68 | 0.76 | 0.52 | — |  |  |  |  |
|  |  |  | Spearman's rho | 0.03 | -0.19 | 0.24 | 0.38 | 0.67 | 0.79 | 0.50 | — |  |  |  |  |
| 9- Risk optimism (negative reversed) | 1.28 | 1.17 | Pearson's r | -0.28 | -0.36 | 0.38 | 0.25 | 0.69 | 0.39 | 0.76 | -0.01 | **α =** .85 |  |  |  |
|  |  |  | p-value | < .001 | < .001 | < .001 | < .001 | < .001 | < .001 | < .001 | .685 | — |  |  |  |
|  |  |  | 95% CI Upper | -0.22 | -0.30 | 0.44 | 0.31 | 0.72 | 0.45 | 0.79 | 0.06 | — |  |  |  |
|  |  |  | 95% CI Lower | -0.35 | -0.42 | 0.32 | 0.18 | 0.65 | 0.33 | 0.73 | -0.08 | — |  |  |  |
|  |  |  | Spearman's rho | -0.25 | -0.35 | 0.39 | 0.30 | 0.67 | 0.34 | 0.76 | -0.03 | — |  |  |  |
| 10 - Risk preference | 3.21 | 1.27 | Pearson's r | 0.10 | -0.03 | 0.06 | 0.09 | 0.07 | 0.12 | 0.04 | 0.13 | -0.03 | — |  |  |
|  |  |  | p-value | .007 | .405 | .087 | .010 | .040 | .001 | .290 | < .001 | .353 | — |  |  |
|  |  |  | 95% CI Upper | 0.17 | 0.04 | 0.13 | 0.16 | 0.14 | 0.18 | 0.11 | 0.20 | 0.04 | — |  |  |
|  |  |  | 95% CI Lower | 0.03 | -0.10 | -0.01 | 0.02 | 0.00 | 0.05 | -0.03 | 0.06 | -0.10 | — |  |  |
|  |  |  | Spearman's rho | 0.08 | -0.04 | 0.05 | 0.06 | 0.06 | 0.12 | 0.03 | 0.12 | -0.03 | — |  |  |
| 11 -Risk preference (gain frame) | 2.80 | 1.48 | Pearson's r | 0.11 | -0.01 | 0.03 | 0.05 | 0.08 | 0.12 | 0.04 | 0.14 | -0.03 | 0.83 | — |  |
|  |  |  | p-value | .002 | .737 | .445 | .200 | .022 | < .001 | .214 | < .001 | .398 | < .001 | — |  |
|  |  |  | 95% CI Upper | 0.18 | 0.06 | 0.10 | 0.12 | 0.15 | 0.19 | 0.11 | 0.21 | 0.04 | 0.85 | — |  |
|  |  |  | 95% CI Lower | 0.04 | -0.08 | -0.04 | -0.02 | 0.01 | 0.05 | -0.03 | 0.07 | -0.10 | 0.81 | — |  |
|  |  |  | Spearman's rho | 0.11 | -0.00 | 0.01 | 0.00 | 0.05 | 0.12 | 0.02 | 0.13 | -0.04 | 0.82 | — |  |
| 12 -Risk preference (loss frame) | 3.61 | 1.54 | Pearson's r | 0.05 | -0.04 | 0.07 | 0.11 | 0.04 | 0.07 | 0.02 | 0.08 | -0.03 | 0.85 | 0.41 | — |
|  |  |  | p-value | .139 | .293 | .036 | .003 | .234 | .048 | .583 | .020 | .471 | < .001 | < .001 | — |
|  |  |  | 95% CI Upper | 0.12 | 0.03 | 0.14 | 0.18 | 0.11 | 0.14 | 0.09 | 0.15 | 0.04 | 0.87 | 0.47 | — |
|  |  |  | 95% CI Lower | -0.02 | -0.11 | 0.00 | 0.04 | -0.03 | 0.00 | -0.05 | 0.01 | -0.10 | 0.83 | 0.35 | — |
|  |  |  | Spearman's rho | 0.04 | -0.04 | 0.07 | 0.09 | 0.04 | 0.08 | 0.02 | 0.08 | -0.02 | 0.84 | 0.40 | — |

*Note.* N=780. The reliability of the scales is reported in the diagonal. Events ambiguity categorization is based on the target article’s, summarized in Table 12.

### Replication: Fear, anger, happiness, and risk preference

We conducted the regression analyses in this section based on the three emotions that were included in the target article, namely fear, anger, and happiness. Following the approach in the target article, the three emotion measures were entered into the regressions simultaneously to control for the influence of each emotion disposition on the two others. The regression results for both the replication of risk preference and risk optimism are summarized in Table 10.

For risk preference, we first regressed the average of participants’ preferences on the three emotions. For anger and happiness, the results supported the appraisal-tendency hypothesis (H2 supported): risk preference was positively associated with anger (*β* = 0.42, *t*(776) = 4.11, *p* < .001) and with happiness (*β* = 0.14, *t*(776) = 2.26, *p* = .024). However, we did not find support for an association with fear (H1) (*β* = 0.08, *t*(776) = -0.97, *p* = .330).

We then examined associations between the three emotions and the difference between two frames, similar to the target article’s Study 1 (1/2 x [loss frame - gain frame]). We found no support for a framing effect (*β* = 0.29, *t*(776) = 1.01, *p* = .310), or for an interaction between anger and framing (*β* = -0.07, *t*(776) = -1.07, *p* = .280), fear and framing (*β* = 0.03, *t*(776) = 0.59, *p* = .560), or happiness and framing (*β* = 0.04, *t*(776) = 0.90, *p* = .370). Same as the original article, we examined the associations within each frame. Within the loss frame, risk preference was positively associated with anger (*β* = 0.35, *t*(776) = 2.81, *p* = .01) and with happiness (β = 0.17, *t*(776) = 2.34, *p* = .02), but not with fear (*β* = -0.05, *t*(776) = -0.49, *p* = .627). Within the gain frame results were similar with anger having a positive association, but both fear and happiness were not associated with risk preference (see Figure 1).

## Replication: Fear, anger, and happiness and risk optimism

For risk optimism (Cronbach alpha = .81; ωh = .40), we created four subfactors: ambiguous events (Cronbach alpha = .64; ωh = .55), unambiguous events (Cronbach alpha = .72; ωh = .53), positive events (Cronbach alpha = .84; ωh = .68), (reverse scored) negative events (Cronbach alpha = .85; ωh = .61). There was no support for an association between the ratings for positive events and negative events (*r* = -.01, *p* = .685).

The results of regressing the overall measure of risk optimism on dispositional emotions supported the appraisal-tendency hypothesis: people with higher fear score tended to make less optimistic risk estimates (H3) (*β* = -0.21, *t*(776) = -4.33, *p* < .001); people with higher anger score tended to be more optimistic (H5) (*β* = 0.22, *t*(776) = 3.53, *p* < .001), and so did people with higher happiness score (H4) (*β* = 0.34, *t*(776) = 8.90, *p* < .001). The same patterns applied to positive events and ambiguous events (H6) specifically.

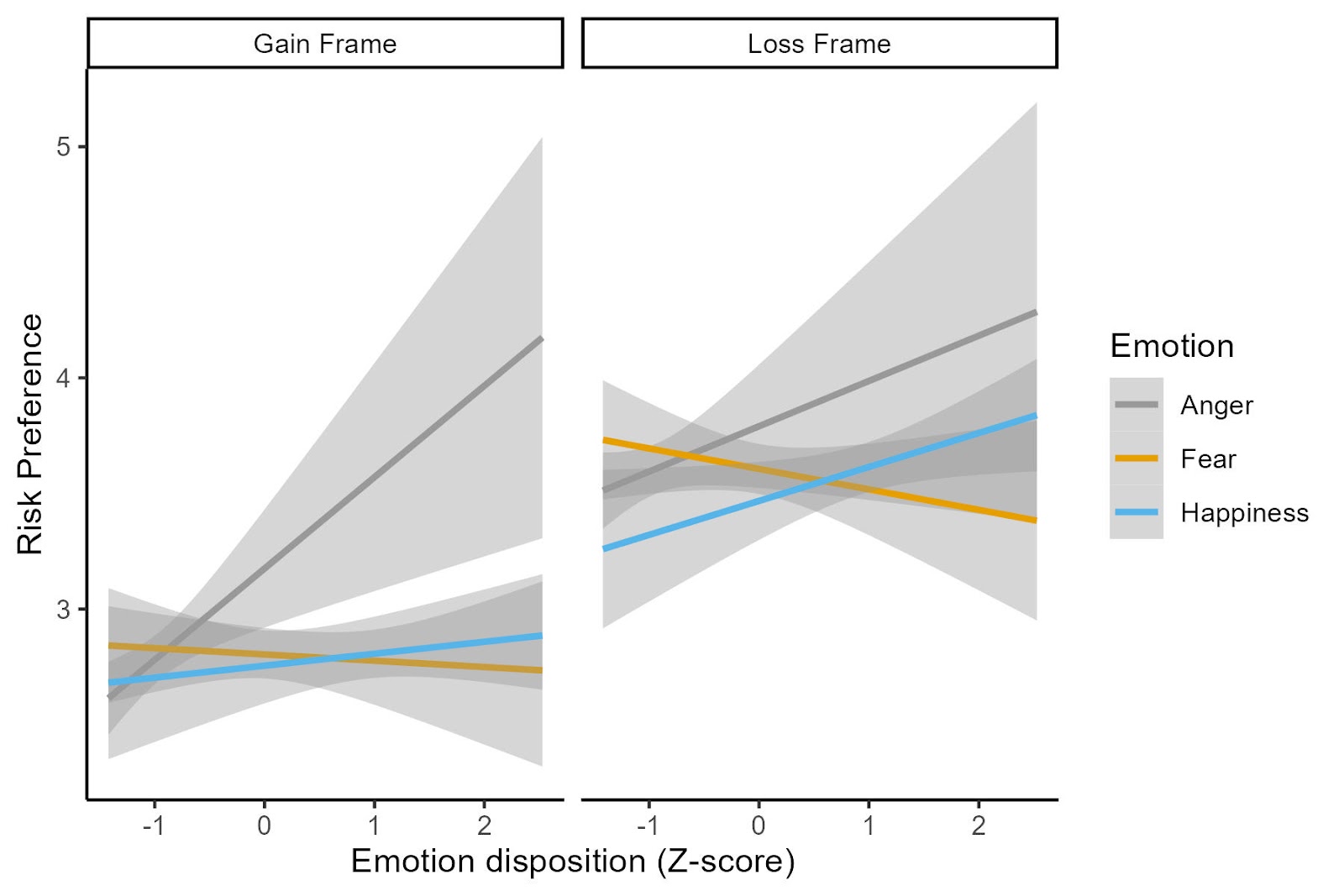
However, for reverse scored negative events, the results supported the valence-based hypotheses: happiness was positively related to optimistic risk estimates (*β* = 0.28, *t*(776) = 5.24, *p* < .001), while the two negative emotions were both negatively related to optimistic risk estimates, for anger (*β* = -0.20, *t*(776) = -2.26, *p* = .024), and for fear (*β* = -0.22, *t*(776) = -3.35, *p* < .001). For unambiguous events, we found no support for anger as a predictor of outcome (*β* = 0.10, *t*(776) = 1.51, *p* = .130), while fear and happiness played similar roles as for risk optimism for all the events (H7).

###### Table 10 *Replication: Linear Regression on three predictors - Anger, Fear, and Happiness*

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Anger** | **Fear** | **Happiness** |
| Risk preference | | | |
| Risk preference | 0.42 [0.22, 0.62]\*\*\* | -0.08 [-0.23, 0.08] | 0.14 [0.02, 0.26]\* |
| Framing effect | -0.07 [-0.20, 0.06] | 0.03 [-0.07, 0.13] | 0.04 [-0.04, 0.12] |
| Risk preference in loss domain | 0.35 [0.11, 0.60]\*\* | -0.05 [-0.23, 0.14] | 0.18 [0.03, 0.33]\* |
| Risk preference in gain domain | 0.49 [0.26, 0.73]\*\*\* | -0.11 [-0.29, 0.07] | 0.10 [-0.04, 0.25] |
| Risk optimism | | | |
| Risk optimism | 0.22 [0.10, 0.34]\*\*\* | -0.21 [-0.30, -0.11]\*\*\* | 0.34 [0.26, 0.41]\*\*\* |
| Risk optimism for positive events | 0.68 [0.48, 0.88]\*\*\* | -0.19 [-0.34, -0.04]\* | 0.41 [0.28, 0.53]\*\*\* |
| Risk optimism for negative events (reversed) | -0.20 [-0.37, -0.03]\* | -0.22 [-0.35, -0.09]\*\*\* | 0.28 [0.17, 0.38]\*\*\* |
| Risk optimism for ambiguous events | 0.51 [0.34, 0.68]\*\*\* | -0.36 [-0.49, -0.23]\*\*\* | 0.36 [0.25, 0.46]\*\*\* |
| Risk optimism for unambiguous events | 0.10 [-0.03, 0.22] | -0.14 [-0.23, -0.05]\*\* | 0.33 [0.26, 0.40]\*\*\* |

*Note.* Values are *β* and 95% confidence intervals. *N* = 780. \**p* < .05. \*\**p*< .01. \*\*\**p* < .001.

###### Figure 1 *Association between risk preference and emotion disposition as a function of frame (gain vs. loss)*

`

*Note*. Emotion dispositions were scaled and are presented as z-scores.

### 

### Extension: Adding hope

As we also measured dispositional hope, the same analyses as above were repeated but now also including the hope measure. That is, regression analyses now included all four dispositional emotions: fear, anger, happiness, and hope. The regression results including dispositional hope for both risk preference and risk optimism are summarized in Table 11.

For risk preference, we first regressed the average of participants’ preferences on the four emotions. Anger was positively related to the preference for risk seeking (*β* = 0.40, *t*(775) = 3.91, *p* < .001). We found no support for fear, happiness, and hope as predictors of risk preference. Then we regressed the difference between two frames (1/2 x [loss frame - gain frame]) of the respondents’ risk preferences on the four emotions. We did not find support for a framing effect (*β* = 0.20, *t*(775) = 0.69, *p* = .490). Also, there was no support for an interaction between any dispositional emotions and framing. Finally, we examined associations within each frame. We found support for anger as positively related to risk seeking for both the loss domain (*β* = 0.32, *t*(775) = 2.56, *p* = .011), and the gain domain (*β* = 0.49, *t*(775) = 4.02, *p* < .001). However, we found no support for fear, happiness, and hope being related to risk seeking in either domain.

For risk optimism, we first regressed the overall measure of risk optimism on the four emotions. We found support for fear as negatively related to risk optimism (*β* = -0.17, *t*(775) = -3.53, *p* < .001), anger as positively related to risk optimism (*β* = 0.17, *t*(775) = 2.81, *p* = .005), happiness as positively related to risk optimism (*β* = 0.18, *t*(775) = 4.05, *p* < .001), and hope as positively related to risk optimism (*β* = 0.18, *t*(775) = 6.65, *p* < .001). Risk optimism for ambiguous and unambiguous events specifically followed similar patterns, except that we found no support for anger being related to risk optimism for unambiguous events (*β* = 0.05, *t*(775) = 0.88, *p* = .378). We did find support for hope and happiness having similar effects in predicting unambiguous events (H8) but no support for fear having similar effects as hope in ambiguous events (H9) (see Table 11). For positive events, anger (*β* = 0.57, *t*(775) = 5.82, *p* < .001) and hope (*β* = 0.40, *t*(775) = 9.53, *p* < .001) both positively predicted risk optimism, while we found no support for fear (*β* = -0.10, *t*(775) = -1.30, *p* = .190) or happiness (*β* = 0.04, *t*(775) = 0.62, *p* = .530) being related to risk optimism. For reverse scored negative events, anger (*β* = -0.19, *t*(775) = -2.15, *p* = .032) and fear (*β* = -0.23, *t*(775) = -3.42, *p* < .001) both negatively predicted risk optimism, happiness positively predicted risk optimism (*β* = 0.30, *t*(775) = 4.81, *p* < .001), with no support for hope as predicting risk optimism (*β* = -0.03, *t*(775) = -0.77, *p* = .439).

###### Table 11 *Extension: Linear Regression on four predictors - Anger, Fear, Happiness, and Hope*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Anger** | **Fear** | **Happiness** | **Hope (extension)** |
| Risk preference | | | | |
| Risk preference | 0.40 [0.20, 0.61]\*\*\* | -0.06 [-0.22, 0.09] | 0.08 [-0.07, 0.23] | 0.07 [-0.02, 0.15] |
| Framing effect | -0.08 [-0.21, 0.05] | 0.04 [-0.06, 0.14] | 0.00 [-0.09, 0.10] | 0.04 [-0.02, 0.09] |
| Risk preference in loss domain | 0.32 [0.08, 0.57]\* | -0.02 [-0.21, 0.17] | 0.08 [-0.09, 0.26] | 0.10 [-0.00, 0.21] |
| Risk preference in gain domain | 0.49 [0.25, 0.72]\*\*\* | -0.10 [-0.28, 0.08] | 0.08 [-0.09, 0.25] | 0.03 [-0.07, 0.13] |
| Risk optimism | | | | |
| Risk optimism | 0.17 [0.05, 0.29]\*\* | -0.17 [-0.26, -0.07]\*\*\* | 0.18 [0.09, 0.27]\*\*\* | 0.18 [0.12, 0.23]\*\*\* |
| Risk optimism for positive events | 0.57 [0.37, 0.76]\*\*\* | -0.10 [-0.24, 0.05] | 0.04 [-0.09, 0.18] | 0.40 [0.32, 0.48]\*\*\* |
| Risk optimism for negative events (reversed) | -0.19 [-0.36, -0.02]\* | -0.23 [-0.36, -0.10]\*\*\* | 0.30 [0.18, 0.43]\*\*\* | -0.03 [-0.10, 0.04] |
| Risk optimism for ambiguous events | 0.44 [0.27, 0.61]\*\*\* | -0.30 [-0.43, -0.17]\*\*\* | 0.13 [0.01, 0.25]\* | 0.24 [0.17, 0.32]\*\*\* |
| Risk optimism for unambiguous events | 0.05 [-0.07, 0.18] | -0.11 [-0.20, -0.01]\* | 0.20 [0.11, 0.29]\*\*\* | 0.14 [0.09, 0.20]\*\*\* |

*Note*. Values are *β* and 95% confidence intervals. *N* = 780. \**p* < .05. \*\**p* < .01. \*\*\**p* < .001.

## 

## Exploratory analyses

As an exploratory analysis, participants rated their own evaluations of perceived controllability or certainty of the events. This means that we could use the in-sample categorizations, rather than the out-of-sample categorizations (from the target article) to determine which events would be deemed ambiguous and which unambiguous. We summarized the descriptive statistics for ambiguity of the events in the current study in Table 12. As the perceived controllability and certainty were strongly correlated (*r* = .53, p < .05), we averaged the two ratings as an index for equally categorizing events into three groups: events that are clearly certain and controllable, events that are clearly uncertain and uncontrollable, and events that are ambiguous in certainty and controllability. The first two groups are together regarded as unambiguous events. See Table 13 for the ambiguity of events in the exploratory analyses.

###### Table 12 *Descriptive statistics for ambiguity of the events in the current study*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item | **Controllability Mean** | **Controllability SD** | **Certainty Mean** | **Certainty SD** |
| Ambiguous events in the target article | | | |  |
| 1. Heart attack within the next 10 years (R) | 3.62 | 1.25 | 1.85 | 1.16 |
| 1. Your achievements in newspaper | 3.78 | 1.44 | 2.05 | 1.48 |
| 1. Gaining statewide recognition | 3.64 | 1.47 | 2.04 | 1.52 |
| 1. Having gum problems (R) | 4.34 | 1.15 | 2.75 | 1.49 |
| 1. Income doubles within the next 10 years | 3.77 | 1.29 | 2.39 | 1.43 |
| 1. Marrying someone wealthy | 3.59 | 1.49 | 2.10 | 1.51 |
| 1. Deciding you chose a wrong career (R) | 4.43 | 1.38 | 2.58 | 1.53 |
| Unambiguous events in the target article | | | |  |
| 1. Having your own car stolen (R) | 2.33 | 1.30 | 1.91 | 1.17 |
| 1. Injured in auto accident (R) | 2.60 | 1.16 | 2.06 | 1.20 |
| 1. Developing cancer (R) | 2.49 | 1.22 | 2.15 | 1.23 |
| 1. Having a mentally gifted child | 2.03 | 1.32 | 2.15 | 1.64 |
| 1. Tripping and breaking bone (R) | 3.08 | 1.31 | 2.13 | 1.21 |
| 1. Home doubles in value in 5 years | 2.41 | 1.29 | 2.44 | 1.44 |
| 1. Being sued by someone (R) | 2.92 | 1.33 | 1.91 | 1.24 |
| 1. Staying healthy all winter | 3.97 | 1.21 | 3.02 | 1.49 |
| 1. Divorced a few years after married (R) | 3.83 | 1.40 | 1.93 | 1.40 |
| 1. Having a drinking problem (R) | 4.47 | 1.50 | 2.36 | 1.62 |
| 1. Getting a good new job offer | 3.70 | 1.16 | 2.61 | 1.44 |
| 1. Being recognized with award | 3.35 | 1.30 | 2.26 | 1.43 |
| 1. Contracting venereal disease (R) | 4.61 | 1.53 | 2.12 | 1.66 |
| 1. Having a decayed tooth (R) | 4.14 | 1.25 | 2.67 | 1.51 |
| 1. Ideal weight constant for 10 years | 4.60 | 1.14 | 2.92 | 1.53 |
| 1. Traveling to Europe | 4.98 | 1.25 | 2.72 | 1.68 |

*Note.* Controllability: *N* = 391; Certainty: *N* = 389.

###### Table 13 *Ambiguity of the events in the exploratory analyses*

|  |  |
| --- | --- |
| Item | Controllability and Certainty Mean |
| Ambiguous events in the target article | |
| 2. Your achievements in newspaper | 2.91 |
| 3. Gaining statewide recognition | 2.84 |
| 5. Income doubles within the next 10 years | 3.08 |
| 6. Marrying someone wealthy | 2.84 |
| 16. Divorced a few years after married (R) | 2.88 |
| 18. Getting a good new job offer | 3.16 |
| 19. Being recognized with award | 2.80 |
| Unambiguous events in the target article (clearly certain and controllable) | |
| 4. Having gum problems (R) | 3.54 |
| 7. Deciding you chose a wrong career (R) | 3.51 |
| 15. Staying healthy all winter | 3.49 |
| 17. Having a drinking problem (R) | 3.41 |
| 20. Contracting venereal disease (R) | 3.37 |
| 21. Having a decayed tooth (R) | 3.40 |
| 22. Ideal weight constant for 10 years | 3.76 |
| 23. Traveling to Europe | 3.85 |
| Unambiguous events in the target article (clearly uncertain and uncontrollable) | |
| 1. Heart attack within the next 10 years (R) | 2.74 |
| 8. Having your own car stolen (R) | 2.12 |
| 9. Injured in auto accident (R) | 2.33 |
| 10. Developing cancer (R) | 2.32 |
| 11. Having a mentally gifted child | 2.09 |
| 12. Tripping and breaking bone (R) | 2.61 |
| 13. Home doubles in value in 5 years | 2.42 |
| 14. Being sued by someone (R) | 2.41 |

*Note.* Controllability: *n* = 391; Certainty: *n* = 389. The numbering of events followed the target article.

Based on this exploratory categorization of the events, we performed correlation and regression analyses for risk optimism for ambiguous and unambiguous events again (See Table 14). The subscales of the risk optimism reached higher reliability scores than in the main analysis where ambiguity of events was based on the categorization from the target article (ambiguous events: Cronbach alpha = .76, ωh = .67; unambiguous events: Cronbach alpha = .78, ωh = .54).

###### 

###### Table 14 *Summary of descriptive statistics and correlations*

|  | *M* | *SD* | Statistics | **Anger** | **Fear** | **Happiness** | **Hope** | **Risk optimism (ambiguous)** | **Risk optimism (unambiguous)** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Risk optimism (ambiguous) | -0.68 | 1.32 | Pearson's r | 0.07 | -0.16 | 0.23 | 0.37 | **α =** .76 |  |
|  |  |  | p-value | .065 | < .001 | < .001 | < .001 | — |  |
|  |  |  | 95% CI Upper | 0.14 | -0.09 | 0.29 | 0.43 | — |  |
|  |  |  | 95% CI Lower | -0.00 | -0.22 | 0.16 | 0.31 | — |  |
|  |  |  | Spearman's rho | 0.03 | -0.17 | 0.22 | 0.35 | — |  |
| Risk optimism (unambiguous) | 0.67 | 0.96 | Pearson's r | -0.24 | -0.41 | 0.46 | 0.40 | 0.29 | **α =** .78 |
|  |  |  | p-value | < .001 | < .001 | < .001 | < .001 | < .001 | — |
|  |  |  | 95% CI Upper | -0.17 | -0.35 | 0.51 | 0.46 | 0.36 | — |
|  |  |  | 95% CI Lower | -0.31 | -0.47 | 0.40 | 0.34 | 0.23 | — |
|  |  |  | Spearman's rho | -0.24 | -0.40 | 0.45 | 0.40 | 0.23 | — |

*Note.* N=780. The reliability of the scales is reported in the diagonal. Events ambiguity categorization is based on the exploratory scale in the current study, summarized in Table 13.

###### Regressing the three dispositional emotions, risk optimism for ambiguous events followed the appraisal-tendency hypotheses (see Table 15) with support for both anger (β = 0.63, *t*(776) = 6.14, *p* < .001) and happiness (β = 0.36, *t*(776) = 5.76, *p* < .001) as positively related to optimistic estimates of risk, while fear (β = -0.17, *t*(776) = -2.22, *p* = .026) was negatively related to risk optimism. Risk optimism for unambiguous events showed similar patterns on fear (β = -0.22, *t*(776) = -4.23, *p* < .001) and happiness (β = 0.33, *t*(776) = 7.89, *p* < .001), though no support for anger as predicting risk estimates (β = 0.04, *t*(776) = 0.61, *p* = .540).

###### Table 15 *Replication: Linear Regression on three predictors - Anger, Fear, and Happiness*

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Anger** | **Fear** | **Happiness** |
| Risk optimism | | | |
| Risk optimism for ambiguous events | 0.63 [0.43, 0.83]\*\*\* | -0.17 [-0.33, -0.02]\* | 0.36 [0.24, 0.48]\*\*\* |
| Risk optimism for unambiguous events | 0.04 [-0.09, 0.18] | -0.22 [-0.32, -0.12]\*\*\* | 0.33 [0.25, 0.41]\*\*\* |

*Note.* Values are *β* and 95% confidence intervals. *N* = 780. \**p* < .05. \*\**p*< .01. \*\*\**p* < .001.

After adding hope (see Table 16), we found support for anger (*β* = 0.53, *t*(775) = -8.09, *p* < .001) and hope (*β* = 0.35, *t*(775) = 8.29, *p* < .001) as positively related to optimistic estimates of risk for ambiguous events, with no support for fear (*β* = -0.09, *t*(775) = -1.20, *p* = .230) and happiness (*β* = 0.04, *t*(775) = 0.53, p = .600) being associated with risk optimism. As for unambiguous events, we found support for happiness (*β* = 0.24, *t*(775) = 4.87, *p* < .001) and hope (*β* = 0.10, *t*(775) = 3.29, *p* = .001) as positively predicting optimistic risk estimates, fear (*β* = -0.20, *t*(775) = -3.78, *p* < .001) as negatively predicting risk optimism, with no support for anger (*β* = 0.01, *t*(775) = 0.21, *p* = .833) being related to risk optimism .

###### Table 16 *Extension: Linear Regression on four predictors - Anger, Fear, Happiness, and Hope*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Anger** | **Fear** | **Happiness** | **Hope (extension)** |
| Risk optimism | | | | |
| Risk optimism for ambiguous events | 0.53 [0.34, 0.73]\*\*\* | -0.09 [-0.24, 0.06] | 0.04 [-0.10, 0.18] | 0.35 [0.27, 0.44]\*\*\* |
| Risk optimism for unambiguous events | 0.01 [-0.12, 0.15] | -0.20 [-0.30, -0.10]\*\*\* | 0.24 [0.14, 0.34]\*\*\* | 0.10 [0.04, 0.15]\*\* |

*Note.* Values are *β* and 95% confidence intervals. *N* = 780. \**p* < .05. \*\* *p*< .01. \*\*\**p* < .001.

## Comparing replication to original findings

The replication successfully replicated some of the original findings. Overall, several predictions made by the appraisal tendency framework were confirmed hinting at some predictive validity of the approach to the role of emotions in decision-making. Following up from the main hypotheses (see Table 1) we summarized our replication in Table 17. The conclusion about the consistency of the replication results compared with the original findings remains the same no matter whether the ambiguity of events is decided by using the categorization from the target article or the exploratory design.

###### 

###### Table 17 *Replication results for each hypothesis*

|  |  |
| --- | --- |
| Hypotheses | Replication results |
| Main hypotheses | |
| 1. Trait fear is negatively associated with risk seeking. | Inconsistent |
| 1. Trait anger is positively associated with risk seeking. | Consistent |
| 1. Trait fear is negatively associated with optimistic risk assessment. | Consistent |
| 1. Trait happiness is positively associated with optimistic risk assessment. | Consistent |
| 1. Trait anger is positively associated with optimistic risk assessment. | Consistent |
| 1. For ambiguous events, trait fear is negatively associated with optimistic risk assessment, whereas trait happiness and trait anger are positively associated with optimistic risk assessment. | Consistent |
| 1. For unambiguous events, trait fear and trait anger are negatively associated with optimistic risk assessment, whereas trait happiness is positively associated with optimistic risk assessment. | Inconsistent |
| Other hypotheses | |
| 1. There are significant correlations between emotions with a shared valence (positively correlated), and emotions with different valences (negatively correlated). | Consistent |
| 1. People show different risk preferences in the loss frame and the gain frame (i.e., the framing effect). | Inconsistent |
| 1. There is no significant fear interaction and anger interaction with framing. | Consistent |
| 1. Emotion patterns show stronger relations under the loss frame than the gain frame. | Inconsistent |
| 1. Ratings for positive and negative events (reverse scored) are significantly correlated. | Inconsistent |
| 1. Fear and anger not only bias the interpretation of negative events. | Consistent |

# Discussion

We conducted a pre-registered replication of Lerner and Keltner (2001). The authors challenged the prevalent valence-based approach to the role of emotions in decision making, suggesting instead that an appraisal tendency approach is more consistent with how emotions affect judgments and decisions. In this way, two specific emotions, such as anger and fear, that share the same valence, may have differing effects on people’s decisions. Our replication focused on the results of the first three studies from the target article. The results of our replication are mixed (see Table 17 for a summary of the replication).

## Replication

Overall, with a larger well-powered sample and some methodological design improvements, we found that: (1) Trait anger and trait happiness were positively associated with risk-seeking and optimistic risk estimates, (2) Trait fear was negatively associated with optimistic risk assessment, though we failed to find an association between fear and risk-seeking, (3) The patterns for optimistic risk estimates also apply for ambiguous events in specific, but not for unambiguous events, and (4) The valence-based approach was only consistent with the results on the risk estimates of negative events. In summary, the replication partially supported the appraisal-tendency framework presented in Lerner and Keltner (2001).

Although we found support for the appraisal-tendency framework as having predictive value by comparing the effects of anger, fear, and happiness, we also note effects that were absent in the current replication. First, investigations about risk preference indicated no support for the role of dispositional fear. We note, however, that this result is consistent with some recent findings. For example, a recent meta-analysis by Bartholomeyczik et al. (2022) found that, although anger increases preferences for risky and uncertain options, there was no evidence for an effect of incidental sadness, fear, or positive emotions on decision- making under risk and uncertainty. In our study, we also failed to find the framing effect on an adapted Asian-disease problem. Second, the framing effect was absent even after excluding participants who indicated they had seen the questions before (see supplementary). This may indicate that the responses to the pandemic problem have been affected by the COVID-19 situation. Even after expanding the figures, the real world’s loss may have changed people’s perception and understanding of the pandemic problem. For instance, Hameleers (2021) replicated the predictions of prospect theory in times of a pandemic, but they did not find consistent support for the effects of gain versus loss framing on support for specific policies that aim to prevent negative outcomes. Nevertheless, our results on the relationship between dispositional emotions and the risk preferences should be taken with this additional consideration. Third, for unambiguous events, we found support for anger as a predictor of risk optimism. Although it suggested that neither the appraisal-tendency framework nor the valence-based approach is accurately predictive for unambiguous events, our results suggest that anger resembles fear more for unambiguous events compared with ambiguous events. Still, whether valence or other factors play a role here needs to be further studied. Notably, risk optimism for negative events conformed to the valence-based approach, which was different from the target article (“The same patterns observed for the combined (26-item) factor also held for the valence-specific outcomes. (Lerner & Keltner, 2001)”). We may infer that the valence of the events may still hold some value in certain contexts or for certain decision-making problems. In summary, our replication confirms the importance for emotion researchers to consider not only the valence of emotions but also their specificity, especially the appraisal tendencies that define them thereby providing some independent support for the tenets of the appraisal tendency framework. This consideration is essential for gaining a deeper understanding of how emotions influence judgments and decisions.

## Extensions

Our primary extension of the target article included the addition of hope as the fourth emotion predictor. Overall, we found no support for hope as having any positive effect on risk-seeking preference and optimistic risk estimates, which is inconsistent with our anticipation based on the appraisal-tendency framework.

The reasoning behind including hope was based on Smith and Ellsworth (1985)’s categorization of the emotion as pleasant (i.e., positive-valenced), uncertain, and with situational control (i.e., low control). As such, this emotion, according to the appraisal tendency framework, is similar to, or has similar appraisal tendencies as fear. While there could be many reasons on why we failed to demonstrate consistent effects between hope and our target decisions one potential reason could be that research is still nascent when it comes to this specific emotion and we may simply lack enough understanding on how best to measure the emotion, as well as how the emotion presents. For example, it has been suggested that hope carries mixed and complex feelings of distress and worry (Halevy, 2017) and that it is distinct from other positive emotions (Rosler et al., 2016). It may thus be that hope is a multifaceted emotion and particularly context dependent. This would imply that any outcomes as predicted by the appraisal tendency framework would not be straightforwardly related to hope. The target article discusses whether fear and anger only bias the perception of negative events, while leaving the option of whether only negative emotions bias the risk perception through their cognitive appraisal themes untested. We may thus also need further studies (e.g., including more distinct emotions) to test whether the appraisal-tendency framework only, or more strongly, applies to negative emotions. One should note here the prevailing presence of a negativity bias in that negative, compared to positive, emotions may be more strongly felt, more easily induced, and thus may display stronger and more consistent downstream effects on decision making (cf., Joseph et al., 2020).

## Ambiguity: Replication criteria

For the IV ambiguity of events, we conducted the main analyses using the categorization that was used in the target article. Additionally, we supplemented this with our own analyses based on an in-sample rating of the events’ controllability or certainty. Though the categorization of events showed apparent differences using the two methods, we noted that the results of regressing risk optimism on ambiguous and unambiguous events were rather similar compared to the main analyses. Referring to the criteria in Table 7, we concluded that our replication found a partially robust phenomenon, i.e., both methods found similar support for some of the hypotheses.

## Implications, limitations, and directions for future research

There were some aspects of the design of the target article that were either not possible to implement or purposefully different. For example, given our online sample, we did not address the potential social effects that were tested in Study 3 of the target article. In the target article, an experimenter presented the event to the participants and recorded their responses in a face to face setting, expecting to reduce the tendency for happy and angry individuals to see themselves as comparatively less vulnerable to negative life events. The authors reported that the optimism differences did not diminish even with this setting. Face-to-face settings can potentially contribute to this effect , as well as possibly lead to more serious responses, we noted that this method requires far more resources, and would therefore be best to first revisit studies with simpler and less costly designs.

Another example is the pre-test and pre-screening in Study 3 of the original study to categorize events and participants. Our sample differed markedly in the events that were considered ambiguous suggesting that different people or people in different contexts may have different standards of what may constitute an ambiguous event. It implies that using a pre-test to categorize events may influence the analyses regarding ambiguous or unambiguous events, as the results of the pre-test participants may not conform to the results of the main test participants. Finally, we purposefully avoided post-hoc dichotomizing of participants into purely angry or fearful groups so as to avoid losing power and unnecessarily applying a cutoff to potentially introduce confounds (Royston et al., 2006).

Some aspects of our replication were different from that of the target article, like the sample. Instead of university students, we recruited participants on MTurk using CloudResearch, a more inclusive and diverse sample. However, a different sample also means modifications of the measures. We accordingly changed the items in the scales to fit the sample more, as well as a result of the lack of information in the target article about which items were selected for each measure. These deviations may have influenced the outcome of the replication. Whether the appraisal-tendency framework has constraints on population generalizability still needs further investigation among a larger population. As the ATF relies on cognitive appraisal of emotions, these could differ cross-culturally thereby impacting the appraisal tendencies associated with the emotions. For example, there is evidence that cultural factors influence appraisal biases, affecting emotional responses in similar situations across different cultures (Scherer & Brosch, 2009) with other evidence pointing to sizable differences between different regions when it comes to general appraisal tendencies (Scherer, 1997). Future research may also consider taking in more dispositional emotions. Until now, research about the appraisal-tendency framework has especially emphasized the comparison of fear and anger. We added dispositional hope, yet found no support for our extension. Future research may test more emotions with different valences and the appraisal tendency of controllability and certainty. It will help construct a more complete map of emotions and risk perception and preference, or to find out whether the appraisal-tendency framework only applies to anger and similar emotions. Last but not least, there are still many appraisal themes that are not sufficiently studied. Emotions are much more complicated than only about valences and the level of certainty and controllability. Future research may consider other aspects of emotions and their influence on a broader range of decision-making processes.

# 

# Conclusion

We conducted a replication and extension Registered Report of Lerner and Keltner (2001)’s appraisal-tendency framework and found mixed support for the original findings. The appraisal-tendency framework was supported for risk optimism in general, risk optimism for positive events, and risk optimism for ambiguous events, but not for risk preference and risk optimism for negative events. Besides, the original finding that the valence-based approach applied to risk optimism for unambiguous events was not supported in the current study. We did not find predicted effects for the addition of hope as another specific emotion with a positive valence yet with cognitive appraisal similar to fear. Future research might take in more emotions to construct a more complete picture of the relationship between emotions and risk-related judgment and decision-making.

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