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

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Sirui Lu conducted the replication as the undergraduate thesis.

Gilad was the supervisor for the thesis and led the replication efforts in the thesis course. Gilad supervised each step in the project, conducted the pre-registrations, and ran data collection.

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**Important links and information**

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## Contributor Roles Taxonomy

In the table below, employ CRediT (Contributor Roles Taxonomy) to identify the contribution and roles played by the contributors in the current replication effort. Please refer to <https://www.casrai.org/credit.html> for details and definitions of each of the roles listed below.

|  |  |  |
| --- | --- | --- |
| **Role** | **Sirui Lu** | **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 |
| Methodology | X |  |
| Project administration |  | X |
| Resources |  | X |
| Software | X |  |
| Supervision |  | X |
| Validation |  | X |
| Visualization | X |  |
| Writing-original draft | X |  |
| Writing-review and editing |  | X |

# Abstract

**[IMPORTANT:   
Results were written using a randomized dataset produced by Qualtrics to simulate what these sections will look like after data collection. These will be updated following the data collection.]**

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 pre-registered experiment with an American online Amazon Mechanical Turk sample (*N* = 700), we conducted an independent close replication of Experiments 1, 2, and 3 in Lerner and Keltner (2001). Our replication [failed to find/found] support for the original findings regarding associations between dispositional emotions and two risk-relevant measures: risk preference and risk optimism [summary effects sizes and CIs]. Extending the replication, we added hope as one dispositional emotion and [failed to find/found] support for the assumptions of the appraisal-tendency framework [effects sizes and CIs]. Materials, data, and code were made 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 is changed from dichotomized between-subject design to continual within-subject design.  Trait hope is 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 |

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

## Background

There is increasing evidence that affect is associated with judgment and decision making, with recent research revealing the differences between specific emotions. Early common approach to studying affect was valence-based, mostly categorizing affect into positive and negative emotions (DeSteno et al., 2000; Lerner & Keltner, 2000). Using 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, regardless of the nature of the emotion or the event (Johnson & Tversky, 1983; Mayer et al., 1992). An alternative, more nuanced view proposed that specific emotions are associated with judgment and decision-making in different ways (DeSteno et al., 2000). Lerner and Keltner (2000) suggested 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). Complementing the valence-based approach, 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 of the appraisal-tendency framework, with design improvement adaptations towards continuous measures analyses. 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, and then introduce the original's hypotheses and design, and our replication’s adjustments and extensions.

## Appraisal-tendency framework

The appraisal-tendency framework (ATF) was developed based on the cognitive-appraisal theories of emotion (Smith & Ellsworth, 1985). Rather than the simple categorization of emotions based on valence, the cognitive-appraisal theories suggested that emotions are related to cognitive appraisals of the environment (Smith & Ellsworth, 1985). ATF identified 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). For example, John feels very fearful that he could contract the new coronavirus. The fear drives him to appraise the environment and future events as lacking control and certainty, which conforms to the core appraisal theme of fear. John may also be more pessimistic about other risks in his life, thinking of himself as more likely than others to die in a traffic accident, to go bankrupt, to get divorced, and so on. The generalized pessimism may linger as long as the pandemic is salient. In the case of dispositional emotions, the predisposition may be even harder to adjust (Lerner & Keltner, 2001). Building on the example of John, if John is higher on trait fear, he may be more inclined to view many aspects of his life in a pessimistic light, or possibly as more uncertain and less controllable.

## 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, impact, and the potential for improving on their methodology and 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 4211 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 also has important practical implications with extensions of this work to other practical 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 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, and then in Study 3 dichotomized participants into those high on fear, high on anger, and high on happiness emotions by choosing those one standard deviation above the mean, and then applying comparisons between those groups using a one-way ANOVA. The dichotomizing and grouping may have led to suboptimal analyses and conclusions. In Study 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 to continuous measures without dichotomizing, 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)’s empirical work consisted of four experiments, and the current replication focused on Studies 1 to 3. Study 4 involved inducing complex 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 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. Framing has been found to influence risk preferences by numerous studies, suggesting that people tend to be risk-seeking under the gain frame, while being risk-aversive under the loss frame (Dawes, 1998). Study 1 showed that while the framing effect existed 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 studies measuring trait emotions and various outcomes, we combined the studies into a single survey design. We first assessed traits 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 assessment of controllability and certainty in random order at the very end. This design allowed us to both test the designs of each of the original studies, and to then run further tests in comparing the effects of the different studies with the potential of drawing additional insights. We successfully employed similar designs 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 will 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 levels 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 valence and certainty/control may moderate the effects (Lerner & Keltner, 2001), and given that trait hope is regarded as a positive-valenced emotion with low certainty and control (Smith & Ellsworth, 1985) it may complement the other measured traits and add to the demonstration of the suggested model.

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) 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** |
| **Positive valence** | Happiness | Hope |
| **Negative valence** | 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 aimed to use the categorization of the target article as is, yet 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 dichotomy 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 pre-registered the experiment on the Open Science Framework (OSF) and data collection was launched later that week. Pre-registrations, power analyses, and all materials used in these experiments are available in the supplementary materials. We provided all materials, data, code, and pre-registration on the OSF: <https://osf.io/t5kz9/>. We provided additional open-science details and disclosures in the supplementary materials under “Open Science disclosures” sub-section.

All measures, manipulations, exclusions conducted for this investigation are reported, all studies were pre-registered, and data collection was completed before any analyses.

# Method

**[IMPORTANT:   
Method and results sections were written using a randomized dataset produced by Qualtrics to simulate what these sections will look like after data collection. These will be updated following the data collection. This is written in past tense yet no pre-registration or data collection have been conducted.]**

## Power analysis

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 10% exclusion 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) and considered weak effects in social psychology (Lovakov & Agadullina, 2021). 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

[*To demonstrate what the results would look like after data collection we simulated a dataset of 700 participants using Qualtrics and wrote the section below as if it is the actual data, which we will later update with the real data.*]

We recruited a total of 700 American Amazon Mechanical Turk (MTurk) participants on TurkPrime.com/CloudResearch (Litman, Robinson, & Abberbock, 2017) (*Mage* = 50.60, *SD* = 28.95; 158 females). Based on our extensive experience of running similar replications on MTurk, 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. We also employed the [Qualtrics fraud and spam prevention measures](https://www.qualtrics.com/support/survey-platform/survey-module/survey-checker/fraud-detection/): reCAPTCHA, prevent multiple submission, prevent ballot stuffing, bot detection, security scan monitor, and relevantID.

Assignment pay is based on the federal wage of 7.25USD/hour, per minute, so for example - 5-8 minutes survey would be paid 1 USD per participant. We first pretest survey duration with 30 participants to make sure our time run estimate was accurate and then adjust pay as needed, the data of the 30 participants will not be analyzed separately from the rest of the sample other than to assess survey completion duration and needed pay adjustments. For those pretest participants, if survey duration was longer than expected, they would be paid a bonus as pay adjustment. A comparison of the target article sample and the replication samples is provided in Table 3.

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 |
| Sample size | 75 | 601 | 118 | 700 | |
| Geographic origin | Not reported | Not reported | Not reported | US American | |
| Gender | 20 males, 55 females | 281 males, 320 females | Not reported | 182 males, 158 females, 360 other/did not disclose | |
| Median age (years) | Not reported | Not reported | Not reported | 51 | |
| Average age (years) | Not reported | Not reported | Not reported | 50.60 | |
| Standard deviation age (years) | Not reported | Not reported | Not reported | 28.95 | |
| Age range (years) | Not reported | Not reported | Not reported | 0-100 | |
| 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. We summarized our combined design as 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. We provided more details and all measures in the supplementary (see the section “Materials and scales used in the replication and extension experiment”).

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 and certainty of the same events. Finally, there were funneling, demographics information, and debriefing sections.

[*For review: The Qualtrics survey .QSF file and an exported DOCX file are provided on the OSF folder. A preview link of the Qualtrics survey is provided on:* [*https://hku.au1.qualtrics.com/jfe/preview/SV\_cTILaV1h7ujS1Bs?Q\_CHL=preview&Q\_SurveyVersionID=current*](https://hku.au1.qualtrics.com/jfe/preview/SV_cTILaV1h7ujS1Bs?Q_CHL=preview&Q_SurveyVersionID=current)]

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

Details of all measures are provided in the supplementary (“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 with the reliability of the measures in the current study (see Table 5). 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* | (composite) .91 | (composite) .89 | Not reported | TBD | |
| 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* | (composite) .84 | .84 | Not reported | TBD | |
| 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* | N/A | .81 | Not reported | TBD | |

### 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 = [TBD]).

### Trait fear

Dispositional fear was measured using Fear Survey Schedule-II (FSS-II; Behl, 1997) (1 = *None*, 7 = *Terror*; Cronbach alpha = [TBD]), and Spielberger’s 20-item trait-anxiety scale (Spielberger, 1983) (1 = *Almost never*, 4 = *Almost always*; Cronbach alpha = [TBD]). 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 original’s method in combining the two scales into an aggregate score.

[If a high correlation (r >= 0.3) is not observed, we will still follow the target article’s method, but conduct a correlation analysis for the two scales separately.]

### Trait happiness

Dispositional happiness predictor was measured using the Mood Survey (Underwood & Froming, 1980) (1 = *Strongly disagree*, 6 = *Strongly agree*; Cronbach alpha = [TBD]). 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 = [TBD]). Details of the measure are provided in the “Dispositional hope: Adult Trait Hope Scale (Snyder et al., 1991)” subsection in the supplementary materials.

### Risk optimism

Risk optimism was measured 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 (Wong et al., 2019). For example, the item “I had a heart attack before age 50” was adjusted to “Heart attack within the next 10 years”. We summarized the specific item adjustments in the “Instructions and experimental material” subsection in the supplementary materials.

Our analysis of the categorization of the ambiguity of events is based on the target article’s dichotomy. For the categorization of events, see Table 12. In addition, we added a 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 a 1000 times, given that under the current 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 the 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 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, instead of comparing the effect size (see our similar implementation in Ziano et al., 2021). We summarized our replication based on the criteria in Table 7.

## Replication closeness evaluation

We provided details on the classification of the replications using the criteria by LeBel et al., (2018) criteria in Table 8 below (see section “replication closeness evaluation” in the supplementary). We summarized the replication as a "close” replication.

Table 6

*Comparing original and replication with a list of adjustments*

|  |  |  |
| --- | --- | --- |
| **Category** | **Lerner and Keltner (2001)** | **Current study** |
| Sample | Undergraduate students | M Turk 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 the conclusion of the replication*

|  |  |
| --- | --- |
| **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 |

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 2 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 |  |

# Results

**[IMPORTANT:   
Method and results sections were written using a randomized dataset produced by Qualtrics to simulate what these sections will look like after data collection. These will be updated following the data collection. This is written in past tense yet no pre-registration or data collection have been conducted.]**

## Data analysis strategy

[*Our data analysis will follow the data analysis code provided with the simulated data. Please see our OSF directory for Rmarkdown code and outputs. Below, we briefly summarize our data analysis plans, followed by a brief outline of the structure of the results section, which will be updated after data collection.*]

### Replication: Original’s analyses

As preliminary analyses, we examined the correlations between all four trait emotions and all dependent variables, supplemented with Spearman’s Rho as an alternative analysis 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 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 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 without and with trait hope.

### Outliers and exclusions

Our generalized exclusion criteria is detailed in the “exclusion criteria” subsection of 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. If the exclusions are larger than 20% (140 of 700) and we fail to find support for the core hypotheses, we will embark on an additional data collection to meet the planned sample size based on the observed exclusion rate and analyze and report the data together.

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”. We plan to focus our main report on the full sample, yet if we fail to find support for the core hypotheses, we will rerun the same analyses with exclusions. 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 will exclude participants who answered three or more of the five attention checks incorrectly. In such a case we will report the findings with both the full sample and the exclusions sample.

## Replication and extension

Descriptive statistics and correlation tests of all measures are presented in Table 9. Statistical tests of the hypotheses are summarized in Table 10 and 11.

In the preliminary analyses, we examined correlations between each two of the four dispositional emotions. The results will be reported here, with the table below summarizing all the correlation analyses. The last row is filled out based on the simulated data as an example.

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 |  |  | Pearson's r | [**α**TBD] |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | p-value | — |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | 95% CI Upper | — |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | 95% CI Lower | — |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | Spearman's rho | — |  |  |  |  |  |  |  |  |  |  |  |
| 2 - Fear |  |  | Pearson's r |  | [**α**TBD] |  |  |  |  |  |  |  |  |  |  |
|  |  |  | p-value |  | — |  |  |  |  |  |  |  |  |  |  |
|  |  |  | 95% CI Upper |  | — |  |  |  |  |  |  |  |  |  |  |
|  |  |  | 95% CI Lower |  | — |  |  |  |  |  |  |  |  |  |  |
|  |  |  | Spearman's rho |  | — |  |  |  |  |  |  |  |  |  |  |
| 3 - Happiness |  |  | Pearson's r |  |  | [**α**TBD] |  |  |  |  |  |  |  |  |  |
|  |  |  | p-value |  |  | — |  |  |  |  |  |  |  |  |  |
|  |  |  | 95% CI Upper |  |  | — |  |  |  |  |  |  |  |  |  |
|  |  |  | 95% CI Lower |  |  | — |  |  |  |  |  |  |  |  |  |
|  |  |  | Spearman's rho |  |  | — |  |  |  |  |  |  |  |  |  |
| 4 - Hope |  |  | Pearson's r |  |  |  | [**α**TBD] |  |  |  |  |  |  |  |  |
|  |  |  | p-value |  |  |  | — |  |  |  |  |  |  |  |  |
|  |  |  | 95% CI Upper |  |  |  | — |  |  |  |  |  |  |  |  |
|  |  |  | 95% CI Lower |  |  |  | — |  |  |  |  |  |  |  |  |
|  |  |  | Spearman's rho |  |  |  | — |  |  |  |  |  |  |  |  |
| 5 -Risk optimism |  |  | Pearson's r |  |  |  |  | [**α**TBD] |  |  |  |  |  |  |  |
|  |  |  | p-value |  |  |  |  | — |  |  |  |  |  |  |  |
|  |  |  | 95% CI Upper |  |  |  |  | — |  |  |  |  |  |  |  |
|  |  |  | 95% CI Lower |  |  |  |  | — |  |  |  |  |  |  |  |
|  |  |  | Spearman's rho |  |  |  |  | — |  |  |  |  |  |  |  |
| 6- Risk optimism (ambiguous) |  |  | Pearson's r |  |  |  |  |  | [**α**TBD] |  |  |  |  |  |  |
|  |  |  | p-value |  |  |  |  |  | — |  |  |  |  |  |  |
|  |  |  | 95% CI Upper |  |  |  |  |  | — |  |  |  |  |  |  |
|  |  |  | 95% CI Lower |  |  |  |  |  | — |  |  |  |  |  |  |
|  |  |  | Spearman's rho |  |  |  |  |  | — |  |  |  |  |  |  |
| 7- Risk optimism (unambiguous) |  |  | Pearson's r |  |  |  |  |  |  | [**α**TBD] |  |  |  |  |  |
|  |  |  | p-value |  |  |  |  |  |  | — |  |  |  |  |  |
|  |  |  | 95% CI Upper |  |  |  |  |  |  | — |  |  |  |  |  |
|  |  |  | 95% CI Lower |  |  |  |  |  |  | — |  |  |  |  |  |
|  |  |  | Spearman's rho |  |  |  |  |  |  | — |  |  |  |  |  |
| 8- Risk optimism (positive) |  |  | Pearson's r |  |  |  |  |  |  |  | [**α**TBD] |  |  |  |  |
|  |  |  | p-value |  |  |  |  |  |  |  | — |  |  |  |  |
|  |  |  | 95% CI Upper |  |  |  |  |  |  |  | — |  |  |  |  |
|  |  |  | 95% CI Lower |  |  |  |  |  |  |  | — |  |  |  |  |
|  |  |  | Spearman's rho |  |  |  |  |  |  |  | — |  |  |  |  |
| 9- Risk optimism (negative reversed) |  |  |  |  |  |  |  |  |  |  |  | [**α**TBD] |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  | — |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  | — |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  | — |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  | — |  |  |  |
| 10 - Risk preference |  |  | Pearson's r |  |  |  |  |  |  |  |  |  | [**α**TBD] |  |  |
|  |  |  | p-value |  |  |  |  |  |  |  |  |  | — |  |  |
|  |  |  | 95% CI Upper |  |  |  |  |  |  |  |  |  | — |  |  |
|  |  |  | 95% CI Lower |  |  |  |  |  |  |  |  |  | — |  |  |
|  |  |  | Spearman's rho |  |  |  |  |  |  |  |  |  | — |  |  |
| 11 -Risk preference (gain frame) |  |  | Pearson's r |  |  |  |  |  |  |  |  |  |  | [**α**TBD] |  |
|  |  |  | p-value |  |  |  |  |  |  |  |  |  |  | — |  |
|  |  |  | 95% CI Upper |  |  |  |  |  |  |  |  |  |  | — |  |
|  |  |  | 95% CI Lower |  |  |  |  |  |  |  |  |  |  | — |  |
|  |  |  | Spearman's rho |  |  |  |  |  |  |  |  |  |  | — |  |
| 12 -Risk preference (loss frame) | 3.71 | 1.73 | Pearson's r | -0.05 | 0.03 | 0.06 | 0.02 | -0.04 | -0.03 | -0.03 | -0.09 | 0.04 | 0.72 | 0.02 | [**α**TBD] |
|  |  |  | p-value | .212 | .464 | .115 | .686 | .341 | .442 | .507 | .017 | .350 | <.001 | .606 | — |
|  |  |  | 95% CI Upper | 0.03 | 0.10 | 0.13 | 0.09 | 0.04 | 0.05 | 0.05 | -0.02 | 0.11 | 0.75 | 0.09 | — |
|  |  |  | 95% CI Lower | -0.12 | -0.05 | -0.02 | -0.06 | -0.11 | -0.10 | -0.10 | -0.16 | -0.04 | 0.68 | -0.06 | — |
|  |  |  | Spearman's rho | -0.05 | 0.02 | 0.06 | 0.01 | -0.04 | -0.04 | -0.02 | -0.09 | 0.05 | 0.71 | 0.02 | — |

*Note.* N=700. 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, and happiness

We conducted the regression analysis in this section based on the three emotions that were included in the target article, namely fear, anger, and happiness.

Table 10

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

|  |  |  |  |
| --- | --- | --- | --- |
|  | *β* and 95% confidence intervals | | |
|  | Anger | Fear | Happiness |
| Risk preference | | | |
| Risk preference | -0.01 [-0.06, 0.04] | -0.00 [-0.02, 0.02] | 0.02 [-0.01, 0.04] |
| Framing effect |  |  |  |
| Risk preference in loss domain |  |  |  |
| Risk preference in gain domain |  |  |  |
| Risk optimism | | | |
| Risk optimism |  |  |  |
| Risk optimism for ambiguous events |  |  |  |
| Risk optimism for unambiguous events |  |  |  |

### Extension: Adding hope

We conducted the regression analysis in this section based on the four emotions included in the current study design, namely fear, anger, happiness, and hope.

Table 11

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | *β* and 95% confidence intervals | | | |
|  | Anger | Fear | Happiness | Hope (extension) |
| Risk preference | | | | |
| Risk preference | -0.01 [-0.06, 0.04] | -0.00 [-0.02, 0.02] | 0.02 [-0.01, 0.04] | 0.01 [-0.02, 0.04] |
| Framing effect |  |  |  |  |
| Risk preference in loss domain |  |  |  |  |
| Risk preference in gain domain |  |  |  |  |
| Risk optimism | | | | |
| Risk optimism |  |  |  |  |
| Risk optimism for ambiguous events |  |  |  |  |
| Risk optimism for unambiguous events |  |  |  |  |

## Exploratory analyses

As an exploratory analysis, participants rated their own evaluations of perceived controllability or certainty of the events. We used these scores to compare participants’ perceptions with the categorization of the nature of events (ambiguous/unambiguous). The comparison and other exploratory analyses will be completed after data collection. We summarized the descriptive statistics for ambiguity of the events in the current study in Table 12.

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) |  |  |  |  |
| 1. Your achievements in newspaper |  |  |  |  |
| 1. Gaining statewide recognition |  |  |  |  |
| 1. Having gum problems (R) |  |  |  |  |
| 1. Income doubles within the next 10 years |  |  |  |  |
| 1. Marrying someone wealthy |  |  |  |  |
| 1. Deciding you chose a wrong career (R) |  |  |  |  |
| Unambiguous events in the target article | | | |  |
| 1. Having your own car stolen (R) |  |  |  |  |
| 1. Injured in auto accident (R) |  |  |  |  |
| 1. Developing cancer (R) |  |  |  |  |
| 1. Having a mentally gifted child |  |  |  |  |
| 1. Tripping and breaking bone (R) |  |  |  |  |
| 1. Home doubles in value in 5 years |  |  |  |  |
| 1. Being sued by someone (R) |  |  |  |  |
| 1. Staying healthy all winter |  |  |  |  |
| 1. Divorced a few years after married (R) |  |  |  |  |
| 1. Having a drinking problem (R) |  |  |  |  |
| 1. Getting a good new job offer |  |  |  |  |
| 1. Being recognized with award |  |  |  |  |
| 1. Contracting venereal disease (R) |  |  |  |  |
| 1. Having a decayed tooth (R) |  |  |  |  |
| 1. Ideal weight constant for 10 years |  |  |  |  |
| 1. Traveling to Europe |  |  |  |  |

*Note.* Controllability: *n* = 350; Certainty: *n* = 350

## Comparing replication to original findings

Since the simulated dataset barely generated any meaningful results, the comparison between replication and original findings will be completed after data collection. We will describe whether the replication successfully replicated the original findings as well as compare the results of the replication to original findings for different hypotheses.

# Discussion

[Please note that the discussion is only to be completed in Stage 2 following data collection]

## Ambiguity: Replication criteria

For the IV ambiguity of events, we will conduct the main analyses using the categorization in the target article. Besides, we will supplement this with our own analyses based on the participants’ rating of the events’ controllability or certainty. If we fail to find support for the target’s conclusions using their categorization, yet succeed to find support using our methods, we will conclude this as an update to the target and/or a need to reframe the target’s theory and conclusions.

We plan to discuss and directly compare the two methods in the discussion section. See Table 13 for the criteria.

Table 13

*Criteria for the conclusion of the analysis based on ambiguity of events*

|  |  |
| --- | --- |
| **Conclusion** | **Criteria** |
| Failed replication | Both failed to find support |
| 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 |
|
| Successful replication, with robustness challenge | Original’s methods succeeded in finding support yet we failed to find support using our method |
| Robust phenomenon | Both found support |

## Implications, limitations, and directions for future research

[There were some aspects of the design of the target article that we could not or chose not to implement. For example, given our online sample, we did not address the potential social factors which were tested in Study 3 of the original study. Discussion of implications…]

[Some aspects of our replication were different from that of the target article, like sample. Discussion… ]

[We will be discussing the limitations of these deviations in the discussion section, following data collection in Stage 2.]

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