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ORIGINAL ARTICLE

# Do Affective States Influence Risk Preferences?

## Evidence from Incentive-Compatible Experiments

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**Abstract** Recent discussions in decision sciences and economics stress the potential impact of affect on decision outcomes. In this study, we conducted incentive-compatible laboratory experiments ($N$ = 253) to investigate whether affect causes temporary fluctuations in risk preferences. In particular, we employed film clips to induce participants into joyful, fearful and sad affective states and subsequently elicited risk preferences by asking the participants to make choices among different lotteries. The financial consequences of the lottery choices varied randomly among the fixed-, low-, and high-stakes treatment groups. We find only weak evidence that affective states influence risk preferences. In particular, we find some evidence that sadness leads to risk aversion, but we find no effects for joy and fear. Our findings question recent claims in the literature that the relationship between affect and risk preferences is strong and unambiguous.

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**JEL-Classification** D03 · D81 · C91

## 1 Introduction

Individual behavior in situations involving risk appears to be systematically influenced by factors that are not directly related to the expected payoffs. For instance, recent studies demonstrate that natural disasters (Botzen et al. 2013; Cameron and Shah 2012; Eckel et al. 2009), terrorist attacks (Viscusi 2009), violent trauma (Callen et al. 2014; Voors et al. 2012), deadly disease (Sunstein 2003), financial crises (Guiso 2013), asset-pricing bubbles (Lin et al. 2012), and air pollution (Levy and Yagil 2011) can change individuals' risk preferences. Even daily events, such as rainy or sunny weather (De Silva et al. 2012, Hirshleifer and Shumway 2003, Kamstra et al. 2000, 2003; Kliger and Levy 2003; Levy and Galili 2008; Saunders 1993), appear to affect the decision-making processes of individuals in situations that involve risk.

These findings challenge the assumptions that individual risk preferences are stable over time and across events with similar prospective outcomes (Stigler and Becker 1977). One possible explanation for these findings suggested in the literature is that individuals' affective responses[1] exert a temporary influence on their risk preferences. Several review articles in the social sciences (e. g., Allen and Badcock 2003; Anderson 2003; Haushofer and Fehr 2014; Loewenstein et al. 2001; Pham 2004, 2007) suggest that individual affective states can impact risk preferences.[2] In addition, other articles have based their main argumentation on the seemingly unambiguous effect of emotions on decisions under risk. For example, a recent review in *Science* suggests that negative affect caused by poverty may exacerbate poverty by prompting individuals to make more risk averse, shortsighted decisions (Haushofer and Fehr 2014). In addition, a meta-analytic review suggests that risk-glorifying media content leads to risk-promoting emotions (Fischer et al. 2011). Another conceptual article develops a decision making model under risk based on the duality of the affective and deliberative system assuming an impact of affective states on decision making under risk (Mukherjee 2010). Finally, an earlier study

[1] Affect is often employed as an umbrella term that refers to the current moods and emotions of individuals. Moods are generally described as low-intensity, diffuse, and relatively enduring affective states that often arise for no particularly salient reason. Compared with moods, emotions are considered to be more intense and short-lived affective states that generally have a definite cause and clear cognitive content (Davidson 1994; Gray and Watson 2001). The distinctions between moods and emotions are largely theoretical rather than empirical in nature. In research practice, identical methods are often used to induce both moods and emotions (Fredrickson 2002). In this paper, we use the terms "affect", "affective state", and "mood" interchangeably. Nevertheless, we believe that the definition of mood – low-intensity, diffuse, and not object-directed – is more appropriate to our empirical examination than the definition of emotion – intense, object-directed, and with clear cognitive content.

[2] Pham (2007) presents a critical review on the empirical evidence on the relationship between emotion and rationality.

in the field of management (Chiles and McMackin 1996) develops a model that explains previously inconsistent findings in transaction cost economics with the effect of trust on risk preferences.

However, contrary to these claims, the available empirical evidence on the relationship between affect and risk preferences is far from unambiguous. The hypothesis that affective states impact risk preferences is rooted in psychology and has been studied for decades.[3] Most of the studies in psychology either experimentally induce general affective states or measure naturally occurring moods and emotions with self-reported scales. Many of these studies have reached conflicting conclusions and provide different explanations for their findings (Fehr-Duda et al. 2011; Heilman et al. 2010; Hockey et al. 2000; Leith and Baumeister 1996; Lerner and Keltner 2001; Raghunathan and Pham 1999). Two opposing theories have emerged to explain the relationship between affect and risk preferences: the mood-maintenance hypothesis (MMH; Isen and Patrick 1983) and the affect-infusion model (AIM; Forgas 1995). The MMH suggests that a positive affect leads to risk-averse behavior and a negative affect produces risk-seeking behavior (Hockey et al. 2000; Kim and Kanfer 2009; Kliger and Levy 2003; Wegener and Petty 1994), whereas the AIM proposes that affect will influence risk preferences in precisely the opposite manner (Finucane et al. 2000; Grable and Roszkowski 2008; Hirshleifer and Shumway 2003; Kamstra et al. 2003; Leith and Baumeister 1996; Levy and Galili 2008).

## 2 Inconsistencies in Prior Studies

There are several possible causes for the inconsistent results in the literature with respect to the influence of affective states on risk preferences. First, most studies that have addressed this topic have only examined general positive and negative affect and therefore neglected the different impacts that may be produced by distinct affective states of the same valence. In particular, different types of negative affect (e. g., anger, fear, sadness) might have a wider variety of impacts than positive affects (e. g., joy, excitement, trust). Furthermore, negative affects may not necessarily have the opposite impact of positive affects (Isen 2000). There are few studies that investigate the specific influences that affective states of the same valence have on decisions that involve risk, but they have not lead to conclusive results. Some of these studies (Carver and Harmon-Jones 2009; Kugler et al. 2012; Lerner and Keltner 2000, 2001) argued that fear and anger could have opposite effects on risk perception although both are affective states with a negative valence. Fear may cause pessimistic risk assessments and risk aversion; by contrast, angry individuals may evaluate risk more optimistically and therefore become more risk seeking. Furthermore, happy individuals may also express optimistic risk estimates and therefore appear to resemble angry individuals with respect to their risk behavior. An early study by (Raghunathan and Pham 1999) reports sad individuals being in favor of risky options

[3] According to Thomson Reuter's web of science, 188 articles have been published on the relationship between affect (emotion, mood) and risk references in the social sciences since 1980 until 2014.

and anxious individuals in favor of less risky options. Thus, further investigating the influence of distinct affective states with different valence levels on risk preferences may help explain the inconsistencies in the findings of prior studies.

Second, the inconsistent empirical results associated with the opposing predictions of the AIM and the MMH may be caused by publication bias, i. e., the tendency of researchers and journals to report findings rather than non-findings (for a discussion of the problem of publication bias, see Ashenfelter et al. 1999; Dickersin and Min 1993; Ioannidis 2005; Landis et al. 2014: *Editorial for the Null Results Special Issue of Journal of Business and Psychology*).[4] In fact, a large scale effort by the Open Science Collaboration could only replicate 39 % of 100 studies published in three of the most prestigious psychology journals (Open Science Collaboration 2015).

A third possible reason for the inconsistent results is that the participants in most studies in the field of psychology make hypothetical decisions without personal consequences. Economists have raised questions concerning the internal and external validity of such studies (Croson and Gneezy 2009; Smith 1982). If the results of decisions do not produce personal consequences, then decision makers will be less inclined to carefully consider their responses, and they may be more likely to attempt to please the experimenter with an anticipated response instead of seeking to maximize their own utility. In addition, other potential sources of utility that are irrelevant outside the laboratory context may influence the decisions that are observed. Furthermore, fixed participation fees instead of incentive-compatible designs may offset randomization across treatments and lead to biased samples (Smith 1982). To address these concerns, Harrison et al. (2009) suggested that experimental studies of decision making should fulfill the salience and dominance criteria. The salience criterion requires clearly understood rewards to be linked to an individual's behavior. The dominance criterion stipulates that monetary rewards or costs dominate all other potential sources of utility.

A number of economic studies have thus adopted a different methodological paradigm and investigated the role of affective states in decision making under risk by assessing observed financial investments in the field, i. e., by examining revealed preferences rather than hypothetical decisions (Hirshleifer and Shumway 2003; Kamstra et al. 2000, 2003; Kliger and Levy 2003; Levy and Galili 2008; Levy and Yagil 2011; Saunders 1993; Shu 2010; Yuan et al. 2006). Many of these economic studies employed naturally occurring affect proxies, such as the weather (Hirshleifer and Shumway 2003; Kliger and Levy 2003; Levy and Galili 2008; Saunders 1993; Shu 2010), biorhythms (Kamstra et al. 2000; Yuan et al. 2006), or seasonal affective disorder (Kamstra et al. 2003). Two noteworthy exceptions in economics conducted laboratory experiments where they employed direct mood induction techniques to study the effects of affective states on risk preferences (Conte et al. 2013) and certainty equivalents (Guiso et al. 2013).

Yet, most economic studies investigate proxies for general positive or negative affects, the interpretations of their results remain vague with respect to which specific

[4] The Journal of Business & Psychology edited a special issue addressing null results and several articles in this special issue served as excellent examples when null results can be meaningful.

affective states are involved in the impact that is observed. For instance, it is unclear how weather will affect individual affective states because rain might produce sadness in certain individuals and anger in others. Thus, for different individuals, the same external events can trigger various affective states with different valence levels and different activation levels. The differences in negative affective states in particular cannot be identified when investigating general negative affect. An incentive-compatible laboratory experiment that induces and measures specific affective states may address these issues and examine whether distinct affective states have a causal influence on elicited risk preferences. Our study reports the results from this type of experiment.

## 3 The Present Study

We combine standard methods from psychology to induce specific affective states with standard methods from economics to measure risk preferences. Specifically, we investigate three distinct affective states (joy, fear, and sadness) relative to a control group that does not receive a mood induction. We study the effect of these affective states on risk preferences with financial consequences in the gain domain.

We chose to induce joy, fear, and sadness because these affective states are likely to be present among economic agents in a wide range of situations (Scherer 2005) and can be triggered by everyday circumstances in most cultures (Ekman 1992). We measure the specific affective states of participants before and after our mood inductions with film clips using subscales of the Positive and Negative Affect Schedule (PANAS-X; Watson and Clark 1994; Watson et al. 1988), which is the most commonly used psychometric measurement of affect in the psychological literature (Harmon-Jones 2003; Stanton et al. 2000).

Following Holt and Laury (2002), we use lottery-choice menus in our study to elicit risk preferences. This is an established and frequently used approach in economics (Blavatskyy 2009; Goeree et al. 2003; Johansson-Stenman 2010; Kugler et al. 2012). Furthermore, we differentiate among fixed, low, and high financial stakes in a random-assignment experimental design. This variation in financial stakes is an important design element of our study for three reasons. First, risk preferences appear to be sensitive to the magnitude of the financial stakes that are involved in a decision (Camerer and Hogarth 1999; Croson and Gneezy 2009; Holt and Laury 2002). Thus, it is not immediately obvious that the results from an experiment on risk preferences that involves small, fixed, or hypothetical financial stakes would be replicable with high stakes or in the field. Second, in a study of the impact of positive affect on risk preferences, Isen and Patrick (1983) found that subjects who faced hypothetical decisions demonstrated behavior that was diametrically opposed to that of individuals who (erroneously) believed that their decisions would affect their course grades. Thus, we vary the financial stakes in our random-assignment experiments to investigate whether and how the financial stakes moderate the impact of affective states on risk preferences. Third, varying both the financial stakes *and* differentiating between specific moods (leading to a $4 \times 3$ between-subjects design) allows us to test a broader spectrum of relevant scenarios than earlier studies.

# 4 Method

## 4.1 Participants

We conducted two studies in a large German university's laboratory for economic experiments. The responsible Ethics Committee of the local university approved the studies and all participants provided written informed consent. Study 1 included three decision tasks, and one of these tasks was the current study on risk preferences. The other two tasks were incentive-compatible measures of ambiguity preferences and overconfidence, the results of which are unpublished. The sequence of the three tasks was randomized to prevent fixed-choice ordering. In study 1, we recruited a total of 322 participants: 142 participants only received a participation fee and no choice-dependent payments (we call this the *fixed stakes* treatment), 144 participants received a participation fee combined with low financial stakes associated with the decisions they made, and 36 participants received a participation combined with high financial stakes. We only used data from the participants who completed the risk preference task directly after the mood induction (108 participants in total, including 48 participants with fixed financial stakes, 48 participants with low financial stakes, and 12 participants with high financial stakes), as these data are the most comparable with the data from study 2. We used the 214 observations on risk preferences from study 1 that could not be pooled with the data from study 2 for further robustness checks, as we discuss below.

Study 2 was identical to study 1 in terms of experimental procedures, except for two differences. First, study 2 included no tasks other than the measurement of risk preferences. Second, we asked participants about their risk preferences in the loss domain before we asked them about their risk preferences in the gain domain in study 2. Because of the rules of the laboratory in which the experiment was conducted, we did not require participants to pay us in cases involving loss. Thus, there was no incentive-compatible measure of risk preferences in the loss domain, and we therefore only include risk preferences from the gain domain in our analyses. In study 2, 37 participants had fixed financial stakes, 41 participants had low financial stakes, and 67 participants had high financial stakes. Our main analyses below are based on the pooled sample from studies 1 and 2 (total $N = 253$), which included 85 participants with fixed financial stakes, 89 participants with low financial stakes, and 79 participants with high financial stakes. We conducted tests to investigate whether the effects of moods are moderated by financial stakes or differences in experimental design between studies 1 and 2.

The experiment was programmed in z-tree (Fischbacher 2007), and we recruited participants using the internet-based ORSEE system (Greiner 2004), which allowed us to ensure that there was no overlap between the participants in studies 1 and 2. In each experimental session, all three of the mood treatments (i. e., the induction of a joyful, fearful, or sad mood) and a control treatment (i. e., no mood induction) were conducted on personal computers that were randomly matched with the participants. The participants had no time restrictions for completing the experiment. On average, participants completed study 1 in 30 minutes and study 2 in 20 minutes.

The results of study 1 seemed to suggest that the magnitude of the financial stakes moderates the role of mood effects on risk preferences (see Table 8), but we did not find a consistent effect of the sadness treatment in our first study. Because we had very limited statistical power for our high stakes condition in our first study, we ran the study 2 with the same design and the explicit goal to increase the number of observations in the high stakes condition. It turned out, however, that several of the results from the first experiment did not replicate in the second study. Instead, we present pooled results in the current paper, based on one of the largest sample sizes that is available until now to study the effects of moods on risk preferences in a carefully controlled, incentivized decision experiment.

The pooled sample of studies 1 and 2 consisted of 104 males and 149 females with an average age of 24 (SD = 3.41). The youngest and oldest participants were 18 and 43 years old, respectively. In total, 243 of the participants were students, and 10 of the participants were non-students. Of the 243 students, 2 % were majoring in the fine arts, 18 % in the humanities, 32 % in the social sciences, 4 % in the biological sciences, and 19 % in the physical sciences. The remaining 25 % were studying other subjects.

### 4.2 Procedures

The pooled observations from studies 1 and 2 followed identical experimental procedures in the following respects. Upon arrival, the participants were introduced to the session and signed consent forms confirming that they had read and understood the terms and conditions of the experiment and that the experimenters had adequately answered all of their questions.

On the first screen of the experiment, the participants were informed that they were about to participate in an experiment on economic decision making that included real financial payoffs. The participants were then asked to complete questions concerning their age, gender, current occupation, level of education, academic major, personality traits (e. g., "I see myself as extraverted, enthusiastic", 7-point Likert scale from 1 "strongly disagree" to 7 "strongly agree", Gosling et al. 2003)[5], and individual risk attitude ("I am generally a person who is fully prepared to take risks", 7-point Likert scale from 1 "strongly disagree" to 7 "strongly agree", Dohmen et al. 2011). After completing these measures, participants were asked to complete self-reported assessments of their pre-induction mood (see Measures below).

Subsequently, the participants in the three treatment groups viewed a film clip that was intended to manipulate their mood. After viewing this film clip, these

[5] Overall, the internal reliabilities for extroversion (Cronbach's $\alpha = 0.74$), agreeableness ($\alpha = 0.23$), conscientiousness ($\alpha = 0.71$), emotional stability ($\alpha = 0.69$), and openness ($\alpha = 0.52$) were not satisfactory. Therefore, we conducted a rotated factor analysis and extracted four components with eigenvalues that were greater than 1, that is, extroversion, emotional stability, conscientiousness, and openness. Agreeableness was not found to be a separate factor and was not included as a control variable in the analysis. The principal component analysis (PCA) considers all available information, whereas sum scores of the items for one personality dimension would ignore the personality differences among participants. The factor scores and the sum scores were nearly perfectly correlated for four of the five personality dimensions examined ($r$s > 0.90, $p$s < 0.001).

**Table 1** Number of subjects with consistent risk-preference measures across financial treatment groups in the pooled studies 1 and 2

| | Fixed stakes | Low stakes | High stakes | *Total* |
|---|---|---|---|---|
| Control | 20 | 18 | 18 | *56* |
| Joy | 18 | 19 | 17 | *54* |
| Fear | 20 | 21 | 17 | *58* |
| Sadness | 17 | 21 | 17 | *55* |
| *Total* | *75* | *79* | *69* | *223* |

30 of the original 253 subjects were excluded from the analyses because they either had inconsistent risk preferences or did not understand the decision task (please see section 2.4.2 for further details)

participants again indicated their mood states (e. g., Heilman et al. 2010; Kim and Kanfer 2009; Lerner and Keltner 2000). The participants in the control group did not view a film clip (Verheyen and Göritz 2009) and instead completed the mood scales only once at the beginning of the experiment with the same mood measurement instrument. All participants then received separate instructions with respect to the magnitude of the financial stakes but completed the same risk-preference task. Table 1 indicates the number of subjects across the treatment groups who had fixed, low, and high financial stakes.

The instructions for the condition that involved fixed financial stakes explained that the individuals who were participating in this condition would receive a fixed payoff of 9 EUR at the end of the experiment, regardless of their performance, which consisted of an attendance fee of 4 EUR and an additional 5 EUR to compensate them for their time. These participants were, however, urged to do their best to complete the subsequent tasks. The participants who experienced the low- and high-stakes treatments were instructed that their payoff at the end of the experiment would depend on their decisions in the subsequent task. These participants received an attendance fee of 4 EUR and the opportunity to earn an additional payoff of up to 15.40 EUR. The participants in the high-stakes treatment were told, in addition, that they had a 1:36 or 2.8 % chance to centuplicate their payoff. The maximum amount that the high-stakes participants might win, therefore, was 1540 EUR. Whether the payoff would be centuplicated depended on the outcome of a fair lottery draw that was explained to the participants in the high-stakes treatment.

After receiving the financial instructions, all participants completed the same risk-preference task. The completion of this task was the last stage of the study for the participants in the fixed-stakes treatment. For the participants in the incentive-compatible treatments, a computer randomly determined the payoffs in accordance with the experimental instructions and observed behavior. Immediately after each session had concluded, all session participants were thanked and separately received their payoffs. The participants in the high-stakes treatment also received a card that stated the time and location for the drawing of a lottery number (ranging from 1 to 36) that would determine whose payoff was centuplicated. At the specified times, the 36 participants in the high-stakes sessions each drew one number in the presence of 35 other high-stakes participants who participated in the same lottery draw. The participants provided their names, addresses, and telephone numbers and signed forms that confirmed the lottery numbers they drew. Two hours later, for each of the three high-stakes lotteries, we randomly drew one of the 36 numbers. The participants with the winning numbers received one hundred times the standard conversion rate of the experimental currency in Euros. The high-stakes participants had all been invited to be present at these drawings, but only a fraction of these participants were actually in attendance for each drawing. The drawings of the numbers were video recorded and subsequently published on a publically accessible faculty website; the names of the winners were not announced, however. We chose this public procedure to increase participants 'trust in our payoff method and simultaneously to ensure the winners' anonymity. The three winners were informed immediately and confidentially, and the money that they had won was transferred to their bank accounts.

### 4.3 The Mood Induction Process

We used three film clips that were each 7 minutes in length extracted from Hollywood films to manipulate participants' moods (Gross and Levenson 1995; Hewig et al. 2005). The film clips for this study were chosen from a broad selection of movies that were tested in two studies from Gross and Levenson (1995) and Hewig et al. (2005). We chose these clips because they were shown to elicit the target mood most effectively. The use of film clips to induce moods is standard methodology for studying affect in experimental settings (Conte et al. 2013; Guiso et al. 2013; Heilman et al. 2010; Lerner et al. 2004; Lin et al. 2012). Film clips have been proven to be one of the most effective mood manipulation mechanisms and have been utilized to induce either positive *or* negative affective states (Gerrards-Hesse et al. 1994; Westermann et al. 1996). In total, 193 participants were induced with joyful (64 participants), fearful (64 participants), or sad (65 participants) moods, using film clips from "When Harry met Sally" (1989), "Paranormal Activity" (2007)[6], and "The Champ" (1979), respectively.

Prior to viewing the film clips, the participants were asked to become involved in the feelings that were suggested in the film clips and to clear their minds of all thoughts, feelings, and memories. The mood induction effects are assumed to be more intense if explicit instructions are provided to study participants (Westermann et al. 1996). After the film clip had concluded, the participants were required to indicate whether they had previously watched the film that was the source of the clip in question.

At the end of the experiment, the participants who received the negative mood inductions were shown the film clip of the joyful mood treatment as a counter induction (Göritz and Moser 2006). We also showed the joyful film clip to the control group participants because this activity consumed a portion of the time that these participants had available while they waited for the other participants to complete the experiment and receive their payoffs.

[6] We pre-tested film clips from "Silence of the Lambs" and "Halloween" as suggested by Hewig et al. (2005) to induce fear in a sample of 50 students. These film clips did not significantly induce a fearful state in our participants. Thus, we chose to use a film clip from "Paranormal Activity" that successfully induced the desired fearful state.

### 4.4 Measures

#### 4.4.1 Mood Measurement

We used three subscales of the short version of the PANAS-X (Watson and Clark 1994; Watson et al. 1988) to measure participants' specific moods during the experiment (once in the control group and twice in the treatment groups). We used the joviality subscale of this metric (e. g., "happy," "joyful," or "delighted"; *Cronbach's* $\alpha_{\text{before induction}}$ = 0.87, $\alpha_{\text{after induction}}$ = 0.92) to assess participants' levels of joy, the fear subscale (e. g., "afraid," "scared," or "frightened," $\alpha_b$ = 0.83, $\alpha_a$ = 0.92) to measure participants' levels of fear, and the sadness subscale (e. g., "sad," "blue," or "downhearted," $\alpha_b$ = 0.88, $\alpha_a$ = 0.90) to measure participants' levels of sadness. Participants indicated their answers on a 5-point Likert scale with the poles 1 "not at all" and 5 "extremely."

#### 4.4.2 Risk Preferences

To measure risk preferences, we used an adaptation of the (Holt and Laury 2002) method, depicted in Table 2, which asks participants to make a series of choices between two lotteries with different payoffs. The payoffs are structured such that one lottery (option *S*) is less risky than the other (option *R*). In addition, the series of payoffs is designed such that at the beginning of the experiment, the expected value of the safe choice (*S*) is higher than the expected value of the risky choice (*R*). Over the course of the series of choices, the difference in expected values between the two choices becomes successively smaller until it reverses; thus, as the series of choices continues, the riskier choice (*R*) has an increasing advantage in the expected value that the participant will receive. The point at which the participants switch from the safe (*S*) to the risky (*R*) lottery reveals their risk preferences. Participants in the incentive-compatible treatments (the low- and high-financial-stakes treatments) knew that one of the decision options would be randomly chosen and that their decisions would affect the quantity of actual money that they received at the end of the experiment. The conversion rate of Experimental Dollars (ED) to Euros

**Table 2** Lottery choice task

| Options S | Option R | S | R |
|---|---|---|---|
| 1/10 of ED 800, 9/10 of ED 640 | 1/10 of ED 1540, 9/10 of ED 40 | O | O |
| 2/10 of ED 800, 8/10 of ED 640 | 2/10 of ED 1540, 8/10 of ED 40 | O | O |
| 3/10 of ED 800, 7/10 of ED 640 | 3/10 of ED 1540, 7/10 of ED 40 | O | O |
| 4/10 of ED 800, 6/10 of ED 640 | 4/10 of ED 1540, 6/10 of ED 40 | O | O |
| 5/10 of ED 800, 5/10 of ED 640 | 5/10 of ED 1540, 5/10 of ED 40 | O | O |
| 6/10 of ED 800, 4/10 of ED 640 | 6/10 of ED 1540, 4/10 of ED 40 | O | O |
| 7/10 of ED 800, 3/10 of ED 640 | 7/10 of ED 1540, 3/10 of ED 40 | O | O |
| 8/10 of ED 800, 2/10 of ED 640 | 8/10 of ED 1540, 2/10 of ED 40 | O | O |
| 9/10 of ED 800, 1/10 of ED 640 | 9/10 of ED 1540, 1/10 of ED 40 | O | O |
| 10/10 of ED 800, 0/10 of ED 640 | 10/10 of ED 1540, 0/10 of ED 40 | O | O |

was 100:1 in the low- and high-stakes treatments. In the high-stakes treatment, participants faced an additional probability of 1/36 to have a conversion rate of 1:1. Thus, although the lottery decision tasks were identical across treatments, the expected values of the choices were different across financial treatments and participants in the high-stakes treatment faced an additional source of uncertainty from the conversion rate.

In total, 30 participants displayed choices that were not compatible with expected utility theory. These participants either preferred the safe option (*S*) in the last lottery choice (i. e., a sure win of 800 ED) – despite that this choice is strictly dominated by the "risky" (*R*) option (i. e., a sure win of 1540 ED) – or switched between the lotteries more than once and thereby displayed inconsistent preferences. We excluded these 30 participants from further analyses to avoid inference problems (Andersen et al. 2006; Holt and Laury 2002).

## 5 Results

### 5.1 Mood Inductions

According to the participants' self-evaluations, all of the mood inductions appear to have worked successfully.[7] In particular, the participants that viewed the joyful film clip reported that their joy after induction was significantly higher than their joy before induction ($t$ $df$ = 63 = –6.19, $p < 0.001$, $d$[8] = 1.56). Similarly, with respect to the fearful film clip, participants exhibited higher fear after induction than before induction ($t$ $df$ = 63 = –5.17, $p < 0.001$, $d = 1.30$), and the sad film clip caused participants to report significantly higher sadness after induction than they had reported before induction ($t$ $df$ = 64 = –4.91, $p < 0.001$, $d = 1.23$). Table 3 indicates the factor scores of the principal component analyses of the self-reported moods across treatments after mood induction. Results from Analyses of Variances (ANOVA) in this table illustrate that study participants significantly self-report the highest mean values for a particular mood after they have been exposed to the appropriate mood treatment.

### 5.2 Descriptions and Correlations

To correct for multiple hypothesis testing that originates from our 4 × 3 between-subjects design, we apply the conservative Bonferroni-adjusted $p$-value of 0.05/12 = 0.0042 as a significance threshold throughout the analysis.

[7] We used factor scores for the analysis because they consider all the available information, whereas sum scores of the items for one mood type would ignore the mood differences among participants that arose from changes in fear or sadness. We included the same PANAS-X items in the principal component analysis (PCA) factor scores as in the sum scores. Varimax rotation is applied. The factor scores and sum scores were nearly perfectly correlated for all three of the examined moods ($r > 0.95$, $p < 0.001$). The results are robust to using sum scores instead of factor scores.

[8] $d = 0.20$ denotes a small effect, $d = 0.50$ a medium effect, and $d = 0.80$ a large effect (Cohen 1988).

**Table 3** Means and standard errors of self-reported moods across treatments after mood induction ($N = 223$)

| | Self-reported joy | | Self-reported fear | | Self-reported sadness | |
|---|---|---|---|---|---|---|
| | *Mean* | *Std. Err* | *Mean* | *Std. Err* | *Mean* | *Std. Err* |
| Control | 0.50 | 0.09 | –0.30 | 0.06 | –0.07 | 0.09 |
| Joy | **0.72** | **0.13** | –0.38 | 0.05 | –0.33 | 0.05 |
| Fear | –0.44 | 0.10 | **1.01** | **0.16** | –0.42 | 0.12 |
| Sadness | –0.73 | 0.07 | –0.34 | 0.10 | **0.80** | **0.15** |
| Model diagnostics | | | | | | |
| *ANOVA* | $F(3, 219) = 47.06$, $p = 0.00$ | | $F(3, 219) = 38.64$, $p = 0.00$ | | $F(3, 219) = 23.76$, $p = 0.00$ | |

Fig. 1 illustrates the proportion of safe choices in each of the 10 lottery decisions. The horizontal axis indicates the number of safe choices, and the vertical axis indicates the probability of safe choices. a one-way analysis of variances (ANOVA, $F3$, $219 = 2.35$, $p = 0.07$) with least-significant differences (LSD) post-hoc test indicates that risk aversion is higher in the sadness ($M = 2.02$, $SD = 1.80$) group than in the joy ($M = 1.28$, $SD = 1.78$, $p = 0.04$, $d = 0.41$), fear ($M = 1.40$, $SD = 1.75$, $p = 0.07$, $d = 0.35$), and control groups ($M = 1.18$, $SD = 1.98$, $p = 0.02$, $d = 0.44$). However, between-group differences are not statistically significant after correction for multiple testing.

The distribution of participants' risk preferences according to the financial stakes conditions in our control group is similar to Holt and Laury's (2002) study. Participants tended towards risk-seeking in the fixed stakes condition (low-hypothetical

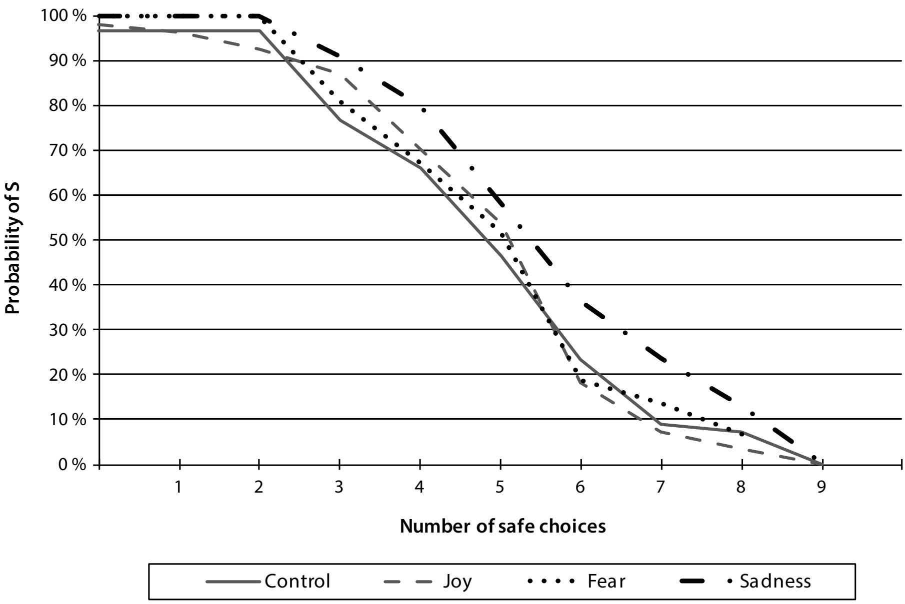


**Fig. 1** Proportion of safe choices – data averages across treatment groups ($N = 223$)

treatment in Holt and Laury's study) and risk-aversion in the low and high stakes conditions (low- and high-real treatment in Holt and Laury's study).

The correlation results[9] indicate that our careful randomization procedures were not entirely successful in distributing personal characteristics equally across treatment groups ($p$s $< 0.05$). Therefore, we included personality characteristics in the following regressions as control variables. The risk attitudes that were self-reported before the mood induction using the general risk question of Dohmen et al. (2011) were weakly correlated with the elicited risk preferences ($r = 0.16$, $p = 0.02$), and they were randomly distributed across the treatment groups. Gender and age are not correlated with either our measure of risk preference or the treatment groups; thus, these factors do not influence the regression results.

### 5.3 Regression Results

To analyze the relationship between moods and risk preferences, we consider a model of the form

$$\begin{aligned} y_i &= \mathrm{a} + \bar{b}_1' \bar{M} + \bar{b}_2' \bar{F} + \bar{b}_3' \bar{S} + \bar{b}_4' \left(\bar{M}\bar{F}\right) + \bar{b}_5' \left(\bar{M}\bar{S}\right) + \bar{b}_6' \left(\bar{F}\bar{S}\right) + \\ &\quad \bar{b}_7' \left(\bar{M}\bar{F}\bar{S}\right) + \bar{b}_8' \bar{C} + \varepsilon_i \\ i &= 1, ..., N \end{aligned} \tag{1}$$

where $y_i$ is the observed risk preference of subject $i$, $M$ is a set of dummy variables for the mood treatment (control, joy, fear, sadness), $F$ is a set of dummy variables for the financial-stakes treatment (fixed, low, high), and $S$ is a dummy for studies 1 and 2. $C$ is a vector of control variables for personality scores and self-reported risk preferences before the experimental treatments. The $\beta$ coefficients are the differential intercepts for the experimental treatments, whereas a gives an estimate of the common intercept.

This model specification that includes dummy variables for the different experimental treatments both in additive and in multiplicative form may be used to test the assumptions that moods ($M$) influence risk preferences independent of the magnitude of the financial stakes ($F$) and the study design ($S$) (Chow 1960; Gujarati 1970). Our main interest lies in the effects of $M$ and $F$ and their interaction, which is reported in Table 4. We control for $S$, $MS$, and $FS$ as potential confounds that may otherwise arise as the result of the slightly different experimental conditions in studies 1 and 2. Model 1 assumes that $\beta_4$ and $\beta_7$ are zero, reflecting the implicit assumption from previous studies that the magnitude of financial stakes does not moderate the effect of moods on risk preferences. Model 2 relaxes this assumption and explicitly estimates $\beta_4$. Model 3 estimates the full set of coefficients as a further robustness check.

In the following OLS regressions, a positive coefficient denotes risk-averse preferences and a negative coefficient indicates risk-seeking preferences. In Model 1, we find one nominally significant effect ($p = 0.03$) which implies that sadness leads to risk aversion. However, the effect does not survive the conservative Bonferroni

[9] Detailed correlation results available upon request.

**Table 4** OLS regressions on risk preferences ($N = 223$)

| | *Model 1* | | *Model 2* | | *Model 3* | |
|---|---|---|---|---|---|---|
| | $\beta$ | $p$ | $\beta$ | $p$ | $\beta$ | $p$ |
| Joy | 0.09 | 0.41 | 0.14 | 0.42 | 0.18 | 0.39 |
| Fear | 0.07 | 0.54 | –0.01 | 0.94 | –0.05 | 0.79 |
| Sadness | 0.22 | 0.03 | 0.27 | 0.11 | 0.25 | 0.21 |
| Low stakes | –0.04 | 0.72 | 0.06 | 0.75 | 0.01 | 0.97 |
| High stakes | –0.10 | 0.28 | –0.15 | 0.37 | –0.14 | 0.49 |
| Joy*Low stakes | – | – | –0.22 | 0.09 | –0.25 | 0.18 |
| Joy*High stakes | – | – | 0.05 | 0.67 | 0.02 | 0.90 |
| Fear*Low stakes | – | – | 0.02 | 0.89 | 0.12 | 0.53 |
| Fear*High stakes | – | – | 0.09 | 0.48 | 0.09 | 0.57 |
| Sadness*Low stakes | – | – | –0.04 | 0.79 | 0 | 1.00 |
| Sadness*High stakes | – | – | –0.05 | 0.71 | –0.05 | 0.76 |
| Joy*Low stakes*Study2 | – | – | – | – | 0.05 | 0.79 |
| Joy*High stakes*Study2 | – | – | – | – | 0.04 | 0.74 |
| Fear*Low stakes*Study2 | – | – | – | – | –0.15 | 0.46 |
| Fear*High stakes*Study2 | – | – | – | – | 0.05 | 0.64 |
| Sadness*Low stakes*Study2 | – | – | – | – | –0.05 | 0.81 |
| Sadness*High stakes*Study2 | – | – | – | – | 0.02 | 0.89 |
| *Model diagnostics* | | | | | | |
| $N$ | 223 | | 223 | | 223 | |
| $R^2$ | 0.11 | | 0.14 | | 0.15 | |
| *Adj.* $R^2$ | 0.04 | | 0.05 | | 0.03 | |
| *Prob* > $F$ | 0.07 | | 0.07 | | 0.20 | |

$\beta$s are standardized for all variables. Note that standardized regressions do not have an intercept term
Control variables are the experimental study design, experimental study design*mood treatments, experimental study design*financial stakes, personality factor scores, and self-reported risk attitudes
The reference groups are the control treatment, fixed financial stakes, and study 1
The results are robust to the exclusion of control variables, the inclusion of additional control variables such as gender, age, and whether the film had been seen before, including personality sum scores instead of factor scores, and to the use of OLogit instead of OLS

correction against multiple testing.[10] Furthermore, the effect of sadness is also not nominally significant anymore when we control for interaction effects of moods and financial stakes in Models 2 and 3. We note, however, that the direction of the sadness treatment remains the same and the estimated effect sizes of sadness are similar across the different model specifications. We find no evidence that joy and fear have an effect on risk preferences in any of the three models in Table 4.

Table 5 provides three separate OLS regressions for the financial stakes conditions of the experiment. We find no evidence for an effect of moods on risk preferences in these models applying conventional significance levels, but we note that the statistical power of these tests is lower due to smaller sample sizes than in Table 4. However, the effects of sadness are consistent to the ones reported in Table 4. We find no evidence that fear has an effect on risk preferences and the sign of the joy

[10] No evidence against poolability was produced by a poolability analysis across the factor of gender.

**Table 5** OLS regressions on risk preferences – by financial stakes ($N = 223$)

| | *Model 1: Fixed stakes* | | *Model 2: Low stakes* | | *Model 3:High stakes* | |
|---|---|---|---|---|---|---|
| | $\beta$ | $p$ | $\beta$ | $p$ | $\beta$ | $p$ |
| Joy | 0.25 | 0.22 | –0.26 | 0.21 | 0.19 | 0.23 |
| Fear | –0.01 | 0.96 | 0.11 | 0.61 | 0.09 | 0.56 |
| Sadness | 0.27 | 0.18 | 0.20 | 0.33 | 0.19 | 0.28 |
| *Model diagnostics* | | | | | | |
| $N$ | 75 | | 79 | | 69 | |
| $R^2$ | 0.22 | | 0.19 | | 0.18 | |
| *Adj.* $R^2$ | 0.07 | | 0.04 | | 0.00 | |
| *Prob* > *F* | 0.18 | | 0.27 | | 0.47 | |

$\beta s$ are standardized for all variables. Note that standardized regressions do not have an intercept term
Control variables are the experimental study design, experimental study design*mood treatments, personality factor scores, and self-reported risk attitudes
The reference group is the control treatment
The results are robust to the exclusion of control variables; the inclusion of additional control variables, such as gender, age, and whether the film had been seen before; including personality sum scores instead of factor scores; and to the use of OLogit instead of OLS

treatment varies depending on the financial stakes. Moreover, a regression analysis using the pooled sample of the incentive-compatible low- and high-stakes treatments together ($N$ 148) does not indicate any significant effects of participants' moods on risk preferences either (see Table 6 in Supporting Information).

We conducted further robustness checks of our results with model specifications identical to Table 4 using the excluded observations from study 1 ($N = 188$, see Table 7) and all observations from study 1 ($N = 278$, see Table 8). We find no evidence in these regressions that moods have an effect on risk preferences at the conventional significance level ($p < 0.05$). In addition, the effect sizes of the mood treatments in Tables 7 and 8 are smaller compared to those reported in Table 4 and 5. However, this could be due to the fact that many participants in study 1 had completed other decision tasks after the mood induction before their risk preferences were assessed. Previous studies (Kim and Kanfer 2009) have demonstrated that mood induction becomes weaker as the time period between induction and task management becomes longer. This is why we focus our main analyses in Table 4 and 5 on participants that completed the risk preference task directly after the mood induction.

We also calculated three separate OLS regressions for the financial stakes conditions with the pooled observations from study 1 ($N = 278$, see Table 9). Model 2 in Table 9 reports higher risk aversion in the sadness group when the financial stakes are low ($p = 0.04$, $N = 123$), but the effect does not survive correction for multiple testing and reverses its sign in the fixed stakes ($N = 122$) and high stakes ($N = 33$) condition. In addition, the effects of the joy and fear treatment in the high stakes condition are small but insignificant. Finally, we used the pooled high-stakes observations from study 1 and from study 2 ($N = 92$, see Table 10) for a regression analysis with model specifications identical to those in Model 1 in Table 4. We do not find significant effects of moods on risk preferences in this test, but we note that statistical power in this test was limited. We had 80 % power to detect $\beta > 0.29$ and

50 % power to detect $\beta > 0.21$ at the conventional significance threshold of $p < 0.05$. Thus, we did not have sufficient statistical power to detect smaller effect sizes.[11]

### 5.4 Bayesian Credibility of Regression Results

We complement our frequentist statistical analyses from above with a Bayesian calculation that quantifies the credibility of the sadness effect in our current data (our approach is similar to Ioannidis 2005 and Rietveld et al. 2014). In contrast to the classic, frequentist approach which forces us to make a binary decision about whether to reject the null hypothesis or not, the Bayesian approach tells us how much a prior belief about the existence of an effect needs to be updated given the strength of the presented evidence. Given that it is not unreasonable to believe that moods can influence risk preferences, but our results above do not allow us to convincingly reject the null hypothesis, these calculations help to put our findings into perspective.

We calculate posterior probabilities of a true association using Bayes' rule:

$$\Pr(truesignificant) = \frac{power \times prior}{power \times prior + (\alpha) \times (1 - prior)} \quad (2)$$

where $\alpha$ is the significance threshold of 0.05 and *power* is calculated for a two-sided test, given $\alpha$ and the estimated effect size.[12] Thus, in contrast to the frequentist approach, Bayes' rule does not only take the observed significance level of a finding into account, but also the power of the statistical test and the prior belief of the observer. Of course, it is difficult to know what an appropriate prior belief should be in the context of our study. Therefore, we present calculations for the entire spectrum of possible prior beliefs.

We focus these calculations on the result for sadness presented in Model 1 in Table 4 for three reasons. First, the sadness treatment is the only one that reaches nominal significance in any of the tests we conducted. Second, the model specification in Table 4 maximizes the statistical power of the test by considering all relevant observations simultaneously. Third, when considering Table 4, sadness is only significant in Model 1.

Note that the estimation of the effect size of the sadness treatment in Table 4 is likely to be upward biased due to the statistical winner's curse (Ioannidis 2008). Although regression analysis gives on average unbiased estimates of the true effect sizes if the model is correctly specified, the expected value of the effect sizes is biased away from zero if we only consider effects that meet statistical significance thresholds. This is particularly likely in small samples that have limited statistical power. Using the empirical Bayes method developed by Rietveld et al. (2014) with 1000 simulations, we estimate that the effect size of the sadness treatment in Table 4

[11] We only consider $\alpha = 0.05$ given that none of our results survives the conservative Bonferroni correction. Statistical power was calculated using formulas derived from first principals, which yields results that are identical to those obtained from using standard software packages such as GPOWER (Erdfelder et al. 1996).

[12] Ibid.

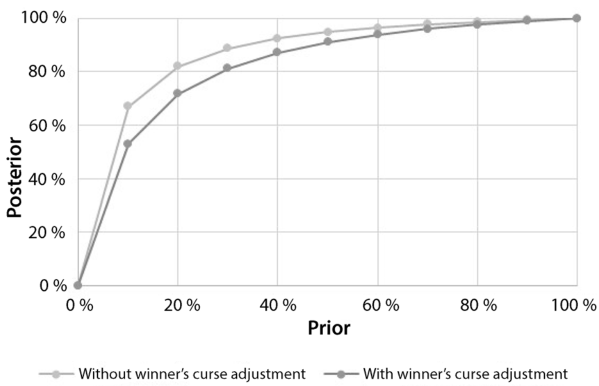


**Fig. 2** Posterior probability of a true association as a function of effect size and prior probability. Effect sizes are based on the estimates of the sadness treatment of Model 1 in Table 4. Significance threshold is α = 0.05

is upward biased by ~40 %. Thus, we also report Bayesian credibility calculations using the winner's curse adjusted effect size.

Fig. 2 displays the results. The extent of upward deviation from the 45 degree line visualizes the credibility of the evidence. We see that our data lead to moderate updates of the belief that there is a true association between sadness and risk preferences. In particular, the data speak in favor of a true effect of sadness on risk preferences for prior beliefs >10 %. Thus, a proper Bayesian who thought that there is at least a 10 % chance that sadness may influence risk preferences would update his/her belief to >50 % after seeing our results.

## 6 Discussion

To study the impact of affective states on risk preferences, our experiment used well-established techniques from psychology to induce and measure affective states and an incentive-compatible technique from economics to elicit risk preferences. In addition to a control group that did not receive mood manipulation, we induced participants with three distinct moods, i. e., joy, fear, and sadness. Furthermore, we varied the financial-stakes treatments across participants, i. e., fixed-, low-, and high-stakes treatments. These two dimensions of random, between-subject variation in our experiment allow us to investigate two possible explanations for the inconsistent empirical results found in the previous literature on this topic – biases that may be introduced by non-incentive-compatible experimental designs and biases introduced by unobserved variation in the induced moods.

Many results on the relationship between affective states and risk preferences come from psychological studies that typically use hypothetical or fixed states. In contrast, several economic studies report direct effects of affective states on risk preferences in incentive-compatible settings, but their affect manipulations and measures are often inferior. Our study presents only moderately credible evidence for an effect of sadness and finds no effects of joy and fear on risk preferences in incentive-compatible low- and high-stakes settings, despite our relatively large sample size compared to many previously published studies (e. g., Cohn et al. 2015;

Conte et al. 2013; Fehr-Duda et al. 2011; Heilman et al. 2010; Hockey et al. 2000; Kugler et al. 2012).

One possible reason that our study observes mainly insignificant effects of affective states on risk preferences may be the mood induction technique we chose. Film clips are a standard affect induction procedure from the psychological literature and suggested to be the most effective to induce positive and negative moods (Gerrards-Hesse et al. 1994; Westermann et al. 1996). In addition, our participants reported strong mood effects after induction (*d*s > 0.80). However, the resulting changes in mood may not have been sufficiently intense to consistently influence risk preferences. Another explanation may be derived from a study by (Heilman et al. 2010), who report an emotion regulation effect through cognitive reappraisal that can reverse the effects of fear- and disgust-inducing videos and naturally occurring states. However, they specifically induced participants into emotion regulation strategies; hence it is unclear whether the participants in our study were able to stimulate the same emotion regulation strategy.

Previous studies have also used a variety of alternative affect induction procedures and measurements, such as writing tasks or music, which may have introduced an unobservable bias across studies that contributed to the inconsistency of the reported results. Moreover, asking participants to complete a mood scale before and after the mood induction may be another reason for the inconsistent effects of our induced moods on the risk task. Studies have shown that emotions' effects on judgments and decisions can be mitigated when people are aware of their current mood (e. g., Schwarz and Clore 1983). However, current studies applying the same approach as in our experiments, i. e., asking participants before and after the induction about their emotional state, do find significant effects of emotions on risk tasks (e. g., Heilman et al. 2010; Kim and Kanfer 2009; Lerner and Keltner 2000). In addition, Kugler et al. (2012) did not find evidence that completing an emotion manipulation check increased participants' awareness of their emotional states and that such awareness affected their risk preferences. Nevertheless, it may be worthwhile to include these considerations in future studies. Investigating whether and how specific affective states and their awareness may influence risk preferences in different contexts will contribute to a better understanding and more robust results.

Despite our successful mood inductions with film clips, vivid, recently experienced events in the real world, such as natural disasters (Cameron and Shah 2012; Eckel et al. 2009), terrorist attacks (Viscusi 2009), traumas (Callen et al. 2014; Voors et al. 2012), the diagnosis of a deadly disease (Sunstein 2003), or financial busts and bubbles (Cohn et al. 2015; Guiso et al. 2013; Lin et al. 2012) might have stronger, longer-lasting affective consequences than film clips that might influence risk preferences more profoundly, even when the financial stakes are substantial. Moreover, affect that is directly caused by the decision situation (i. e., emotion), instead of being induced independent of the decision (i. e., mood), might also produce stronger effects (Davidson 1994; Gray and Watson 2001) on risk preferences.

Nevertheless, recent laboratory experiments that employed similar affect induction procedures to ours found significant effects of affective states on risk preferences (Conte et al. 2013), ambiguity preferences (Baillon et al. 2014), time preferences (Ifcher and Zarghamee 2011), asset-pricing bubbles (Lin et al. 2012), and certainty equivalents (Guiso et al. 2013). Whereas the first four studies used incentive-compatible designs with small financial rewards, the study by Guiso et al. (2013) investigated the relationship between fear and risk aversion using fixed financial incentives. Furthermore, the study by Conte et al. (2013) used a within-subject design inducing participants with five different affective states (neutral, joviality, fear, sadness, anger) before they responded to 100 lottery pairs. The within-subject design makes it difficult to parse between emotional spillover effects and to ensure that the emotional states lasted for all 100 choice problems. Yet, these studies imply that brief film clips, such as those used in our study, can – in principle – change economic preferences and behavior. Moreover, these studies suggest the possibility that affect is more relevant for other types of decisions than choices involving risk in the gain domain that we studied here.

Another possible reason for our relatively weak findings may be the measure for risk preferences that we used in this study (Holt and Laury 2002). For example, using a different measure for risk preferences (Hey 2001), but similar film clips as an affect induction procedure, Conte et al. (2013) found significant influences of affective states on risk preferences. Kugler et al. (2012) used the same risk preferences measure in their first experiment, but a writing task to induce emotions, and found that fearful participants are significantly more risk-averse than angry participants. They replicate their findings with a different risk preferences measure in the subsequent experiments. However, their results also suggest that the impact of affective states on risk-taking is contingent on the type and degree of uncertainty involved. For lottery risks, fear increases risk-aversion and anger reduces it; for person-based uncertainty, they report the reverse pattern.

In Study 1, participants completed the risk task for potential losses before they faced the lotteries with potential gains. We only used the observations in the gain domain for our analyses since the losses were only hypothetical to our participants. Nonetheless, the sequence of losses and gains in Study 1 may have influenced participants' moods and their subsequent risk preferences for the gain domain. However, it is unlikely that this design feature has heavily contributed to the lack of our findings. We asked participants to complete the risk task for gains before they completed it for losses in Study 2. Since our pooled sample includes observations from both studies and a control variable for Study 1 and 2, it is unlikely that this design feature is driving our findings.

Finally, as indicated by the Columbia University's Decision Making Individual Differences Inventory (DMIDI), there are more than 20 psychometric measures available for risk preferences. In addition, many economic studies have used field measures for risk preferences such as financial market data. This diversity in the measurement of risk preferences has likely contributed to the inconsistent findings regarding the impact of affective states on risk preferences. Ultimately, risk preferences may vary across domains (Weber et al. 2002), and measuring the impact of affective states on risk preferences in different domains may have also contributed to the mixed findings.

## 7 Conclusion

To foster comparability with the existing literature, our study combined standard methods from psychology and economics to investigate the influence of moods on risk preferences. We found only moderately credible evidence suggesting that sadness may induce risk aversion and no effects of joy and fear. This is noteworthy because our experiments had more observations and hence higher statistical power to detect true effects than several earlier studies that reported strong results (e. g. Haushofer and Fehr 2014, Mukherjee 2010, Chiles and McMackin 1996).

We conclude that claims about strong, universally-valid relationships between affective states and risk preferences should be viewed with some caution. Similarly, we think it is premature to speculate about how the interplay between affect and risk preferences may influence important real-world phenomena such as investment decisions.

## Appendix

We estimated regressions using the model specifications in Table 4 and only the incentive-compatible low- and high-financial-stakes observations from our sample in studies 1 and 2 ($N$ = 148). There are no significant effects of moods on risk preferences after correction for multiple testing.

In Table 7, we used the excluded observations from study 1 ($N$ = 188) and calculated regressions with identical model specifications as for models 1 and 2 in Table 4. These observations were obtained from participants in study 1 who had completed one or two other tasks between the completion of their mood induction and their risk-preference assessment. Previous studies (Kim and Kanfer 2009) have demonstrated that mood induction becomes weaker as the time period between the induction and task measurement becomes longer. It is therefore unsurprising that none of the mood treatments had a significant effect on risk preferences in the data from these excluded observations. Indeed, none of the experimental treatments had a significant effect in these data after correcting for multiple testing.

In Table 8, we used the pooled data from study 1 ($N$ = 278) and conducted regression analyses with the model specifications of models 1 and 2 in Table 4. We find no significant mood effects on risk preferences.

**Table 6** OLS regressions on risk preferences with incentive-compatible observations

| | *Model 1* | | *Model 2* | | *Model 3* | |
|---|---|---|---|---|---|---|
| | $\beta$ | $p$ | $\beta$ | $p$ | $\beta$ | $p$ |
| Joy | 0.03 | 0.84 | 0.18 | 0.22 | 0.18 | 0.25 |
| Fear | 0.10 | 0.42 | 0.13 | 0.38 | 0.09 | 0.59 |
| Sadness | 0.20 | 0.13 | 0.17 | 0.28 | 0.16 | 0.34 |
| Low stakes | 0.06 | 0.54 | 0.20 | 0.29 | 0.16 | 0.47 |
| Joy* Low stakes | – | – | –0.34 | 0.05 | –0.33 | 0.11 |
| Fear* Low stakes | – | – | –0.08 | 0.65 | 0.02 | 0.94 |
| Sadness* Low stakes | – | – | 0.04 | 0.83 | 0.06 | 0.79 |
| Joy* Low stakes* Study 2 | – | – | – | – | –0.001 | 0.99 |
| Fear* Low stakes* Study 2 | – | – | – | – | –0.29 | 0.34 |
| Sadness* Low stakes* Study 2 | – | – | – | – | –0.04 | 0.90 |
| *Model diagnostics* | | | | | | |
| $N$ | 148 | | 148 | | 148 | |
| $R^2$ | 0.12 | | 0.16 | | 0.16 | |
| Adj. $R^2$ | 0.03 | | 0.05 | | 0.03 | |
| Prob > $F$ | 0.22 | | 0.14 | | 0.22 | |

$\beta$s are standardized for all variables. Note that standardized regressions do not have an intercept term
Control variables are the experimental study design, experimental study design* mood treatments, experimental study design* financial stakes, personality factor scores, and self-reported risk attitudes
The reference groups are the control treatment, high financial stakes, and study 1
The results are robust to the exclusion of control variables, including additional control variables (such as gender, age, and whether the film had been seen before), including personality sum scores instead of factor scores, and to the use of OLogit instead of OLS

**Table 7** OLS regressions on risk preferences with the observations excluded from study 1

| | *Model 1* | | *Model 2* | |
|---|---|---|---|---|
| | $\beta$ | $p$ | $\beta$ | $p$ |
| Joy | –0.01 | 0.80 | –0.08 | 0.56 |
| Fear | 0.07 | 0.47 | –0.05 | 0.70 |
| Sadness | 0.07 | 0.46 | –0.06 | 0.68 |
| Low stakes | –0.09 | 0.24 | –0.31 | 0.05 |
| High stakes | 0.10 | 0.21 | 0.16 | 0.35 |
| Joy* Low stakes | – | – | 0.12 | 0.38 |
| Joy* High stakes | – | – | –0.03 | 0.80 |
| Fear* Low stakes | – | – | 0.17 | 0.22 |
| Fear* High stakes | – | – | 0.03 | 0.83 |
| Sadness* Low stakes | – | – | 0.25 | 0.07 |
| Sadness* High stakes | – | – | –0.10 | 0.39 |
| Model diagnostics | | | | |
| $N$ | 188 | | 188 | |
| $R^2$ | 0.04 | | 0.08 | |
| $Adj.\ R^2$ | –0.01 | | –0.01 | |
| $Prob > F$ | 0.62 | | 0.59 | |

26 out of 214 subjects are excluded because of unreasonable or inconsistent choices
$\beta s$ are standardized for all variables. Note that standardized regressions do not have an intercept term.Control variables are the personality factor scores and self-reported risk attitudes
The reference groups are the control treatment and fixed financial stakes
The results are robust to the exclusion of control variables, including additional control variables (such as gender, age, and whether the film had been seen before), including personality sum scores instead of factor scores, and to the use of OLogit instead of OLS

Table 9 reports the regression results by financial stakes when using the pooled data from study 1 ($N$ = 278) and model specifications identical to those in Table 5. None of the experimental treatments has a significant effect in these data after correcting for multiple testing.

In Table 10, we used the pooled high-stakes observations from study 1 and from study 2 ($N$ = 92) to conduct a regression analysis with model specifications identical to those in Model 1 in Table 4. We do not find significant effects of moods on risk preferences.

**Table 8** OLS regressions on risk preferences with pooled observations from study 1

| | *Model 1* | | *Model 2* | |
|---|---|---|---|---|
| | $\beta$ | $p$ | $\beta$ | $p$ |
| Joy | –0.01 | 0.93 | 0.01 | 0.90 |
| Fear | 0.07 | 0.38 | –0.01 | 0.95 |
| Sadness | 0.10 | 0.19 | 0.03 | 0.81 |
| Low stakes | 0.01 | 0.92 | –0.08 | 0.54 |
| High stakes | 0.16 | 0.01 | 0.18 | 0.17 |
| Joy* Low stakes | – | – | –0.02 | 0.86 |
| Joy* High stakes | – | – | –0.03 | 0.78 |
| Fear* Low stakes | – | – | 0.09 | 0.45 |
| Fear* High stakes | – | – | 0.06 | 0.50 |
| Sadness* Low stakes | – | – | 0.15 | 0.19 |
| Sadness* High stakes | – | – | –0.07 | 0.49 |
| Model diagnostics | | | | |
| $N$ | 278 | | 278 | |
| $R^2$ | 0.04 | | 0.06 | |
| *Adj.* $R^2$ | 0.01 | | 0.01 | |
| *Prob* > *F* | 0.29 | | 0.34 | |

44 out of 322 subjects are excluded because of unreasonable or inconsistent choices
$\beta s$ are standardized for all variables. Note that standardized regressions do not have an intercept term
Control variables are the personality factor scores and self-reported risk attitudes
The reference groups are the control treatment and fixed financial stakes
The results are robust to the exclusion of control variables, including additional control variables (such as gender, age, and whether the film had been seen before), including personality sum scores instead of factor scores, and to the use of OLogit instead of OLS

**Table 9** OLS regressions on risk preferences by stakes with observations from study 1

| | *Model 1: Fixed stakes* | | *Model 2: Low stakes* | | *Model 3: High stakes* | |
|---|---|---|---|---|---|---|
| | $\beta$ | $p$ | $\beta$ | $p$ | $\beta$ | $p$ |
| Joy | 0.002 | 0.98 | –0.03 | 0.82 | –0.28 | 0.27 |
| Fear | 0.02 | 0.86 | 0.10 | 0.37 | 0.26 | 0.29 |
| Sadness | –0.02 | 0.89 | 0.23 | 0.04 | –0.22 | 0.37 |
| Model diagnostics | | | | | | |
| $N$ | 122 | | 123 | | 33 | |
| $R^2$ | 0.02 | | 0.08 | | 0.24 | |
| *Adj.* $R^2$ | –0.05 | | 0.01 | | –0.03 | |
| *Prob* > *F* | 0.96 | | 0.33 | | 0.52 | |

44 out of 322 subjects are excluded because of unreasonable or inconsistent choices
$\beta s$ are standardized for all variables. Note that standardized regressions do not have an intercept term
Control variables are the personality factor scores and self-reported risk attitudes
The reference group is the control treatment
The results are robust to the exclusion of control variables, including additional control variables (such as gender, age, and whether the film had been seen before), including personality sum scores instead of factor scores, and to the use of OLogit instead of OLS

**Table 10** OLS regressions on risk preferences with pooled high-stakes observations from studies 1 and 2

| | $\beta$ | $p$ |
|---|---|---|
| Joy | 0.13 | 0.34 |
| Fear | 0.12 | 0.37 |
| Sadness | 0.07 | 0.62 |
| Model diagnostics | | |
| $N$ | 92 | |
| $R^2$ | 0.04 | |
| *Adj.* $R^2$ | –0.05 | |
| *Prob* > *F* | 0.92 | |

10 out of 102 subjects are excluded because of unreasonable or inconsistent choices
$\beta s$ are standardized for all variables. Note that standardized regressions do not have an intercept term
Control variables are the personality factor scores and self-reported risk attitudes.
The reference group is the control treatment
The results are robust to the exclusion of control variables, including additional control variables (such as gender, age, and whether the film had been seen before), including personality sum scores instead of factor scores, and to the use OLogit instead of OLS

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