NEGATIVE AFFECT AND OVERCONFIDENCE:

A LABORATORY INVESTIGATION

John Ifcher and Homa Zarghamee

Draft: December 2011

We conduct a carefully designed random-assignment experiment to investigate whether negative affect impacts overconfidence. Our result indicates that, compared to neutral-affect, fear and sadness significantly increase overconfidence. All decisions were incentivized, and the result is robust to various specification checks. Further, our result has implications for the role of emotions in economic decision making, in general. Finally, we reconfirm the ubiquity of overconfidence and start to explore its determinants (JEL D01, D83, D03).

The authors contributed equally to this work. Ifcher: Department of Economics, Santa Clara University, 500 El Camino Real, Santa Clara, CA 95053 (e-mail:jifcher@scu.edu); Zarghamee: Department of Economics, Santa Clara University, Santa Clara, CA 95053 (e-mail: hzarghamee@scu.edu). We wish to thank seminar participants at various locations. Financial support from Santa Clara University's Presidential Research Grant DPROV004 and Leavey Grant is gratefully acknowledged. All opinions and errors are those of the authors.

Introduction

Overconfidence, defined as the "overestimat[ion] of [one's own] performance in tasks requiring ability, including the precision of [one's own] information (DellaVigna 2009, p. 341)," is an important deviation from standard utility theory. A vast behavioral finance literature has identified overconfidence as a key determinant of financial outcomes (Alpert and Raiffa 1982; and Barberis and Thaler 2003). While corollaries of overconfidence abound, its identified determinants number few; generally, overconfidence is higher in men than women and is prevalent across levels of task-performance and expertise.

In recent work, Ifcher and Zarghamee (2011b) establish that positive affect significantly increases overconfidence in a laboratory experiment. From this work, though, the effect of negative affect on overconfidence cannot be determined: negative and positive affects do not necessarily have opposing effects, and different negative affective states—i.e. fear versus anger—often give rise to very different behaviors (Isen 2007). Following the design of Ifcher and Zarghamee (2011b), we conduct a laboratory experiment to identify the effect of three negative affects—fear, anger, and sadness—on overconfidence. After completing a monetarily incentivized set of trivia and math questions, subjects watch an affect-inducing film clip and then estimate their performance, both in absolute terms and relative to other subjects. These estimations are also monetarily incentivized. We find that, like positive affect, these negative affects increase overconfidence, reducing earnings.

Literature Review[1]

Overconfidence

It has been consistently found that decision makers' own-estimated performance exceeds their actual performance, and their estimated ranking among peers exceeds their actual ranking (DellaVigna 2009). Overconfidence has been identified amongst both novices and experts in a variety of professions, including clinical psychologists, physicians, nurses, investment bankers, engineers, entrepreneurs, lawyers, negotiators, and managers (Barber and Odean 2001).

In the behavioral finance and economics literature, overconfidence has been shown to cause overtrading (DeBondt and Thaler 1995; Barber and Odean 2001; Statman et al. 2006; Glaser and Weber 2007; and Kim and Nofsinger 2007), speculative bubbles (Daniel et al. 1998; Scheinkman and Xiong 2003; Shiller 2003; and Michailova 2010) inferior corporate investments (Malmendier and Tate 2005), and acceptance of stock options as compensation (Oyer and Schafer 2005).

Although its effects are many, the known determinants of overconfidence are few. Aspects of the choice task can exacerbate overconfidence. These include abstractly defined goals, and decisions that are low in frequency or produce noisy feedback (Malmendier and Tate 2005). Overconfidence has also been consistently linked to gender, with men exhibiting more overconfidence than women (Lundeberg et al. 1994; Barber and Odean 2001; Niederle and Vesterlund 2007; Croson and Gneezy 2009). The current research aims to determine whether negative affects impact overconfidence.

[1] For a more detailed review of the overconfidence literature, see Ifcher and Zarghamee (2011b).

Behavioral Effects of Negative Affect

The literature on the behavioral effects of emotions can be broadly divided based on the valence of the emotions—namely positive or negative. Although there is not 100% unanimity amongst psychologists, the view that positive affect promotes cognitive flexibility—openness to information, broadening of focus and attention, and improved integration of information—is generally supported by the experimental evidence (see Isen 2008), and even by neural research (Ashby et al. 1999; and Isen 2008).

The effects of negative affect, though equally important, are not as easily organized or summarized as those of positive affect. First off, the independence of positive and negative affect is well-established in psychology, so positive and negative affect do not necessarily have opposite effects (Norman M. Bradburn 1969; Diener and Emmons 1984; Watson et al. 1988; Lyubomirsky et al. 2005; and Isen 2007). Further, distinct positive affects are less likely to have variant effects on behavior than are distinct negative affects (Isen 2007)[2], so the negative-affect literature must be considered separately by affect.

Theories of how affects impact behavior have evolved considerably, and the most current theory—the appraisal-tendency framework—comprises elements of its predecessors, to which we now turn. Theories of availability and mood-congruency hold that positive (negative) moods affect behavior by favoring the accessibility of similarly "valenced"—i.e. positive (negative)—thoughts and memories (Tversky and Kahneman 1973; Isen et al. 1978). For example, a depressed mood may make available thoughts and memories of a friend's accidental death; these thoughts distort the probability I

[2] Much of this is due to the fact that the distinct positive affect that most studies are concerned with is a happy mood. Also, many studies that consider negative affect elicit only a particular affect—usually sadness.

assign to accidents and thus make me more likely to purchase insurance. Subsequent theories take into account affect's impact on not just perceptions but motives. The theory of mood-maintenance avers that good moods, as desirable end-goals, change behavior in order to be prolonged (Isen 1984); inversely, the theory of mood-repair suggests that bad moods change our behavior in order to improve mood (Zillman 1988). Yet another class of theories sees affect as an indirect source of information for decision-making: when evaluating an item or choice, a good or depressed mood may be misinterpreted as relevant information and so sway judgments and behavior (Schwarz and Clore 1983): respondents to a survey conducted on a rainy day report lower life-satisfaction than those surveyed on a sunny day (Schwarz and Clore 1983), and stock returns are decreased by unexpected cloud-cover (Saunders 1993; and Hirshleifer and Shumway 2003) and important sports losses (Edmans et al. 2007).

The appraisal-tendency framework relies upon each emotion's characterization along a range of dimensions (Smith and Ellsworth 1985; and Lerner and Keltner 2001). These dimensions—the emotion's appraisal tendencies—determine how the emotion alters our perceptions or motives, what information it conveys, and ultimately how it impacts our behavior. For example, disgust "revolves around the appraisal theme of being too close to an indigestible object or idea (Lerner et al. 2004, p. 337);" it therefore encourages expulsion and attenuates status-quo bias (Han et al. 2010). Below, we review appraisal tendencies of fear, anger, and sadness and evidence of their effects.

Fear

The appraisal-tendencies associated with fear are unpleasantness, high uncertainty over outcomes, and low control over the situation (Smith and Ellsworth 1985). Indeed, in controlled experiments, induced fear has been shown to increase perceived risk (Johnson and Tversky 1983; Lerner and Keltner 2001). The appraisal-tendency framework thus suggests that the reduction of uncertainty and avoidance of risk take on paramount importance as motives (Raghunathan and Pham 1999). Evidence of this is also provided by controlled experiments, wherein induced fear increases preference for low-risk, low-reward lotteries over high-risk, high-reward lotteries (Raghunathan and Pham 1999). Uncertainty-reduction and risk-avoidance suggest, albeit indirectly, that induced fear should decrease overconfidence.

Anger

Anger, like fear, is a negative emotion, but is fear's opposite in many dimensions: it is associated with certainty about a negative situation and who is to blame for it and with a sense of personal control over fixing or coping with it (Lerner and Tiedens 2006). Further, the sense of certainty it imbues is thought to reduce the motivation to process new information carefully (Inbar and Gilovich 2011). Controlled experiments have found that it increases risk-seeking (Lerner and Tiedens 2006), stereotyping (Bodenhausen 1994), preferences for in-group members versus out-group (Mackie et al. 2000; and DeSteno et al. 2004), rejection of unfair ultimatum-game offers (Andrade and Ariely 2009), and punishing behavior (Goldberg et al. 1999); and decreases perceived risk (Johnson and Tversky 1983; Lerner and Keltner 2001), trust (Dunn and Schweitzer 2005), and preference for public welfare assistance (Small and Lerner 2005). Because it

enhances a sense of personal control and diminishes careful thought-processing, anger is hypothesized to increase overconfidence.

Sadness

The appraisals associated with sadness are loss, helplessness, and diminished sense of control over the situation (Smith and Ellsworth 1985; Lerner et al. 2004). Controlled experiments have found that sadness evokes behavior that rewards both the self and others: it increases self-evaluations[3] (Jundt and Hinsz 2002); consumption of tasty, fattening foods (Garg et al. 2007; valuation of, willingness to pay for, and spending on new products (Lerner et al. 2004; Cryder et al. 2008); preference for high-risk, high-reward lotteries over low-risk, low-reward lotteries (Raghunathan and Pham 2005) despite increased perceived risk (Johnson and Tversky 1983; Lerner and Keltner 2001); helping behavior (Manucia et al. 1984); and reciprocity in gift-exchange games (Kirchsteiger et al. 2006).

The above findings are consistent with mood-repair: sad individuals take actions to improve their affective states (Clark and Isen 1982). Another account relies on the consistent finding that sadness increases self-focus (Wood et al. 1990; Salovey 1992; and Silvia et al. 2006). Cryder et al. (2008) demonstrate that the effect of sadness on spending is mediated by self-focus, and they hypothesize that sadness and self-focus indirectly "trigger[] an implicit desire to enhance the self (p. 526)."

From these findings, we would expect sadness to increase overconfidence. Further support for this hypothesis is offered from papers that explicitly study the effect

[3] Brown and Mankowski (1993) find that sadness only decreases self-evaluations in individuals with low self-esteem.

of sadness on overconfidence. Although Allwood and Bjorhag (1991) find that negative affect has no effect on overconfidence, Allwood et al. (2002) and Kuvaas and Kaufmann (2004) compare the effect of positive to negative affect (sadness, specifically) on overconfidence without a neutral condition and find no difference. This would be consistent with sadness increasing overconfidence, given that Ifcher and Zarghamee (2011b) find that positive-affect increases overconfidence relative to neutral-affect.

Experimental Design

In brief, the experimental procedure was as follows (additional details are provided below): First, subjects read detailed instructions regarding the experimental session; the instructions were also read aloud by the experimenter. Second, subjects read and signed the informed consent form. Third, subjects took a 30-question quiz. Fourth, the mood-inducement procedure was administered. Fifth, subjects evaluated their performance on the quiz. Sixth, subjects answered questions regarding their mood. Seventh, subjects answered questions regarding their demographic and psychological characteristics. Finally, subjects received their payments and exited the experimental session. In total, the experimental session lasted approximately 45 minutes, and subjects received an average of $15 for their participation (all instructions and forms are presented in Appendix A).

Subjects

The laboratory experiment was conducted at the Center for Experimental Social Science (CESS) laboratory at New York University. One-hundred and seventy-nine students were

recruited using CESS's online recruitment tool. Prospective subjects were told that participation in the study would take less than an hour and that they would be paid for their participation, with an average payment between $15 and $20, a minimum payment of $10, and a maximum payment of $25.

Quiz (Activity 1)

In the first part of the experiment, called Activity 1, subjects were given 15 minutes to complete a 30-question quiz. The instructions for Activity 1, which were also read aloud, stated that subjects would be paid $0.50 for each answer that was exactly correct, and that no partial credit would be given. The quiz included 20 trivia and 10 "math" questions. The trivia questions ranged in difficulty from, "The United States shares the longest unguarded border in the world with what country?" (correct answer: "Canada") to, "Who ruled Iraq before Saddam Hussein?" (correct answer: "Ahmed Hassan al-Bakr"). The trivia questions closely followed those used by Moore and Small (2007). The math questions asked subjects to add five two-digit numbers; the two-digit numbers were generated randomly. The math questions were similar to those used in Niederle and Vesterlund (2007).

Mood inducement

We attempted to manipulate subjects' mood by showing them a short film clip. The use of film clips to induce moods is common in psychological and, increasingly, economic experiments (Gross and Levenson 1995; Kirchsteiger et al. 2006; Rottenberg et al. 2007; Ifcher and Zarghamee 2011a; and Oswald et al. 2011). Further, the use of film clips has

been shown to be one of the most effective means of inducing negative affects (Westerman et al. 1996).

In our experiment, subjects were randomly assigned either to one of three treatment groups—fear (44 out of 179), anger (44 out of 179), and sadness (49 out of 179)—and watched a film clip intended to induce the appropriate negative affect; or to the control group (42 out of 179) and watched a film clip intended to induce neutral affect. Except for the variant film clip, the experimental procedure was identical for the treatment and control groups.

Our choice of film clips followed Gross and Levenson (1995), in which over 200 film clips were evaluated for their efficacy in inducing each of eight different affects. The film clip in the anger treatment was a scene from *My Bodyguard* (Simon, 1980), in which bullies taunt and beat-up a silent, teenage boy. The film clip in the fear treatment was a scene from *Silence of the Lambs* (Goetzman, 1991), in which a female FBI agent pursues a suspect into a dark and eerie basement. The film clip in the sadness treatment was a scene from *The Champ* (Lovell, 1979), in which a boy's father, a boxer, dies after a match while the boy is watching. The neutral-affect film clip was a "screensaver"-like animation of colored sticks. The film clips were each roughly 4 minutes long.

Performance self-evaluation (Activity 2)

In activity 2 subjects evaluated their performance on the quiz (Activity 1) by answering the following four questions:

1. "How many of the 30 questions in Activity 1 do you think you answered correctly?"

2. "How well do you think you did in Activity 1?" where possible responses ranged from 1, "Very poor," to 7, "Very well"
3. "I think that I answered _____ more / fewer (circle one) questions correctly than did the typical participant in this session."[4]
4. "In terms of correct answers in Activity 1, how do you think you performed relative to all the other participants in this session?" where possible responses ranged from 1, "Well below average," to 7, "Well above average"

Two of the four questions, the first and third, were incentivized financially. The instructions to Activity 2, which were also read aloud, informed the subjects in detail about the payment scheme for Activity 2. Specifically, subjects were informed that they would receive $5 if their answer to question 1 was correct, and $3 ($1) if their answer was within 3 (6) of the correct answer. The payment scheme for question 3 was similar, except that subjects had to estimate their relative performance within 2 (4) questions correctly to receive the $3 ($1) payment, respectively (again Appendix A contains the instructions for the entire experiment).

Affect check (questionnaire 1)

Next subjects completed the Positive Affect Negative Affect Schedule (PANAS) to confirm that the mood-inducement procedure had the intended effect (Watson et al. 1988). Specifically, subjects were asked to rate how much of 7 positive and 9 negative

[4] Immediately preceding this question on the form was the following statement: "Activity 1 had 30 questions. Compared to the typical participant in this session, how many more or fewer questions do you think you answered correctly? (In other words, compare how many of the 30 questions in Activity 1 you think the typical participant answered correctly to your answer to question #1 above).

affects they felt during the film clip, where possible responses ranged from 1 ("You do not feel even the slightest bit of the emotion") to 10 ("You feel the most of the emotion you have ever felt in your life"). The seven positive affects are amusement, arousal, contentment, happiness, interest, relief, and surprise; the nine negative affects are anger, confusion, contempt, disgust, embarrassment, fear, pain, sadness, and tension. The PANAS was framed to capture emotions felt during the film clip to avoid any confounding mood-effects from completing the self-evaluation (Activity 2). Further, since the primary objective of this research is to examine the impact of negative affects on overconfidence, the self-evaluation (Activity 2) was administered before the affect check. This order of events eliminated the possibility that the induced mood would be moderated, or nullified, by the affect check. Finally, as a secondary affect check subjects were also asked whether the film clip made them: "angrier," "more fearful," or "sadder" in questionnaire 2 (described below).

Demographic and personality traits (questionnaire 2) and completing the session

Finally, subjects were asked about their demographic and psychological characteristics as well as how the film clip made them feel. When all subjects had completed Questionnaire 2 they received their payments and exited the experimental session. They were given the experimenters' contact information and were instructed to contact the experimenters if they had questions.

Descriptive results

Demographic characteristics

Over half of the subjects are female (64 percent), most are U.S. citizens (79 percent), and subjects' average age is 20 (see Table 1). Almost all of the subjects are either Asian (56 percent) or White (29 percent). Subjects were mostly students in the College of Arts & Science (63 percent) or the School of Business (21 percent). More than two-thirds of the subjects are either freshmen (35 percent) or sophomores (35 percent). The most heavily represented religious identities are atheist (39 percent) and Christian (38 percent), accounting for more than three-quarters of the subjects. Less than half of the subjects (41 percent) reported that they practice their religion and almost half (48 percent) rarely attend religious services (once per year at most). Fifty-five percent report family incomes below $100,000, 15 percent above $200,000, and 30 percent in between. Finally, 46 percent of subjects self-identify as liberal, 43 percent as moderate, and 8 percent as conservative.

For most demographic characteristics, there are not statistically significant differences between subjects in the treatment and control groups. However, despite random assignment, there are five differences with a p-value of less than 0.05. Four of these are between the fear treatment and the control group. The proportion of male students, White students, students in the College of Arts & Sciences, and students with family incomes above $200,000 is greater in the fear treatment than in the control group. Lastly, the average age of subjects in each treatment group is lower than in the control group. While there is no obvious reason to believe that these differences would confound the results—since it is unclear how gender, race, college, family income, and age interact with affect and overconfidence—it is nonetheless prudent to control for these demographic characteristics in the econometric analysis.

Affect check

Subjects in each treatment group report significantly higher levels of the target affect than subjects in the control group: 5.19 versus 2.56, $p = 0.00$, for anger; 4.48 versus 1.98, $p = 0.00$, for fear; and 5.18 versus 1.80, $p = 0.00$, for sadness (see Table 2). Further evidence that the mood-inducement procedure has the intended effect can be seen in responses to the following questions from Questionnaire 2: "Did seeing the video clip make you?" (1) "angrier," (2) "more fearful," or (3) "sadder." The proportion of subjects in each treatment group who state that the film clip changes their mood as intended is significantly greater than it is in the control group: 0.46 versus 0.12, $p < 0.01$, for angrier; 0.36 versus 0.10, $p < 0.01$, for more fearful; and 0.63 versus 0.10, $p = 0.00$, for sadder (see Table 2). Finally, total negative affect—the sum of the nine negative affect scores from the PANAS—is greater for subjects in each treatment group than it is for subjects in the control group: 37.63 versus 22.22, $p = 0.00$, for anger; 27.60 versus 22.22, $p < 0.10$, for fear; and 31.53 versus 22.22, $p = < 0.01$ for sadness.

Total positive affect—the sum of the seven positive affect scores from the PANAS—is marginally lower for subjects in anger and sadness treatments than for subjects in the control group: 16.91 versus 20.54, $p < 0.10$, for anger; and 16.87 versus 20.54, $p< 0.10$, for sadness. Interestingly, however, total positive affect is greater, but not significantly so, for subjects in the fear treatment than for subjects in the control group: 22.21 versus 20.54, n.s. This difference arises because the fear treatment's film clip increases *interest* scores compared to the neutral-affect film clip: 6.09 versus 4.05, $p < 0.01$; neither of the other negative-affect film clips has this impact. As a matter of fact,

all other positive-affect scores for subjects in the three treatment groups are weakly less than the scores for subjects in the control group. Thus, the negative-affect film clips do not increase positive-affect scores in general. Finally, subjects in the fear treatment report that they enjoy watching the film clip significantly more than subjects in the control group: 4.68 versus 3.54 ($p = 0.00$). Again, neither of the other negative-affect film clips has this impact.[5] In the econometric analysis, we control for subjects' *interest* scores and how much they enjoyed the film clip.

Finally, each negative-affect film clip statistically significantly ($p < 0.1$) increases untargeted negative-affect scores. The anger treatment's film clip significantly increases *contempt*, *disgust*, *embarrassment*, *sadness*, and *tension* scores; the fear treatment's film clip increases *disgust*, and *tension* scores; and the sadness treatment's film clip increases *disgust*, *fear*, *pain*, and *sadness* scores. Further, the proportion of subjects in the anger treatment who state that the film clip made them sadder is significantly greater than it is in the control group: 0.57 versus 0.10, $p < 0.01$. Thus, we were not able to induce the three negative affects—anger, fear, and sadness—without "spillover" to other negative affects. Consequently, we examine the impact of negative affect on overconfidence with the treatment groups combined—pooling across all the negative affects—as well as separately.

Overconfidence

[5] We believe these two unanticipated effects in the fear treatment—elevated *interest* scores and greater enjoyment—stem from the fact that *Silence of the Lambs* is a well-known film that many subjects may have already seen featuring a contemporary celebrity many subjects are familiar with. The other negative-affect film clips are less well-known.

The two primary measures of overconfidence used in this research are derived from the responses to questions 1 and 3, the incentivized questions from Activity 2. In particular, "Absolute Overconfidence" (AOC) is defined as the difference between the estimated (question 1 from Activity 2) and actual number of correct answers on the quiz. For example, if a subject estimated that she answered 20 (14) questions correctly but actually answered 17 correctly, then the subject's AOC would be +3 (-3). "Relative Overconfidence" (ROC) is defined as the difference between a subject's estimated (question 3 from Activity 2) and actual number of correct answers on the quiz relative to all subjects in the same session. For example, if a subject estimated that she answered 4 more (4 fewer) questions correctly than the average subject in the same session—and she actually answered 2 more questions correctly than the average in the session—then the her ROC would be +2 (-6).

Subjects exhibit both AOC and ROC statistically significantly greater than zero. Across all subjects average AOC is 1.61 and ROC is 0.85 (see Columns (2) and (3) of Table 3). Overconfidence is diffuse, 64 percent of subjects exhibit AOC and 63 percent exhibit ROC. The magnitude of AOC is substantial. Subjects overestimate their own performance by 9 percent, estimating, on average, that they answer 1.61 more questions correctly than they actually do; subjects average 18.31 correct answers on the quiz, but the average estimate is 19.92.

Given the well-established finding that men exhibit greater overconfidence than women, it is of interest to examine AOC and ROC by gender. As measured by AOC, men exhibit marginally statistically significant greater overconfidence than do women (2.3 versus 1.2, $p < 0.06$); and a greater proportion of men exhibit overconfidence than do

women (0.69 versus 0.61, n.s.) (see Columns (5) and (8) of Table 3). As measured by ROC, however, there is no evidence that men exhibit greater overconfidence than do women (0.85 versus 0.85, n.s.) (see Columns (6) and (9) of Table 3). It is also interesting to note that men answer a significantly greater number of quiz questions correctly (19.2 versus 17.3, p-value < 0.01) (see Columns (4) and (7) of Table 2).

Finally, AOC and ROC are regressed separately on each demographic characteristic to determine if there is a statistically significant relationship between overconfidence and the demographic characteristic; robust standard errors are calculated by clustering subjects by session. With AOC as the regressand, five variables (in addition to female) have at least marginally statistically significant coefficients: U.S. citizen (positive), Asian (negative), White (positive), senior (positive), and graduate student (negative) (see Table 4). With ROC as the regressand, one variable has a statistically significant coefficient: graduate student (negative).

Main results

To study the effect of negative affect on overconfidence, we estimate a model of the following form:

(1) $$Overconfidence = \beta_T Treatment + X'\beta_X + Y'\beta_Y$$

where *Overconfidence* is measured by AOC or ROC; *Treatment* is a treatment dummy that equals one if the subject is in the treatment group and zero otherwise (the negative-affects treatments are first pooled and then included separately); *X* denotes the vector of

demographic control variables (gender, age, citizenship, race, college, graduating class, religious identity, religious practice, family income, and political identity); and *Y* denotes the vector of additional control variables (performance on the quiz, *interest* score, and enjoyment of the film clip). The first additional control is included since overconfidence varies with quiz performance. The other two are included because the fear treatment's film clip increases *interest* scores on the PANAS and subjects in the fear treatment enjoy watching the film clip more than any other group. Finally, OLS is used to estimate equation (1). Robust standard errors are calculated by clustering observations by session.

AOC treatment effect

Estimating equation (1) with the treatment groups pooled, the coefficient on T*reatment* is positive, but insignificant, with no control variables ($b = 1.01$, n.s.). Adding the demographic control variables increases the magnitude and the significance of the coefficient: it is now larger and statistically significant ($b = 1.46$, $p < 0.05$). Finally, adding the additional control variables, *Y*, does not martially change the coefficient ($b = 1.73$, $p < 0.05$) (see Columns (1) – (3) of Panel (1) in Table 5). The results appear to indicate that putting subjects in a negative mood increases their overconfidence (as measured by AOC). The size of the effect appears quite large. The treatment effect is greater than 60 percent of average AOC, 1.61, across all specifications.[6]

Given that Asians and females exhibit significantly less AOC than non-Asians and males, respectively, we examine whether the pooled treatment effect differs by race

[6] Only two other coefficients from estimating equation (1) are marginally statistically significant. The coefficient on *age* is positive and marginally statistically significant and the coefficient on *not a U.S. citizen* is negative and marginally statistically significant (see Table 6).

(Asian versus non-Asian) or gender.[7] Specifically, the following interaction terms are added individually to equation (1): *Treatment*Asian* and *Treatment*Female*. Interestingly, the coefficient on each interaction term is negative, though not statistically significant; and the corresponding coefficient on *Treatment* is positive, statistically significant, and greater than it was before (see Columns (4) & (5) of Panel (1) in Table 5). For example, the coefficient on *Treatment*Asian* is -1.85, n.s., and the coefficient on *Treatment* is 2.96, $p < 0.01$. This appears to indicate that Asians' AOC is less affected by the induced negative mood than is non-Asians' AOC. Further evidence of the variant treatment effect is apparent when one estimates equation (1) for Asians and non-Asians separately. The coefficient on *Treatment* is smaller when the sample is restricted to Asians than when it is restricted to non-Asian ($b = 1.56$, n.s., versus $b = 3.27$, $p < 0.10$, respectively) (see Columns (4a) and (4b) of Panel (1) in Table 5). The same pattern emerges when one interacts gender with *Treatment* (see Columns (5), (5a) and (5b) of Panel (1) in Table 5). Thus, not only do Asians and females exhibit less AOC, on average, than non-Asian and males, respectively, but they also appear to be less affected by the induced negative mood.[8]

Estimating equation (1) with the treatment groups not pooled, one finds that the treatment effect is always positive but not necessarily statistically significant. The strength of the results vary by treatment with the sadness treatment having the strongest

[7] Recall that 56 percent of the sample was Asian. The next largest group was whites, 29 percent.
[8] We explore the possibility that this results from the mood-inducement procedure having varying efficacy across race (Asian versus non-Asian) and gender. However, there is no statistically significant difference in the target-affect scores across race and gender in each treatment group. Further, there is only one statistically significant difference in total negative affect across race and gender. Female subjects in the sadness treatment report significantly greater total negative affect than male subjects. This would appear to indicate that the sadness treatment's film clip has a greater effect on female subjects' mood than on male subjects' mood. Thus, the variant treatment effect across race and gender does not appear to result from the mood-inducement procedure having a variant effect across race and gender.

results, the fear treatment having the next strongest results, and the anger treatment having the weakest results. In the second and third specification, the coefficient on *Treatment* is positive and statistically significant for the sadness treatment ($b = 1.92$, $p < 0.05$, and $b = 2.24$, $p < 0.05$, respectively); positive and marginally statistically significant with the fear treatment ($b = 1.31$, $p < 0.10$, and $b = 1.82$, $p < 0.10$, respectively); and positive and insignificant with the anger treatment (see Columns (2) & (3) of Panel (2) in Table 5).

Interacting *Treatment* (not pooled) with race (Asian and non-Asians) and gender, one finds a similar pattern as with the pooled treatments. Again, the coefficient on each interacted term is negative though generally not statistically significant (4 out of 6), and the corresponding coefficient on *Treatment* is positive and generally, at least, marginally statistically significant (5 out of 6). For example, for the sadness treatment, the coefficient on *Treatment*Asian* is negative and statistically significant, and the corresponding coefficient on *Treatment* is positive and statistically significant ($b = -3.41$, $p < 0.05$, and $b = 4.61$, $p < 0.01$, respectively), indicating that the sadness treatment appears to increase non-Asians' overconfidence more than Asains' overconfidence (as measured by AOC). Among the interaction results, the following is interesting and worth noting: in the anger treatment, the coefficients on *Treatment*Female* and *Treatment* are virtually equal in magnitude and are both statistically significant, but of opposite signs. This appears to indicate that while the anger treatment has a large, positive impact on men's overconfidence, it has virtually no impact on women's overconfidence (as measured by AOC).

ROC treatment effect

The effect of negative affect on ROC is similar to its effect on AOC, but less marked both in terms of magnitude and statistical significance. In the regression of ROC on the pooled treatment groups, the coefficient on *Treatment* is always positive but only approaches statistical significance in the second and third specifications: $b = 0.92$, $p < 0.11$, and $b = 0.93$, $p < 0.13$ (see Columns (1) to (3) of Panel (1) in Table 7). With the treatment groups not pooled, the coefficient on *Treatment* is again always positive but only approaching statistical significance for the fear treatment: $b = 1.45$, $p < 0.11$ and $b = 1.46$, $p < 0.01$ for the second and third specifications, respectively (see Columns (1) to (3) of Panel (2) in Table 7). Interacting *Treatment* with race (Asian versus non-Asian) and gender, one finds that all the interaction terms' coefficients to be positive but not statistically significant, and the corresponding coefficient on *Treatment* is smaller than it was before and never statistically significant (see Columns (4) & (5) of Panel 2 in Table 7).

In summary, there is moderate evidence that negative affect increases overconfidence (as measure by ROC). However, the size and statistical significance of the effect is smaller than when overconfidence is measured by AOC. The ROC results are strongest for the fear treatment and weakest for the anger treatment; in contrast, the AOC results are strongest for the sadness treatment. Finally, there is weak evidence that Asians and females' ROC is more affected by the negative-mood inducement than is non-Asians and males' ROC, respectively; this is the opposite of what is observed for AOC.

Discussion

To identify the effect of negative affects on overconfidence, we conducted a random-assignment experiment in which subjects evaluated their performance on a quiz after experiencing either a negative- or neutral-affective shock. In summary, we find that negative affect increases overconfidence: compared to subjects who experience a neutral-affect shock, those who experience a negative-affect shock estimate having performed better on the quiz in absolute terms, and to lesser extent, relative to their peers. On average, a negative-affect shock increases AOC and ROC by between 1 to 3.7, and 0.4 to 0.9, respectively. These effects correspond to an AOC-increase of between 123% and 457% (the average AOC for subjects in the neutral-affect inducement is roughly 0.8 questions) and an ROC-increase of between 73% and 111% (the average ROC for subjects in the neutral-affect inducement is roughly 0.9 questions). Comparing these figures to Ifcher and Zarghamee's (2011b) estimations of the effect of positive affect on overconfidence, we find that, in percentages, the effect of negative affect on AOC is approximately three times greater that of positive affect, but that the effect on ROC is roughly a quarter of that of positive affect.

In contrast to our hypotheses, our qualitative findings do not depend on the specific negative affect induced: fear, anger, and sadness all increase overconfidence (only for fear and sadness are the effects generally statistically significant). While sadness has the hypothesized effect, our prediction that fear would decrease overconfidence was sharply contrasted, and our prediction that anger would increase overconfidence was only qualitatively support. We believe that this is primarily due to affective spillovers in the negative-affect-inducements. Each of the negative-affect-inducements increases other negative affects in addition to its target affect, thereby

precluding clean identification of the effects on overconfidence of the target affects. That said, each negative-affect-inducement has the largest effect on its target affect, so it may be that the results for individual affects are valid and our hypotheses were misguided.[9]

Importantly, the data does not suggest that the increased overconfidence attributed to negative affect is purely a result of positive affect—an established determinant of overconfidence—having been produced by the mood-inducement procedure (Ifcher and Zarghamee 2011b). Relative to the neutral-affect treatment, the anger and sadnesstreatments do not produce more enjoyment of the clip, arousal, interest, or any other positive affect. The fear treatment does increase interest, total positive affect, and enjoyment of the film clip; but econometric analysis reveals a strong fear-effect even controlling for positive affect. That positive and negative affect both increase overconfidence is suggestive of a "hot-cold" effect, perhaps that overconfidence is exacerbated by any emotional arousal. Be that as it may, behavioral effects of intense mood-states are not necessarily amplifications of the effects of mild ones, so intensification of negative affect will not necessarily increase overconfidence (Isen 2007).

[9] That all negative affects had the same effect on overconfidence is not at odds with the appraisal-tendency framework, nor does it imply that valence-based theories of affect are supported. Further research is necessary to establish the mechanism behind our results. The emotion-regulation literature offers another possible mechanism. Emotions—particularly negative ones—potentially give rise to regulatory processes like suppressing the expression of emotion or reappraising the meaning of the situation; so the estimated effects of emotions may be the effects of the regulatory processes (Heilman et al. 2010). Being in a laboratory experiment with a roomful of subjects may well encourage emotional regulation, but we have no way to analyze this possibility.

References

Allwood, Carl Martin, and Carl Gustav Bjorhag. 1991. "Mood and Realism of Confidence Judgements of One's Own Answers to General Knowledge Questions." *Scandinavian Journal of Psychology*, 32(4): 358-71.

Allwood, Carl Martin, Par Anders Granhag, and Anna-Carin Jonsson. 2002. "Does Mood Influence the Realism of Confidence Judgments?" *Scandinavian Journal of Psychology*, 43: 253-60.

Alpert, Marc, and Howard Raiffa. 1982. "A Progress Report on the Training of Probability Assessors." In *Judgment Under Uncertainty: Heuristics and Biases*, ed. Daniel Kahneman, Paul Slovic, and Amos Tversky, 294–305. Cambridge and New York: Cambridge University Press.

Andrade, Eduardo B., and Dan Ariely. 2009. "The enduring impact of transient emotions on decision making." *Organizational Behavior and Human Decision Processes*, 109: 1-8.

Ashby, F. Gregory, Alice M. Isen, and And U. Turken. 1999. "A Neuropsychological Theory of Positive Affect and its Influence on Cognition." *Psychological Review*, 106(3): 529-50.

Barber, Brad M., and Terrance Odean. 2001. "Boys Will Be Boys: Gender, Overconfidence, and Common Stock Investment." *Quarterly Journal of Economics*, 116(1): 261–92.

Barberis, Nicholas, and Richard Thaler. 2003. "A Survey of Behavioral Finance." In *Handbook of the Economics of Finance*, ed. George M. Constantinides, Milton Harris, and René M. Stulz, 1053-121. Amsterdam: Elsevier.

Bodenhausen, Galen V., Lori A. Sheppard, and Geoffrey P. Kramer. 1994. "Negative affect and social judgment: the differential impact of anger and sadness." *European Journal of Social Psychology*, 24: 45–62.

Bradburn, Norman M. 1969. *The Structure of Psychological Well-Being*. Chicago: Aldine Publishing Company.

Brown, Jonathon D., and Tracie A. Mankowski. 1993. "Self-Esteem, Mood, and Self-Evaluation: Changes in Mood and the Way You See You." *Journal of Personality and Social Psychology*, 64(3): 421-30.

Clark, Margaret S., and Alice M. Isen. 1982. "Toward understanding the relationship between feeling states and social behavior." In *Cognitive social psychology*, ed. Albert H Hastorf and Alice M. Isen, 73-108. Amsterdam: Elsevier.

Croson, Rachel, and Uri Gneezy. 2009. "Gender Differences in Preferences." *Journal of Economic Literature*, 47(2): 448-74.

Cryder, Cynthia E., Jennifer S. Lerner, James J. Gross, and Ronald E. Dahl. 2008. "Misery is not Miserly: Sad and Self-Focused Individuals Spend More." *Psychological Science*, 19(6): 525-30.

Daniel, Kent, David Hirshleifer, and Avanidhar Subrahmanyam. 1998. "Investor Psychology and Security Market Under- and Overreactions." *Journal of Finance*, 53(6): 1839–85.

De Bondt, Werner F. M., and Richard H. Thaler. 1995. "Financial Decision-Making in Markets and Firms: A Behavioral Perspective." In *Handbooks in Operations Research & Management Science*, vol 9, ed. R.A. Jarrow, V Maksimovic, and W.T. Ziemba, 383-41. Oxford: Elsevier.

DellaVigna, Stefano. 2009. "Psychology and Economics: Evidence from the Field." *Journal of Economic Literature*, 47(2): 315-72.

DeSteno, David, Nilanjana Dasgupta, Monica Y. Bartlett, and Aida Cajdric. 2004. "Prejudice from thin air: the effect of emotion on automatic intergroup attitudes." *Psychological Science*, 15: 319–324.

Diener, Ed, and Robert A. Emmons. 1984. "The Independence of Positive and Negative Affect." *Journal of Personality and Social Psychology*, 47(5): 1105-17.

Edmans, Alex, Diego Garcia, and Oyvind Norli. 2007. "Sports Sentiment and Stock Returns." *Journal of Finance*, 62(4): 1967–98.

Garg, Nitika, Brian Wansink, and J. Jeffrey Inman. 2007. "The influence of incidental affect on consumers' food intake." *Journal of Marketing*, 71: 194-206

Glaser, Markus, and Martin Weber. 2007. "Overconfidence and Trading Volume." *The Geneva Risk and Insurance Review*, 1: 1-36.

Goetzman, Gary (Executive Producer). 1991. *Silence of the Lambs* [Movie].

Goldberg, Julie H., Jennifer S. Lerner, and Philip E. Tetlock. 1999. "Rage and reason: the psychology of the intuitive prosecutor." *European Journal of Social Psychology*, 29: 781–795.

Gross, James J., and Robert W. Levenson. 1995. "Emotion Elicitation Using Films." *Cognition and Emotion*, 9(1): 87-108.

Han, Seunghee, Jennifer S. Lerner, and Richard Zeckhauser. 2010. "Disgust Promotes Disposal: Souring the Status Quo." Harvard Kennedy School Faculty Research Working Paper Series, RWP10-021.

Heilman, Renata M., Liviu G. Crisan, Daniel Houser, Mircea Miclea, and Andrei C. Miu. 2010. "Emotion Regulation and Decision Making Under Risk Uncertainty." *Emotion*: 10(2): 257-65.

Hirshleifer, David, and Tyler Shumway. 2003. "Good Day Sunshine: Stock Returns and the Weather." *Journal of Finance*, 58(3): 1009–32.

Ifcher, John, and Homa Zarghamee. 2011a. "Happiness and Time Preference: The Effect of Positive Affect in a Random-Assignment Experiment." *American Economic Review*, 101(7): 3109-29.

Icher, John, and Homa Zarghamee. 2011b. "Positive Affect an Overconfidence: A Laboratory Investigation." Working Paper.

Inbar, Yoel, and Thomas Gilovich. 2011. "Angry (or Disgusted), but Adjusting? The Effect of Specific Emotion on Adjustment From Self-Generated Anchors." *Social Psychological and Personality Science*, 2(6): 563-9.

Isen, Alice M. 1984. "Toward Understanding the Role of Affect in Cognition." In *Handbook of Social Cognition*, ed. Robert S. Wyer and Thomas K. Srull, 179-236. Hillsdale NJ: Lawrence Erlbaum Associates.

Isen, Alice M. 2007. "Positive Affect, Cognitive Flexibility, and Self-Control." In *Persons in Context: Building a Science of the Individual*, ed. Yuichi Shoda, Daniel Cervone, and Geraldine Downey, 130-47. New York: The Guilford Press.

Isen, Alice M. 2008. "Some Ways in Which Positive Affect Influences Decision Making and Problem Solving." In *Handbook of Emotions*, ed. Michael Lewis, Jeannette M. Haviland-Jones, and Lisa Feldman Barrett, 548-73. New York: The Guilford Press.

Isen, Alice M., Thomas E. Shalker, Margaret Clark, and Lynn Karp. 1978. "Affect, accessibility of material in memory, and behavior: A cognitive loop?" *Journal of Personality and Social Psychology*, 36(1): 1-12.

Johnson, Eric J., and Amos Tversky. 1983. "Affect, generalization, and the perception of risk." *Journal of Personality and Social Psychology*, 45(1): 20–31.

Jundt, Dustin K., and Verlin B. Hinsz. 2002. "Influences of Positive and Negative Affect on Decisions Involving Judgmental Biases." *Social Behavior and Personality*, 30(1): 45-52.

Kim, Kenneth A., and Nofsinger, John R. 2007. "The behavior of Japanese individual investors during bull and bear markets." *Journal of Behavioral Finance*, 8: 138-53.

Kirchsteiger, Georg, Luca Rigotti, and Aldo Rustichini. 2006. "Your morals might be your moods." *Journal of Economic Behavior and Organization*, 59(2): 155-72.

Kuvaas, Bard, and Geir Kaufmann. 2004. "Impact of Mood, Framing, and Need for Cognition on Decision Makers' Recall and Confidence." *Journal of Behavioral Decision Making*, 17: 59-74.

Lerner, Jennifer S., and Dacher Keltner. 2001. "Fear, Anger, and Risk." *Journal of Personality and Social Psychology*, 81(1): 146-59.

Lerner, Jennifer S. and Larissa Z. Tiedens. 2006. "Portrait of The Angry Decision Maker: How Appraisal Tendencies Shape Anger's Influence on Cognition." *Journal of Behavioral Decision Making,* 19: 115-37.

Lerner, Jennifer S., Deborah A. Small, and George Loewenstein. 2004. "Heart Strings and Purse Strings." *Psychological Bulletin*, 15(5): 337-341.

Lovell, Dyson (Executive Producer). 1979. *The Champ* [Movie].

Lundeberg, Mary A., Paul W. Fox, and Judith Puchochar. 1994. "Highly Confident but Wrong: Gender Differences and Similarities in Confidence Judgments." *Journal of Educational Psychology*, 86(1): 114-21.

Lyubomirsky, Sonja, Laura King, and Ed Diener. 2005. "The Benefits of Frequent Positive Affect: Does Happiness Lead to Success?" *Psychological Bulletin*, 131(6): 803-55.

Mackie, Diane M., Thierry Devos, and Eliot R. Smith. 2000. "Intergroup emotions: explaining offensive action tendencies in an intergroup context." *Journal of Personality and Social Psychology*, 79: 602–616.

Malmendier, Ulrike, and Geoffrey Tate. 2005. "CEO Overconfidence and Corporate Investment." *Journal of Finance*, 60(6): 2661–700.

Manucia, Gloria K., Donald J. Baumann, and Robert B. Cialdini. 1984. "Mood influences on helping: Direct effects or side effects?" *Journal of Personality and Social Psychology,* 46: 357–364.

Michailova, Julija. 2010. "Overconfidence and bubbles in experimental asset markets." MPRA Paper 26390, University Library of Munich, Germany.

Moore, Don A., and Deborah A. Small. 2007. "Error and bias in comparative

judgment: On being both better and worse than we think we are." *Journal of Personality and Social Psychology*, 92, 972–89.

Niederle, Muriel, and Lise Vesterlund. 2007. "Do Women Shy Away from Competition? Do Men Compete Too Much?" *Quarterly Journal of Economics*, 122(3): 1067-101.

Oswald, Andrew, Eugenio Proto, and Daniel Sgroi. 2011. "Happiness and Productivity." Working paper.

Oyer, Paul, and Scott Schaefer. 2005. "Why Do Some Firms Give Stock Options to All Employees?: An Empirical Examination of Alternative Theories." *Journal of Financial Economics*, 76(1): 99–133.

Raghunathan, Rajagopal, and Michel Tuan Pham. 1999. "All Negative Moods Are Not Equal: Motivational Influences of Anxiety and Sadness on Decision Making." *Organizational Behavior and Human Decision Processes*, 79(1): 56-77.

Rottenberg, Jonathan, Rebecca D. Ray, and James J. Gross. 2007. "Emotion Elicitation Using Films." In *The Handbook of Emotion Elicitation and Assessment*, ed. James A. Coan and John J. B. Allen, 9-28. London: Oxford University Press.

Salovey, Peter. 1992. "Mood-induced self-focused attention." *Journal of Personality and Social Psychology*, 62: 699–707.

Saunders, Edward M., Jr. 1993. "Stock Prices and Wall Street Weather." *American Economic Review*, 83(5):1337–45.

Scheinkman, Jose A., and Wei Xiong. 2003. "Overconfidence and speculative bubbles", Journal of Political Economy, 111(6): 1183-219.

Schwarz, Norbert, and Gerald L. Clore. 1983. "Mood, misattribution and judgments of well-being: informative and directive functions of affective states." *Journal of Personality and Social Psychology*, 45: 513–523.

Shiller, Robert J. 2003. "From Efficient Market Theory to Behavioral Finance." *Journal of Economic Perspectives*, 17(1): 83–104.

Silvia, Paul J. 2006. *Exploring the psychology of interest*. New York: Oxford University Press.

Simon, Melvin (Executive Producer). 1980. *My bodyguard* [Movie].

Small, Deborah A., and Jennifer S. Lerner. 2005. "Emotional politics: Personal sadness and anger shape public welfare preferences." Paper presented at the Society for Personality and Social Psychology, New Orleans, LA.

Smith, Craig A., and Phoebe C. Ellsworth. 1985. "Patterns of cognitive appraisal in emotion." *Journal of Personality and Social Psychology*, 48(4): 813–38.

Statman, Meir, Steven Thorley, and Keith Vorkink. 2006. "Investor Overconfidence and Trading Volume." *The Review of Financial Studies*, 19(4): 1531-65.

Watson, David, Lee Anna Clark, and Auke Tellegen. 1988. "Development and Validation of Brief Measures of Positive and Negative Affect: The PANAS Scales." *Journal of Personality and Social Psychology*, 54(6): 1063-70.

Tversky, Amos, and Daniel Kahneman. 1973. "Availability: A Heuristic for Judging Frequency and Probability." *Cognitive Psychology*, 5(2): 207-32.

Westerman, Rainer, Kordelia Spies, Gunter Stahl, and Friedrich W. Hesse. 1996. "Relative Effectiveness and Validity of Mood Induction Procedures." *European Journal of Social Psychology*, 26(4): 557-80.

Wood, Joanne V., Judith A. Saltzberg, and Llyod A. Goldsamt. 1990. "Does affect induce self-focused attention?" *Journal of Personality and Social Psychology*, 58: 899–908.

Zillmann, Dolf. 1988. "Mood Management Through Communication Choices." *American Behavioral Scientist*, 31 (3): 327-341.

Table 1: Demographic characteristics of the subjects

	All	Neutral affect (control)	Anger affect (treatment 1)	Fear affect (treatment 2)	Sadness affect (treatment 3)
Female	0.637 (0.04)	0.738 (0.07)	0.636 (0.07)	0.477 (0.08) **	0.694 (0.07)
Age^	19.644 (0.17)	20.865 (0.70)	19.250 (0.17) **	19.250 (0.19) **	19.429 (0.16) **
U.S. citizen^	0.790 (0.03)	0.795 (0.07)	0.864 (0.05)	0.841 (0.06)	0.673 (0.07)
Race^+					
Asian	0.559 (0.04)	0.595 (0.08)	0.523 (0.08)	0.386 (0.07) *	0.714 (0.07)
Black	0.078 (0.02)	0.095 (0.05)	0.136 (0.05)	0.068 (0.04)	0.020 (0.02)
Hispanic	0.056 (0.02)	0.071 (0.04)	0.045 (0.03)	0.045 (0.03)	0.061 (0.03)
White	0.291 (0.03)	0.190 (0.06)	0.295 (0.07)	0.477 (0.08) ***	0.204 (0.06)
College					
Arts & Sciences	0.631 (0.04)	0.548 (0.08)	0.682 (0.07)	0.773 (0.06) **	0.531 (0.07)
Business	0.207 (0.03)	0.167 (0.06)	0.159 (0.06)	0.159 (0.06)	0.327 (0.07) *
Other	0.162 (0.03)	0.286 (0.07)	0.159 (0.06)	0.068 (0.04) ***	0.143 (0.05) *
Class					
Freshman	0.346 (0.04)	0.238 (0.07)	0.364 (0.07)	0.432 (0.08) *	0.347 (0.07)
Sophomore	0.352 (0.04)	0.381 (0.08)	0.364 (0.07)	0.295 (0.07)	0.367 (0.07)
Junior	0.128 (0.03)	0.167 (0.06)	0.159 (0.06)	0.114 (0.05)	0.082 (0.04)
Senior	0.134 (0.03)	0.143 (0.05)	0.114 (0.05)	0.136 (0.05)	0.143 (0.05)
Graduate student	0.039 (0.01)	0.071 (0.04)	0.000 (0.00) *	0.023 (0.02)	0.061 (0.03)
Religious identity^					
Atheist	0.385 (0.04)	0.405 (0.08)	0.295 (0.07)	0.409 (0.07)	0.429 (0.07)
Christian	0.380 (0.04)	0.310 (0.07)	0.477 (0.08)	0.341 (0.07)	0.388 (0.07)
Other religion	0.235 (0.03)	0.286 (0.07)	0.227 (0.06)	0.250 (0.07)	0.184 (0.06)
Practicing religion^	0.409 (0.04)	0.475 (0.08)	0.455 (0.08)	0.279 (0.07) *	0.429 (0.07)
Religious service attendance^					
≤Once a year	0.475 (0.04)	0.429 (0.08)	0.432 (0.08)	0.523 (0.08)	0.510 (0.07)
>Once a year & ≤Once a month	0.263 (0.03)	0.238 (0.07)	0.318 (0.07)	0.295 (0.07)	0.204 (0.06)
>Once a month	0.223 (0.03)	0.214 (0.06)	0.250 (0.07)	0.136 (0.05)	0.286 (0.07)
Family Income^					
< $100,000	0.547 (0.04)	0.548 (0.08)	0.500 (0.08)	0.432 (0.08)	0.694 (0.07)
>$100,000 & <$200,000	0.240 (0.03)	0.190 (0.06)	0.341 (0.07)	0.273 (0.07)	0.163 (0.05)
> $200,000	0.151 (0.03)	0.071 (0.04)	0.136 (0.05)	0.250 (0.07) **	0.143 (0.05)
Political identity^					
Liberal	0.458 (0.04)	0.405 (0.08)	0.477 (0.08)	0.545 (0.08)	0.408 (0.07)
Moderate	0.430 (0.04)	0.452 (0.08)	0.455 (0.08)	0.318 (0.07)	0.490 (0.07)
Conservative	0.078 (0.02)	0.071 (0.04)	0.068 (0.04)	0.091 (0.04)	0.082 (0.04)
Observations	179	42	44	44	49

standard errors in parenthesis.

^ the following data is missing: age (5 observations), citizenship (3), race (2), religious identity (2), practicing religion (3), religious service attendance (6), family income (11), and political identity (6).

+ one subject indicated a race other than Asian, Black, Hispanic, or White.

*, **, and *** signify that the means are significantly different with a p-value < 0.10, 0.05, and 0.01, respectively.

Table 2: Results of affect check

	All	Neutral affect (control)	Anger affect (treatment 1)	Fear afect (treatment 2)	Sadness affect (treatment 3)
Panel 1: affect scores from PANAS					
Total negative affect	29.920 (1.11)	22.225 (2.58)	37.628 (2.14) ***	27.591 (1.90) *	31.531 (1.72) ***
Anger	3.096 (0.19)	2.561 (0.42)	5.186 (0.36) ***	1.932 (0.21)	2.755 (0.33)
Confusion	4.503 (0.17)	4.634 (0.38)	4.209 (0.33)	3.977 (0.33)	5.122 (0.29)
Contempt	2.727 (0.17)	2.275 (0.34)	4.163 (0.38) ***	2.364 (0.30)	2.163 (0.21)
Disgust	3.565 (0.20)	1.854 (0.33)	5.698 (0.39) ***	3.477 (0.39) ***	3.204 (0.31) ***
Embarrassment	2.040 (0.14)	1.750 (0.29)	2.837 (0.33) **	1.432 (0.21)	2.122 (0.24)
Fear	3.000 (0.18)	1.975 (0.35)	2.488 (0.30)	4.477 (0.41) ***	2.959 (0.28) **
Pain	2.756 (0.17)	2.225 (0.39)	3.000 (0.31)	1.727 (0.25)	3.898 (0.34) ***
Sadness	3.455 (0.20)	1.800 (0.29)	4.326 (0.35) ***	2.182 (0.30)	5.184 (0.37) ***
Tension	4.767 (0.21)	3.150 (0.42)	5.721 (0.39) ***	6.023 (0.41) ***	4.122 (0.34) *
Total positive affect	19.064 (0.69)	20.538 (1.83)	16.907 (1.08) *	22.205 (1.33)	16.872 (1.15) *
Amusement	2.966 (0.16)	3.585 (0.36)	2.279 (0.25) ***	3.364 (0.33)	2.694 (0.33) *
Arousal	2.316 (0.16)	2.390 (0.39)	2.326 (0.34)	2.409 (0.31)	2.163 (0.28)
Contentment	2.257 (0.15)	2.600 (0.32)	2.047 (0.28)	2.568 (0.31)	1.875 (0.27) *
Happiness	1.983 (0.15)	2.650 (0.38)	1.558 (0.22) **	2.000 (0.24)	1.796 (0.32) *
Interest	4.631 (0.18)	4.049 (0.37)	4.186 (0.33)	6.091 (0.33) ***	4.188 (0.33)
Relief	1.727 (0.12)	2.122 (0.27)	1.279 (0.12) ***	1.818 (0.30)	1.708 (0.21)
Surprise	3.571 (0.18)	3.732 (0.41)	3.233 (0.34)	3.955 (0.38)	3.388 (0.34)
Panel 2: proportion who state seeing the film clip made them?					
Angrier	0.201 (0.03)	0.119 (0.05)	0.455 (0.08) ***	0.045 (0.03)	0.184 (0.06)
More fearful	0.179 (0.03)	0.095 (0.05)	0.114 (0.05)	0.364 (0.07) ***	0.143 (0.05)
Sadder	0.352 (0.04)	0.095 (0.05)	0.568 (0.08) ***	0.068 (0.04)	0.633 (0.07) ***
Observations	179	42	44	44	49

standard errors in parenthesis.

*, **, and *** signify that the means are significantly different than control group with a p-value < 0.10, 0.05, and 0.01, respectively.

Table 3: Mean quiz performance, AOC, and ROC by gender

	All subjects			Female			Male		
	Quiz performance (1)	Absolute overconfidence (2)	Relative overconfidence (3)	Quiz performance (4)	Absolute overconfidence (5)	Relative overconfidence (6)	Quiz performance (7)	Absolute overconfidence (8)	Relative overconfidence (9)
Mean	18.31 (0.23)	1.61 (0.29)	0.85 (0.25)	17.61 (0.28) ***	1.19 (0.38) *	0.85 (0.32)	19.55 (0.36) ***	2.34 (0.43) *	0.85 (0.39)
Proportion	-	0.64 (0.04)	0.63 (0.04)	-	0.61 (0.05)	0.61 (0.05)	-	0.69 (0.06)	0.66 (0.06)
Minimum	9	-10	-9.0	9	-10	-9.0	11	-5	-6.9
Maximum	26	14	12.0	24	10	12.0	26	14	9.1
Observations^	179	179	169	114	114	105	65	65	64

standard errors in parenthesis.

^ ten ROC observations are missing.

*, **, and *** signify that the means are significantly different for men and women with a p-value < 0.10, 0.05, and 0.01, respectively.

Table 4: Results from regressing each demographic characteristic on AOC and ROC

	Absolute overconfidence	Relative overconfidence
Female	-1.145 (0.58) *	0.002 (0.23)
Age^	0.204 (0.16)	0.016 (0.09)
U.S. citizen^	2.385 (0.74) ***	0.806 (0.77)
Race^^+		
Asian	-1.470 (0.52) **	-0.040 (0.53)
Black	0.502 (0.70)	0.581 (0.98)
Hispanic	-1.069 (1.79)	-0.821 (0.71)
White	1.690 (0.49) ***	0.182 (0.46)
College		
Arts & Sciences	0.101 (0.54)	0.379 (0.64)
Business	-0.257 (0.60)	-0.400 (0.63)
Other	0.137 (0.87)	-0.166 (0.76)
Class		
Freshman	-0.734 (0.52)	-0.239 (0.73)
Sophomore	-0.474 (0.60)	0.006 (0.76)
Junior	1.197 (0.72)	0.867 (0.53)
Senior	1.943 (0.74) **	0.133 (0.76)
Graduate student	-2.269 (1.21) *	-1.558 (0.63) **
Religious identity^		
Atheist	-0.401 (0.55)	0.591 (0.44)
Christian	0.299 (0.63)	-0.491 (0.59)
Other religion	0.138 (0.62)	-0.143 (0.81)
Practicing religion^	0.352 (0.55)	-0.259 (0.36)
Religious service attendance^		
≤Once a year	-0.577 (0.58)	-0.113 (0.24)
>Once a year & ≤Once a month	0.819 (0.65)	0.298 (0.42)
>Once a month	-0.076 (0.80)	0.015 (0.41)
Family Income^		
< $100,000	-0.196 (0.58)	-0.168 (0.54)
>$100,000 & <$200,000	0.538 (0.54)	0.412 (0.48)
> $200,000	-0.019 (0.88)	0.341 (0.53)
Political identity^		
Liberal	0.037 (0.86)	0.635 (0.66)
Moderate	-0.658 (0.51)	0.165 (0.49)
Conservative	0.452 (0.63)	-0.486 (0.41)
Observations^^^	179	169

standard errors in parenthesis.

^ the following data is missing: age (5 observations), citizenship (3), race (2), religious identity (2), practicing religion (3), religious service attendance (6), family income (11), and political identity (6).

^^^ 10 subjects did not report their ROC

+ one subject indicated a race other than Asian, Black, Hispanic, or White.

*, **, and *** signify that the means are significantly different with a p-value < 0.10, 0.05, and 0.01, respectively.

Table 5: Treatment effects estimated from equation (1) using AOC

Panel 1	(1)	(2)	(3)	(4)	(4a) Asian only	(4b) Nonasian only	(5)	(5a) Female only	(5b) Male only
All negative affects pooled (T1 + T2 + T3)	**1.01** (0.81)	**1.46** (0.61) **	**1.73** (0.71) **	**2.96** (0.88) ***	**1.56** (0.86)	**3.27** (1.69) *	**3.71** (1.36) **	**1.50** (1.14)	**2.82** (3.33)
All * Asian				**-1.85** (1.02)					
All * Female							**-2.44** (1.94)		
Covariates included									
Demographics+	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Enjoyment, interest, and performance on quiz (quartic)	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations^	179	179	179	177	100	77	179	114	65

Panel 2	(1)	(2)	(3)	(4)	(4a) Asian only	(4b) Nonasian only	(5)	(5a) Female only	(5b) Male only
Anger (T1)	**0.80** (1.47)	**0.97** (1.17)	**1.05** (1.19)	**2.06** (1.57)	**1.54** (1.13)	**2.38** (2.04)	**4.70** (1.55) **	**0.27** (1.54)	**3.40** (3.02)
Anger (T1) * Asian				**-1.43** (1.43)					
Anger (T1) * Female							**-4.77** (1.95) **		
Fear (T2)	**1.19** (0.71)	**1.31** (0.63) *	**1.82** (0.91) *	**2.80** (0.77) ***	**1.87** (1.04)	**3.29** (1.56) *	**3.16** (1.52) *	**2.33** (1.33)	**1.46** (3.61)
Fear (T2) * Asian				**-1.25** (1.27)					
Fear (T2) * Female							**-0.93** (2.14)		
Sadness (T3)	**1.04** (0.83)	**1.92** (0.75) **	**2.24** (0.76) **	**4.61** (1.09) ***	**1.46** (1.00)	**4.43** (1.85) **	**3.87** (1.31) **	**2.50** (1.31) *	**3.73** (2.99)
Sadness(T3) * Asian				**-3.41** (1.34) **					
Sadness (T3) * Female							**-1.88** (2.11)		
Covariates included									
Demographics+	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Enjoyment, interest, and performance on quiz (quartic)	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations^	179	179	179	177	100	77	179	114	65

standard errors in parenthesis.
*, **, and *** signify that the means are significantly different (two-tail test) for the treatment and control groups with a p-value < 0.10, 0.05, and 0.01, respectively.
+ gender, age, not US citizen, race, college, graduating class, religious identity, religious practice, family income, and political identity

Table 6: All coefficients from estimating equation (1) using AOC

	(1)	(2)	(3)
Treatment effect (pooled)	**1.01 (0.81)**	**1.46 (0.61) ****	**1.73 (0.71) ****
Female		-0.554 (0.81)	-0.858 (0.77)
Age^		0.285 (0.18)	0.304 (0.15) *
Not U.S. citizen^		-1.861 (0.94) *	-1.821 (1.00) *
Race^ (reference group is other race)			
Asian		0.404 (1.02)	0.520 (1.19)
White		0.609 (1.25)	0.810 (1.39)
College (reference group is College of Arts & Sciences)			
Business school		-0.086 (0.67)	-0.567 (0.83)
Other		0.481 (1.06)	0.573 (0.79)
Class (reference group is senior)			
Freshman		-0.729 (1.18)	-0.487 (1.25)
Sophomore		-0.766 (0.94)	-0.917 (0.96)
Junior		0.261 (1.42)	-0.300 (1.64)
Graduate student		-3.498 (2.78)	-3.336 (2.62)
Religious identity^ (referecence group is other religion)			
Atheist		0.595 (0.40)	0.280 (0.49)
Christian		-0.070 (0.83)	-0.067 (0.98)
Practicing religion^		0.416 (0.51)	0.158 (0.55)
Religious service attendance^ (reference group is more than 1 per year & less than (weakly) 1 per month)			
≤Once a year		-1.058 (0.68)	-1.036 (0.68)
>Once a month		-0.492 (1.01)	-0.339 (1.24)
Family Income^ (reference group is between $100,000 and $200,000)			
< $100,000		-0.131 (0.72)	-0.173 (0.60)
> $200,000		-0.447 (0.90)	0.041 (1.08)
Political identity^ (reference group is moderate)			
Liberal		0.026 (0.85)	0.086 (0.81)
Conservative		-0.600 (0.57)	-0.301 (0.66)
Covariates included			
Demographics+	No	Yes	Yes
Enjoyment, interest, and performan	No	No	Yes
Observations	179	179	179

standard errors in parenthesis.

^ the following data is missing: age (5 observations), citizenship (3), race (2), religious identity (2), practicing religion (3), religious service attendance (6), family income (11), and political identity (6).

*, **, and *** signify that the means are significantly different with a p-value < 0.10, 0.05, and 0.01,

Table 7: Treatment effects estimated from equation (1) using ROC

Panel 1	(1)	(2)	(3)	(4)	(4a) Asian only	(4b) Nonasian only	(5)	(5a) Female only	(5b) Male only
All negative affects pooled (T1 + T2 + T3)	**0.40** (0.67)	**0.92** (0.53)	**0.93** (0.55)	**-0.40** (0.52)	**1.52** (0.77) *	**0.33** (0.76)	**0.22** (1.13)	**1.30** (0.43) **	**-1.83** (1.54)
All * Asian				**2.02** (1.06) *					
All * Female							**0.88** (1.03)		
Covariates included									
Demographics+	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Enjoyment, interest, and performance on quiz (quartic)	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations^	169	169	169	169	95	72	169	105	64

Panel 2	(1)	(2)	(3)	(4)	(4a) Asian only	(4b) Nonasian only	(5)	(5a) Female only	(5b) Male only
Anger (T1)	**0.19** (0.81)	**0.54** (0.62)	**0.22** (0.51)	**-0.97** (0.84)	**0.86** (0.83)	**0.06** (0.79)	**-1.03** (1.49)	**0.94** (0.40) **	**-2.75** (1.57)
Anger (T1) * Asian				**1.85** (1.15)					
Anger (T1) * Female							**1.60** (1.40)		
Fear (T2)	**0.76** (0.81)	**1.45** (0.83)	**1.46** (0.80) *	**0.47** (0.83)	**1.65** (0.87)	**1.74** (0.70) **	**0.50** (1.11)	**1.96** (0.78) **	**-1.86** (1.59)
Fear (T2) * Asian				**1.35** (1.16)					
Fear (T2) * Female							**1.23** (1.08)		
Sadness (T3)	**0.25** (0.79)	**0.96** (0.74)	**1.26** (0.84)	**-0.43** (0.57)	**1.89** (0.86) *	**0.39** (0.92)	**0.74** (1.35)	**1.37** (0.71) *	**-1.10** (1.65)
Sadness(T3) * Asian				**2.47** (1.12) *					
Sadness (T3) * Female							**0.55** (0.97)		
Covariates included									
Demographics+	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Enjoyment, interest, and performance on quiz (quartic)	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations^	169	169	169	169	95	72	169	105	64

standard errors in parenthesis.
*, **, and *** signify that the means are significantly different (two-tail test) for the treatment and control groups with a p-value < 0.10, 0.05, and 0.01, respectively.
+ gender, age, not US citizen, race, college, graduating class, religious identity, religious practice, family income, and political identity
^ 10 subjects did not report their ROC