Mood and Economic Decision-Making: Experimental Evidence From a Sports Bar*

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Abstract

We develop a new experimental paradigm to study how emotions affect decision-making. We use it to investigate the impact of short-term fluctuations in incidental happiness on economic decisions. Experimental subjects watch an NFL football game in a sports bar. At various commercial breaks, we measure subjects' happiness and observe their decisions regarding charitable giving, willingness to pay for a consumer good, risk taking, and trust. We find that events in the game impact the incidental happiness of our subjects, and these changes lead to predictable changes in choices. We provide a simple model that rationalizes how subjects' behavior varies with incidental happiness and provides insight into how mood can be tractably included in economics models. Our experimental paradigm can be leveraged by other researchers interested in exploring the impact of emotions on behavior.

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1 Introduction

Every day, we face myriad opportunities to be generous, buy things, take risks, and trust others. Between making these decisions, we face the outcomes of numerous unrelated events: whether it is a sunny day, whether the barista making our coffee is friendly, whether the episode of TV that we are watching has a happy ending, and whether our favorite sports team wins a game. While these events may temporarily change our mood, the incidental emotions they induce do not have a direct effect on our material well-being, and so standard economic theory dictates that they should not affect our decisions.

If such subtle changes in happiness were to systematically affect the choices we make, we might want to be conscious of this relationship to avoid taking actions we might later regret.[1] In addition, those who might potentially profit from our choices would also want to understand the relationship between our emotions and behavior.

In this paper, we introduce a new kind of experiment to explore the effects of emotions on behavior. We run a lab-in-the-field experiment that allows us to observe the impact of fluctuations in incidental happiness on behavior over the course of a few hours.[2] Our design leverages naturally occurring short-term variations in emotions from seemingly frivolous exogenous events while holding all other aspects of the subjects' lives constant. In particular, we leverage the short-term fluctuations in mood induced when subjects watch a live NFL football game. Experimental subjects watch the football game in a sports bar (allowing them to engage with the game as they normally would). During selected commercial breaks, we repeatedly measure each subject's self-reported happiness and present the subject with a set of four economic decision-making tasks: charitable giving, buying a consumer good, taking a risky gamble, and trusting or being trustworthy.

Our main empirical approach leverages instrumental variables (IV) specifications. This empirical approach requires the reasonable assumption that events in the game affect happiness but do not have a direct effect on economic deci-

1. While individuals who are angry are advised to "sleep on it" before making decisions out of anger, individuals are rarely advised to contemplate how incidental happiness might influence their purchase or charitable giving behaviors.

2. In what follows, we use "mood" to refer to incidental happiness. We use mood in the colloquial sense (e.g., being in a good mood or a bad mood). When we say that mood improves, we mean that incidental happiness has increased.

sions.[3] The NFL games subjects watched generated variation in self-reported happiness for the vast majority (81%) of subjects, suggesting the potential for a first stage of our IV approach. We capture the impact of game events using measures of the time-varying probability that a subject's favored team will win the game. We run the analysis two ways, each with one version of this probability. One version is an objective (i.e., external) prediction of a team's probability of winning from a popular sports statistics website. The other version uses a subjective prediction of the team's probability of winning provided by the subject.[4] Using these IV approaches, we find that changes in incidental happiness statistically significantly affect behavior in two of the four decision-making tasks: charitable giving and trust.

In addition, we provide a simple theory of incidental happiness and decision-making that can rationalize our results.[5] Our modeling assumption is that changes in incidental happiness have a similar effect on decision-making as changes in wealth, by altering the decision maker's marginal utility of income. Increases in happiness (like increases in wealth) decrease marginal utility of income, while decreases in happiness increase it. We use this model to make predictions about the effect of mood on the four economic decision tasks in the experiment. Our model predicts that agents in a better mood will: donate more to charity, spend more on consumer goods, take more risks, and be more trustworthy. That subjects are more willing to donate money to charity and to trust more when they are relatively happier are consistent with the predictions of this theory. In addition, the non-statistically significant effects on the other outcomes are also in the direction predicted by the theory.

Our experimental paradigm complements a rich line of experimental work (discussed in Section 5) that explores the effects of emotions on decision-making in laboratory settings. Our design differs significantly from the approaches in this earlier work, which has generally induced emotions (e.g., by having subjects

3. We see direct effects of the events of the game on economic behavior as being unlikely. Importantly, subjects report not having placed bets on the game, the only obvious channel through which events in the game might directly affect economic choices. We return to this point in Section 4.

4. The latter measure is more highly correlated with incidental happiness, but requires a bit stronger of an assumption to satisfy the exclusion restriction (as discussed in Section 4).

5. Our work is related to the model in Kimball and Willis 2006, which includes happiness in a model of life-cycle utility maximization. In that framework, happiness is considered as a shock to lifetime utility. In our experiment, however, we see an effect on economic decisions of short-term happiness fluctuations induced by events that have no effect on lifetime utility. Consequently, we find that happiness can affect behavior even when it does not impact long-term outcomes.

watch an emotionally charged video clip or by asking them to recall a prior experience). This prior work was conducted in the laboratory, presumably because of the difficulty of controlling emotions experimentally in field settings. To overcome this, we do not attempt to control emotions. Instead, we let exogenous events in the football game induce changes in incidental happiness to explore the relationship between happiness and decision-making. While we sacrifice the control of the laboratory, we gain the ability to observe subject behavior in a more naturalistic setting and the ability to observe a time-series of emotional swings and decisions (i.e., we see subjects get both happier and less happy over the course of the game). By recruiting football fans to our study, we get to observe how subjects respond to emotional stimuli that they endogenously choose to experience, heightening the external validity of the results. We see our approach as a complement to the existing laboratory approaches exploring emotions.

This paper proceeds as follows. In Section 2 we present our experimental design. In Section 3 we describe the model. In Section 4 we present our results. In Section 5 we relate our work to other research from economics and psychology on the relationship between emotions and decision-making. In Section 6 we offer some conclusions.

2 Experimental Design

The experiment involved two experimental sessions, each of which took place at a sports bar in the Upper East Side neighborhood of New York City. Subjects were recruited from an NBC Sports subject pool consisting of people who had volunteered in the past to take part in focus groups.[6] Recruitment materials informed potential subjects that in the study they would watch an NFL game in a sports bar, be given \$15 to subsidize their food consumption, be guaranteed \$30 for showing up, and have the chance to earn additional money during the experiment depending on their decisions.

Subjects watched *live* NFL football games (i.e., so game outcomes were not known by anyone). On December 29, 2013, subjects watched the Dallas Cowboys play against the Philadelphia Eagles (for the NFC East division title). Philadelphia entered the game as strong favorites. Philadelphia led throughout the game and eventually won $24 - 22$. On January 4, 2014, different subjects

6. The project was funded by NBC Sports as part of a larger program investigating the impact of sports viewing on decision-making.

watched the New Orleans Saints play against the Philadelphia Eagles. Philadelphia entered the game as slight favorites but eventually lost $24 - 26$.

Subjects arrived one hour before the game started and were provided instructions about the experiment. It was explained that they would engage in four incentivized decision-making tasks and answer four unincentivized questions at the start of the game and at a number of commercial breaks during the broadcast. On average, subjects entered data (i.e., made decisions and answered questions) 15 times over the course of the study. Subjects were told that, at the end of the experiment, the computer would randomly pick one of the decision tasks and one of the entry times and their decision in that task and entry time would determine payoffs.

2.1 Demographic Questionnaire

Before the game, we recorded demographic information about our subjects by asking each of them about their work status, education level, gender, age, and income, the results of which are reported in Table 1.

Since subjects were invited to a sports bar, they had to be at least 21 years old to participate in the study. Consequently, our subjects are demographically distinct from the undergraduates traditionally used in laboratory experiments. In addition to being older, our sample is almost all working rather than in school (49 out of 64 subjects reported having full-time employment while only 1 out of 64 was a student) and our sample has relatively high incomes (48 out of 64 subjects reported earning \$50,000 or more). The average age of subjects was 41 years old and 51 of 64 had completed at least a Bachelor's degree, with 30% having an advanced degree.

In addition to providing demographic information, subjects reported their feelings about watching sports in general, football in particular, and the game they were about to watch (see the full list of questions and a summary of answers in Appendix A). The subjects were also asked to choose among a set of charities to which they might donate during the experiment and among a set of consumer goods that they might buy during the experiment (as described in the following subsections).

2.2 Four Decision Tasks and the Happiness Question

In the following subsections we describe the four decision tasks that subjects faced as well as the unincentivized questions they answered. Each time subjects

Table 1: Subject Demographics

Demographics	**Mean (SD)**
Number of Subjects	64
Female	37.50%
Age	41.05 (12.11)
Education	
PhD	1.56%
Masters Degree	28.13%
Bachelors Degree	50.00%
Some College	18.75%
High School	1.56%
Employment	
Full-time employed	76.56 %
Part-time employed	17.19%
Student	1.56 %
Unemployed	4.69%
Income	
Income over $100,000	32.81%
Income $50,000 to $99,999	42.19 %
Income $25,000 to $49,999	6.25 %
Income less than $25,000	18.75 %

Table reports the percentage of the subjects in each demographic category. For age, the only continuous variable, the mean and standard deviation are reported.

provided data in the experiment, these tasks and questions were displayed to subjects (in the order they are described below).

2.2.1 Charitable Giving

In the charitable giving task, subjects were told they had the opportunity to donate money to a charity. At the start of the experiment, they were asked to choose a favorite charity from a set of three: (a) United Way, (b) The American Cancer Society, and (c) The World Wildlife Fund. Each time subjects entered data, they were asked how much of a $40 endowment they wanted to donate to the charity they had chosen at the start of the experiment (see Instructions in Appendix B). If this task was chosen for payment at the end of the experiment, any money not donated was given to the subject. Subjects were explicitly told that any money donated would actually be given to the charity they selected.[7]

2.2.2 Willingness to Pay for Consumer Good

In the consumer good task, subjects had a $40 endowment that they could use to buy a consumer good. At the start of the experiment, subjects had the option to choose a good from a set of three options: (a) a wool hat (they could choose either a men's hat or a women's hat), (b) Sony headphones, or (c) a "Chromecast," Google hardware for streaming video. Each of these goods had a retail price of $30 to $40. Each time subjects entered data, they were asked how much out of their $40 endowment for this task they were willing to pay for the good they had selected using the Becker-DeGroot-Marschak (BDM) mechanism. The mechanism was explained to subjects and they were explicitly told it was in their best interest to report the highest amount of money they would be willing to pay for the good but not more (see Instructions in Appendix B). If the subject ended up buying the consumer good at the BDM-determined price, that price was subtracted from their $40 endowment and they got to take home the good. If they did not buy the consumer good, they kept the $40 endowment.

2.2.3 Willingness to Pay for a Risky Gamble

In the risky gamble task, subjects were asked about willingness to pay for a lottery ticket that offered a 50% chance of receiving $40 and a 50% chance of receiving $0. Each time subjects entered data, they were asked how much out

7. Subjects were told verbally: "You can be 100% confident that the money will be donated." Donations were made after both sessions of the study were run.

of their \$40 endowment for this task they were willing to pay for the lottery ticket. We again used the BDM mechanism to elicit their willingness to pay (see Instructions in Appendix B). If the subject ended up buying the lottery ticket at the BDM-determined price, that price was subtracted from their \$40 endowment and the risky lottery was realized (they either received an extra \$40 or an extra \$0). If they did not buy the lottery ticket, they kept their \$40 endowment.

2.2.4 Trust Game

The final task was a trust game. In this game, each subject interacted anonymously with another subject in the session. Subjects were randomly assigned to be either a sender ("Player A" in the instructions, see Appendix B) or a receiver ("Player B" in the instructions). Subjects were told that the sender started with \$32 and the receiver started with \$0. The sender could choose to send \$0, \$8, \$16, \$24, or \$32 of his \$32 to the receiver. The receiver would get three times the amount of money transferred by the sender and have the opportunity to transfer money back—from \$0 up to the total amount received. This money was returned one-for-one to the sender without being multiplied.

Each sender was asked to choose one amount (\$0, \$8, \$16, \$24, or \$32) to send to the receiver. Each receiver was asked to choose one amount to return for each of the possible amounts she might get from the sender using the strategy method. In particular, each receiver was asked how much she wanted to return to the sender if she received \$24, if she received \$48, if she received \$72, and if she received \$96. No feedback was given during the experiment, but subjects were told that if this decision was chosen for cash payment, senders and receivers would be paired and the choices of the sender and the receiver would implemented to determine payoffs.

2.3 Questionnaire

After subjects engaged in each of the four decision tasks, they made self-reports about their current emotional state and their reaction to the recent events in the game. Subjects were asked to report (on a scale from 1 to 7) answers to the following four questions, in the following order:

1. How surprised are you about the recent events in the game, i.e. events since the last commercial break entry? (7-point Likert scale where 1 is

"not at all," 3 is "somewhat," 5 is "a lot," and 7 is "incredibly.")

2. How exciting do you find the game you are watching? (7-point Likert scale where 1 is "not at all," 3 is "somewhat," 5 is "a lot," and 7 is "incredibly.")

3. How do you feel right now? (7-point Likert scale where 1 is "very unhappy," 2 is "unhappy," 3 is "somewhat unhappy," 4 is "neither happy nor unhappy," 5 is "somewhat happy," 6 is "happy," and 7 is "very happy.")

4. What do you think the chances are that the team you said you were rooting for will win? (Scale from 0 to 100 where 0 is "definitely won't win" and 100 is "definitely will win.")

We are primarily interested in how being in a good mood affects the decision tasks noted above, which leads us to focus on question 3 about happiness, and in how subjects perceive the events in the game, which leads us to focus on question 4 about likelihood of winning. In this analysis, measures of excitement and surprise serve as controls that capture other things about the game that might influence decisions but not work through an effect on happiness.[8]

2.4 Comments on our experimental design

A few things about our experimental design are worth noting. First, doing experiments in sports bars is not common. In a field setting like a sports bar, researchers may not be able to maintain the same control over the environment as is typically possible in the lab.[9]

One particularly important element of the lack of control in a sports bar is alcohol. Subjects in our experiment were each given a voucher worth $15 for food but they had to purchase drinks themselves. While some subjects did drink,

8. We also explore excitement and surprise in related work (see Kessler, McClellan, and Schotter 2017). Results including surprise and excitement as controls are presented in Appendix A. These results are very similar to the main specifications, although we consider them as secondary due to concerns about the endogeneity of surprise and excitement.

9. We ran the first session of our experiment on a separate floor of the sports bar that was designated for our study. We ran the second session of our experiment in a different sports bar and had the entire back end of the bar, which was isolated from the rest of the patrons. In both sessions, we ensured that all screens subjects could see were showing the specific game we were analyzing. However, other patrons cheering for other games in other parts of the bars could have theoretically distracted subjects. In addition, subjects completed the experiment on web-based software (written specifically for this experiment) that was accessible on tablets that could be used from anywhere in the bar. This had the advantage of allowing subjects to sit wherever they wanted in our designated sections and to watch the football game as they would have otherwise; however, we did not force subjects to stay seated, so they could leave the bar to smoke or to go to the bathroom and thus miss an opportunity to enter data.

our observation was that alcohol consumption was relatively light (e.g., no one became obviously intoxicated during the study). While alcohol consumption has been known to influence choice (see Burghart, Glimcher, and Lazzaro 2013; Corazzini, Filippin, and Vanin 2015; Bregu et al. 2017), we had no indication that it was a major factor in the behavior of subjects.

In addition, our research design mitigates against alcohol consumption driving our results. Since we use variation in happiness induced by game events to identify the effect of happiness on decision-making—and since this variation in happiness varies both positively and negatively over time for different subjects (depending on which team they favor)—a simple increase in alcohol consumption over the course of the night would be unlikely to explain our results.[10] Further, since there is a lag between when alcohol is consumed and when it has physiological effects on the body, even if consumption were sparked by events in the game (e.g., after a favored team scores) this would not be a threat to our empirical strategy, which relies on relating changes in happiness with contemporaneous choices.

Second, our design differs from prior research exploring emotions on decisions. We use an NFL football game to induce a dynamic path of emotions, which allows us to follow the same person as his or her mood fluctuates over the course of a few hours—allowing us to explore behavior over a time series of emotional states.[11] This design contrasts with a more-typical experiment exploring the effect of emotions on decisions. In those studies, an experimenter might induce one or two emotions (e.g., happiness or sadness) at one point in time by either: (a) showing a subject a happy or sad movie clip (see, e.g., Kirchsteiger, Rigotti, and Rustichini 2006; Ifcher and Zarghamee 2011) or (b) having them recollect in writing a sad or happy event in their life using the Autobiographical Emotional Memory Task (see, e.g., Strack, Schwarz, and Gschneidinger 1985; Myers and Tingley 2016). After subjects are primed with these emotions, they engage in a decision task and the behavior of those primed with different emotions is compared.

10. Indeed, in the analysis presented below, we get very similar results whether or not we include a game-quarter dummies, which should be correlated with alcohol consumption to the extent that subject imbibe alcohol over the course of the night. That our results do not change with the game-quarter dummies supports our assertion that alcohol consumption does not has a large impact on our results.

11. We are not the only researchers to recognize that sports can be a useful way to vary emotions of sports fans. A paper by Lambsdorffl et al. 2015 uses soccer as an emotional prime. However, their set-up is quite different from ours on a number of dimensions, the most prominent difference is that subjects only make one decision and do so before the game begins.

Our design complements this prior laboratory work in at least two important ways. It allows us to demonstrate the robustness of the relationship between emotions and decisions by showing that the relationship between emotions and behavior can be observed—–and measured—outside of the laboratory environment. In addition, our random variation in emotions is naturally occurring and arises among individuals who endogenously expose themselves to stimuli that induce such variation in emotions (i.e., fans of football who also choose to watch football outside of the context our study). The nature of our stimuli thus makes us even more confident that the relationship we observe in our study is likely to be observed regularly in practice.[12]

Third, since subjects were recruited from a pool maintained by NBC Sports, the experiment did not select a random sample of the population but was skewed toward sports fans.[13] This feature of our design serves us well, since we are interested in using the random variation of events in the football games to generate swings in mood, and such mood swings are more likely to be arise with sports fans who might care about the game. It also reinforces the points raised above about the realism of our paradigm and helping to ensure that we are observing changes in behavior due to changes in mood that are likely to arise in practice (i.e., sports fans endogenously watch sports and are thus likely to have their mood manipulated outside of our study as it is manipulated in our study).

Fourth, while subjects faced financial incentives for the economic decisions, they do not face incentives to answer questions about emotions or beliefs. Self-reported emotions have been successfully used in economics (see, e.g., Winden 2007) and in psychology. We know of no scheme to provide incentives to honestly report emotions, and we expect that the biggest risk of the lack of incentives is for subjects to answer randomly or without consideration, which would introduce noise into our measurement and make it unlikely for us to find any relationships between mood and economic decisions.

12. While variation in emotions can be cleanly induced in the laboratory (e.g., by exposing subjects to a video clip), changes in behavior may only arise among subjects who would not have endogenously chosen to expose themselves to such emotions (e.g., if a response to a sad movie clip only arises among individuals who take efforts to avoid exposure to such stimuli), minimizing the potential empirical relevance of the findings outside of the laboratory. Our setting avoids this potential external validity concern.

13. In a survey at the start of the study, we asked subjects about their attitudes towards sports and football. They were asked: "Do you like watching sports in general?" using a 7-point Likert scale where 1 is "Not very much" and 7 is "More than all other types of entertainment" and "Do you like watching football in particular?" using a Likert scale where 1 is "Not very much" and 7 is "Football is my favorite sport to watch." The mean responses were 5.77 (standard deviation 0.16) and 5.61 (standard deviation 0.17), respectively.

3 A Model of Mood and Decision-Making

In standard economic theory, utility is typically a function of material payoffs. In recent years, however, some scholars have argued that it may also be mood dependent (see, e.g., Loewenstein 2000). In this section, we propose a model of decision-making that depends on incidental happiness, can rationalize the results of our experiment, and can serve as a framework for modeling the impact of mood on economic behavior more generally.[14] In particular, we model a change in the mood of agents like a change in their wealth. That is, we allow an increase in mood to operate like an increase in wealth (i.e., decreasing the marginal utility of monetary payoffs and the level of risk aversion).

To start, let us distinguish two types of situations where mood may be relevant: one-person decision problems and multi-person strategic situations. In both cases, we take mood as exogenous (e.g., affected by the events in the game being watched) and do not allow it to be changed by the agent (i.e., it cannot be affected by choices in the decision tasks).[15]

For one-person decision tasks, we propose a simple utility function where utility is a function of exogenous mood and material payoff as follows:

$$u_i\ (\sigma_i, \pi_i), \tag{1}$$

where σ_i, is the exogenous mood (e.g., determined by the events of the game) and π_i is the material payoff of person i.

In the case of a two-person interaction between i and j, we posit the following utility function:

$$U_i\ (\sigma, \pi) = \ \beta_i\ u_j\ (\sigma_j, \pi_j\ ) + u_i\ (\sigma_i, \pi_i), \tag{2}$$

where σ_i is again the decision maker's exogenous mood and σ_j is the exogenous mood of person j, with whom person i is interacting, β_i is the weight given by person i to j's utility. π_j is the material payoff of person j.

While a decision maker i can be assumed to know his own mood at any time, he may only know the distribution, $\mu(\sigma_j)$, from which the mood of j is drawn,

14. Most similar to our model is Kimball and Willis 2006 in which happiness is considered as a shock to life-time utility (as opposed to the short-term incidental happiness explored here); see also our discussion in footnote 5.

15. The assumption that mood is exogenous means that when subjects make decisions in our tasks, we take mood as fixed (i.e., we look at decision-making conditional on mood).

so we can write the utility function as:

$$U_i(\sigma, \pi) = \int_j [\beta_i u_j(\sigma_j, \pi_j) + u_i(\sigma_i, \pi_i)] \, d\mu(\sigma_j). \tag{3}$$

In order to simplify the notation, we define $u_1 = \frac{\partial u_i(\sigma_i, \pi_i)}{\partial \sigma_i}$, $u_2 = \frac{\partial u_i(\sigma_i, \pi_i)}{\partial \pi_i}$, and $u_{12} = \frac{\partial^2 u_i(\sigma_i, \pi_i)}{\partial \sigma_i \partial \pi_i}$.

In the next several subsections we will intuitively explore the consequences of these utility functions for the behavior of our subjects as their mood changes during the course of the football game they watch. All proofs are Appendix C. Each subsection will relate to one of the four tasks our subjects faced.

3.1 Charitable Giving

Each subject was given an endowment of w ($40 in the experiment) from which he could donate $c \leq w$ to charity and keep $w - c$ for himself. Since the subject's choice has an externality on the charity we use (3) to represent the subject's utility function

$$U_i(\sigma, \pi) = \int_j [\beta_i u_j(\sigma_j, c) + u_i(\sigma_i, w - c)] \, d\mu(\sigma_j).$$

We treat the charity here not as an abstract entity but rather as the hypothetical person who receives the dollars donated by our subject. Hence, the charity is merely a conduit for giving to others. One important point is that whatever the expected mood of the recipient of the charity is, it is fixed exogenously and does not change as the events in the football game unfold.

The key to understanding how charitable giving is affected by mood is to assume $u_{12} < 0$, meaning that as the subject has a more positive mood, his marginal utility of consumption decreases.[16] Put differently, one can think of an enhanced mood as akin to a sudden increase in wealth for the subject, which decreases the marginal utility of money. The impact of wealth on the marginal utility of money, and on risk aversion, will be the key to our results.

For the charitable giving task, let c^* be the current equilibrium amount

16. While our model is agnostic to the specific utility function that generates the negative cross-partial of $u_{12} < 0$, our empirical results would be rationalized by a utility function of the form $u_i(f(\sigma_i) + g(\pi_i))$ where $u_{12} < 0$ is guaranteed by $f' > 0$, $g' > 0$ and the concavity of u_i. This formulation suggests that mood and money are substitutes, that a positive mood shock increases utility, and makes it easy to interpret our results as suggesting being in a better mood makes subjects feel richer.

given to charity and suppose that mood increases. If we assume that $u_{12} < 0$, then giving one more dollar to charity entails a smaller marginal sacrifice in u_i. However, since the recipient's mood has not changed, the marginal utility of giving an extra dollar beyond c^*, $\beta u_2(\sigma_j, c^*)$, has not changed. Hence, if the subject was giving c^* before a change in mood, then as his mood increases his giving will increase. If we instead assume that $u_{12} > 0$, we will get the opposite result. We summarize this in the following proposition.

Proposition 1. *If $u_{12} < 0$, then charitable giving is increasing in mood. If $u_{12} > 0$, then charitable giving is decreasing in mood.*

Proof. In Appendix C. □

3.2 Willingness to Pay for a Consumer Good

Since this decision contains no externality, we use Equation (1) to represent the subject's utility. Under the Becker-DeGroot-Marschak mechanism, once a subject states a price for a good, she either receives it or not depending on the realization of the random variable of the mechanism. Let $c \in \{0, 1\}$ be a variable which indicates whether subject i received the good and expand the utility function to $u_i(\sigma_i, \pi_i, c_i)$. Her utility function is $u_i(\sigma_i, w - p^*, 1)$ when she wins the good at price p and $u_i(\sigma_i, w, 0)$ when she does not. Then subject i is asked to choose a p^* such that

$$u_i\left(\sigma_i, w - p^*, 1\right) = u_i(\sigma_i, w, 0).$$

We assume that the utility of good consumption and money is separable and that the utility of receiving the good does not depend on mood.[17] We denote $v_i(1)$ as the utility component of the good so that the utility when the subject wins the good is

$$u_i\left(\sigma_i, w - p, 1\right) = v_i\left(1\right) + u_i(\sigma_i, w - p).$$

17. This assumption is less innocuous than a similar assumption made in our analysis of charitable giving since in that case the recipient of charity was an entity completely separate from the donor. In this case, it is possible that a change in mood by the decision maker may also alter her attitude about the goods she buys. This will make our results ambiguous. Such ambiguity may help to explain why we get significant results for the charitable giving task but why results of the effect of mood on willingness to pay for a consumer good are properly signed but not statistically significant (see results in Section 4).

As with the previous task, whether p^* is increasing or decreasing in mood depends on whether the marginal utility of money is increasing or decreasing in mood. For example, if $u_{12} < 0$, then the marginal value of money is decreasing in mood while the marginal increase in the probability of winning the good remains constant. Hence, it is less costly to increase the probability of winning the good. A subject with p^* before the mood change would be willing to increase p^* as mood improves, representing an increase in willingness to pay. The following proposition follows:

Proposition 2. *Let utility be additive in the good. If $u_{12} < 0$, then willingness to pay is increasing in mood. If $u_{12} > 0$, then willingness to pay is decreasing in mood.*

Proof. In Appendix C. □

3.3 Willingness to Pay for a Risky Gamble

In this task, we asked the subjects to choose x, where x is the amount they are willing to pay for a gamble offering \$40 or \$0 with equal probability. The subjects start off with \$40. Using a Becker-DeGroot-Marschak mechanism, a number $y \in [0, 40]$ is drawn and a subject receives the gamble if $y < x$ and would have final wealth levels $80 - y$ if she won the gamble and $40 - y$ if she lost. Subjects therefore choose the x that solves:

$$\mathbb{E}\left[u|\text{gamble at price } x\right] = \mathbb{E}\left[u|\text{no gamble}\right],$$
$$\frac{1}{2}\left(u_i\left(\sigma_i, w - x\right) + u_i\left(\sigma_i, 2w - x\right)\right) = u_i\left(\sigma_i, w\right).$$

The main path through which changes in mood affect behavior in this risky gamble task is through a subject's level of risk aversion. Again, if we interpret mood as acting as an increase in wealth, then this condition is similar to the usual condition for decreasing absolute risk aversion. To investigate this, we consider how the coefficient of absolute risk aversion changes with mood and make an additional assumption concerning the form of u_1, namely that u_1 is a convex transformation of u_i. The condition that u_1 is a convex transformation of u_i has a sensible interpretation in the case when $u_{12} < 0$. We can show that convexity condition implies that

$$-\frac{u_{22}}{u_2} \leq -\frac{u_{122}}{u_{12}},$$

which is equivalent to the coefficient of absolute risk aversion $A(w, \sigma_i) = \frac{-u_{22}(\sigma_i, w)}{u_2(\sigma_i, w)}$ decreasing in σ_i.[18] This leads us to the following proposition:

Proposition 3. *If u_1 is a convex transformation of u_i, then the willingness to pay for the gamble is increasing in mood. If u_1 is a concave transformation of u_i, then the willingness to pay for the gamble is decreasing in mood.*

Proof. In Appendix C. □

3.4 Trust Game

Unlike the previous three decision tasks, this task actively involves two players in a game and is therefore considerably more involved. As a result, we will offer a more scaled-down description of our analysis here and refer the reader to the Appendix C for a formal proof. Interestingly, the main mediating factor for behavior here is again the wealth effect generated by an increase or decrease in mood.

In the Trust Game, the sender starts off with w and can choose an amount $t \leq w$ to send to the receiver. The amount the receiver gets is $3t$, from which she can choose an amount $c \leq 3t$ to return to the sender. Thus the monetary outcomes for the sender and receiver are $w - t + c$ and $3t - c$, respectively. Using our utility functions, we have that the utility of the sender, when he sends t and receives c in return is:

$$\int_j \left[\beta_i u_j \left(\sigma_j, 3t - c\right) + u_i \left(\sigma_i, w - t + c\right)\right] d\mu \left(\sigma_j | c\right).$$

The receiver's utility when she gets $3t$ and returns c is:

$$\int_i \left[\beta_j u_i \left(\sigma_i, w - t + c\right) + u_j \left(\sigma_j, 3t - c\right)\right] d\mu(\sigma_j | t).$$

Since this is an extensive form game we can solve it using backward induction starting with the receiver and working our way back to the sender. The analysis of the receiver is fairly straight forward. Since we can use our analysis for

18. Consider a utility function of the form $u_i(f(\sigma_i) + w)$. Then $\frac{u_{122}}{u_{12}} = \frac{u_i'''(f(\sigma_i)+w)}{u_i''(f(\sigma_i)+w)}$ and $\frac{u_{22}}{u_2} = \frac{u_i''(f(\sigma_i)+w)}{u_i'(f(\sigma_i)+w)}$, so the convexity condition implies that

$$-\frac{u_i''(f(\sigma_i) + w)}{u_i'(f(\sigma_i) + w)} \leq -\frac{u_i'''(f(\sigma_i) + w)}{u_i''(f(\sigma_i) + w)},$$

which is the standard assumption for decreasing absolute risk aversion. Hence, the convexity assumption translates well into standard assumptions on the utility function when $u_{12} < 0$.

charitable giving to conclude that if $u_{12} < 0$ ($u_{12} > 0$) holds, then as the receiver's mood increases (decreases), she will return more (less) of any transfer. Knowing this, but not knowing the specific mood of the receiver, the sender faces a lottery: depending on the receiver's mood, the receiver may return more or less than the sender sends. Using the same condition on u_1 as under the risky gamble, we can find the effects of the sender's mood on transfers.[19] Combining all these results, we get our final proposition:

Proposition 4. *If $u_{12} < 0$, then the amount returned by the receiver is increasing in mood. If $u_{12} > 0$, then the amount returned by the receiver is decreasing in mood. If u_1 is a convex transformation of u_i and $u_{12} < 0$, then the amount returned by the receiver is decreasing in mood. If u_1 is a concave transformation of u_i and $u_{12} > 0$, then the transfer by the sender is decreasing in mood.*

Proof. In Appendix C. □

4 Results

In this section, we report on the results of the experiment and show how our results compare with the predictions of the model presented in Section 3.

On average, subjects enter data—that is, complete the four decision tasks and report their mood—14.9 times during the study.[20] Importantly for our design, the vast majority of subjects display variation in their emotional state over the course of the game they watch. Table 2 reports the percentage of subjects who change their emotional state and change their decision task choices at least once during the course of the game.

A total of 52 of the 64 subjects (81%) changed their answer to the incidental happiness question: "How do you feel right now?" at least once during the study. It is reassuring to see this variation in reported mood, since such variation is necessary for us to evaluate how changes in mood affect economic decision-making. In addition, this variation in mood is not random; it predictably responds to the

19. This condition is in fact stronger than we need. In the case of $u_{12} > 0$ ($u_{12} < 0$), $A(w, \sigma_i)$ decreasing (increasing) in σ_i is sufficient.

20. The minimum number of entries was 10 and the maximum was 18. Not every subject entered data every time it was requested. Subjects may have been otherwise occupied (e.g., eating or in the restroom) when asked to enter data. In addition, subjects were technically able to enter data at times other than when we asked them to do so. Nevertheless 55% of subjects submitted exactly 15 reports, and 91% of subjects submitted either 14, 15, or 16 reports. Due to technical issues, the first entry for the first game was done with paper and pencil, which we had prepared in the event of such technical issues; all other responses were entered through the web interface on the tablets.

Table 2: Variation in Questions and Decisions

Question or Decision	*% of subjects with variation*
Happiness	81.25%
Surprise	95.31%
Excitement	95.31%
Probability favored team wins	93.75%
Donation to charity	46.88%
Willingness to pay for good	56.25%
Willingness to pay for gamble	56.25%
Transfer to trustee (out of 32 subjects)	50.00%
Return/transfer by trustee to any (out of 32 subjects)	78.13%
Return/transfer by trustee to 24 (out of 32 subjects)	43.75%
Return/transfer by trustee to 48 (out of 32 subjects)	56.25%
Return/transfer by trustee to 72 (out of 32 subjects)	63.50%
Return/transfer by trustee to 96 (out of 32 subjects)	71.88%
Variation in at least one decision task	89.06%

Table shows the percentage of subjects whose responses varied within each question or decision task over the course of the study.

events of the game. Events that constitute good news for a subject's preferred team on average make that subject happier. Our main empirical strategy uses these game events to construct an instrument for self-reported happiness.

We also observe variation in the economic decisions subjects made over the course of the game. In particular, 30 of the 64 subjects (47%) change the amount they choose to donate; 36 of the 64 subjects (56%) change the maximum amount they are willing to pay for a consumer good, and the same number, 36 of the 64 subjects (56%), change the maximum amount they are willing to pay for a lottery that pays $40 with 50% probability. In the trust game, of the 32 subjects who were senders, 16 changed the amount sent, and of the 32 subjects who were receivers, 25 changed at least one of the four amounts they returned. In total, 89% of subjects display variation in at least one decision task.[21]

As noted above, our main empirical strategy is to use events in the game to construct an instrument for incidental happiness. Events in the game are clearly exogenous. As we will show in the next section, game events are good predictors of incidental happiness, and so they generate a reasonable first stage. In addition, we believe they are likely to satisfy the exclusion restriction as they

21. In addition, 95% of subjects change their excitement reports and 95% of subjects change their surprise reports.

are unlikely to have a direct effect on economic behavior that is not through mood.[22]

4.1 Mood is Predictable

In this section, we show that incidental happiness moves in response to events in the game. At the start of each session, we asked each subject which of the two teams playing in the game they favored. All but 3 of the 64 subjects reported having a preference between the two teams playing.[23] Our analysis will cover the 61 subjects who reported favoring one team who was playing over the other. It is perhaps important to note that our experiment took place in a sports bar in New York City where one might expect subjects to be fans of the local teams (the New York Giants and the New York Jets). Since neither the Giants nor the Jets were in the playoffs in the year of the study, the results of the games that were watched could not have affected these teams.[24] We consequently expect that the relationship between the events of the game and subjects' moods may have been muted and that our results would have been even stronger if the Giants or Jets were playing.

What is the effect of game events on incidental happiness? One way to see this is looking at Figure 1, which plots the difference in average happiness for subjects favoring the two teams (plotted on the top panel) and the difference in

22. A violation of the exclusion restriction would require game events to have some effect on material well-being. The main concern would be about gambling (e.g., if subjects had bet on a certain team and so their likelihood of winning money fluctuated over the course of the game). Our survey explicitly asked subjects whether they were gambling on the game and all subjects reported that they were not. A more obscure potential confound would arise if the outcome of today's game affects whether I will watch football in future weeks, assuming my alternative entertainment options are more or less costly than watching football. As discussed in Section 4.1, however, such a potential concern is mitigated by the fact that the teams playing in our games are not subjects' favorite football teams and so their presence or absence in future playoff games is unlikely to affect whether they watch future games. Note also that if the outcome of today's game affects my happiness because it changes my anticipation of future happiness—but not my material well-being—this would not challenge our exclusion restriction, since contemporaneous decisions are still being affected by changes in contemporaneous happiness.

23. In the December 29, 2013 game between the Philadelphia Eagles and the Dallas Cowboys, 17 subjects favored the Eagles and 12 subjects favored the Cowboys. In the January 4, 2014 game between the Philadelphia Eagles and the New Orleans Saints, 13 subjects favored the Eagles and 19 favored the Saints.

24. Subjects were asked to report their favorite football team at the start of the study, and none of the reported favorite teams were playing. The results of the December 29, 2019 Eagles versus Cowboys game did not affect any other team's playoff chances. The winner of the January 4, 2014 Eagles versus Saints game would face the Seattle Seahawks in the Divisional round of the playoffs. No subjects reported that the Seahawks were their favorite team.

score between the two teams (plotted in the bottom panel) over the course of the game (game time out of 60 minutes is on the x-axis). The first game is shown in Figure 1(a) and the second game is shown in Figure 1(b). The difference in score starts at 0 (when the score is 0-0).

Three observations are clear from Figure 1. First, the happiness difference and the score difference and tend to track each other: when a favored team is doing better (e.g., winning by more points) subjects who favor that team are relatively happier than subjects who favor the competing team. Second, many big changes in the happiness lines come when the score difference changes (i.e., when one of the teams scores). Third, there are changes in the happiness lines even when no team has scored, which likely reflect other game events (e.g., changes of possession or changes in the probability of a future score).

Given that happiness responds to game events beyond scores, we examine the effect that the probability that a subject's favored team will win the game has on happiness. How should we measure this probability? We take two approaches. The first is to collect and analyze an objective measure of the probability the favored team will win the game, by using data from a third-party company called pro-football-reference.com (PFR), which has an analytical model assessing the probability a football team will win a game given the events in the game thus far. The second is to ask each subject the probability that their favored team will win the game (see question 4 of the questionnaire outlined in Section 2.3).

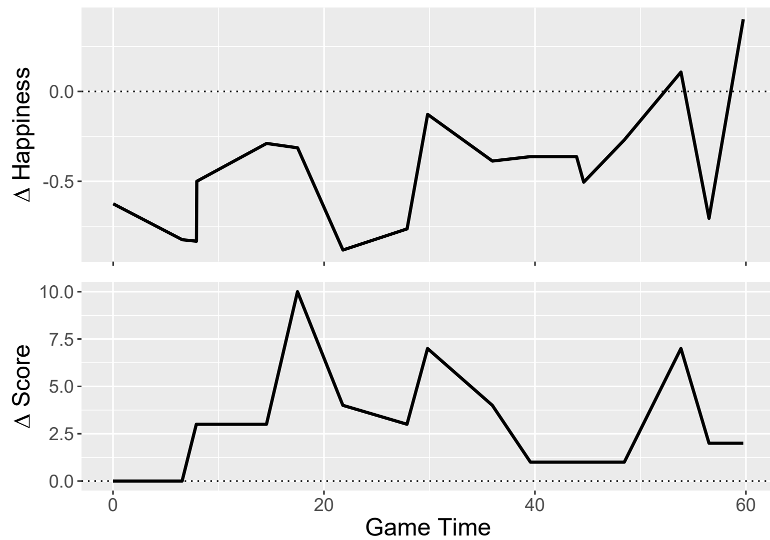
Figure 2 displays the PFR estimate of the Eagles winning and the average self-reported probability of the Eagles winning (i.e., averaged across subjects) for both Eagles fans and Cowboys fans. The first game is shown in Figure 2(a) and the second game is shown in Figure 2(b).[25] Movements in the average self-reported probabilities for both fans are similar (although with a clear bias for their favored team), and they match those of the PFR measure.

In game 1, the mean of the PFR measure is generally above the average self-reported probabilities of both groups. The Eagles were heavy favorites going into the game (the Vegas Line was Eagles -7.0), which the subjects did not fully account for in their self-reported probabilities. In game 2, the PFR measure starts between Eagles and Saints fans, as the Eagles were only moderate favorites (the Vegas Line was Eagles -3.0).

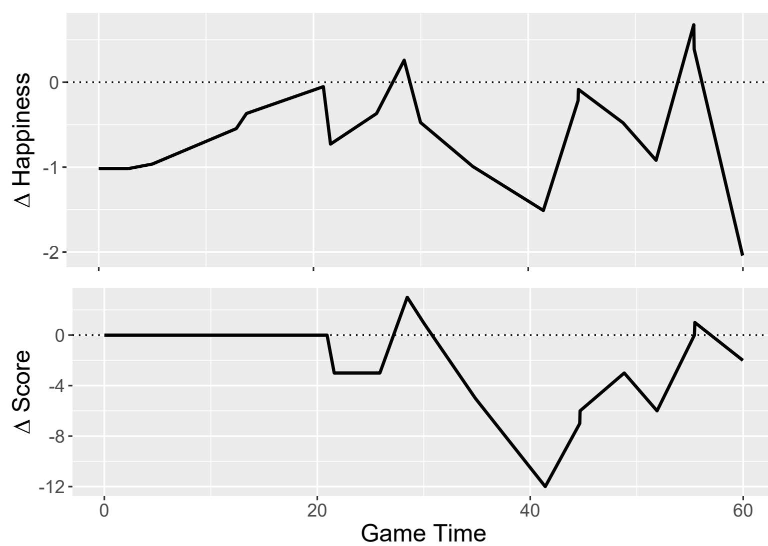
These results are summarized in Table 3. Column (1) of Table 3 shows a

25. The self-reported probability of the Eagles winning is the self-reported probability of one's favored team winning for subjects who favor the Eagles, and 1 minus the self-reported probability for subjects who favor the Cowboys in game 1 and the Saints in game 2.

Figure 1: Happiness and Game Events

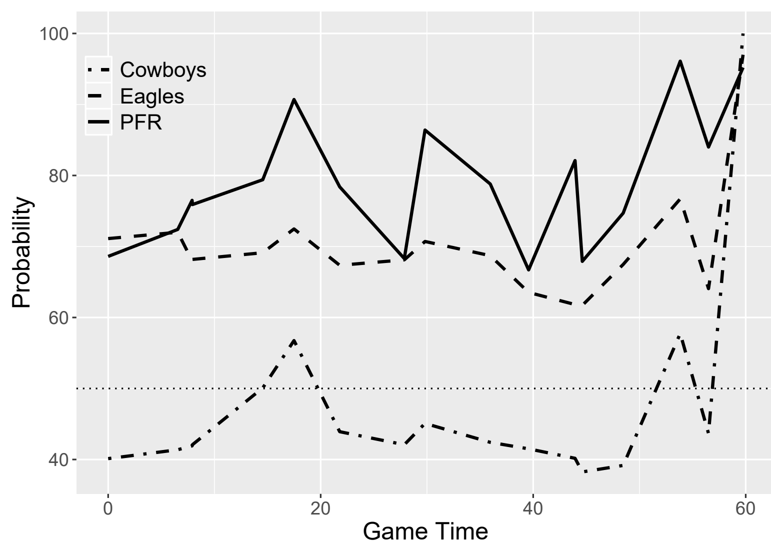


(a) Game 1: December 29, 2013 game between the Philadelphia Eagles and the Dallas Cowboys. Top panel is average happiness for Eagles fans minus average happiness for Cowboys fans. Bottom panel is the Eagles score minus Cowboys score.

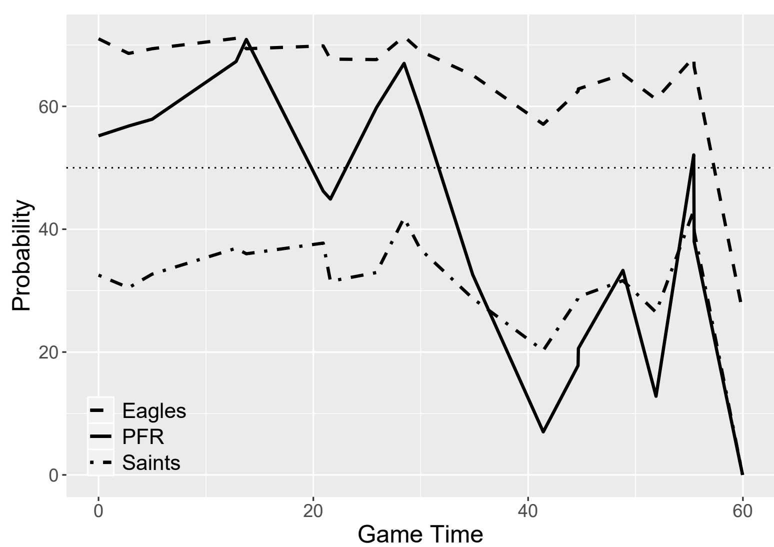


(b) Game 2: January 4, 2014 game between the Philadelphia Eagles and the New Orleans Saints. Top panel is average happiness for Eagles fans minus average happiness for Saints fans. Bottom panel is the Eagles score minus Saints score.

Figure 2: Probabilities of the Eagles Winning



(a) Game 1: December 29, 2013 game between the Philadelphia Eagles and the Dallas Cowboys. Solid line is the PFR probability that the Eagles will win. Dashed line is the average self-reported probability that the Eagles will win, reported by Eagles fans. Dot-dashed line is the average self-reported probability that the Eagles will win, reported by Cowboys fans.



(b) Game 2: January 4, 2014 game between the Philadelphia Eagles and the New Orleans Saints. Solid line is the PFR probability that the Eagles will win. Dashed line is the average self-reported probability that the Eagles will win, reported by Eagles fans. Dot-dashed line is the average self-reported probability that the Eagles will win, reported by Saints fans.

Table 3: How Mood Responds to Events in the Game

	Self-reported happiness				
	(1)	(2)	(3)	(4)	(5)
Score difference	0.0343***			-0.0153	0.0166
	(0.0129)			(0.0107)	(0.0104)
PFR probability		0.0104***		0.0125***	
		(0.00293)		(0.00324)	
Self-reported prob			0.0194***		0.0185***
			(0.00352)		(0.00322)
N	911	911	911	911	911
Subjects (Clusters)	61	61	61	61	61
R-Squared	0.0564	0.0915	0.153	0.0934	0.158

Table reports the effect of game events on self-reported happiness elicited in a Likert-scale measured on a 1 to 7 scale for the 61 subjects who reported a favored team in the game. *Score difference* is the difference in score between a subject's favored team and disfavored team. *PFR prob* is the PFR probability that a subject's favored team wins (at that given moment in the game). *Self-reported prob* is the self-reported probability that a subject's favored team wins (at that given moment in the game). All regressions include subject fixed effects as well as game-quarter dummies. Standard errors clustered at the individual level are reported in parenthesis. Significance denoted as * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

regression of subjects' self-reported happiness on the score difference between a subject's favored team and disfavored team. Column (2) is a regression of happiness on the PFR probability (from 0 to 100) that a subject's favored team will win. Column (3) replaces the PFR measure with a subject's self-reported measure of their favored team winning (from 0 to 100). As expected, subjects report being happier as the probability of their team winning increases. The coefficient on the self-reported probability in column (3) is larger than the coefficient on the PFR measure in column (2). This highlights that the self-reported belief measure is more highly correlated with incidental happiness than the PFR measure. Columns (4) and (5) include both the score difference and the probabilities. In both cases, the score difference is no longer significant, reflecting that the probabilities capture most of the information contained in the scores. In what follows, we use the probability measures as instruments for incidental happiness.

4.2 How Mood Affects Decision-making

How does self-reported happiness affect economic decisions? Table 4 shows the results from the reduced form and our two instrumental variables specifications. Each row of the table reports on a different specification and shows results from five regressions, where the independent variable is always self-reported happiness and the dependent variables are charitable giving, willingness to pay for the consumer good, willingness to pay for the risky gamble, amount transferred in the trust game, and average percentage returned in the trust game.[26] Each of the dependent variables has been transformed into a percentage of the maximum possible that could be chosen by subjects, so that the effects can be more easily compared.[27] Each of the three models also include game-quarter dummies.[28]

In this section, we describe the results from each of the three specifications and then discuss what assumptions one must believe for the results of each of the specifications to be valid. We see the PFR specification as the most conservative and so we consider it our primary specification. However, we believe all of the specifications are informative of the relationship between mood and decision-making and thus we present all three.

The first specification in Table 4 is the reduced form (OLS), which shows the raw relationship between the economic decisions and self-reported happiness. The coefficients for all five regressions are positive, sometimes statistically significantly so. When subjects report being happier, they part with more money in all of the economic decisions.

The second specification in Table 4, which we call the PFR probability model, is an instrumental variables (IV) specification using the PFR probability as an instrument. The first stage corresponds to specification (2) in Table 3. We see signs and magnitudes that are similar to the reduced form. In particular, the effect of happiness on charitable giving is significant, with a coefficient that is significantly larger than the reduced form estimate. The effect of happiness on the remaining decisions are not significant (although the coefficient estimate for

26. As described in Section 2, receivers were asked how much they wanted to return to the sender if they received \$24, \$48, \$72 or \$96. We construct the average for these 4 amounts to use as the dependent variable. Running the regressions with each amount individually yields very similar results.

27. For example, the maximum amount a subject could give to charity was \$40. If a subject donated \$25, the variable would be $25/40 = 0.625$. The maximum amount was also \$40 for the WTP for the consumer good and for the risky gamble. The maximum amount that could be transferred in the trust game was \$32. The maximum amount that could be returned in the trust game depended on the initial transfer.

28. Results without the game-quarter dummies are presented in Table A7 in Appendix A and are very similar.

the WTP for the consumer good and the transfer in the trust game are similar in size to the reduced form estimates). The sign of the WTP for the average return in the trust game is directionally negative but very close to zero.

The third specification in Table 4, which we call the self-reported probability model, is an instrumental variables specification using the self-reported probability as an instrument. The first stage corresponds to specification (3) in Table 3. We see an identical pattern with regard to the sign of the coefficients as in the reduced form, but generally find larger coefficient estimates. The effect of happiness on charitable giving is significant with a coefficient that is three times as large as the reduced form estimate and similar in magnitude to the estimate from the PFR probability model. The effect of happiness on the amount subjects are willing to transfer in the trust game is also statistically significant, and the coefficient is nearly three times as large as the reduced form estimate and nearly twice as large as PFR probability model estimate. That this specification delivers more statistical significance than the PFR probability model is perhaps not surprising given that the self-reported probabilities are more highly correlated with self-reported happiness than the PFR probabilities—as can be seen in Table 3—and so this specification delivers a stronger first stage.

What can we learn from each model? For the reduced form specification to provide causal estimates of the effect of happiness on decision-making, one has to believe there there are no omitted variables that might drive both self-reported happiness and subjects' economic decisions. One might worry about alcohol consumption as being a potential omitted variable, although we note that we include game-quarter dummies in all specifications, which we might expect to soak up any level effect of alcohol consumption over the course of the game. Other potential omitted variables that would simultaneously affect happiness and economic decisions might include learning news about future streams of financial well-being (e.g., learning that one's stock portfolio performed well or poorly that day or getting a good or bad email from work).[29] While one might consider all of these events unlikely over a three-hour time period, to the extent that one worries about such shocks arising, we include our IV specifications discussed next.

The instrumental variables (IV) approaches avoid concerns about such omitted variables, since we use exogenous game events as instruments for happiness. For these specifications, we want to ask what might challenge the exclusion

29. As discussed in Footnote 3 and discussed below, we rule out gambling on the game as a potential source of such shocks.

Table 4: How Mood Effects Decision-Making

	Charitable Giving Donation	WTP: Good WTP	WTP: Gamble WTP	Trust game Transfer	Average return
Reduced Form	0.0133*	0.0102**	0.00918	0.0265*	0.0108
	(0.00667)	(0.00466)	(0.00672)	(0.0141)	(0.00919)
PFR	0.0406**	0.00934	0.0258	0.0360	-0.0263
	(0.0169)	(0.0167)	(0.0227)	(0.0350)	(0.0319)
Self-Reported	0.0444**	0.00823	0.0136	0.0667**	0.0259
	(0.0214)	(0.00827)	(0.0177)	(0.0338)	(0.0185)
N	911	911	911	440	454

The effect of self-reported happiness on economic decision-making. The table reports 3 different models, each of which includes 5 regressions. Model "Reduced Form" is the regression of self-reported happiness on economic decision-making. Model "PFR" is the instrumental variables regression where the first stage is specification (2) in Table 3. Model "Self-Reported" is the instrumental variables regression where the first stage is specification (3) in Table 3. All regressions include individual fixed effects, and game-quarter dummies. Standard errors clustered at the individual level are reported in parenthesis. Significance denoted as * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

restriction necessary to interpret the IV estimates as causal.

For the PFR specification, our most conservative specification, a violation would require the exogenous events of the game to have a direct effect on economic behavior. We view this as highly unlikely. As discussed in Footnote 3, subjects report not having placed bets on the game, the only obvious channel through which events in the game might directly affect economic choices (see also the discussion in Footnote 22). We also rule out concerns about alcohol driving our results in this specification, as discussed in Section 2.4.

For the self-reported probability specification, one might be more concerned about the exclusion restriction being satisfied, since the self-reported probability is produced by the subject and so is endogenous to the subject's mental process. In addition to the conditions needed for the PFR specification, the exclusion restriction here requires that, over the course of the experiment, subjects are not hit with shocks—unrelated to the events of the game—that affect their beliefs about their favored team's chances and their economic decisions. For example, a shock during the game that made subjects more generally optimistic could make them believe their favored team has a higher chance of winning, could make them feel happier, and could affect their decision-making. If such shocks arise and are different from incidental happiness, we may misinterpret our IV estimates. To the extent that one worries about such shocks, one should be more skeptical of this specification and rely more on the results from the PFR specification.

Taken together, our results suggest that incidental happiness affects charitable giving, and perhaps trust. While many of our results are not statistically significant, the totality of our empirical results—including the signs of directional results that are not significant—can be rationalized in our model with the assumption that $u_{12} < 0$, which suggests that being in a good mood has a similar effect on decision making as being wealthier.

We emphasize that the changes in behavior we observe are induced by watching a football game, which individuals endogenously choose to do. That subjects expose themselves to such mood altering activities suggests that these mood induced changes in behavior are likely to be empirically relevant in practice.

5 Relation to the Literature

Our work on incidental happiness affecting decisions relates to a growing line of work on emotions at the intersection of psychology and economics that has shown that emotions can affect a variety of decisions including: trust and trustworthiness (see, e.g., Capra 2004; Dunn and Schweitzer 2005; Kirchsteiger, Rigotti, and Rustichini 2006; Myers and Tingley 2016); time preference (see Ifcher and Zarghamee 2011); risk (see, e.g., Johnson and Tversky 1983; Nygren et al. 1996; Lerner and Keltner 2001; Loewenstein et al. 2001); willingness to pay (see, e.g., Lerner, Small, and Loewenstein 2004); productivity (Oswald, Proto, and Sgroi 2015 and Isen 2008); and overconfidence and helping behavior (see, e.g., Aderman 1972; Isen and Levin 1972; Rosenhan, Underwood, and Moore 1974; Konow and Earley 2008).

While our paper mainly aims to contribute to the economics literature, our results speak to related research in psychology. When viewing our experiment from the point of view of the "Appraisal-Tendency Framework," one would conclude that the momentary variations in happiness that result from events in the game are associated with specific automatic functions that may not be in line with long-term judgment (Lerner and Keltner 2000). For example, an agent may be willing to pay more for a good than his perceived value of that good after an unrelated rise in happiness, which is consistent with what we find. In line with the "Broaden and Build Model," one would see incidental fluctuations in happiness that arise from positive events in the game (for example, a touchdown for one's favored team) as affecting information processing differently than negative events. Positive events are believed to broaden the decision-maker's awareness, leading to benevolent behaviors, whereas negative ones narrow awareness and result in survival-oriented, non-cooperative behaviors (Fredrickson 2001). Consistent with these results we find more charitable giving and perhaps more trusting when subjects are in a better mood. The "Hedonic Contingency Model," which asserts that those in positive moods are more likely to engage in activities for which they will be hedonically rewarded, would predict higher WTP, charitable giving, and cooperation, which is consistent with what we find.

6 Conclusion

This paper investigates the impact of short-term changes in incidental happiness on economic decision-making. We focus on short-term fluctuations in mood caused by events within NFL football games that have no connection to the fundamentals of subjects' well-being. Standard economic theory has no channel for such transient mood to affect behavior, and yet we find that subjects systematically change their economic decisions when they are temporarily made happier or less happy by the events of the games.

In particular, we find that when subjects' mood improves—that is, when they report being happier—they give more to charity and may be more likely to pay more for a good, be less risk averse, and be more trusting and trustworthy. Of these results, giving to charity—and possibly trusting—are statistically robust. We heed the advice of prominent researchers calling for the integration of emotions into economic models of decision-making (see, e.g., Elster 1998 and Loewenstein 2000) and present a simple theory that incorporates mood directly into a decision maker's utility function.[30] Our theory allows us to succinctly explain the data generated by our experiment and suggests that an individual being in a good mood can be modeled as equivalent to an individual feeling wealthier. If other emotions can also be parsimoniously included into models of decision-making, there may be traction in getting economic theory to consider the role of emotions more generally.

Our results suggest that emotions may contribute to the error terms of existing discrete choice models. In these models, it is assumed that when a decision maker chooses between several discrete objects, her utility for any object is affected by a random utility shock drawn from a particular distribution (e.g., an Extreme Value Type I distribution). However, the source of these shocks is rarely discussed. Our results suggest that one source for these shocks may be the mood that the decision maker happens to be in at the precise time the decision needs to be made. Since in our daily lives we are bombarded by exogenous events that are likely to change our mood, it may not be surprising if these utility shocks were in some way related to shocks to our happiness.

We present an experiment in which mood is varied by naturally occurring events over the course of an NFL football game. In this way, our paper relates to a line of applied papers that also introduce emotions into the calculus of decision-

30. Models of economic decision-making rarely include emotions as inputs into behavior (see Wälde and Moors 2017 and Wälde 2016 for recent surveys).

making.[31] Since most of these applied papers rely on naturally occurring data, they do not observe changes in emotions directly. Instead, they assume mood has been altered by exogenous events. None provide an associated model to explain the changes in behavior.[32] Our results provide additional evidence that mood might mediate changes in behavior in these varied settings.

Most notably, we introduce a new experimental paradigm that leverages the emotional swings subjects experience in naturally occurring settings—in our case, watching a live NFL football game—to estimate the effect of happiness on economic decisions. We see this method as a complement to existing experimental work on emotions. In addition to being able to observe the relationship between happiness and economic decisions in a setting outside of the lab, we recruit subject who endogenously choose to watch football, allowing us to observe how behavior responds to emotional swings that individuals endogenously choose to experience. That individuals are willing to expose themselves to stimuli that alter their behavior reinforces the empirical relevance of mood having impacts on choices in practice.

31. See, e.g., Ariely and Loewenstein 2006 on willingness to engage in risky sexual activity in response to sexual arousal; Edmans, Garcia, and Norli 2007 on stock markets dips in response to a country's elimination from the world cup; Card and Dahl 2011 on spikes in domestic violence when a city's football team suffers a surprise loss; Otto, Fleming, and Glimcher 2016 on an increase in lottery sales in response to unexpected local sports team wins and sunny days; and Eren and Mocan 2018 on changes in judicial sentencing after a state's college team unexpectedly loses or wins.

32. While Card and Dahl 2011 do provide some theoretical structure in their paper, they tailor their model to fit the situation they are trying to describe rather than to provide a general model of incidental happiness on economic decision–making.

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A Demographic Questionnaire and Additional Tables

Table A1: Demographic Questionnaire

Question	Entry
1. Name	User entered on text interface.
2. Work Status	Full time employed, Part time employed, Student, Unemployed.
3. Gender	Male, Female.
4. Highest Education Achieved	PhD, Masters Degree, Bachelors Degree, Some College, High School.
5. Do you like watching sports in general?	Likert scale where 1 is “Not very much” and 7 is “More than all other types of entertainment.”
6. Do you like watching football in particular?	Likert scale where 1 is “Not very much” and 7 is “Football is my favorite sport to watch.”
7. What is your favorite team?	Any of the 32 NFL teams.
8. Which team are you rooting for in the game today?	One of the two teams playing in the game (or another team, interpreted as indifference).
9. How strongly do you care for the team you are rooting for in the game today?	Likert scale where 1 is “Not at all”, 3 is “Somewhat”, 5 is “A lot”, and 7 is “Passionately.”
10. How strongly do you dislike the team you are not rooting for in the game today?	Likert scale where 1 is “I hate them with a passion”, 3 is “I dislike them somewhat”, 5 is “I like them”, and 7 is “I like them almost as much as the other team.”
11. Why do you want the team you are rooting for today to win?	“They are my favorite team,” “Several players on that team are on my fantasy football team,” “I need that team to win in order for my truly favorite team to make the playoffs,” and “I bet on that team.”

Table A2: Additional Subject Demographics

Demographics	**Mean (SD)**
5. Do you like watching sports in general?	5.77 (0.16)
6. Do you like watching football in particular?	5.61 (0.17)
7. What is your favorite team?	
Buffalo Bills	1.56 %
New England Patriots	3.13 %
New York Jets	25.00 %
Baltimore Ravens	3.13 %
Cleveland Browns	1.56%
Pittsburgh Steelers	3.13%
Tennessee Titans	1.56%
Dallas Cowboys	3.13 %
New York Giants	29.69 %
Philadelphia Eagles	1.56%
Washington Redskins	1.56 %
Chicago Bears	1.56%
Detroit Lions	4.69 %
Green Bay Packers	3.13 %
Carolina Panthers	1.56 %
Los Angeles Rams	3.13 %
San Francisco 49ers	7.81 %
Not specified	3.13%
8. Which team are you rooting for in the game today?	
Dallas Cowboys	18.75%
Philadelphia Eagles	46.88 %
New Orleans Saints	29.69 %
Indifferent	4.69%
9. How strongly do you care for the team you are rooting for in the game today?	2.81 (0.20)
10. How strongly do you dislike the team you are not rooting for in the game today?	4.06 (0.27)

Table reports the average value and standard deviation of questions 5–10 of the demographic questionnaire reported in Table A1. Subject's favorite team and the team they are rooting for are discrete and frequencies are reported. 'Not specified' in question 7 refers to subjects who didn't choose one of the 32 NFL teams. 'Indifferent' in question 8 refers to subjects who didn't choose one of the teams playing in that game.

Table A3: How Surprise Responds to Events in the Game

	Self-reported surprise				
	(1)	(2)	(3)	(4)	(5)
Score difference	0.00124			-0.0302*	-0.00221
	(0.0111)			(0.0160)	(0.0113)
PFR prob		0.00377		0.00793**	
		(0.00233)		(0.00344)	
Self-reported prob			0.00348		0.00360
			(0.00411)		(0.00423)
N	911	911	911	911	911
Subjects (Clusters)	61	61	61	61	61
R-Squared	0.166	0.169	0.167	0.172	0.167

The effect of the game on self-reported surprise elicited in a Likert-scale measured on a 1 to 7 scale. All regressions include individual fixed effects and game-quarter dummies. Standard errors clustered at the individual level are reported in parenthesis. Significance denoted as * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A4: How Excitement Responds to Events in the Game

	Self-reported excitement				
	(1)	(2)	(3)	(4)	(5)
Score difference	-0.000140			-0.0304**	-0.00961
	(0.0108)			(0.0136)	(0.0109)
PFR prob		0.00345		0.00763***	
		(0.00220)		(0.00284)	
Self-reported prob			0.00936***		0.00989***
			(0.00245)		(0.00250)
N	911	911	911	911	911
Subjects (Clusters)	61	61	61	61	61
R-Squared	0.261	0.265	0.279	0.270	0.280

The effect of the game on self-reported excitement elicited in a Likert-scale measured on a 1 to 7 scale. All regressions include individual fixed effects and game-quarter dummies. Standard errors clustered at the individual level are reported in parenthesis. Significance denoted as * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A5: Correlation in Emotion Measures

	Happiness	Surprise	Excitement
Happiness	1.0000		
Surprise	0.2955***	1.0000	
Excitement	0.4439***	0.6823***	1.0000

Correlations between the changes in the emotions measured as the difference between the current report and the previous report. The correlation matrix suggests that changes in happiness are positively correlated with changes in excitement and changes in surprise, which are also positively correlated with each other. Significance denoted as * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A6: How Happiness Responds to Events in the Game - No Game-Quarter Dummies

	Self-reported happiness				
	(1)	(2)	(3)	(4)	(5)
Score difference	0.0355***			-0.0158	0.0177*
	(0.0123)			(0.0111)	(0.00979)
PFR prob		0.0107***		0.0129***	
		(0.00283)		(0.00325)	
Self-reported prob			0.0194***		0.0184***
			(0.00360)		(0.00333)
N	911	911	911	911	911
Subjects (Clusters)	61	61	61	61	61
R-Squared	0.0233	0.0614	0.118	0.0634	0.123

The effect of the game on self-reported surprise elicited in a Likert-scale measured on a 1 to 7 scale. All regressions include individual fixed effects. Standard errors clustered at the individual level are reported in parenthesis. These specifications do not include game-quarter dummies. Significance denoted as * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A7: How Mood Effects Decision-Making - No Game-Quarter Dummies

	Charitable Giving Donation	WTP: Good WTP	WTP: Gamble WTP	Trust game Transfer	Average return
Reduced Form	0.0148**	0.00671	0.0111	0.0240*	0.0103
	(0.00657)	(0.00443)	(0.00805)	(0.0136)	(0.00877)
PFR	0.0430**	0.00131	0.0276	0.0349	-0.0269
	(0.0190)	(0.0167)	(0.0211)	(0.0387)	(0.0306)
Self-Reported	0.0437**	0.00858	0.0135	0.0677*	0.0262
	(0.0214)	(0.00902)	(0.0177)	(0.0353)	(0.0198)
N	911	911	911	440	454

The effect of self-reported happiness on economic decision-making. The table reports 3 different models, each of which includes 5 regressions. Model "Reduced Form" is the regression of self-reported happiness on economic decision-making. Model "PFR" is the instrumental variables regression where the first stage is specification (2) in Table A6. Model "Self-Reported" is the instrumental variables regression where the first stage is specification (3) in Table A6. All regressions include individual fixed effects. Standard errors clustered at the individual level are reported in parenthesis. These specifications do not include game-quarter dummies. Significance denoted as * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A8: How Happiness Responds to Events in the Game - Excitement and Surprise as Controls

	Self-reported happiness				
	(1)	(2)	(3)	(4)	(5)
Score difference	0.0343***			-0.00734	0.0183*
	(0.0122)			(0.00986)	(0.00984)
PFR prob		0.00946***		0.0105***	
		(0.00277)		(0.00300)	
Self-reported prob			0.0177***		0.0167***
			(0.00349)		(0.00316)
Surprise	0.0796**	0.0741**	0.0871***	0.0736**	0.0864***
	(0.0301)	(0.0301)	(0.0275)	(0.0300)	(0.0281)
Excitement	0.203***	0.191***	0.152***	0.189***	0.155***
	(0.0497)	(0.0506)	(0.0497)	(0.0506)	(0.0497)
N	911	911	911	911	911
Subjects (Clusters)	61	61	61	61	61
R-Squared	0.134	0.160	0.209	0.160	0.214

The effect of the game on self-reported excitement elicited in a Likert-scale measured on a 1 to 7 scale. All regressions include individual fixed effects and game-quarter dummies. Standard errors clustered at the individual level are reported in parenthesis. These specifications include excitement and surprise as controls. Significance denoted as * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A9: How Mood Effects Decision-Making - Excitement and Surprise as Controls

	Charitable Giving Donation	WTP: Good WTP	WTP: Gamble WTP	Trust game Transfer	Average return
Reduced Form	0.0119*	0.0132***	0.00923	0.0164*	0.00910
	(0.00668)	(0.00487)	(0.00624)	(0.00868)	(0.00857)
PFR	0.0419**	0.0128	0.0277	0.0210	-0.0219
	(0.0185)	(0.0183)	(0.0247)	(0.0422)	(0.0267)
Self-Reported	0.0455**	0.0117	0.0144	0.0574	0.0248
	(0.0223)	(0.00880)	(0.0179)	(0.0363)	(0.0192)
N	911	911	911	440	454

The effect of self-reported happiness on economic decision-making. The table reports 3 different models, each of which includes 5 regressions. Model "Reduced Form" is the regression of self-reported happiness on economic decision-making. Model "PFR" is the instrumental variables regression where the first stage is specification (2) in Table A8. Model "Self-Reported" is the instrumental variables regression where the first stage is specification (3) in Table A8. All regressions include individual fixed effects and game-quarter dummies. Standard errors clustered at the individual level are reported in parenthesis. These specifications include measurements of excitement and surprise as controls. Significance denoted as * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

B Experimental Instructions

Instructions

Thank you for participating in this study. This study is about decision-making and entertainment. Over the course of the study, you will answer questions and make decisions. We will record your answers on the tablet in front of you. Please make sure that you are always using the tablet assigned to you. If you have difficulty with the tablet, just raise your hand and someone will come over to help you. However, please do not use the tablet for any purpose other than this study. If you want to surf the Web please use your own cell phone or tablet. We will now describe the study and the ways in which you may earn money in the study.

Over the course of the study you will watch an NFL football game. Before the game and at certain commercial breaks during the game, we will ask you to answer a set of questions and to choose a decision for each of four decision problems. The questions and decision problems will be the same at the beginning of the game and at each commercial break. You can enter the same answer or different answers each time you are asked. At the end of the study, we will randomly select one of the four decision problems you engaged in and randomly select your choice made before the game or during one of the commercial breaks and pay you cash based on your choice for that decision problem. In addition to the money you make in the decision problem you will receive $30 just for showing up.

Only one of your decisions will be randomly chosen for payment, so each time you are asked to make a decision you should answer as if this is the only decision you are making today. In other words, each time you make a decision you should answer it as if that answer is your best answer ignoring everything else you have done today, since that answer may be the only one that counts.
The decision problems are described below.

Decision Problem 1:

During this game you may have the opportunity to donate money to a charity.

There are three possible charities to which you can donate as part of this study. The three charities are: CHARITY A (The United Way), CHARITY B (The American Cancer Society), and CHARITY C (The World Wildlife Fund). On your tablet you will be asked to select one when the time arrives.

If this decision is randomly selected for payment, you will receive $40 dollars and you will have the opportunity to donate some of this money to the charity you selected.

In particular, you will keep $40 minus the amount you choose to donate to the charity and the charity will receive the amount you chose to donate to the charity. If this decision problem is chosen for payment, you will receive your $30 show-up fee plus whatever amount of the $40 you decided to keep.

We will collect all the money donated to charity by all people in the room and write checks to those charities when the study is over. You can be 100% confident that the money will be donated.

Only one of the decisions you made either before the game or during a commercial break will be randomly chosen for payment, so each time you are asked this question you should answer as if this is the only decision you are making today.

Please raise your hand if you have any questions.

Decision Problem 2:

For this decision problem, we will give you \$40 out of which you might spend to buy one of three goods of your choosing, which will be shown to you now.

During this game you may have the opportunity to buy your chosen good. When the time comes, you will select the good you would like to be offered for purchase by entering it in your tablet.

Once before the game and at each commercial break, we will ask you how much you are willing to pay out of your \$40 for the good that you have selected. Whether you actually are able to buy the good, and at what price, will be described below, but it is in your best interest to write down exactly the most you would be willing to pay for the good (and not more or less than the most you would be willing to pay) each time you are asked.

The way that we determine whether you buy your good is that we will randomly select a price between \$0 and \$40. If the price is below the amount you report you are willing to pay, you pay that randomly selected price and get the good. If the price is above the amount you report that you are willing to pay, you will not receive the good but will be able to keep the entire \$40. For example, if you report \$25 as what you are willing to pay, then if the price is randomly selected to be \$10 you will pay \$10 to get the good. In this case you will pay \$10 for the good out of your \$40 and also get the good. If you report \$25 as what you are willing to pay, then if the price is randomly selected to be \$30, you will not pay for the good and you will not receive the good but will keep the entire \$40. So here you will leave the experiment with \$40. Given that the price is randomly selected and not determined by what you report, it is in your best interest to write down exactly the most you would be willing to pay for the good (and not more or less than the most you would be willing to pay). Remember, whatever your payment is in this decision problem you will be paid your \$30 show-up fee in addition.

Only one of the decisions you made either before the game or during a commercial break will be randomly chosen for payment, so each time you are asked this question you should answer as if this is the only decision you are making today.

Please raise your hand if you have any questions.

Decision Problem 3:

For this decision problem, we will give you \$40 out of which you might spend money to buy a risky gamble that gives you a 50% chance of receiving \$0 and a 50% chance of receiving \$40.

Once before the game and at each commercial break, we will ask you how much you are willing to pay for this risky gamble. Whether you actually are able to buy the risky gamble, and at what price, will be described below, but it is in your best interest to write down exactly the most you would be willing to pay for the risky gamble (and not more or less than the most you would be willing to pay).

The way that we determine whether you get the gamble is that we will randomly select a price between \$0 and \$40. If the price is below the amount you report you are willing to pay, you pay that randomly selected price and get the risky gamble. If the price is above the amount you report that you are willing to pay, you will not get the risky gamble. Instead, you will get to keep the \$40 we gave you. For example, if you report \$25 as what you are willing to pay, then if the price is randomly selected to be \$10 you will pay \$10 to get the risky gamble. In this case you will pay \$10 for the gamble out of your \$40 and also get to engage in the gamble. If the gamble ends up paying you \$40, then your payoff will be $\$70 = \$40 - \$10 + \$40$. However, if the gamble ends up paying you \$0, then your payoff will be $\$30 = \$40 - \$10 + \$0$. If you report \$25 as what you are willing to pay, then if the price is randomly selected to be \$30, you will not get the gamble. You will be able to keep your initial \$40 so your payoff will be \$40. Remember, whatever your payment is in this decision problem you will be paid your \$30 show-up fee in addition.

Given that the price is randomly selected and not determined by what you report, it is in your best interest to write down exactly the most you would be willing to pay for the risky gamble (and not more or less than the most you would be willing to pay). If you buy the risky gamble, we will have the computer flip a coin and you will either get \$0 with 50% probability or \$40 additional dollars with 50% probability.

Only one of the decisions you made either before the game or during a commercial break will be randomly chosen for payment, so each time you are asked this question you should answer as if this is the only decision you are making today.

Please raise your hand if you have any questions.

Decision Problem 4:

During this game you will interact anonymously with another person in this study. In the interaction, you will be randomly assigned to be Player A or Player B. At the start of the interaction, Player A has \$32 and Player B has \$0. Player A can choose to send \$0, \$8, \$16, \$24, or \$32 to Player B. Player B will receive three times (i.e. $3\times$) the amount of money transferred by Player A. For example, if Player A transfers \$32, Player B will receive \$96, if Player A transfers \$16, Player B will receive \$48, if Player A transfers \$0, Player B will receive \$0.

Player B then has the opportunity to transfer money back to Player A, from \$0 up to the total amount Player B received from Player A's transfer. This money is transferred one-for-one without being multiplied. For example, if Player B transfers \$32 back to Player A, Player A receives \$32; if Player B transfers \$16 back to Player A, Player A receives \$16; if Player B transfers \$0 back to Player A, Player A receives \$0.

If you are randomly chosen to be Player A, you will choose how much money to send to Player B. If you are randomly selected to be Player B, you will choose how much money to send back to Player A for each amount of money he or she might send to you.

If this decision problem is chosen for cash payment, we will look at the decisions you made either before the game or at one randomly chosen commercial break. If you are Player A your payoff will be equal to the \$32 you started out with minus what you sent to Player B plus what Player B sent back to you. If you are Player B, your payoff will be equal to the amount Player A sent to you minus what you sent back to Player A. Remember, whatever your payment is in this decision problem you will be paid your \$30 show-up fee in addition.

You will not receive any feedback from this decision problem and will be asked for choices at the start of the game and at each of the commercial breaks.

Only one of the decisions you made either before the game or during a commercial break will be randomly chosen for payment, so each time you are asked this question you should answer as if this is the only decision you are making today.

Please raise your hand if you have any questions.

C Proofs

We will now go over the proofs of the propositions in Section 3. As a quick reminder on notation, we will use $u_1 = \frac{\partial u_i(\sigma_i,\pi_i)}{\partial \sigma_i}$, $u_2 = \frac{\partial u_i(\sigma_i,\pi_i)}{\partial \pi_i}$ and $u_{12} = \frac{\partial^2 u_i(\sigma_i,\pi_i)}{\partial \sigma_i \partial \pi_i}$.

Proposition 1. *In the charitable giving game, if $u_{12} < 0$, then charitable giving is increasing in mood. If $u_{12} > 0$, then charitable giving is decreasing in mood.*

Proof. The utility function of the dictator who is endowed with wealth w and chooses to give c is given by

$$U_i\left(\sigma_i, w, c\right) = \int_j \left[\beta u_j\left(\sigma_j, c\right) + u_i(\sigma_i, w - c)\right] d\mu(\sigma_j).$$

If we take the derivative of this utility function with respect to σ_i and c, we get

$$\frac{\partial^2 U_i\left(\sigma_i, w, c\right)}{\partial \sigma_i\ \partial c} = \int_j \left[-u_{i,12}(\sigma_i, w - c)\right] d\mu(\sigma_j).$$

Our assumption that $u_{12} \geq 0$ implies that the above expression is submodular. Hence, by Topkis's Theorem, we get that c is decreasing in σ_i. The proof for when $u_{12} \leq 0$ is analogous. $\square$

Proposition 2. *In the willingness to pay task, if utility be additive in the good and $u_{12} < 0$, then willingness to pay is increasing in mood. If utility be additive in the good and $u_{12} > 0$, then willingness to pay is decreasing in mood.*

Proof. When considering the willingness to pay for a good by subject i, the utility function of other players doesn't enter into i's utility function. Our assumption on the utility form ensures that utility of a i when he receives the good and pays a price p is

$$U_i\left(\sigma_i, w - p, g\right) = v\left(g\right) + u(\sigma_i, w - p).$$

Again, we will show use Topkis's Theorem. Note that the cross-partial derivative of $U_i\left(\sigma_i, w - p, g\right)$ is

$$\frac{\partial^2 U_i\left(\sigma_i, w - p, g\right)}{\partial \sigma_i\ \partial p} = -u_{12}(\sigma_i, w - p).$$

Hence, our assumption that $u_{12} \geq 0$ implies that the above expression is submodular, and we conclude that p is decreasing in mood. The proof for when

$u_{12} \leq 0$ is analogous. $\square$

Proposition 3. *If* $\frac{\partial u_i(\sigma_i,\pi)}{\partial \sigma_i} = u_1(\sigma_i,\pi)$ *is a convex transformation of* $u_i(\sigma_i,\pi)$*, then the willingness to pay for the gamble will be increasing in mood. If* $\frac{\partial u_i(\sigma_i,\pi)}{\partial \sigma_i} = u_1(\sigma_i,\pi)$ *is a concave transformation of* $u_i(\sigma_i,\pi)$*, then the willingness to pay for the gamble is decreasing in mood.*

Proof. Subjects were asked to choose and x which solved the following equation

$$\frac{1}{2}\left(u_i\left(\sigma_i, w-x\right)+u_i\left(\sigma_i, 2w-x\right)\right)=u_i\left(\sigma_i, w\right).$$

Let $x(\sigma_i)$ be the function which gives the x which solves this equation for different moods σ_i. If we plug this into the above equation and take the derivative with respect to σ_i, we get

$$\begin{aligned}\frac{1}{2}\Big(u_1\left(\sigma_i, w-x\left(\sigma_i\right)\right)+u_1\left(\sigma_i, 2w-x\left(\sigma_i\right)\right)-\ &\frac{\partial x\left(\sigma_i\right)}{\partial \sigma_i}\left(u_2\left(\sigma_i, 2w-x\left(\sigma_i\right)\right)\right.\\ &\left.+u_2\left(\sigma_i, w-x\left(\sigma_i\right)\right)\right)\Big)=u_1\left(\sigma_i, w\right).\end{aligned}$$

Rearranging this equation to solve for $\frac{\partial x(\sigma_i)}{\partial \sigma_i}$, we get that

$$\frac{\partial x\left(\sigma_i\right)}{\partial \sigma_i}=\frac{\frac{1}{2}\left(u_1\left(\sigma_i, w-x\left(\sigma_i\right)\right)+u_1\left(\sigma_i, 2w-x\left(\sigma_i\right)\right)\right)-u_{,1}\left(\sigma_i, w\right)}{u_2\left(\sigma_i, 2w-x\left(\sigma_i\right)\right)+u_2\left(\sigma_i, w-x\left(\sigma_i\right)\right)}.$$

Hence, $\frac{\partial x(\sigma_i)}{\partial \sigma_i} > 0$ is positive if and only if $\frac{1}{2}\left(u_1\left(\sigma_i, w-x\left(\sigma_i\right)\right)+u_1\left(\sigma_i, 2w-x\left(\sigma_i\right)\right)\right) > u_1\left(\sigma_i, w\right)$.

Suppose that $u_{i1}(\sigma_i,\pi)$ is a convex transformation of $u_i(\sigma_i,\pi)$ (i.e., there is a convex function φ such that $u_1(\sigma_i,\pi) = \varphi(u_i(\sigma_i,\pi))$. By an application of Jensen's Inequality, we get

$$\begin{aligned}u_1\left(\sigma_i, \pi\right)=\varphi\left(u_i\left(\sigma_i, \pi\right)\right) &=\varphi\left(\frac{1}{2}\left(u_i\left(\sigma_i, w-x\right)+u_i\left(\sigma_i, 2w-x\right)\right)\right) \\ &\leq \frac{1}{2}\left(\varphi(u_i\left(\sigma_i, w-x\right))+\varphi(u_i\left(\sigma_i, 2w-x\right))\right) \\ &= \frac{1}{2}\left(u_1\left(\sigma_i, w-x\left(\sigma_i\right)\right)+u_1\left(\sigma_i, 2w-x\left(\sigma_i\right)\right)\right).\end{aligned}$$

Thus, $\frac{\partial x(\sigma_i)}{\partial \sigma_i} > 0$ and the willingness to pay for the gamble is increasing in mood.

Suppose that $u_1(\sigma_i,\pi)$ is a concave transformation of $u_i(\sigma_i,\pi)$ (i.e., there is a concave function ψ such that $u_1(\sigma_i,\pi) = \psi(u_i(\sigma_i,\pi))$. Again, by using

Jensen's inequality, we have

$$
\begin{aligned}
u_1(\sigma_i, \pi) = \psi(u_i(\sigma_i, \pi)) = \psi\left(\frac{1}{2}(u_i(\sigma_i, w-x) + u_i(\sigma_i, 2w-x))\right) \\
\geq \frac{1}{2}(\psi(u_i(\sigma_i, w-x)) + \psi(u_i(\sigma_i, 2w-x))) \\
= \frac{1}{2}(u_1(\sigma_i, w-x(\sigma_i)) + u_1(\sigma_i, 2w-x(\sigma_i))).
\end{aligned}
$$

Thus, $\frac{\partial x(\sigma_i)}{\partial \sigma_i} < 0$ and the willingness to pay for the gamble is decreasing in mood. □

Proposition 4. *If $u_{12} < 0$, then the amount returned by the receiver is increasing in mood. If $u_{12} > 0$, then the amount returned by the receiver is decreasing in mood. If u_1 is a convex transformation of u_i and $u_{12} < 0$, then the amount returned by the receiver is decreasing in mood. If u_1 is a concave transformation of u_i and $u_{12} > 0$, then the transfer by the sender is decreasing in mood.*

Proof. Let us first focus on the case of the receiver. Suppose that the receiver j has received $3t$ and must choose c (i.e., how much to send back). His utility function is given by

$$
U_j(\sigma_j, 3t, c) = \int_i [u_j(\sigma_j, 3t-c) + \beta u_i(\sigma_i, w-t+c)] \, d\mu(\sigma_i|t).
$$

We note that this problem is very similar to that of the dictator game. The receiver gets to choose how much to share, just as the dictator did.

If we take the cross-partial derivatives, we note that

$$
\frac{\partial^2 U_j(\sigma_j, 3t, c)}{\partial \sigma_j \, \partial c} = \int_i [-u_{j,12}(\sigma_j, 3t-c)] \, d\mu(\sigma_i|t),
$$

where $u_{j,12}$ is defined in the same way as u_{12}, only now for u_j. As in the dictator game, Topkis's Theorem gives us our desired results for the receiver.

Now we move back a step to the sender's problem. Since our sender is rational, he can predict what the receiver would return in a given mood. Let $c(\sigma_j, t)$ be the amount returned by a receiver in mood σ_j when he is sent an amount t. Since receivers and senders are randomly matched, the sender is not aware of the receiver's mood and must take an expectation over the receiver's possible moods. Hence, the sender's utility when he is in mood σ_i and sends t

is given by

$$U_i(\sigma_i, t, c) = \int_j [\beta u(\sigma_j, 3t - c(\sigma_j, t)) + u(\sigma_i, w - t + c(\sigma_j, t))]\, d\mu(\sigma_j).$$

Let $c_2(\sigma, t) := \frac{\partial c(\sigma,t)}{\partial t}$. Taking the derivative with respect to t, the first-order condition for t is

$$\begin{aligned}\frac{\partial U_i(\sigma_i, t, c)}{\partial t} = & \int_j [\beta u_{j,2}(\sigma_j, 3t - c(\sigma_j, t))(3 - c_2(\sigma_j, t)) \\ & + (1 - c_2(\sigma_j, t)) u_2(\sigma_i, w - t + c(\sigma_j, t))]\, d\mu(\sigma_j) = 0.\end{aligned}$$

The problem of the sender is thus a bit more involved than our previous problems. The sender must consider how much the receiver will return for a given amount t. First, let us think about the problem when we assume that $u_{12} \leq 0$ and suppose that we have an interior solution (i.e., $t < w$). Then there must be some receivers who are returning at a rate less than one, by which we mean $c(\sigma_j, t) < t$. If this were not so, than the sender could increase t slightly and be better off.

Because $u_{j,2} > 0$, we have that

$$\int_j [(1 - c_2(\sigma_j, t)) u_2(\sigma_i, w - t + c(\sigma_j, t))]\, d\mu(\sigma_j) < 0.$$

We can find a set N of σ_j with $1 > c_2(\sigma_j, t)$ such that[33]

$$\int_{j \notin N} [(1 - c_2(\sigma_j, t)) u_2(\sigma_i, w - t + c(\sigma_j, t))]\, d\mu(\sigma_j) = 0.$$

Let Z be the set of all j not in N, with Z_- being the set of all σ_j such that $c_2(\sigma_j, t) < 1$ and Z_+ be the σ_j with $c_2(\sigma_j, t) \geq 1$.

We argue that every receiver who doesn't return at a rate greater than one must be returning zero. Take any receiver with an interior allocation of c. The first-order condition for the receiver is

$$\int_i [-u_{j,2}(\sigma_j, 3t - c) + \beta u_2(\sigma_i, w - t + c)] d\mu(\sigma_i) = 0.$$

33. If the set of σ_j have mass points, we can divide the mass point into N.

Take the derivative with respect to t, we get that

$$\frac{\partial c(\sigma_j, t)}{\partial t} = \frac{\int_i 3u_{j,22}(\sigma_j, 3t - c) + \beta u_{22}(\sigma_i, w - t + c)]d\mu(\sigma_i)}{\int_i u_{j,22}(\sigma_j, 3t - c) + \beta u_{22}(\sigma_i, w - t + c)]d\mu(\sigma_i)},$$

which is greater than one. Therefore any receiver returning more than 0 must be have $c_2(\sigma_j, t) \geq 1$ (any receiver at the boundary condition of $c(\sigma_j, t) = 3t$ will have $c_2(\sigma_j, t) = 3$). Therefore we know that $c(\sigma_j, t) > c(\sigma_k, t)$ for all $c_2(\sigma_k, t) < 1 < c_2(\sigma_j, t)$.

Consider the case when $u_{12} < 0$. For every point $j \in Z_+$, we can match it with a $k \in Z_-$ of mass y such that

$$0 = u_2(\sigma_i, w - t + c(\sigma_j, t))(1 - c_2(\sigma_j, t)) + u_2(\sigma_i, w - t + c(\sigma_k, t))(1 - c_2(\sigma_k, t))y.$$

The derivative of this equation with respect to σ_i is positive if and only if

$$\frac{-u_{12}(\sigma_i, w - t + c(\sigma_k, t))}{u_2(\sigma_i, w - t + c(\sigma_k, t))} > \frac{-u_{12}(\sigma_i, w - t + c(\sigma_j, t))}{u_2(\sigma_i, w - t + c(\sigma_j, t))},$$

which holds by u_1 being a convex transformation of u and $c(\sigma_k, t) < c(\sigma_j, t)$. Therefore, we have that

$$\int_{j \in Z} [(1 - c_2(\sigma_j, t))u_{12}(\sigma_i, w - t + c(\sigma_j, t))] \, d\mu(\sigma_j) > 0.$$

Moreover, we know that

$$\int_{j \in N} [(1 - c_2(\sigma_j, t))u_{12}(\sigma_i, w - t + c(\sigma_j, t))] \, d\mu(\sigma_j) > 0.$$

Together, these equations imply

$$\begin{aligned} \frac{\partial^2 U_i(\sigma_i, 3t, c)}{\partial t \partial \sigma_i} = & \int_{j \in N} [(1 - c'(\sigma_j, t))u_{12}(\sigma_i, w - t + c(\sigma_j, t))] \, d\mu(\sigma_j) \\ & + \int_{j \in Z} [(1 - c'(\sigma_j, t))u_{12}(\sigma_i, w - t + c(\sigma_j, t))] \, d\mu(\sigma_j) > 0. \end{aligned}$$

By Topkis's Theorem, we have that t is increasing in σ_j. The case when $u_{12} > 0$ is shown in the same manner, only now flipping the inequalities on u_{12}.

$\square$