Penalty Structures and Deterrence in a Two-Stage Model: Experimental Evidence

Lisa R. Anderson*

Gregory DeAngelo†

Winand Emons ‡

Beth Freeborn §

Hannes Lang**

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Abstract: Multi-period models of criminal enforcement based on the standard economic approach of Becker (1968) generally find that the optimal penalty structure is either flat or declining. We present the first experimental test of a two-stage theoretical model that predicts decreasing penalty structures will yield greater deterrence than increasing penalty structures. Our results are consistent with the theoretical prediction that decreasing fine structures are more effective at reducing risky behavior. Additionally, we adapt the model to derive predictions for a distribution of risk preferences and examine consistency with theory across risk levels. Extremely risk averse subjects are more likely to be consistent with theory while risk loving subjects are significantly less likely to follow predicted behavior. Our econometric analysis also reveals that subjects are deterred by past convictions, even though the probability of detection is independent across decisions. Further, subjects appear to take the two-stage nature of the decision making task into account, suggesting that subjects consider both current and future penalties. Even controlling for the fine a subject faces for any given decision, being in a decreasing fine structure has a significant, negative effect on the probability of offending.

JEL codes: C91, K42, K10

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* College of William and Mary, lisa.anderson@wm.edu.

† West Virginia University, gregory.deangelo@gmail.com, corresponding author.

‡ University of Bern, winand.emons@vwi.unibe.ch.

§ Federal Trade Commission, bafreeborn@gmail.com. The views expressed are those of the author and do not represent those of the Federal Trade Commission or any individual Commissioner.

** Technische Universität München, TUM School of Life Sciences Weihenstephan, hanneslang1@gmail.com.

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1. Introduction

Most legal systems punish repeat offenders more severely for the same offense than first-time offenders. Increasingly harsh penalties characterize traditional crimes such as theft and murder, but also violations of environmental and labor regulations as well as tax evasion. This principle of escalating sanctions based on offense history is so widely accepted that it is embedded in many penal codes and sentencing guidelines.[1] In some cases, there are compelling reasons to have an escalating penalty structure (e.g. first time offenders might have committed a crime by accident).[2] But there are many enforcement situations with no obvious justification for low penalties for first offenders. For example, a firm that has defrauded customers out of large sums of money might be expected to pay a fine equal to consumer harm, regardless of whether it is the firm's first offense. Furthermore, there is evidence that escalating sanctions are not always effective at deterring crime; Sloan et al (2013a) show that increasing penalties for domestic violence do not result in reductions in future arrests and convictions.

The literature on optimal law enforcement follows the pioneering work of Becker (1968).[3] However, Becker (1968) does not address the issue of repeat offending. Multi-period models of criminal enforcement based on this standard economic approach generally find that the optimal penalty structure is either flat or declining.[4] In this paper, we study a two-period version of Becker's (1968) model in a lab experiment to assess whether the declining or flat penalty structures implied by theory lead to greater levels of deterrence than the commonly used increasing penalty structures.[5] We are not aware of any other experimental study that has addressed this question.[6]

We use the basic theoretical framework of Emons (2003) to motivate our experimental design. In a model where criminal acts are strictly undesirable, Emons (2003, 2004) shows that greater deterrence is reached when fines are declining over a two period time horizon. This theoretical result is in stark contrast to the practices embodied in penal codes. In the Emons model, agents live for two stages and may commit an offense in each stage.[7] The agents

[1] For example, in the US under the Clean Water Act, the maximum penalties are doubled for subsequent offenses and the Immigration Reform and Control Act imposes minimum fines of $250 for a first offense, $2000 for a second offense, and $3000 for subsequent offenses. In Switzerland, the fine for travelling without a valid ticket on a regional train is 100 SFR for the first offense, 140 SFR for the second offense, and 170 SFR for any further offense. See Polinsky and Shavell (1998) for more examples.

[2] See, e.g., Rubinstein (1979); Chu et al. (2000); Emons (2007); Ben-Shahar (1997) and Bebchuk and Kaplow (1993) for models that allow crimes to be committed by accident.

[3] See, e.g., Garoupa (1997) or Polinsky and Shavell (2000) for surveys of the earlier law enforcement literature.

[4] For example, Burnovski and Safra (1994) and Emons (2003,2004).

[5] In addition to deterring criminal behavior, legal systems also seek to sanction those who violate laws with criminal penalties and fines. For the purposes of this paper, we abstract away from the notion of punishment and assume that legal systems solely seek to optimize deterrence.

[6] Behavioral and experimental economics have been used to investigate theoretical concepts in many sub-disciplines within economics, but are less prevalent in studying issues within law and economics. See Tietelbaum and Zeiler (forthcoming), Camerer and Talley (2007), McAdams and Ulen (2008), Arlen and Taylor (2008), and Engel (2013) for reviews of the literature. Limited work has focused on the exact nature and context of enforcement. In a large-scale field experiment examining different enforcement strategies to collect fees from consumers, Fellner et al. (2013) show that making a high detection regime salient to potential offenders has a significant deterrence effect.

[7] Emons (2003) also assumes that the benefit to the offender is smaller than the harm caused by the offense. Our experiment does not address the harm aspect of the offense, since our focus is on agent behavior, and agent utility is not affected by the harm caused to society. Adding "harm to society" in our experimental framework in a way that

are wealth constrained; increasing the fine for the first offense means a reduction in the sanction for the second offense and vice versa. The government seeks to minimize enforcement cost as measured by the probability of apprehension. Since the probability of being detected for a first offense is higher than the probability of being detected for two offenses, a high penalty for the first offense is a more effective use of the scarce (money penalty) resource. This result is consistent with Becker's (1968) maximal fine result; in order to minimize enforcement cost, the government uses the agent's entire wealth for sanctions in the first stage.[8] In related theoretical work, Motchenkova (2014) shows that the results of Emons (2003, 2004) also hold for more than two periods; however, she does not allow for history dependent strategies.

The model of Emons (2003) assumes risk-neutral agents; however, other theoretical models have suggested individual risk preference may play a role in the decision to commit a crime. Becker (1968) shows that only risk loving agents will be criminals under an efficient criminal justice system. Friedman (1984) shows, however, that Becker's result is driven by a corner solution where fines approach infinity, and this is not realistic. Neilson and Winter (1997) note that if certain assumptions about expected utility maximization are relaxed, it is possible for offenders to be both risk averse and more sensitive to changes in the certainty of punishment. Recently, Mungan and Klick (2014, 2015) present theoretical models that show criminals do not necessarily need to be risk loving.

We extend the Emons (2003) model to derive predictions for other levels of risk tolerance. We experimentally elicit a measure of individual's risk preference using the method of Holt and Laury (2002). Although the optimal strategy within a penalty structure is generally consistent across most risk preferences, we do find that the optimal strategy changes across penalty structures for subjects who are either risk loving or extremely risk averse. We then test whether subjects in a specific risk category (e.g., risk-loving or highly risk averse) are more or less likely to follow the optimal strategy as predicted by theory. We find that extremely risk averse subjects are more likely to be consistent with theory while risk loving subjects are significantly less likely to follow predicted behavior.

Recall that Emons (2003) finds that decreasing penalty structures lead to a greater level of deterrence. Our experimental results generally confirm the predictions of Emons (2003). We find that decreasing penalty structures result in higher deterrence than increasing or flat penalty structures. However, the decreasing penalty structures have the highest rate of repeat offenses, since the second offense has a relatively small fine. We also perform analyses on the individual decision of whether to commit the offense. In addition to finding greater levels of deterrence when subjects are faced with declining penalty structures, we observe greater offense levels when subjects are male, less risk averse, and have committed offenses in previous rounds.

We also find that being caught under previous penalty structures has a deterrent effect in the current penalty structure, even though the probability of being caught and the fine are independent of previous rounds. This suggests that subjects' perceptions about the risk of being caught are influenced by previous detection. Lochner (2007) reports

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affects subject payoffs would lead to strategic interactions between players and make it harder for us to isolate the effect of the penalty structure on behavior.

[8] If sanctions are less than total wealth, sanctions can be increased and the probability of apprehension lowered so as to keep deterrence constant.

a similar finding using survey-based data; specifically, young men who engage in criminal behavior and are undetected revise their likelihood of being detected downward while those detected revise their probability upward.

In the next section, we present the model that we test. Section 3 describes the experimental design, Sections 4, 5, and 6 present results, and in the final section, we offer a discussion of our results and conclude.

2. Model

Agents have initial wealth, w, and maximize expected utility by making decisions in two stages. In each stage, an agent can engage in an illegal activity with a monetary benefit, b. The government seeks to deter individuals from engaging in the illegal activity by choosing a two-part fine structure of the format (f_1, f_2). The first sanction, f_1, applies to the first detected offense, and the second sanction, f_2, applies to the second detected offense. The government cannot confiscate more than the agent's wealth, thus $f_1 + f_2 \leq w$.[9] Throughout the experiment, we set $f_1 + f_2 = w$ so as to be consistent with Emons (2003). Moreover, the government sets the level of detection that determines the probability that an offense will be detected, p.[10] Since we hold p and the overall level of the fines constant, any variation in observed behavior (i.e., the decision to commit) may be attributed to whether fines are increasing or decreasing.

To derive the optimal decision for each fine structure, we compare expected utility levels associated with all possible strategy sets, (a_1, a_2), where a_1 represents the action taken by the agent in the first stage and a_2 represents the action taken by the agent in the second stage. We let (a_1, a_2) be represented by 0 if the agent does not engage in the illegal activity and 1 if the agent does engage in the illegal activity. Thus, there are four possible strategy sets to consider that are not history dependent: (0, 0), (1, 1), (0, 1), and (1, 0). The agent also can choose between two history dependent strategies. First, she commits the criminal act in stage 1 and then commits the criminal act in stage 2 only if she *is not* detected in stage 1. We call this strategy (1, (1|not detected; 0|otherwise)). Alternatively, she commits the act in stage 1, and then commits the act in stage 2 only if she *is* detected in stage 1. We call this strategy (1, (0|not detected; 1|otherwise)).[11]

Emons (2003) assumes that agents are risk neutral. However, we know from a plethora of experimental studies that, on average, subjects tend to be slightly risk averse.[12] For this reason, we generalize risk preferences by assuming constant absolute risk aversion. Following Holt and Laury (2002), let

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[9] While there is research that focuses on sanctions that exceed an individual's wealth (see Polinsky and Shavell, 2000), we focus on situations where monetary sanctions do not exceed an individual's wealth. This focus is sensible in a lab experiment. In practice, we cannot take funds from participants. Additionally, situations where sanctions exceed wealth typically involve excessively criminal acts, which we do not attempt to model in the lab.
[10] Behavior is anticipated to vary with the probability of apprehension (Bar-Ilan and Sacerdote, 2001). We reduce this dimension of variation by holding the probability fixed throughout the experiment.
[11] Note that both of the history-dependent strategies involve the agent committing the crime in the first stage, since there is no chance of paying a fine in the first stage if the crime is not committed.
[12] For example, Anderson and Mellor (2009) report that 75% of their subjects are risk averse.

$$U(x) = \begin{cases} x^{1-r}, & r < 1; \\ ln(x), & r = 1; \\ \dfrac{x^{1-r}}{1-r}, & r > 1, \end{cases}$$

where x denotes income and r measures risk aversion: for $r < 0$ the agent is risk loving, for $r = 0$ she is risk neutral, and for $r > 0$, she is risk averse. The following set of equations describes the expected utilities for all possible strategy sets (a_1, a_2).

(1) $$E[\boldsymbol{U}(\mathbf{0},\mathbf{0})] = \boldsymbol{U}(\boldsymbol{w})$$

(2) $$\boldsymbol{E}[\boldsymbol{U}(\mathbf{1},\mathbf{1})] = \boldsymbol{p}^2\boldsymbol{U}(\boldsymbol{w}+\mathbf{2}\boldsymbol{b}-\boldsymbol{f}_1-\boldsymbol{f}_2) + \mathbf{2}\boldsymbol{p}(\mathbf{1}-\boldsymbol{p})\boldsymbol{U}(\boldsymbol{w}+\mathbf{2}\boldsymbol{b}-\boldsymbol{f}_1) + (\mathbf{1}-\boldsymbol{p})^2\boldsymbol{U}(\boldsymbol{w}+\mathbf{2}\boldsymbol{b})$$

(3) $$\boldsymbol{E}[\boldsymbol{U}(\mathbf{0},\mathbf{1})] = \boldsymbol{E}[\boldsymbol{U}(\mathbf{1},\mathbf{0})] = \boldsymbol{p}\boldsymbol{U}(\boldsymbol{w}+\boldsymbol{b}-\boldsymbol{f}_1) + (\mathbf{1}-\boldsymbol{p})(\boldsymbol{w}+\boldsymbol{b})$$

(4) $$\boldsymbol{E}\big[\boldsymbol{U}\big(\mathbf{1},(\mathbf{1}|\boldsymbol{not\ detected};\mathbf{0}|\boldsymbol{otherwise})\big)\big] = \boldsymbol{p}\boldsymbol{U}(\boldsymbol{w}+\boldsymbol{b}-\boldsymbol{f}_1) + (\mathbf{1}-\boldsymbol{p})\boldsymbol{p}\boldsymbol{U}(\boldsymbol{w}+\mathbf{2}\boldsymbol{b}-\boldsymbol{f}_1) + (\mathbf{1}-\boldsymbol{p})^2\boldsymbol{U}(\boldsymbol{w}+\mathbf{2}\boldsymbol{b})$$

(5) $$\boldsymbol{E}\big[\boldsymbol{U}\big(\mathbf{1},(\mathbf{0}|\boldsymbol{not\ detected};\mathbf{1}|\boldsymbol{otherwise})\big)\big] = \boldsymbol{p}^2\boldsymbol{U}(\boldsymbol{w}+\mathbf{2}\boldsymbol{b}-\boldsymbol{f}_1-\boldsymbol{f}_2) + (\mathbf{1}-\boldsymbol{p})\boldsymbol{U}(\boldsymbol{w}+\boldsymbol{b}) + (\mathbf{1}-\boldsymbol{p})\boldsymbol{p}\boldsymbol{U}(\boldsymbol{w}+\mathbf{2}\boldsymbol{b}-\boldsymbol{f}_1)$$

Note from equation 1 that an agent who never plans to commit an offense will not earn the benefit, and will not pay any fines. Hence, her expected utility is her initial wealth, adjusted for her risk preference. In this case, if she is risk neutral, r = 0, and expected utility is equal to wealth. Also note from equation 3 that if an agent plans to commit an offense in one stage only, expected utility does not vary depending on whether the offense is committed in the first or second stage. In this case, with probability p, the offense will be detected, and the agent will earn her initial wealth (w) plus the benefit of committing the offense (b) minus the fine for being detected for a first offense (f_1). And with probability $1 - p$, the offense will not be detected, and the agent will earn her initial wealth plus the benefit of committing the offense. The expected utilities for strategies that involve multiple offenses or contingent strategies are less intuitive because of compound probabilities. Following from this set of equations, Table 1 shows the optimal strategy for each penalty structure over a range of risk aversion. We chose the risk tolerance categories in Table 1 to show the points where the optimal strategy for a particular penalty structure changes with risk tolerance.

Table 1. Optimal strategy by risk type and penalty structure

	Penalty Structure				
Range of Risk Aversion	f_1 = \$1 f_2 = \$9	f_1 = \$3 f_2 = \$7	f_1 = \$5 f_2 = \$5	f_1 = \$7 f_2 = \$3	f_1 = \$9 f_2 = \$1
r < 0 (Risk Loving)	(1, 1|not detected, 0|otherwise)	(1, 1|not detected, 0|otherwise)	(1, 1)	(1, 0|not detected, 1|otherwise)	(0, 0)
r = 0 (Risk Neutral)	(1, 1|not detected, 0|otherwise)	(1, 1|not detected, 0|otherwise)	(1, 1)	(0, 0) or (1, 0|not detected, 1| otherwise)	(0, 0)
0 < r ≤ 0.75 (Risk Averse)	(1, 1|not detected, 0|otherwise)	(1, 1|not detected, 0|otherwise)	(1, 1)	(0, 0)	(0, 0)
0.75 < r ≤ 1.17 (Very Risk Averse)	(1, 1|not detected, 0|otherwise)	(1, 1|not detected, 0|otherwise)	(1, 1|not detected, 0|otherwise)	(0, 0)	(0, 0)
r > 1.17 (Extremely Risk Averse)	(1, 1|not detected, 0|otherwise)	(1, 1|not detected, 0|otherwise)	(0, 0)	(0, 0)	(0, 0)

In summary, the model has the following predictions:

Prediction 1: *Under the increasing sanction scheme (\$1, \$9), agents will choose the history-dependent strategy (1, (1|not detected; 0|otherwise)) regardless of the level of risk aversion.*

Prediction 2: *Under the increasing sanction scheme (\$3, \$7), agents will choose the history-dependent strategy (1, (1|not detected; 0|otherwise)) regardless of the level of risk aversion.*

Prediction 3: *Under the constant sanction scheme (\$5, \$5), risk loving, risk neutral and mildly risk averse (for r < 0.75) agents will choose the strategy (1,1). Very risk averse subjects will choose the history-dependent strategy (1, 1|not detected, 0|otherwise). And extremely risk averse subjects will choose never to offend (0, 0).*

Prediction 4: *Under the decreasing sanction scheme (\$7, \$3), risk loving subjects will choose the history-dependent strategy (1, 0|not detected;1|otherwise). Risk neutral agents are indifferent between the strategy (0, 0) and the history-dependent strategy (1, (0|not detected; 1|otherwise)). Finally, all risk averse agents will choose never to offend (0, 0).*

Prediction 5: *Under the steeply decreasing sanction scheme ($9, $1), agents will choose the strategy (0,0) regardless of the level of risk aversion.*

Note from Table 1 that the penalty structures with decreasing fines generally achieve better deterrence, as indicated by the (0, 0) optimal strategy sets, than the constant or increasing fine schemes. This is even more pronounced for risk averse agents. Recall that the model assumes rational forward-looking agents who view each stage within a penalty structure as interrelated; whether an agent offends in the first stage depends on the fine for the second offense. This forward-looking behavior is a key assumption of the model for the following reason. The agent can only be apprehended for a second crime after she has already been apprehended for a first crime, meaning that the agent pays the first sanction with probability 1/3 and the second sanction with probability 1/9. Since paying the first fine is more likely than paying the second one, shifting resources from the second to the first sanction increases deterrence.[13] Table 1 also shows that even with relatively high levels of risk aversion, the model predicts that some offenses will be committed in the schemes with increasing sanctions. The constant fine scheme leads to the highest level of predicted offenses and is also the most sensitive to risk tolerance.

3. Experimental Design

We conducted 35 experimental sessions at the College of William and Mary in Virginia, USA. Participants were recruited from on-campus advertisements to participate in paid economics experiments. A total of 367 undergraduate students participated in the experiment and no person was permitted to participate in more than one session. The number of subjects in each session ranged from 4 to 14, and sessions lasted approximately 45 minutes. Subjects began each session by completing the Holt and Laury (2002) lottery choice experiment using the Internet-based Veconlab website.[14]

After completing the lottery choice experiment to elicit a measure of individual risk-aversion, subjects completed another computerized experiment that was programmed and administered using z-tree (Fischbacher, 2007). The experiment was divided into five periods, with each period corresponding to a different enforcement regime (i.e., fine structure).[15] Subjects were endowed with $10 at the beginning of each period, and they faced two decision-making stages within the period. In a context free treatment, subjects could “take a chance” or not. Every time a subject chose to take a chance, she earned an additional $2 but she also faced a 1 in 3 chance of being “checked” and financially penalized. Thus, a subject could earn an additional $4 but could also pay two separate fines each period.

[13] Emons (2003) determines the optimal sanction scheme in the sense of Becker (1968), i.e., the scheme that minimizes the cost of enforcement. In terms of our example, the probability of apprehension is minimized at 0.25 by choosing the (10,0) sanction scheme. However, in this experiment we fix the probability of apprehension at 1/3 and focus on the potential differences in deterrence from increasing versus decreasing penalty structures.

[14] See Anderson and Mellor (2008) for more details about how to derive the measure of risk tolerance, *r*, from this lottery choice experiment.

[15] At the beginning of each session, subjects also participated in a “practice” period with hypothetical earnings.

In addition to the context free treatment, there were three additional treatments that varied only in the way the decision was presented to subjects. In the context treatments, decisions were presented as "driving over the speed limit," "cheating on your taxes," and "shoplifting." Each subject made decisions using only one of the four contexts. We ran both context free and framed experiments to examine how subjects treated specific proscribed behavioral environments in comparison to a sterile risk environment, since previous research has shown considerable differences (see, for example, Sonneman et al., 2013). The complete instructions for the context-free experiment are available in the Appendix. Instructions for the experiments with context are available upon request.

All subjects made decisions for each of five different enforcement regimes denoted (1,9), (3,7), (5,5), (7,3) and (9,1), where the first number is the fine associated with the first detected offense and the second number is the fine for the second detected offense within a given period. At the beginning of each period, subjects were told the relevant fines for the two stages in that period, but they were not told fines for future periods. In every decision making period, subjects were asked what decisions they planned to make before they committed to the actual decisions that affected their earnings; below we refer to these responses as the subjects' *stated strategies* as opposed to the observed behavior with actual earnings. In the discussion that follows, we refer to the enforcement regimes with a higher fine for the second offense as *increasing* fine regimes (i.e., (1,9) and (3,7)) and the regimes with a higher fine for the first offense as *decreasing* fine regimes (i.e., (7,3) and (9,1)).

To control for possible order effects, there were two treatments that differed in the order in which enforcement regimes were presented to subjects. Approximately half of the subjects saw the five regimes in the order treatment presented above, with relatively low first-offense fines in periods 1 and 2. The other subjects saw the five regimes in the following order treatment: (9,1), (7,3), (5,5), (3,7) and (1,9). To avoid wealth effects, subjects were told that one of the five periods would be randomly chosen for payment at the end of the experiment. Subject earnings averaged $10.54 for the deterrence experiment.

4. Consistency of Behavior with Theory

In this section we first focus on the correlation between theoretical predictions and observed behavior. Regardless of whether or not the experiment was presented to subjects with context, for ease of exposition we use the term "offend" to describe all subject choices that correspond to committing the crime.

4.1 Descriptive Statistics

We begin our empirical analysis by examining the frequency with which behavior is consistent with the theoretically predicted strategy. Table 2 reports the proportion of subjects in all sessions (with and without context) who play the predicted strategy. Recall that subjects were also asked to state the strategy that they planned to follow in the experiment prior to making actual decisions. Table 2 also reports the proportion of these "stated strategies"

that are consistent with theory in parentheses. These results are reported for each of five risk tolerance categories shown in Table 1.[16]

Table 2. Consistency of Behavior with Theory

	Penalty Structure: % observed strategies (stated strategies) consistent with theory					
Range of Risk Aversion	f_1 = \$1 f_2 = \$9	f_1 = \$3 f_2 = \$7	f_1 = \$5 f_2 = \$5	f_1 = \$7 f_2 = \$3	f_1 = \$9 f_2 = \$1	Overall Level of Consistency (by risk type)
r < 0 Risk Loving (n =15)	0.33 (0.27)	0.20 (0.27)	0.27 (0.13)	0.07 (0.00)	0.67 (0.47)	0.31 (0.23)
r = 0 Risk Neutral (n = 64)	0.59 (0.55)	0.52 (0.48)	0.31 (0.20)	0.61 (0.48)	0.56 (0.45)	0.52 (0.43)
0 < r ≤ 0.75 Risk Averse (n = 182)	0.57 (0.49)	0.47 (0.36)	0.17 (0.07)	0.63 (0.54)	0.69 (0.50)	0.51 (0.39)
0.75 < r < 1.17 Very Risk Averse (n = 66)	0.64 (0.54)	0.48 (0.36)	0.23 (0.19)	0.76 (0.60)	0.75 (0.71)	0.57 (0.48)
r > 1.17 Extremely Risk Averse (n = 33)	0.68 (0.42)	0.37 (0.26)	0.74 (0.53)	0.74 (0.58)	0.74 (0.68)	0.65 (0.49)
Overall Level of Consistency (by penalty structure)	0.57 (0.50)	0.46 (0.37)	0.25 (0.15)	0.64 (0.52)	0.68 (0.54)	

Looking at the overall level of consistency between theory and behavior, we find that the extremely risk averse subjects and subjects facing the decreasing penalty structures are most likely to follow the theorized strategy. Risk loving subjects and subjects who face a constant fine structure are least likely to follow the theorized strategy. Recall that the model predicts the highest level of offenses under this fine structure. We find that the most

[16] Note that seven subjects made an irrational decision in the Holt and Laury (2002) experiment by choosing a certain lower payoff in one situation. We were not able to impute a risk tolerance parameter for those subjects, resulting in 360 subjects with risk preference information.

commonly used strategy in the (5,5) penalty structure is for subjects *never* to commit an offense. This non-optimal strategy of (0, 0) was followed by 46% of the subjects. Table 2 also shows that for each penalty structure, actual behavior is closer to theoretical predictions than subjects' stated strategies.[17]

Overall, we find that about two-thirds of subjects choose their optimal strategy in the decreasing fine structures, but for some other penalty structures less than half of the subjects make decisions that are consistent with theory. A possible explanation for inconsistencies between theory and observed behavior is that agents are myopic and treat each stage as a one-shot decision. Consider the simplest example, where agents are risk neutral. In this case, given that the benefit of the crime is $2 and the probability of apprehension is 1/3, myopic risk neutral agents will commit the act as long as the fine is less than $6. We would expect myopic risk averse subjects to still commit when the fine is somewhat lower than $6 (the exact amount depends on the risk parameter). But, in situations where myopic behavior predicts offenses will be committed under risk neutrality, we observe offense rates of 75%, 61% and 35% with the $1 fine, the $3 fine, and the $5 fine, respectively. In the situation where we expect no offenses with myopic behavior under risk neutrality, we observe a 21% offense rate with the $7 fine and a 19% offense rate with the $9 fine. These offense rates do not support the idea that people consider each stage decision separately. These aggregate results also suggest that risk tolerance affects whether or not behavior follows theory.

4.2 Econometric Analysis of Behavioral Deviations from Theory

As noted above, the observed behavior in our experiment is not always consistent with the predicted optimal choices. Across all risk preferences and penalty structures, only 52 percent of observed actions follow the predicted strategy. Additionally, 42 percent of stated strategies are consistent with optimal behavior. In this section, we explore which factors drive a subject to deviate from optimal behavior. We begin by defining two variables: (1) an indicator for whether the subject's stated strategy is equal to the optimal strategy and (2) an indicator for whether the observed strategy is equal to the optimal strategy. Recall from the experimental design section that we elicit each subject's stated strategy for each penalty structure before they actually face that penalty structure with monetary consequences.

In Table 3 we examine a variety of factors that may be driving deviations from the optimal strategy, as determined by theory. In Model 1, we estimate and provide the marginal effects from a probit model where the outcome is a binary variable for whether the stated strategy is consistent with theoretically predicted behavior. Model 2 presents the marginal effects from the probit regression where the outcome is the binary variable for whether observed behavior is consistent with theory. Consistency with optimal strategy is dependent on the subjects individual risk profile as presented in Table 1. We include indicators for the subject's risk category: risk loving ($r < 0$), risk neutral ($r = 0$), risk averse ($0.75 \geq r > 0$), very risk averse ($1.17 \geq r > 0.75$), and extremely risk averse ($r > 1.17$) groups. The omitted category is risk neutral subjects. We also include information about whether the subject was caught in the first stage of the penalty structure, the percentage of times that the subject was detected

[17] We also perform Wilcoxon tests to test whether the proportion of subjects who state a strategy consistent with theory is significantly different from the proportion of subjects who follow a strategy consistent with optimal behavior. For each test, the p-value is 0.000

when they committed an offense, as well as information about the penalty structure, presentation order of treatments, dummy variables for the three contexts, and a dummy variable for whether the subject was male.

Table 3: Average Marginal Effects on Likelihood of Consistency with Optimal Strategy

	Dependent Variable = 1 if Stated Strategy is Optimal Strategy; 0 Otherwise	Dependent Variable = 1 if Observed Strategy is Optimal Strategy; 0 Otherwise
	Model 1 (Stated Strategy)	Model 2 (Observed Actions)
Risk Loving (r < 0)	-0.203***	-0.209***
	(0.05)	(0.05)
Risk Averse ($0.75 \geq r > 0$)	-0.045	-0.017
	(0.03)	(0.04)
Very Risk Averse ($1.17 \geq r > 0.75$)	0.022	0.014
	(0.04)	(0.04)
Extremely Risk Averse (r > 1.17)	0.033	0.116**
	(0.06)	(0.05)
Male	0.087***	0.059**
	(0.03)	(0.03)
Percentage of detected chances taken	0.0549	0.0586
	(1.31)	(1.53)
Caught in first stage of current period	0.011	0.142***
	(0.03)	(0.03)
Penalty Structure (3,7)	-0.135***	-0.125***
	(0.02)	(0.03)
Penalty Structure (5,5)	-0.366***	-0.332***
	(0.03)	(0.03)
Penalty Structure (7,3)	0.018	0.076**
	(0.04)	(0.04)
Penalty Structure (9,1)	0.047	0.125***
	(0.03)	(0.04)
N	1795	1795

Standard errors in parentheses. *, **, *** denote significance at the 10, 5, and 1 percent levels, respectively. Standard errors are clustered at the subject level. Additional controls include indicators for each of the presented contexts, an indicator for the presentation order treatment, and interactions of the presentation treatment by penalty structure.

Our results provide some interesting insights regarding deviations from the optimal strategy. Overall, stated strategies and observed actions are relatively similar in terms of which characteristics are correlated with the probability of being consistent with the optimal strategy. Male subjects are more likely than female subjects to both state a strategy that is consistent with the optimal strategy and choose actual behavior consistent with theory. Risk loving subjects are approximately 21 percent more likely to deviate from the optimal strategy than risk neutral subjects. Extremely risk averse subjects are more likely to take actions that are consistent with the optimal strategies than risk neutral subjects, however this is not the case in their stated strategies. Moreover, as the fine structure moves away from an increasing penalty structure toward a flat penalty structure, subject's behavior tends to be less consistent with the theoretical predictions. However, when the fine structure becomes decreasing, subjects become increasingly more likely to behave in accordance with behavior that is predicted by theory (i.e. not committing offenses). Overall, our results indicate that the predictive power of the model depends on the penalty structure and on subject-specific characteristics.

5. Consistency of Behavior across Decision-Making Stages

In addition to examining consistency with theory, we next focus on whether individuals make the same decision each time they face the same fine. This analysis provides further evidence that subjects treat the two decision-making stages within a penalty structure as interrelated. Table 4 displays the consistency of behavior across the two stages of the experiment when subjects face the same fine at different stages. Since we are comparing behavior across two decisions for the same subject, we aggregated these results over all risk preference types.

Column (1) shows the total number of subjects who choose not to offend in stage 1 for each penalty structure. Of those subjects who do not offend in stage 1, column (2) shows the number who also did not offend in stage 2. Note that these subjects face the same fine in stage 2 as they did in stage 1, since they did not offend in stage 1. Thus, we would expect subjects who treat each stage as a one-shot decision to make the same decisions in these two stages. Column (3) presents the percentage of subjects that made consistent decisions across stages when facing the same fine. A surprisingly large number of subjects make different decisions across the two stages, despite facing the same fine. The lack of consistency in choosing not to offend across these two columns could be evidence of learning or evidence that the two-stage nature of the problem affects the way subjects make each individual decision. Note also consistency across columns (1) and (2) is largest for the decreasing fine structures.

Table 4. Behavioral Consistency Across the Two Stages of the Experiment

	(1)	(2)	(3)	(4)	(5)	(6)
Fine Structure	Do not offend in Stage 1	Do not offend in Stage 1 and do not offend in Stage 2	% Consistent decisions = (2)/(1)	Offend in Stage 1 and are not caught	Offend in Stage 1 and are not caught and also offend in Stage 2	% Consistent decisions = (5)/(4)
(1,9)	54	26	0.48	211	127	0.60
(3,7)	114	72	0.63	166	99	0.60
(5,5)	215	169	0.79	109	42	0.39
(7,3)	284	236	0.83	55	18	0.33
(9,1)	295	251	0.85	54	18	0.33

Note: The total number of subjects who participated in the experiment is 367.

The right hand side of Table 4 examines an alternative situation where subjects face the same fine in both stages of decision-making. Column (4) shows the number of subjects who offend in stage 1, but are not caught. Column (5) shows how many of those people go on to offend again in stage 2. Again, with subjects who treat each stage as independent, we expect everyone to offend in stage 1 under the increasing and constant fine structures and no one to offend under the decreasing fine structures, regardless of their risk type. Since column (4) is conditional on subjects not being caught in stage 1, the same predictions hold for column (5). We find very low rates of consistency in offending between the two stages with decreasing penalty structures, and only 60% consistency in the increasing fine structures for this comparison of offending when subjects are facing the same fine. In addition to learning and taking the two-stage decision into account, another possible explanation for inconsistency here is an irrational belief

by subjects that they are more likely to be caught in stage 2 after avoiding detection in stage 1.[18] In section 6.2 we attempt to isolate these separate effects using econometric analysis.

[18] Another situation where subjects make decisions under the same fine is across fine structures. For example, a subject faces the $1 fine in the (1, 9) scenario and also faces the $1 fine in the (9, 1) scenario. This comparison is complicated by a selection problem; in order to face the $1 fine in the (9, 1) scenario, a subject must offend and be detected in the first stage. Thus, it is difficult to disentangle the effects of selection, learning, and any effect the detection might have on decision making in the second stage.

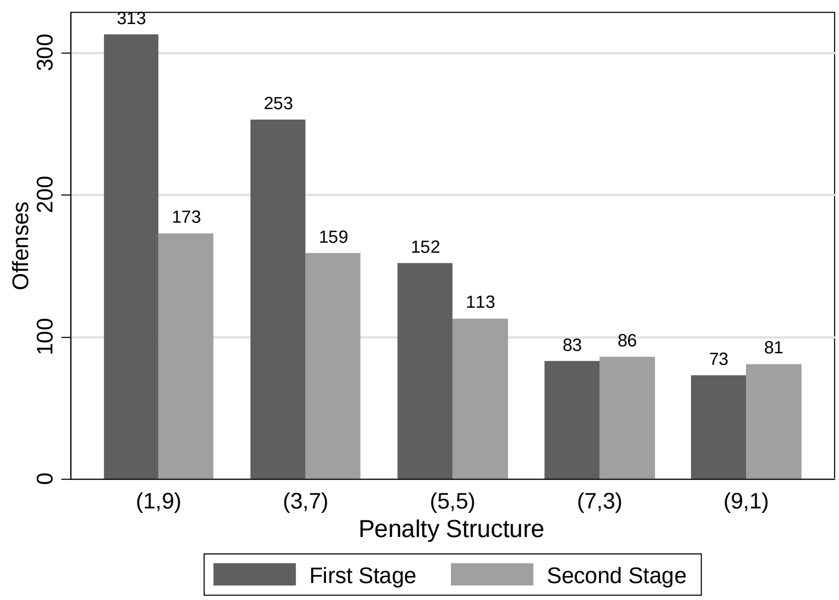
6. Deterrence

Next we turn our attention to identifying which enforcement regimes yield the greatest level of deterrence. We also examine the individual characteristics correlated with the decision to offend.

6.1 Descriptive Statistics

Figure 1 shows the total number of offenses by decision stage and enforcement regime. The most striking observation is that increasing fine regimes have over twice as many offenses as decreasing fine regimes. The constant fine mechanism has fewer offenses relative to increasing enforcement regimes, but more offenses compared to decreasing fine regimes. In short, we find descriptive evidence consistent with the theoretical prediction that a decreasing, rather than increasing penalty structure, yields greater specific deterrence. [19]

Figure 1: Total Offenses by Decision Stage and Penalty Structure



Note: For each penalty structure, there are 367 subjects making decisions in two stages, thus the maximum number of offenses for each decision stage is 367.

Figure 1 also shows how offense rates vary across the two stages of decision-making. Note that the number of offenses falls sharply between the first and second stage in the increasing fine regimes. This is not surprising since first stage offense rates are relatively high in these two regimes, which means that relatively more people get caught and face the high penalty associated with a second offense in the second stage of these regimes. On the other hand, the number of offenses is fairly constant across the two decision stages in the decreasing sanction schemes. While committing an offense in the first stage is not optimal under these schemes, if a subject offends and is caught in the first stage, it is optimal to recommit in the second stage. Note, however, that Figure 1 provides no information about

[19] We also find statistical evidence that decreasing penalty structures yield greater deterrence. Wilcoxon tests show that the average number of offenses are significantly different across all but one of the penalty structures, with p-values all smaller than 0.001. The only exception is the pair (7,3) and (9,1), which does not have significantly different numbers of offenses (p-value equal to 0.323).

which fine subjects face in the second stage, since it does not distinguish between people who committed an offense and were caught in the first stage and those who were not caught.

Table 5 provides the number of subjects that face the first fine or second fine in stage 2. Subjects who face the first fine in stage 2 either did not commit an offense or they committed an offense and were not caught in the first stage. Subjects who face the second fine in the penalty structure represent those who committed an offense and were caught in the first stage. Consistent with Figure 1, the number of subjects facing the second fine in stage 2 is decreasing with the first fine, as fewer subjects commit an offense at all in the first stage when facing a decreasing penalty structure ((7,3) or (9,1)).

Table 5: Number of Subjects Facing Each Fine in Stage 2

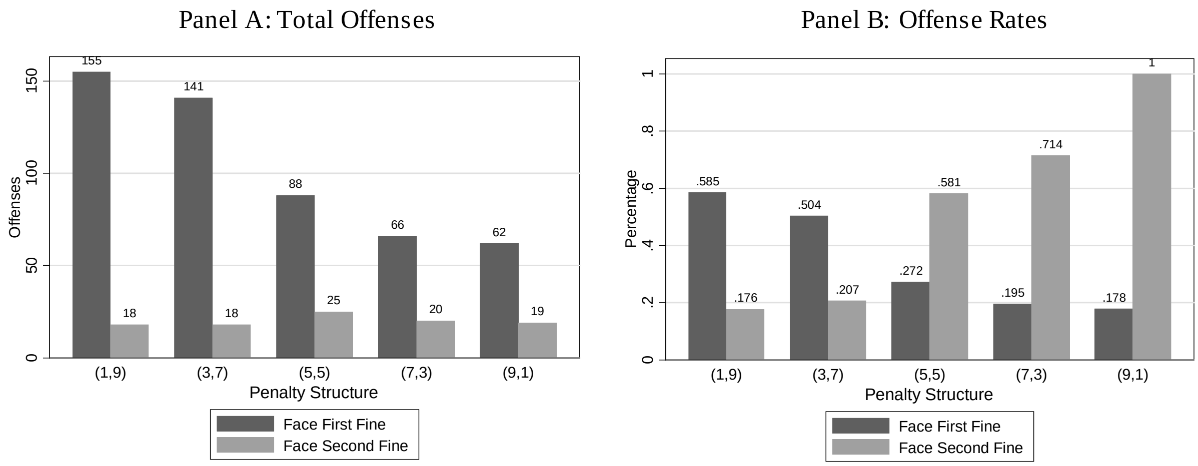
Fine Structure	Face First Fine in Stage 2	Face Second Fine in Stage 2
(1,9)	265	102
(3,7)	280	87
(5,5)	324	43
(7,3)	339	28
(9,1)	348	19

Figure 2 focuses on second stage decisions and provides information about offenses and the specific fine faced by the subject. Panel A of Figure 2 shows that among subjects who face the first fine, there are significantly more second stage offenses in the increasing penalty structures than in the decreasing penalty structures.[20] For those subjects who face the second fine, very few second stage offenses are committed overall, but there are more second stage offenses in the constant and decreasing penalty structures than in the increasing penalty structures.[21]

[20] Wilcoxon tests show that the number of second stage offenses for subjects facing the first fine are significantly higher in penalty structures (1,9) and (3,7) relative to the other penalty structures (p-values equal 0.000 comparing (1,9) to (5,5), (7,3), and (9,1) and comparing (3,7) to the constant and decreasing penalty structures). In addition, the constant fine structure (5,5) results in significantly more second stage offenses than the decreasing penalty structures (p-value is 0.0192 comparing to (7,3) and 0.0037 comparing to (9,1)). The decreasing penalty structures (7,3), and (9,1) do not have significantly different numbers of second stage offenses when subjects face the first fine.

[21] The following pairs are found to have significantly different numbers of second stage offenses conditional on being caught in the first stage with p-values equal to 0.000: (1,9) and (5,5); (1,9) and (7,3); (1,9) and (9,1); (3,7) and (5,5); (3,7) and (7,3); and (3,7) and (9,1). In addition, these pairs are also significantly different: (5,5) and (9,1) (p-value = 0.001), and (7,3) and (9,1) (p-value = 0.011). In other words, conditional on being caught in the first stage the two increasing penalty structures are not significantly different from one another in the second stage offenses, and (5,5) does not result in significantly more offenses than (7,3).

Figure 2: Second Stage Offenses by Penalty Structure



Panel B of Figure 2 presents the second stage offense data in percentage terms. For each bar in Panel A, we divide the number of offenses committed in that scenario by the total number of decisions made. This figure reveals that recidivism rates among those who were caught in the first stage are much higher in the decreasing penalty structures than in the increasing penalty structures.[22] For example, all 19 subjects who offended and were caught in the first stage under the (9,1) penalty structure offended again in the second stage. As noted above, given that a subject makes the irrational decision to commit a first stage offense in the (7,3) or (9,1) penalty structure and gets caught, the optimal second stage decision is to recidivate.

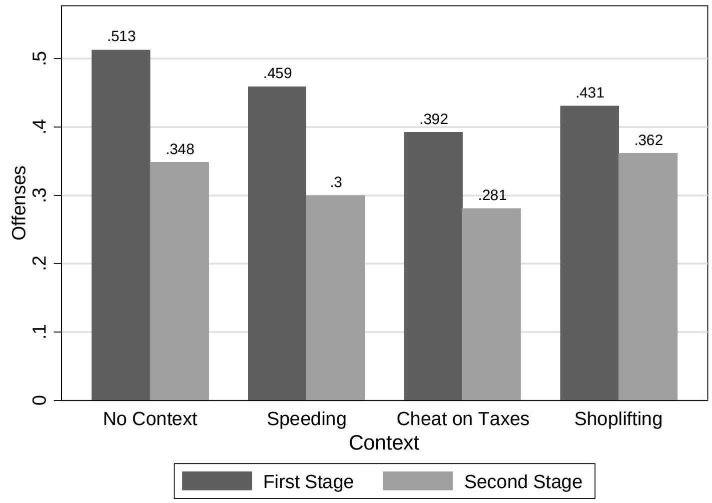
Recall that some subjects participated in experimental sessions where the action was presented with an illegal context (speeding, cheating on taxes, or shoplifting). Figure 3 presents the offense rates for each context. The raw data suggests that adding an illegal context results in fewer total offenses in the experiment. Paired Wilcoxon tests reveal significant differences in the offense rate when the decision is described as "taking a chance" as opposed to "driving over the speed limit," or "cheating on your taxes."[23] Thus, we may identify some possible stigma effect of committing criminal behavior as opposed to simply risky behavior.[24] However, there was no significant difference in the offense rate with no context and with the shoplifting context, perhaps because shoplifting is a criminal behavior with which our subject pool is less familiar.

[22] As noted in the previous footnote, penalty structures (9,1) and (7,3) have significantly higher repeat offense rates than (1,9) and (3,7). However, it is important to remember that fewer subjects have the chance to be a repeat offender in the decreasing penalty scenarios because few subjects choose to offend in the first stage of a decreasing penalty structure.

[23] The p-value from the Wilcoxon test comparing the context-free to the speeding context is 0.062. The p-value for the Wilcoxon test for comparing context-free to cheating on taxes is 0.001.

[24] See Shoji (2013) and Tadelis (2011) for a discussion of guilt and shame associated with others' perceptions of one's choice in the lab and field.

Figure 3. Offense Rates by Context



Overall, the graphs of offense levels and rates suggest that our results are consistent with the theoretical model of Emons (2003); decreasing penalty structures lead to greater levels of deterrence than increasing penalty structures across all contexts.[25] However, there may also be potentially confounding effects of individual characteristics on offending.

In addition to whether the fine structure is increasing or decreasing, individual subject characteristics may play a role in how likley the subjects are to choose to offend. Table 6 provides details on how many offenses subjects commit by gender and risk tolerance. Notice that about 5% of the subjects never commit an offense and almost 4% commit 9 or 10 offenses. Table 6 also reports that female subjects are significantly more likely than male subjects to commit a lower number of offenses.[26] We also now divide our sample into those who are risk averse and those who are not risk averse based on their decisions on the Holt and Laury (2002) lottery choice experiment.[27] As the numbers in the table suggest, risk averse subjects commit significantly fewer total offenses than those who are not risk averse.[28,29]

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[25] We repeat our analysis separately for each context and the results remain consistent; decreasing penalty structures result in fewer offenses than increasing penalty structures, regardless of the context. These results are available upon request.

[26] The average number of times a female subject offends is 3.78 compared to 4.41 for male subjects. A Wilcoxon test rejects the hypothesis these are equal (p-value = 0.002). One subject did not report gender on the survey, thus the total number of female and male subjects is 366.

[27] Previously we examined consistency with theoretical predictions across a more fine categorization of risk groups (risk loving, risk neutral, risk averse, very risk averse, extremely risk averse). For the analysis on offending, we consolidate into risk averse and not risk averse for ease of presentation. Results using the finer risk preference categories are not qualitatively different and are available upon request.

[28] Subjects who are not risk averse offend an average of 4.79 times and subjects that are risk averse offend an average of 3.87 times. The p-value for the Wilcoxon test is 0.002. Recall that seven subjects made an irrational decision in the Holt and Laury (2002) experiment by choosing a certain lower payoff in one situation, resulting in 360 subjects with risk preference information.

[29] There is survey-based evidence that how people perceive risk is associated with the propensity to commit crimes. See, for example, Dionne et al., Fluet and Desjardins (2007) and Sloan et al. (2013b).

Table 6. Total Offenses Committed by Gender and Risk Tolerance

Total Offenses	All Subjects	%	Female	%	Male	%	Not Risk Averse	%	Risk Averse	%
0	17	4.64	10	4.93	7	4.29	2	2.47	14	5.02
1	31	8.47	24	11.82	7	4.29	5	6.17	24	8.60
2	55	15.03	38	18.72	17	10.43	6	7.41	49	17.56
3	58	15.85	27	13.30	31	19.02	12	14.81	44	15.77
4	60	16.39	35	17.24	25	15.34	11	13.58	48	17.20
5	47	12.84	26	12.81	21	12.88	16	19.75	31	11.11
6	46	12.30	20	9.85	25	15.34	12	14.81	34	12.19
7	22	6.01	6	2.96	16	9.82	5	6.17	16	5.73
8	18	4.92	7	3.45	11	6.75	7	8.64	11	3.94
9	8	2.19	8	3.94	0	0.00	2	2.47	6	2.15
10	5	1.37	2	0.99	3	1.84	3	3.70	2	0.72
Total	367	100	203	100	163	100	81	100	279	100

6.2 Econometric Analysis of Deterrence

Given that demographic characteristics appear to be correlated with the frequency of offending, we examine the effect of the penalty scheme on deterrence by running an ordered probit of total offenses in a period controlling for the subject's gender, a dummy for whether the subject is risk averse, context, presentation order treatment, and an indicator for whether the subject was caught in the first stage. [30,31] Based on these probit results, we calculate the predicted probability that an individual never commits an offense, commits an offense one time, or commits an offense in both stages under a particular penalty structure. These results are presented in Table 7.

[30] As described in the experimental design section, subjects saw one of two order treatments in the experiment, starting with the (1,9) penalty structure regime and proceeding to the (9,1) regime (Treatment 1) or the reverse order where subjects saw the (9,1) penalty first (Treatment 2). In considering the effect of order we find that the qualitative comparisons between the different penalty structures within a presentation order treatment are consistent across treatments. That is, there are always more offenses in the (1,9) penalty structure than in the (3,7) penalty structure, regardless of whether (1,9) is seen first or last.

[31] Marginal effects from the ordered probit regression using the *margins* command in STATA14 are available upon request. We find that being risk averse increases the likelihood of not offending and decreases the likelihood of offending 1 or 2 times. Male subjects are also significantly less likely to offend zero times, and significantly more likely to offend 1 or 2 times.

Table 7: Predicted Probabilities of Outcomes

Penalty Structure	No Offenses	One Offense	Two Offenses
(1,9)	0.160	0.408	0.431
(3,7)	0.232	0.443	0.325
(5,5)	0.424	0.418	0.158
(7,3)	0.603	0.320	0.077
(9,1)	0.628	0.305	0.067

Individuals are most likely to commit no offenses in the decreasing penalty regime (where there is a higher first stage penalty). On the other hand, increasing penalty structures have the highest predicted rate of subjects committing two offenses (at 43% and 33%), perhaps because individuals who are not caught in the first stage have high incentives to recidivate. Even after controlling for individual characteristics, being caught in the first stage, context, and the order in which the fines were presented, the overall implication of Table 7 is that decreasing penalty structures are far more effective in deterring offenses and are more likely to result in zero offenses than increasing penalty structures.[32]

While Table 7 shows that a decreasing fine structure reduces the overall number of offenses, we have not examined the impact of fine structures, amongst other things, on the individual choice to commit offenses in each stage. To do so, we run probit regressions on the individual decision of whether or not to offend in each stage.[33] Table 8 presents the marginal effects from the analysis. We control for subject characteristics (male, dummy for whether the subject is risk averse), the presentation order treatment, the context, the number of times a subject has offended in previous rounds, the number of times a subject has been caught in previous rounds (excluding the first stage of the current round), and an indicator for whether the subject was caught in the first stage of the particular round. To isolate the effect of the penalty structure, in Model 1 we include controls for whether the decision is a second stage decision and an indicator for each penalty structure.[34] Errors are clustered at the subject level to account for the potential correlation across the 10 individual decisions.

The results at the individual level confirm the aggregate results; the coefficients on the decreasing fine structures (7,3) and (9,1) are significantly different from the omitted category penalty structure (1,9).[35] By disaggregating the data to the individual level decisions, we also observe some phenomena that we did not observe in the aggregated data. Subjects who offend more often ("Number of Offenses Committed") are almost 9 percentage points more likely to continue to offend in the particular stage. Moreover, the average marginal effect of an

[32] The marginal effects of the penalty structures are all negative and significant relative to the baseline penalty structure of (1,9) with p-values equal to 0.000. In addition, we perform pairwise Wald tests of the coefficients on the penalty structures. Each penalty structure is significantly different from the other with p-values equal to 0.000 except for the pair (7,3) and (9,1).

[33] Note that when we look at individual decisions, each subject makes 10 decisions, thus the total number of observations is now 3590 (359 individuals with non-missing demographic information times 10 decision per subject).

[34] Model 1 also includes an interaction term for presentation order treatment and penalty structure.

[35] Consistent with our previous results, Wald tests show the coefficients on penalty structures are all significantly different from one another (p-values equal to 0.000) with the exception of the pair (7,3) and (9,1).

additional instance of being caught in previous penalty structures decreases the likelihood of offending by slightly more than 2 percentage points, even though being caught under a previous penalty structure has no impact on the current period's potential payoffs. This is suggestive of a specific deterrence effect; subjects respond to previous punishment experience even when that previous punishment is not affecting the current cost of offending. Lastly, we find that being caught in the first stage reduces the probability of offending in the second stage by about 15 percentage points (in addition to the 16 percentage point reduction in probability of offending that exists for the average second stage decision).

Model 2 addresses the issue of the penalty structure in a slightly different way. Instead of including indicator variables for each penalty structure, we include an indicator variable to capture whether subjects are making decisions under an increasing fine scheme. We also include a variable to capture the separate effect of the specific fine faced by the subject. The qualitative results from Model 1 hold, with one exception. The coefficient on the indicator variable for being caught in the first stage is no longer significant. Model 2 reveals that, independent of the specific fine faced for any given decision, being in an increasing penalty structure increases the probability a subjects will commit an offense by a little more than 5%. This provides additional evidence that subjects take the two-stage nature of the decision into account when making decisions and are less deterred by increasing penalty structures.

Table 8: Marginal Effects on Likelihood of Offending

	Dependent Variable = Probability of Offending	
	Model 1	Model 2
Male	0.036**	0.050**
	(0.02)	(0.02)
Risk averse	-0.057***	-0.069***
	(0.02)	(0.03)
Number of offenses committed	0.086***	0.030***
	(0.01)	(0.01)
Second stage decision	-0.161***	
	(0.02)	
Penalty Structure (3,7)	-0.091***	
	(0.02)	
Penalty Structure (5,5)	-0.303***	
	(0.02)	
Penalty Structure (7,3)	-0.415***	
	(0.02)	
Penalty Structure (9,1)	-0.420***	
	(0.02)	
"Speeding" context	-0.026	-0.033
	(0.02)	(0.03)
"Cheating on Taxes" context	-0.054**	-0.079***
	(0.02)	(0.03)
"Shoplifting" context	-0.021	-0.032
	(0.02)	(0.03)
Number of times caught in all previous periods	-0.025*	-0.033**
	(0.01)	(0.01)
Caught in first stage of current period	-0.152***	0.002
	(0.03)	(0.03)
Fine faced in current stage		-0.063***
		(0.00)
Increasing penalty structure		0.054***
		(0.02)
Number of Observations	3590	3590

* p<0.1, ** p<0.05, *** p<0.01. Note: All variables are indicator variables except number of times caught, number of offenses, number of times caught in all previous periods and fine faced in current period. Standard errors are clustered at the subject level. Additional controls include an indicator for the presentation order treatment. Model 1 also includes interactions of the presentation treatment by penalty structure.

7. Conclusion

There is a large literature on optimal law enforcement following the pioneering work of Becker (1968). For example, Emons (2003, 2004) presents multi-period models of criminal enforcement based on the standard Becker approach and finds that decreasing penalties are optimal. As is standard in this literature, Emons (2003) models the law enforcer's joint choice of the probability of detection and the penalty if detected. A number of experimental

papers have examined the tradeoff between the probability of detection and the penalty if detected in a repeated one-shot decision.[36] To our knowledge, however, we present the first experimental study to examine whether increasing or decreasing penalty schemes are better at deterring risky behavior.

We chose the basic model of Emons (2003) as the starting point for our design. We find that decreasing, rather than increasing, sanction schemes provide better deterrence in our repeated decision making situation. Although numerous arguments have been put forth for the use of increasing penalty schemes, our results provide evidence that decreasing penalty schemes yield greater deterrence. The relative simplicity of the model might explain why the theoretical prediction is different from the increasing sanctions we observe in most penal codes. Some multi-period models support the use of escalating penalties by adding special features in a Becker-style model. For example, Polinsky and Rubinfeld (1991) assume that offenders differ in their propensities to commit socially undesirable acts, and an escalating fine structure may be useful as a screening device.[37] A natural extension of our study is to incorporate more complicated theoretical assumptions into our experimental design.

Although we find evidence that decreasing penalties provide greater deterrence, observed behavior is only consistent with the theoretical prediction in 52 percent of the decision making periods. When we examine the relationship between individual characteristics and consistency with theory, we find that extreme risk preferences (risk loving and extremely risk averse) are correlated with the likelihood of consistency, as well as the gender of the subject. Consistency with theory also increases with previous detection, suggesting the penalty and potential effect on expected utility become more salient as the subject experiences being caught.

Additionally, we explore some behavioral features of the decision making process that are not predicted by the rational decision-making model. We observe greater offense levels when subjects are male, less risk averse, and have committed offenses in previous rounds. We also observe that being caught under previous penalty structures has a small deterrence effect in the current penalty structure, even though both the probability of being caught and the fine are independent of previous rounds. Even after controlling for the specific fine a subject faces, we find that the probability of committing an offense is higher under an increasing penalty regime. When we examine the subject

[36] See, for example, Anderson and Stafford (2003), Harel and Segal (1999), DeAngelo and Charness (2012), Friesen (2012) and Schildberg-Horisch and Strassmair (2012).

[37] Some other models incorporate a learning-by-doing effect of crime (Baik and Kim 2001; Mungan, 2010; Garoupa and Jellal 2004), which may justify increasing sanctions under certain conditions. One argument for the learning-by-doing model as an explanation for increasing sanctions is that as offenders learn from their crimes, the costs of apprehension increase and thus the penalties should also increase. A potential offsetting effect, however, is that enforcers will likely pursue repeat offenders more vigorously, which suggests optimal penalties are decreasing (Dana, 2001; Mungan, 2010). Polinsky and Shavell (1998) assume that the government observes an agent's age and her criminal record; under certain conditions, they find it is optimal to punish old first-time offenders less severely than old repeat-offenders and young first-time offenders. Several other studies allow for the possibility that first-time offenders have committed their crimes by accident (Rubinstein 1979; Chu et al. 2000; Emons, 2007; Ben-Shahar 1997; and Bebchuk and Kaplow 1993) or through experimentation (McCannon, 2009; Miceli 2013). Another strand of literature justifying escalating penalties focuses on the stigma effect of a criminal conviction, which acts as a supplement to formal criminal penalties in deterring some offenders (Rasmussen, 1996; Dana, 2001; Funk, 2004; and Miceli and Bucci, 2005). Rubinstein (1980) shows that within the context of Becker's model there exists a utility function for offenders that makes an escalating penalty scheme optimal. This special result, however, cannot account for the pervasiveness of the practice.

responses to current fines faced, we also find evidence that subjects treat the choice to offend in each stage as part of a two-stage interrelated decision (i.e., subjects consider the full penalty structure of the period) and do not respond solely to the amount of the fine.

References

Anderson, L. and Mellor, M.: Are Risk Preferences Stable? Comparing an Experimental Measure with a Validated Survey-Based Measure, *Journal of Risk and Uncertainty*, 39(2) (2009), 137-160.

Anderson, L. and Mellor, M.: Predicting Health Behaviors with an Experimental Measure of Risk Preference, *The Journal of Health Economics*, 27(5) (2008), 1260-1274.

Anderson, L. and S. Stafford: Punishment in a Regulatory Setting: Experimental Evidence from the VCM, *Journal of Regulatory Economics*, 24(1) (2003), 91-110.

Arlen, J. and E. Taylor: *Experimental Law and Economics* (Edward Elgar Publishing, 2008).

Baik, K. H. and I.-G. Kim: Optimal Punishment when Individuals may learn deviant Values, *International Review of Law and Economics*, 21 (2001), 271-285.

Bar-Ilan, A. and B. Sacerdote: Response to Fines and Probabilities in a Natural Experiment. *Journal of Law and Economics*, 47(1) (2004): 1-17.

Bebchuck L. and L. Kaplow: Optimal Sanctions when Individuals are Imperfectly Informed about the Probability of Apprehension, *Journal of Legal Studies*, 21 (1993), 365-370.

Becker, G.: Crime and Punishment: An Economic Approach, *Journal of Political Economy*, 76 (1968), 169-217.

Ben-Shahar O.: “Playing without a Rulebook": Optimal Enforcement When Individuals Learn the Penalty Only By Committing the Crime, *International Review of Law and Economics*, 17 (1997), 409- 421.

Burnovski, M. and Z. Safra: Deterrence Effects of Sequential Punishment Policies: Should Repeat Offenders be more Severely Punished, *International Review of Law and Economics*, 14 (1994), 341-350.

Camerer, C. and E. Talley: Experimental law and economics, In M. Polinsky and S. Shavell (Eds.), Handbook of Law and Economics, Amsterdam, North-Holland (2007), 1619-1650.

Chu, C., S. Hu and T. Huang: Punishing Repeat Offenders more Severely, *International Review of Law and Economics*, 20 (2000), 127-140.

Dana, D. A.: Rethinking the Puzzle of Escalating Penalties for Repeat Offenders, *Yale Law Journal*, 110 (2001), 733-783.

DeAngelo, G. and G. Charness: Deterrence, expected cost, uncertainty and voting: Experimental evidence, *Journal of Risk and Uncertainty*, 44(1) (2012), 73-100.

Dionne, G., C. Fluet, and D. Desjardins: Predicted risk perception and risk-taking behavior: The case of impaired driving, *Journal of Risk and Uncertainty*, 35(3) (2007), 237-264.

Emons, W.: A Note on the Optimal Punishment for Repeat Offenders, *International Review of Law and Economics*, 23 (2003), 253-259.

Emons, W.: Subgame Perfect Punishment for Repeat Offenders, *Economic Inquiry*, 42 (2004), 496-502.

Emons, W.: Escalating Penalties for Repeat Offenders, *International Review of Law and Economics*, 27 (2007), 170-178.

Engel C.: Behavioral Law and Economics: Empirical Methods, Bonn, *Preprints of the Max Planck Institute for Research on Collective Goods*, 01 (2013).

Fellner, G., R. Sausgruber and C. Traxler: Testing Enforcement Strategies in the Field: Threat, Moral Appeal and Social Information, *Journal of the European Economic Association*, 11(3) (2013), 634-660.

Fischbacher, U:. z-Tree: Zurich Toolbox for Ready-made Economic Experiments. *Experimental Economics*, 10(2), (2007), 171-178.

Friedman, D.: Efficient Institutions for the Private Enforcement of Law, *Journal of Legal Studies*, 13 (1984), 379-397.

Friesen, L.: Certainty of Punishment versus Severity of Punishment: An Experimental Investigation, *Southern Economic Journal*, 79 (2012), 399-421.

Funk, P.: On the Effective Use of Stigma as a Crime-deterrent, *European Economic Review*, 48 (2004), 715-728.

Garoupa, N.: The Theory of Optimal Law Enforcement, *Journal of Economic Surveys*, 11 (1997), 267-295.

Garoupa, N. and M. Jellal: Dynamic Law Enforcement with Learning, *Journal of Law, Economics, and Organization* 20 (2004), 192-206.

Harel, A. and U. Segal: Criminal Law and Behavioral Law and Economics: Observations on the Neglected Role of Uncertainty in Deterring Crime, *American Law and Economics Review*, 1 (1999), 276-312.

Holt, C. and S. Laury: Risk Aversion and Incentive Effects, *American Economic Review*, 92(5) (2002), 1644-1655.

Lochner, L.: Individual Perceptions of the Criminal Justice System, *American Economic Review*, 97 (2007), 444-460.

McAdams, R. H. and T. S. Ulen: Behavioral Criminal Law and Economics, *Public Law & Legal Theory Working Papers* 244, (2008)

McCannon, B.: Differentiating Between First and Repeat Offenders, *Contemporary Economic Policy* 27 (2009), 76-85.

Miceli T.: Escalating Penalties for Repeat Offenders: Why are they So Hard to Explain? *Journal of Institutional* and *Theoretical Economics* 169 (2013), 587–604.

Miceli T. and C. Bucci: A Simple Theory of Increasing Penalties for Repeat Offenders, *Review of Law & Economics* 1 (2005), Article 5, www.bepress.com/rle/vol1/iss1/art5

Motchenkova E.: Cost minimizing sequential punishment policies for repeat offenders, *Applied Economics Letters* 21 (2014) 360-365

Mungan, M. Repeat Offenders: If They Learn, We Punish Them More Severely, *International Review of Law and Economics*, 30 (2010), 173-177.

Mungan, M. and J. Klick: Forfeiture of Illegal Gains, Attempts, and Implied Risk Preferences, *Journal of Legal Studies*, 43(1) (2014), 137-153.

Mungan, M. and J. Klick: Discounting and Criminals' Implied Risk Preferences, *Review of Law and Economics*, 11 (2015).

Neilson W. and H. Winter.: On Criminals' Risk Attitudes, *Economics Letters*, 55 (1997), 97-102.

Polinsky, M. and D. Rubinfeld: A Model of Fines for Repeat Offenders, *Journal of Public Economics* 46 (1991), 291-306.

Polinsky, M. and S. Shavell: On Offense History and the Theory of Deterrence, *International Review of Law and Economics*, 18 (1998), 305-324.

Polinsky, M. and S. Shavell: The Economic Theory of Public Enforcement of Law, *Journal of Economic Literature*, 38 (2000), 45-76.

Rasmusen, E.: Stigma and Self-fulfilling Expectations of Criminality, *Journal of Law and Economics*, 39 (1996), 519-543.

Rubinstein, A.: An Optimal Conviction Policy for Offenses that May Have Been Committed by Accident, in: Applied Game Theory, S. Brams, A. Schotter, and G. Schwödiauer (Eds.) Würzburg, Physica-Verlag, (1979), 406-413.

Rubinstein, A.: On an Anomaly of the Deterrent Effect of Punishment, *Economics Letters*, 6 (1980), 89-94.

Schildberg-Horisch, H and C. Strassmair: An Experimental Test of the Deterrence Hypothesis, *Journal of Law, Economics, & Organization* (2012), 447-459.

Shoji, M.: Guilt Aversion and Peer Effects in Crime: Experimental and Empirical Evidence from Bangladesh, *Munich Personal RePEc Archive* (2013), 1-37.

Sloan, F., A. Platt, L. Chepke, and C. Blevins: Deterring Domestic Violence: Do Criminal Sanctions Reduce Repeat Offenses?, *Journal of Risk and Uncertainty*, 46 (1) (2013a), 51-80.

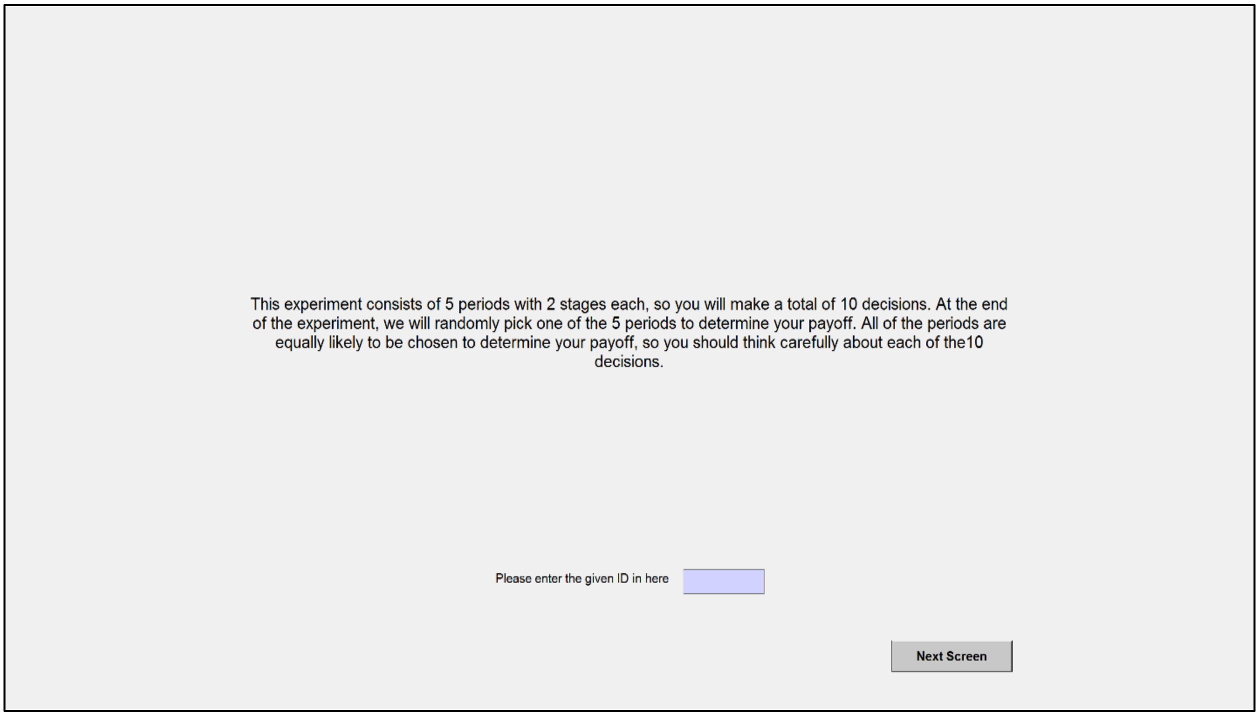
Sloan, F., L. Eldred, T. Guo, and Y. Xu: Are people overoptimistic about the effects of heavy drinking?, *Journal of Risk and Uncertainty*, 47 (2) (2013b), 93-127.

Sonnemann, U., Camerer, C. F., Fox, C. R., & Langer, T.: How Psychological Framing Affects Economic Market Prices in the Lab and Field, *Proceedings of the National Academy of Sciences* (2013).

Tadelis. S.: The Power of Shame and the Rationality of Trust, *SSRN Working Paper1006169* (2011).

Tietelbaum, J. and K. Zeiler: Research Handbook on Behavioral Law and Economics, Edward Elgar Publishing Ltd (Forthcoming).

Appendix A: Screenshots of Experiment



To determine whether or not you are being observed, the computer will generate a random number equally likely to be 1, 2, or 3. If the random number is 3, you will be observed. Hence, the chance of being observed is **1 in 3.** You will lose money only if you choose to **TAKE A CHANCE** and are **OBSERVED.**

Each of the 5 periods has a different payoff structure, so be sure that you understand the payoff structure in each period before you make your decisions.

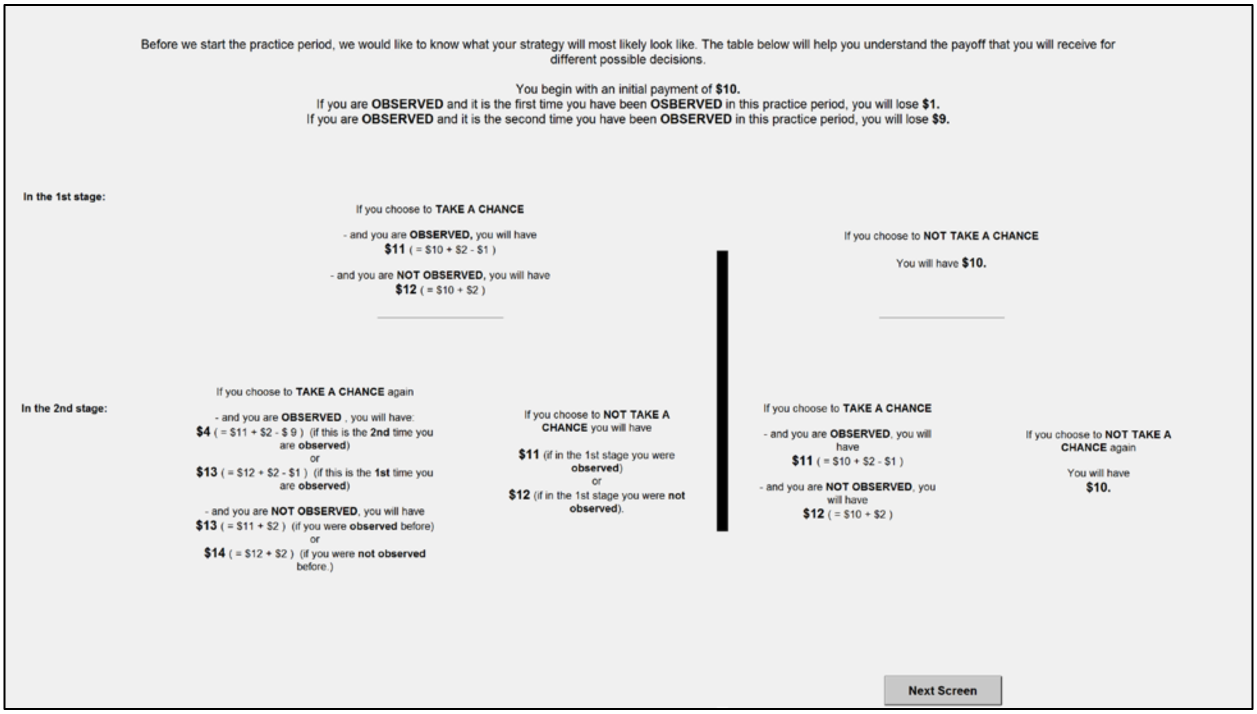
Next Screen

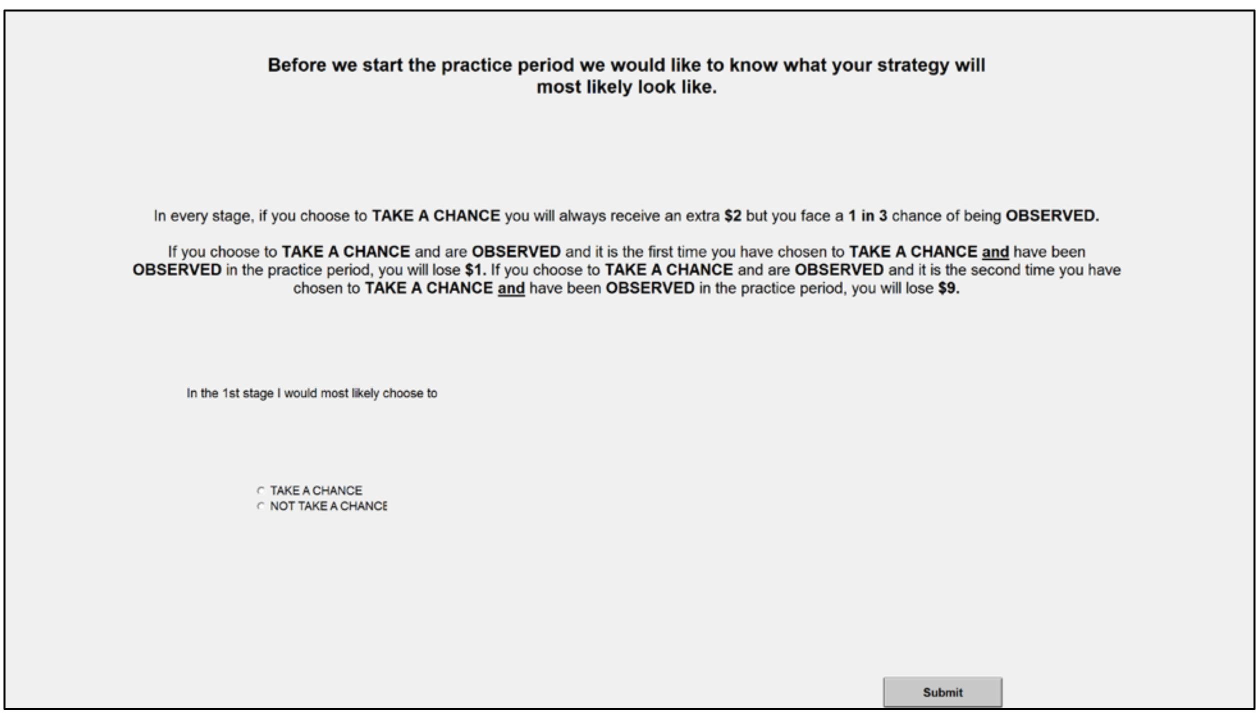
Now you will play a practice period to help you understand how the game works. This practice period will have 2 stages just like the 5 actual periods you will play in a moment. Because this is a practice period, your decisions in this period will **NOT** affect your actual earnings today.

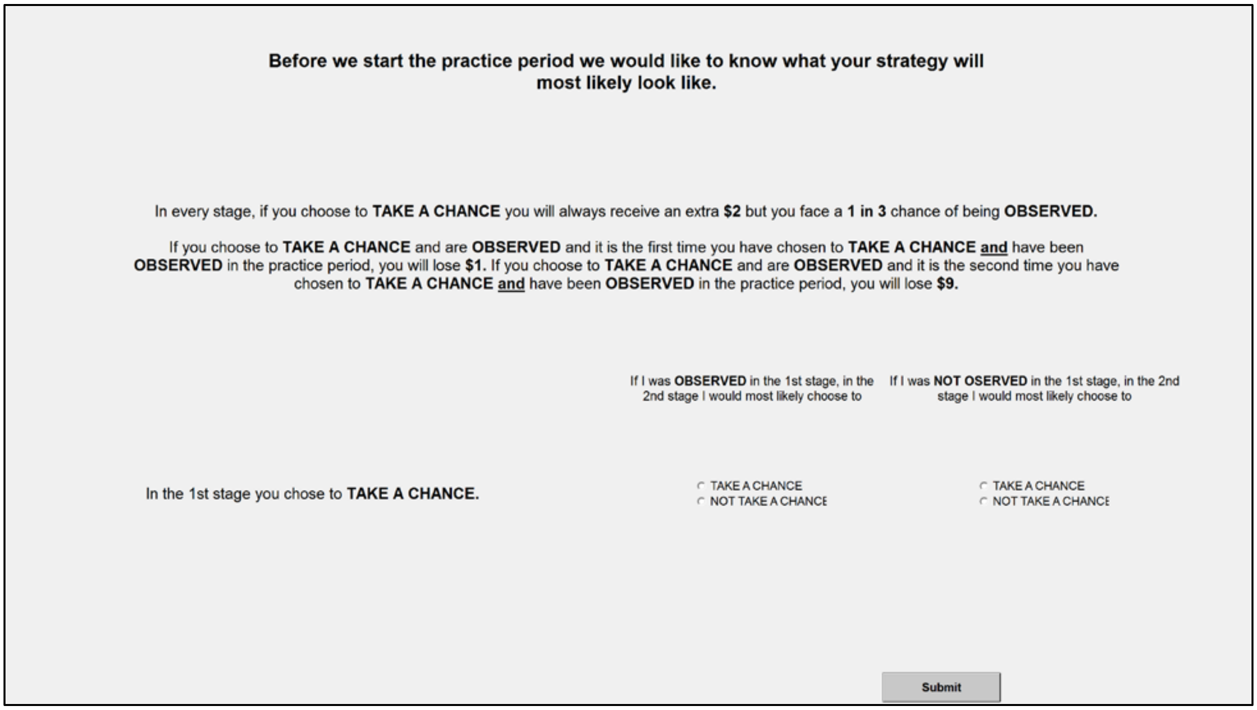
Remember: You begin with an initial payment of **$10.**

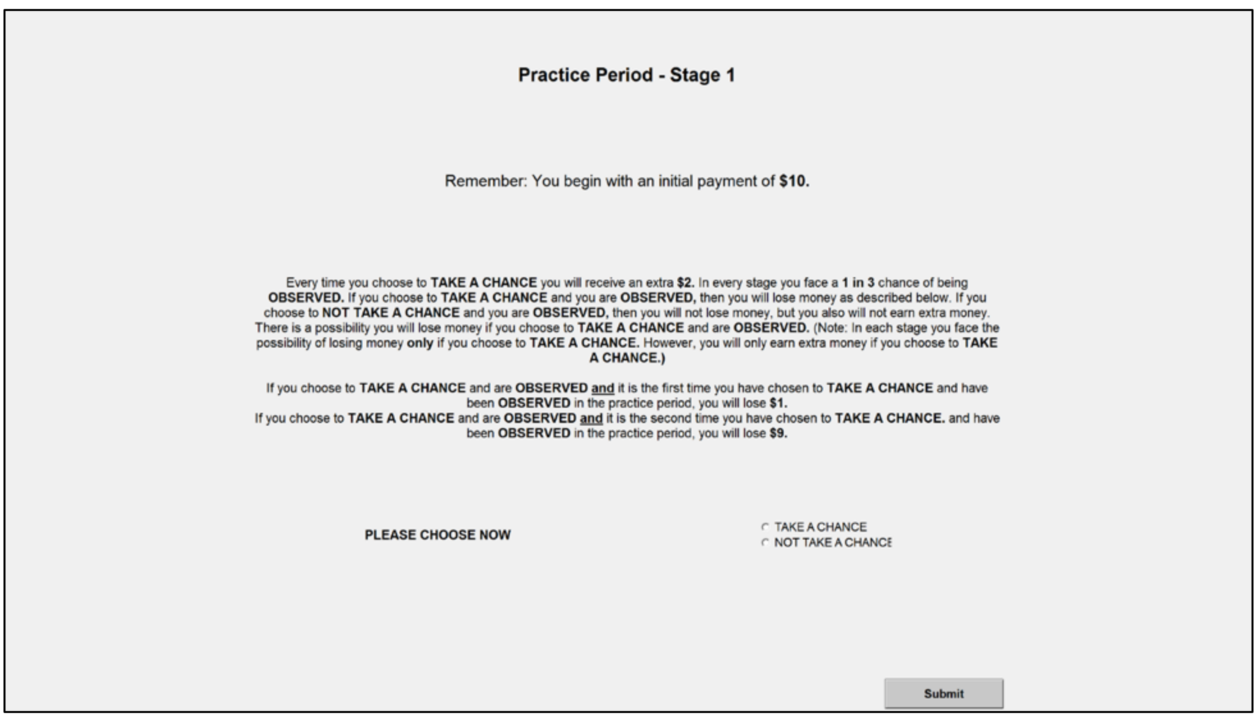
Every time you choose to **TAKE A CHANCE** you will receive an extra **$2,** but you face a **1 in 3** chance of being **OBSERVED.** If you choose to **TAKE A CHANCE** and are **OBSERVED,** then you will lose money as described on the next screen. If you choose to **NOT TAKE A CHANCE,** and you are **OBSERVED,** then you will not lose money, but you will also not earn extra money.

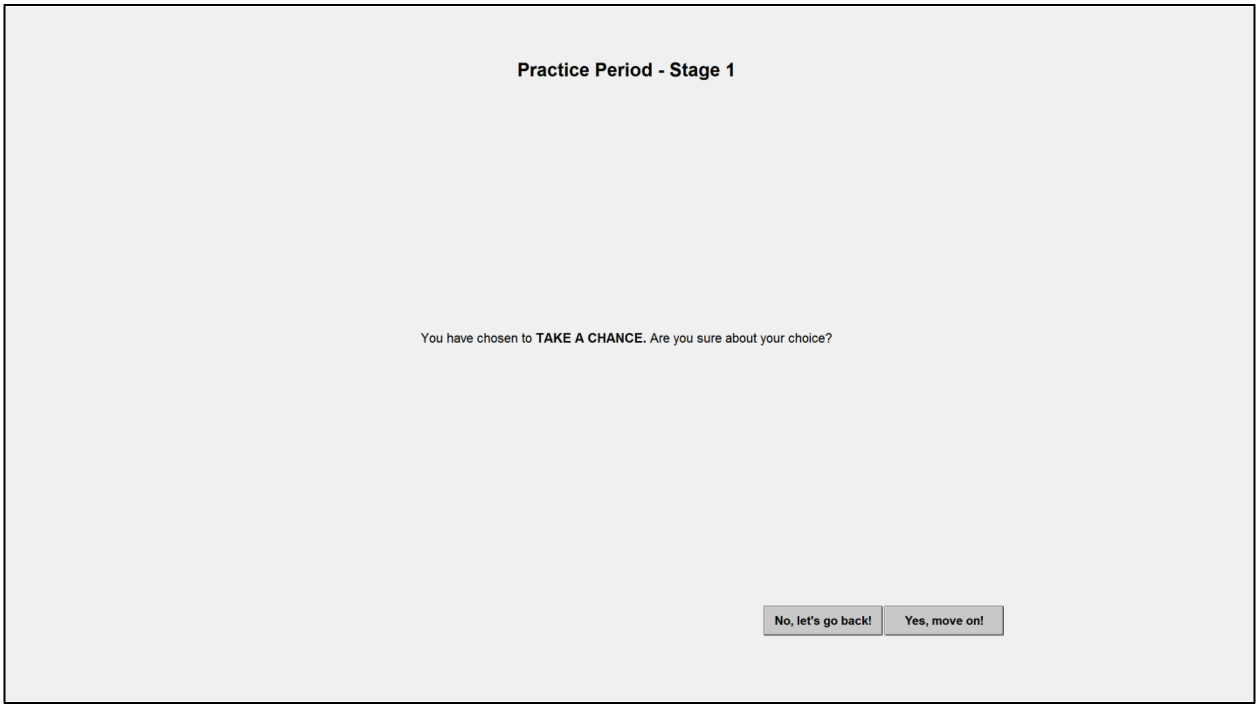
Next Screen


Before we start the practice period, we would like to know what your strategy will most likely look like. The table below will help you understand the payoff that you will receive for different possible decisions.
You begin with an initial payment of $10.
If you are OBSERVED and it is the first time you have been OSBERVED in this practice period, you will lose $1.
If you are OBSERVED and it is the second time you have been OBSERVED in this practice period, you will lose $9.
In the 1st stage:
If you choose to TAKE A CHANCE
- and you are OBSERVED, you will have $11 (= $10 + $2 - $1)
- and you are NOT OBSERVED, you will have $12 (= $10 + $2)
If you choose to NOT TAKE A CHANCE
You will have $10.
In the 2nd stage:
If you choose to TAKE A CHANCE again
- and you are OBSERVED , you will have:
$4 (= $11 + $2 - $ 9) (if this is the 2nd time you are observed)
or
$13 (= $12 + $2 - $1) (if this is the 1st time you are observed)
- and you are NOT OBSERVED, you will have
$13 (= $11 + $2) (if you were observed before)
or
$14 (= $12 + $2) (if you were not observed before.)
If you choose to NOT TAKE A CHANCE you will have
$11 (if in the 1st stage you were observed)
or
$12 (if in the 1st stage you were not observed).
If you choose to TAKE A CHANCE
- and you are OBSERVED, you will have
$11 (= $10 + $2 - $1)
- and you are NOT OBSERVED, you will have
$12 (= $10 + $2)
If you choose to NOT TAKE A CHANCE again
You will have
$10.
Next Screen

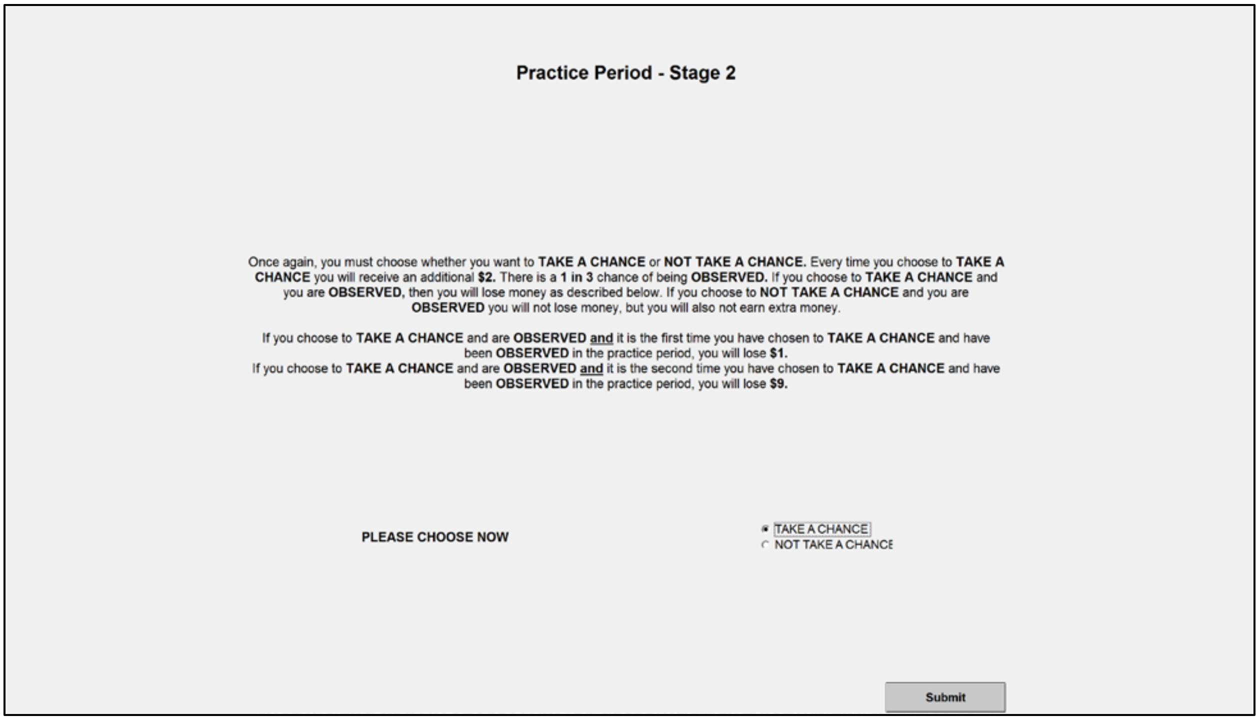

Before we start the practice period we would like to know what your strategy will most likely look like.
In every stage, if you choose to TAKE A CHANCE you will always receive an extra $2 but you face a 1 in 3 chance of being OBSERVED.
If you choose to TAKE A CHANCE and are OBSERVED and it is the first time you have chosen to TAKE A CHANCE and have been OBSERVED in the practice period, you will lose $1. If you choose to TAKE A CHANCE and are OBSERVED and it is the second time you have chosen to TAKE A CHANCE and have been OBSERVED in the practice period, you will lose $9.
In the 1st stage I would most likely choose to
TAKE A CHANCE
NOT TAKE A CHANCE
Submit

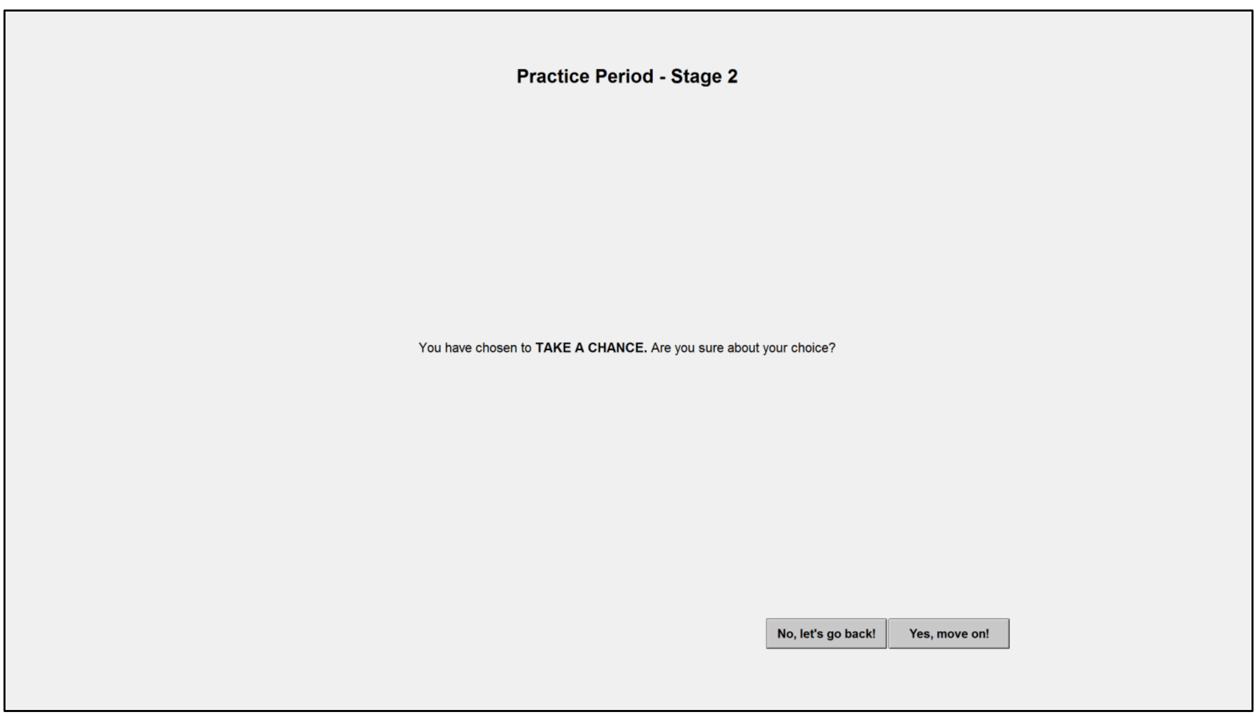

Before we start the practice period we would like to know what your strategy will most likely look like.
In every stage, if you choose to TAKE A CHANCE you will always receive an extra $2 but you face a 1 in 3 chance of being OBSERVED.
If you choose to TAKE A CHANCE and are OBSERVED and it is the first time you have chosen to TAKE A CHANCE and have been OBSERVED in the practice period, you will lose $1. If you choose to TAKE A CHANCE and are OBSERVED and it is the second time you have chosen to TAKE A CHANCE and have been OBSERVED in the practice period, you will lose $9.
If I was OBSERVED in the 1st stage, in the 2nd stage I would most likely choose to
If I was NOT OSERVED in the 1st stage, in the 2nd stage I would most likely choose to
In the 1st stage you chose to TAKE A CHANCE.
TAKE A CHANCE
NOT TAKE A CHANCE
TAKE A CHANCE
NOT TAKE A CHANCE
Submit


Practice Period - Stage 1
Remember: You begin with an initial payment of $10.
Every time you choose to TAKE A CHANCE you will receive an extra $2. In every stage you face a 1 in 3 chance of being OBSERVED. If you choose to TAKE A CHANCE and you are OBSERVED, then you will lose money as described below. If you choose to NOT TAKE A CHANCE and you are OBSERVED, then you will not lose money, but you also will not earn extra money. There is a possibility you will lose money if you choose to TAKE A CHANCE and are OBSERVED. (Note: In each stage you face the possibility of losing money only if you choose to TAKE A CHANCE. However, you will only earn extra money if you choose to TAKE A CHANCE.)
If you choose to TAKE A CHANCE and are OBSERVED and it is the first time you have chosen to TAKE A CHANCE and have been OBSERVED in the practice period, you will lose $1.
If you choose to TAKE A CHANCE and are OBSERVED and it is the second time you have chosen to TAKE A CHANCE. and have been OBSERVED in the practice period, you will lose $9.
PLEASE CHOOSE NOW
TAKE A CHANCE
NOT TAKE A CHANCE
Submit


Practice Period - Stage 1
You have chosen to TAKE A CHANCE. Are you sure about your choice?
No, let's go back!
Yes, move on!


You have chosen to TAKE A CHANCE.
As this is just a practice period, NO ONE was OBSERVED .
Therefore your payoff would be $10 + $2 = $12.
Next Screen


Practice Period - Stage 2
Once again, you must choose whether you want to TAKE A CHANCE or NOT TAKE A CHANCE. Every time you choose to TAKE A CHANCE you will receive an additional $2. There is a 1 in 3 chance of being OBSERVED. If you choose to TAKE A CHANCE and you are OBSERVED, then you will lose money as described below. If you choose to NOT TAKE A CHANCE and you are OBSERVED you will not lose money, but you will also not earn extra money.
If you choose to TAKE A CHANCE and are OBSERVED and it is the first time you have chosen to TAKE A CHANCE and have been OBSERVED in the practice period, you will lose $1.
If you choose to TAKE A CHANCE and are OBSERVED and it is the second time you have chosen to TAKE A CHANCE and have been OBSERVED in the practice period, you will lose $9.
PLEASE CHOOSE NOW
TAKE A CHANCE
NOT TAKE A CHANCE
Submit


Practice Period - Stage 2
You have chosen to TAKE A CHANCE. Are you sure about your choice?
No, let's go back!
Yes, move on!

You have chosen to **TAKE A CHANCE.**

As this is just a practice period, **NO ONE** was **OBSERVED.**

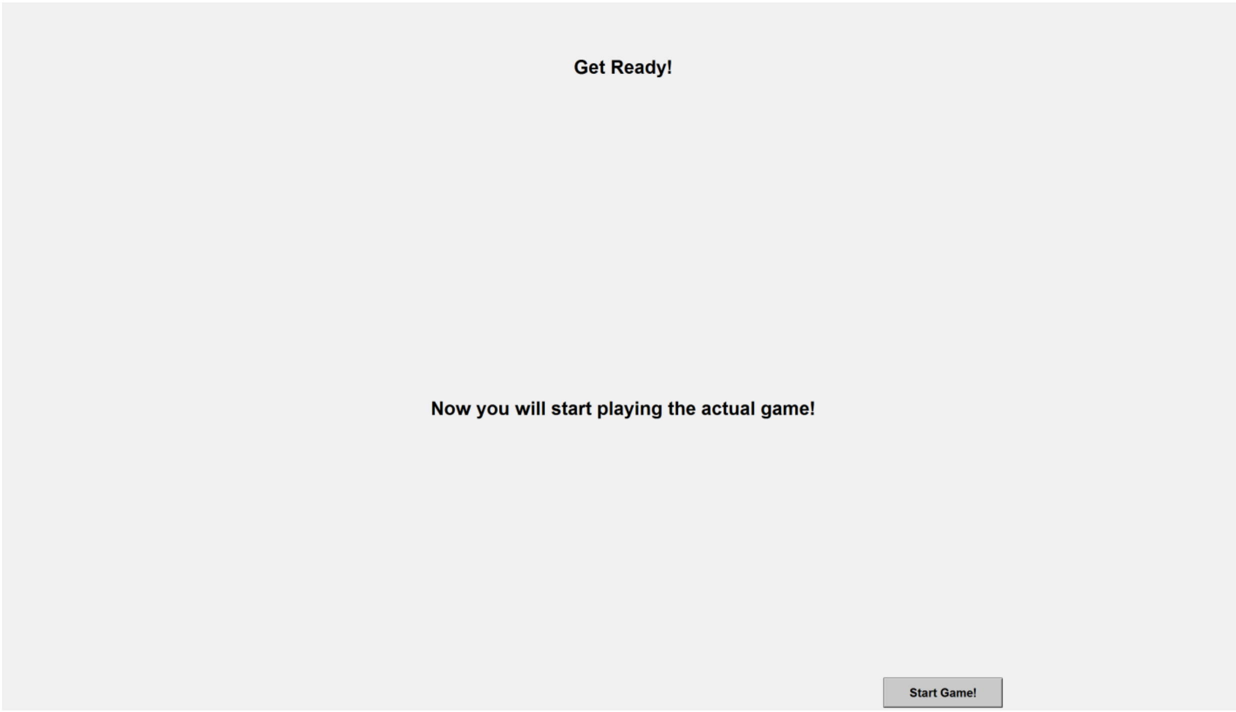
Therefore your payoff for the practice period would be **$14.**

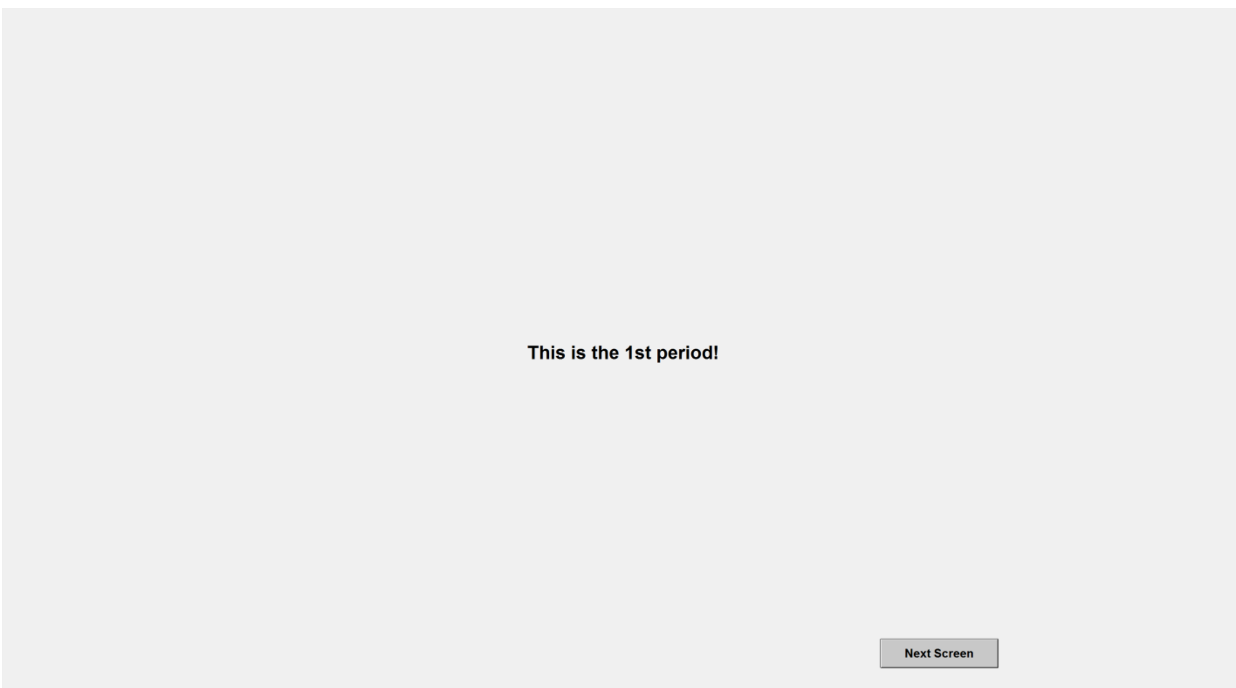
Next Screen

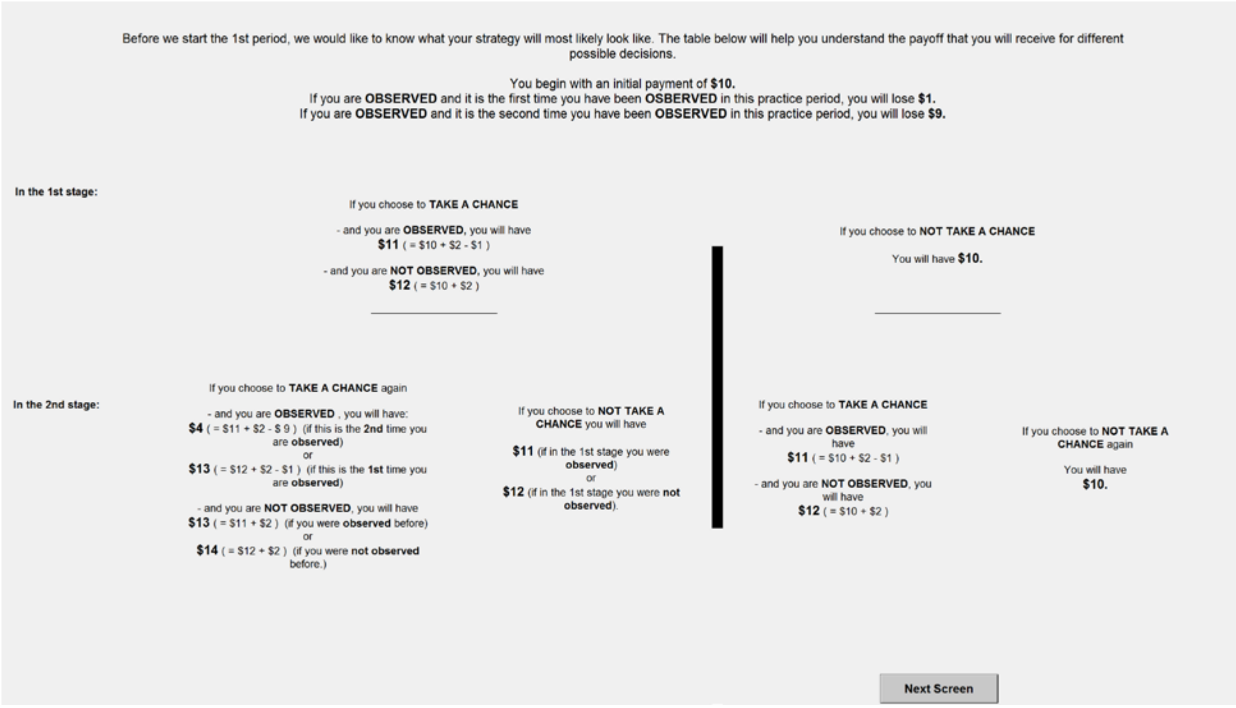
Questions?

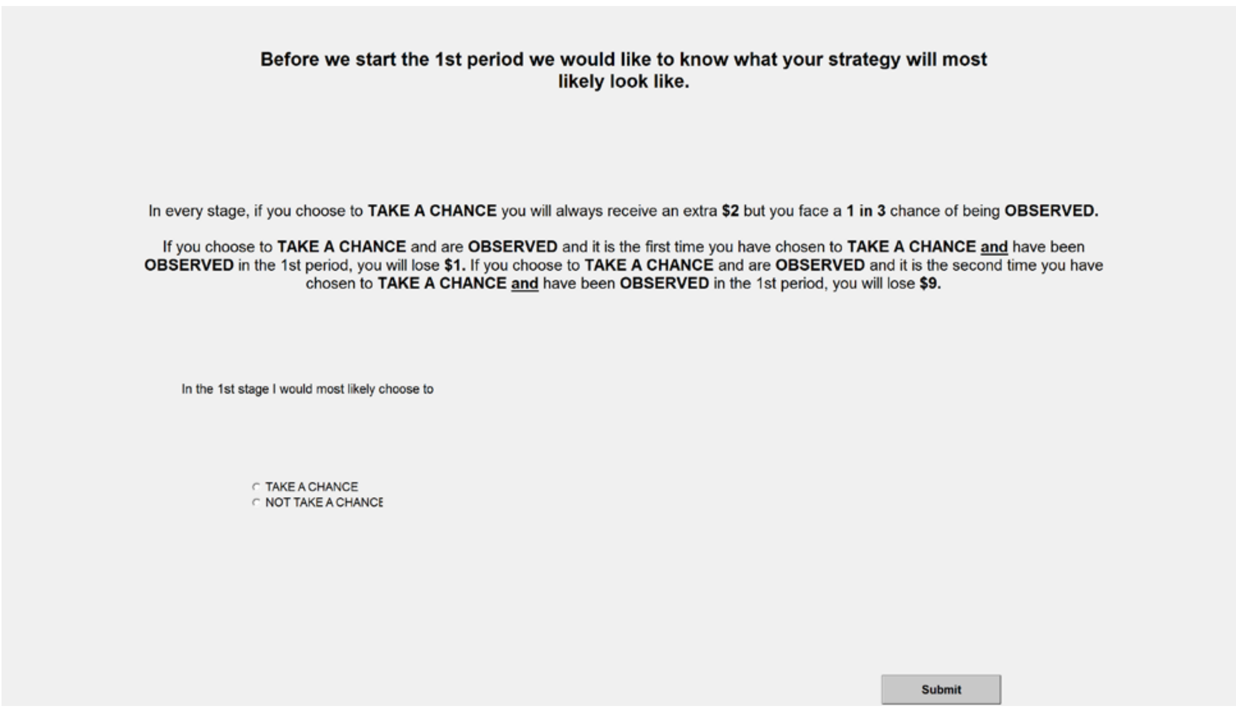
If you have any questions about the game or if something is unclear please raise your hand and we will come to your desk to answer it.

Next Screen


Get Ready!
Now you will start playing the actual game!
Start Game!


This is the 1st period!
Next Screen


Before we start the 1st period, we would like to know what your strategy will most likely look like. The table below will help you understand the payoff that you will receive for different possible decisions.
You begin with an initial payment of $10.
If you are OBSERVED and it is the first time you have been OSBERVED in this practice period, you will lose $1.
If you are OBSERVED and it is the second time you have been OBSERVED in this practice period, you will lose $9.
In the 1st stage:
If you choose to TAKE A CHANCE
- and you are OBSERVED, you will have $11 (= $10 + $2 - $1)
- and you are NOT OBSERVED, you will have $12 (= $10 + $2)
If you choose to NOT TAKE A CHANCE
You will have $10.
In the 2nd stage:
If you choose to TAKE A CHANCE again
- and you are OBSERVED , you will have:
$4 (= $11 + $2 - $ 9) (if this is the 2nd time you are observed)
or
$13 (= $12 + $2 - $1) (if this is the 1st time you are observed)
- and you are NOT OBSERVED, you will have
$13 (= $11 + $2) (if you were observed before)
or
$14 (= $12 + $2) (if you were not observed before.)
If you choose to NOT TAKE A CHANCE you will have
$11 (if in the 1st stage you were observed)
or
$12 (if in the 1st stage you were not observed).
If you choose to TAKE A CHANCE
- and you are OBSERVED, you will have $11 (= $10 + $2 - $1)
- and you are NOT OBSERVED, you will have $12 (= $10 + $2)
If you choose to NOT TAKE A CHANCE again
You will have $10.
Next Screen


Before we start the 1st period we would like to know what your strategy will most likely look like.
In every stage, if you choose to TAKE A CHANCE you will always receive an extra $2 but you face a 1 in 3 chance of being OBSERVED.
If you choose to TAKE A CHANCE and are OBSERVED and it is the first time you have chosen to TAKE A CHANCE and have been OBSERVED in the 1st period, you will lose $1. If you choose to TAKE A CHANCE and are OBSERVED and it is the second time you have chosen to TAKE A CHANCE and have been OBSERVED in the 1st period, you will lose $9.
In the 1st stage I would most likely choose to
TAKE A CHANCE
NOT TAKE A CHANCE
Submit

Before we start the 1st period we would like to know what your strategy will most likely look like.

In every stage, if you choose to **TAKE A CHANCE** you will always receive an extra **$2** but you face a **1 in 3** chance of being **OBSERVED.**

If you choose to **TAKE A CHANCE** and are **OBSERVED** and it is the first time you have chosen to **TAKE A CHANCE** **and** have been **OBSERVED** in the 1st period, you will lose **$1.** If you choose to **TAKE A CHANCE** and are **OBSERVED** and it is the second time you have chosen to **TAKE A CHANCE** **and** have been **OBSERVED** in the 1st period, you will lose **$9.**

	If I was **OBSERVED** in the 1st stage, in the 2nd stage I would most likely choose to	If I was **NOT OBSERVED** in the 1st stage, in the 2nd stage I would most likely choose to
In the 1st stage you chose to **TAKE A CHANCE.**	○ TAKE A CHANCE ○ NOT TAKE A CHANCE	○ TAKE A CHANCE ○ NOT TAKE A CHANCE

Submit

Period 1 - Stage 1

Remember: You begin with an initial payment of **$10.**

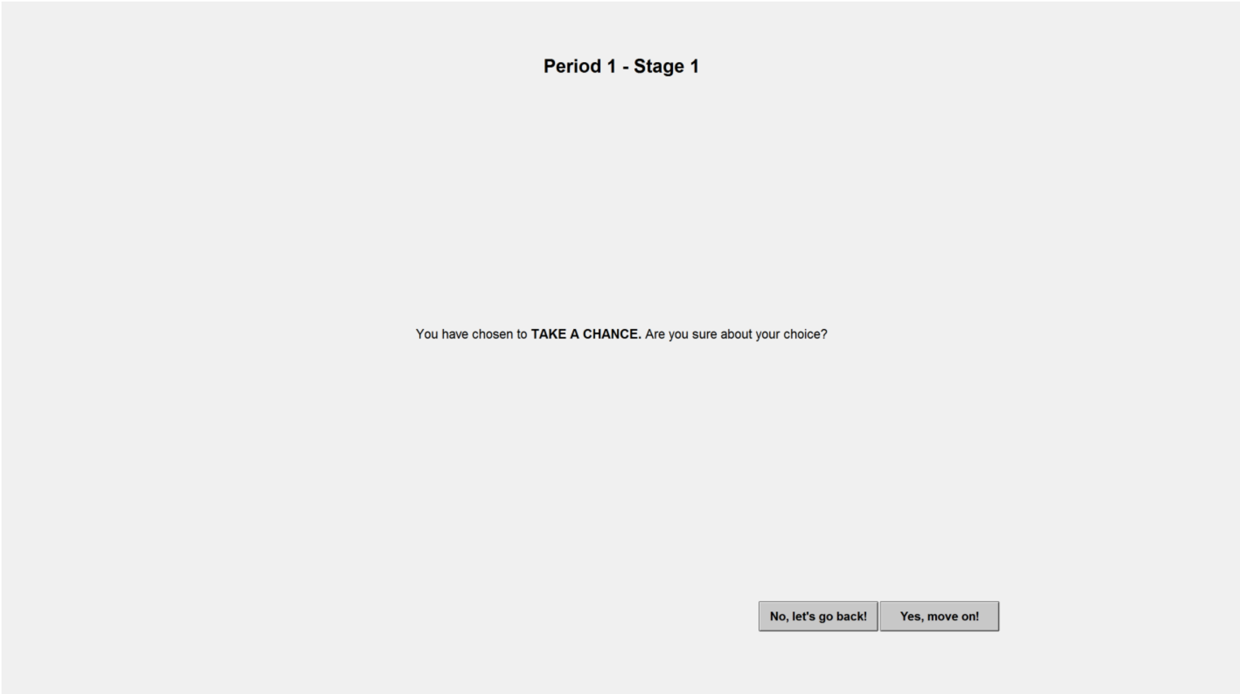
Every time you choose to **TAKE A CHANCE** you will receive an extra **$2.** In every stage you face a **1 in 3** chance of being **OBSERVED.** If you choose to **TAKE A CHANCE** and you are **OBSERVED,** then you will lose money as described below. If you choose to **NOT TAKE A CHANCE** and you are **OBSERVED,** then you will not lose money, but you also will not earn extra money. There is a possibility you will lose money if you choose to **TAKE A CHANCE** and are **OBSERVED.** (Note: In each stage you face the possibility of losing money **only** if you choose to **TAKE A CHANCE.** However, you will only earn extra money if you choose to **TAKE A CHANCE.**)

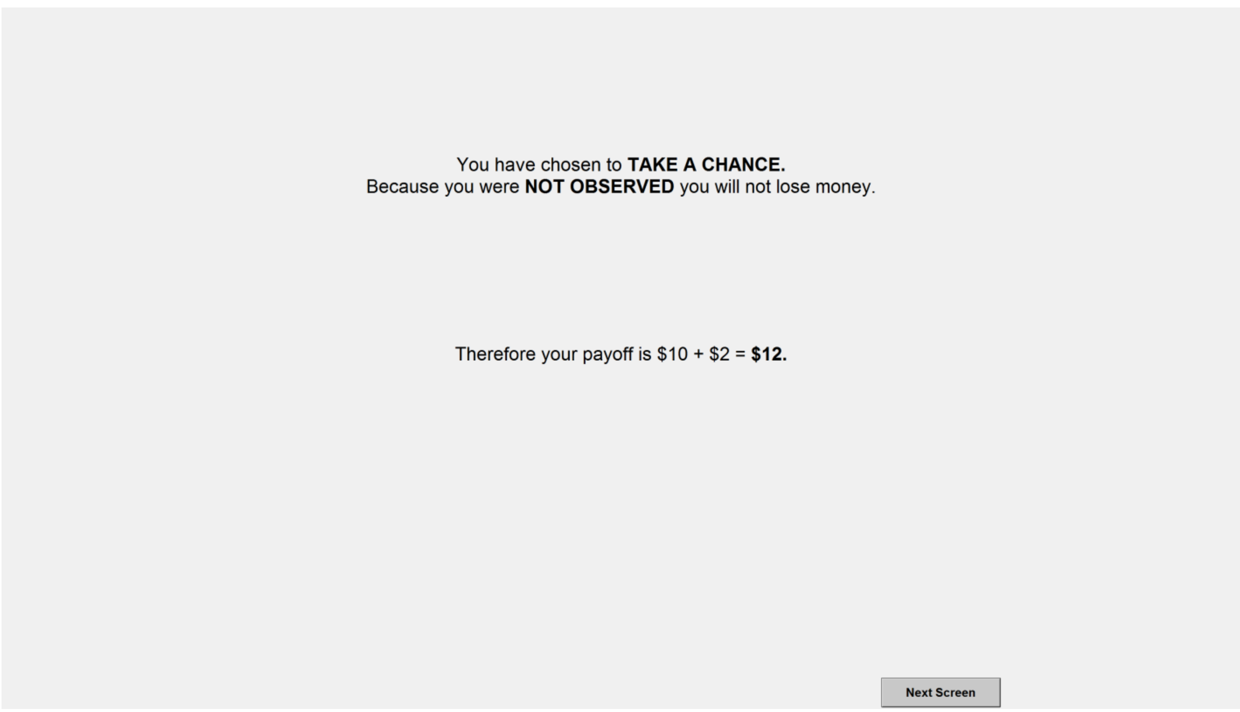
If you choose to **TAKE A CHANCE** and are **OBSERVED** **and** it is the first time you have chosen to **TAKE A CHANCE** and have been **OBSERVED** in the 1st period, you will lose **$1.** If you choose to **TAKE A CHANCE** and are **OBSERVED** **and** it is the second time you have chosen to **TAKE A CHANCE.** and have been **OBSERVED** in the 1st period, you will lose **$9.**

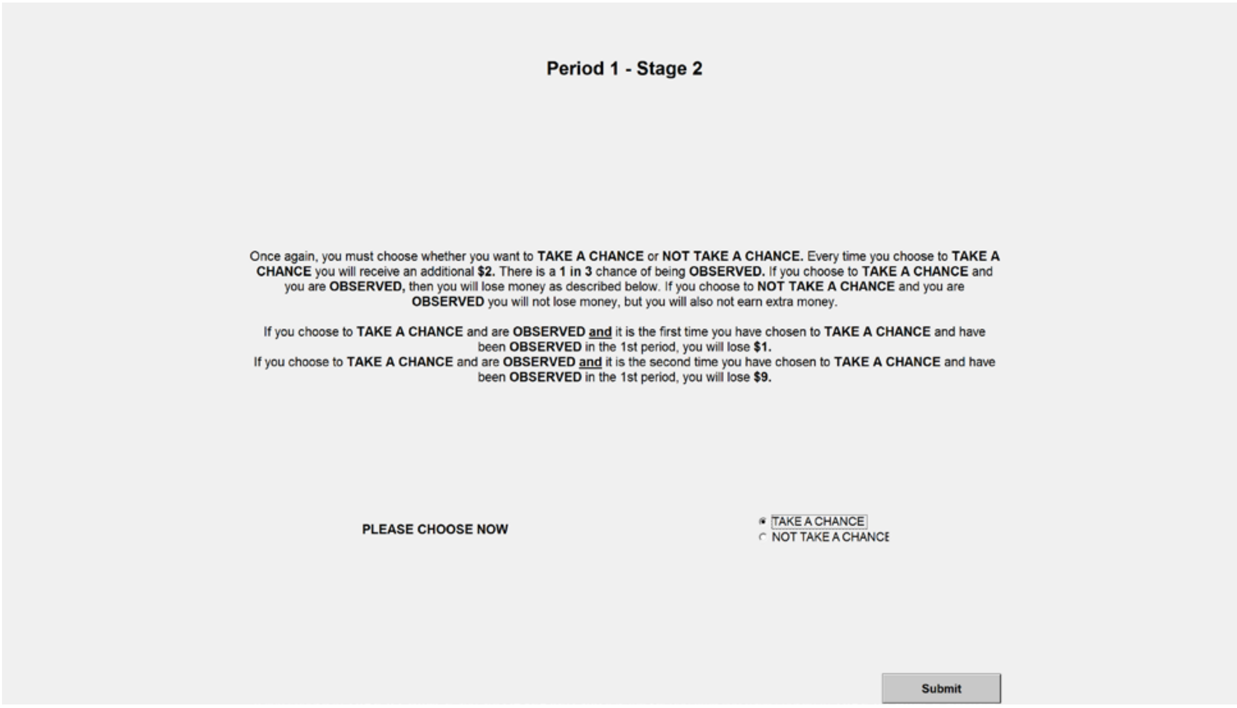
PLEASE CHOOSE NOW

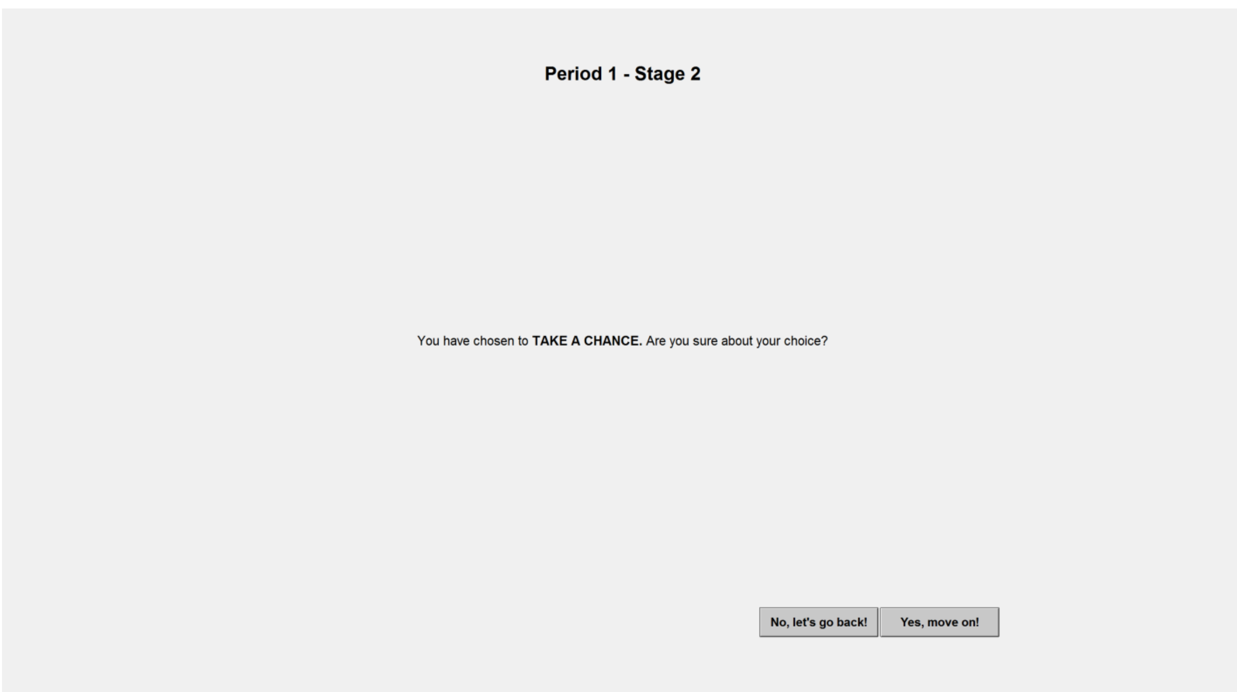
○ TAKE A CHANCE
○ NOT TAKE A CHANCE

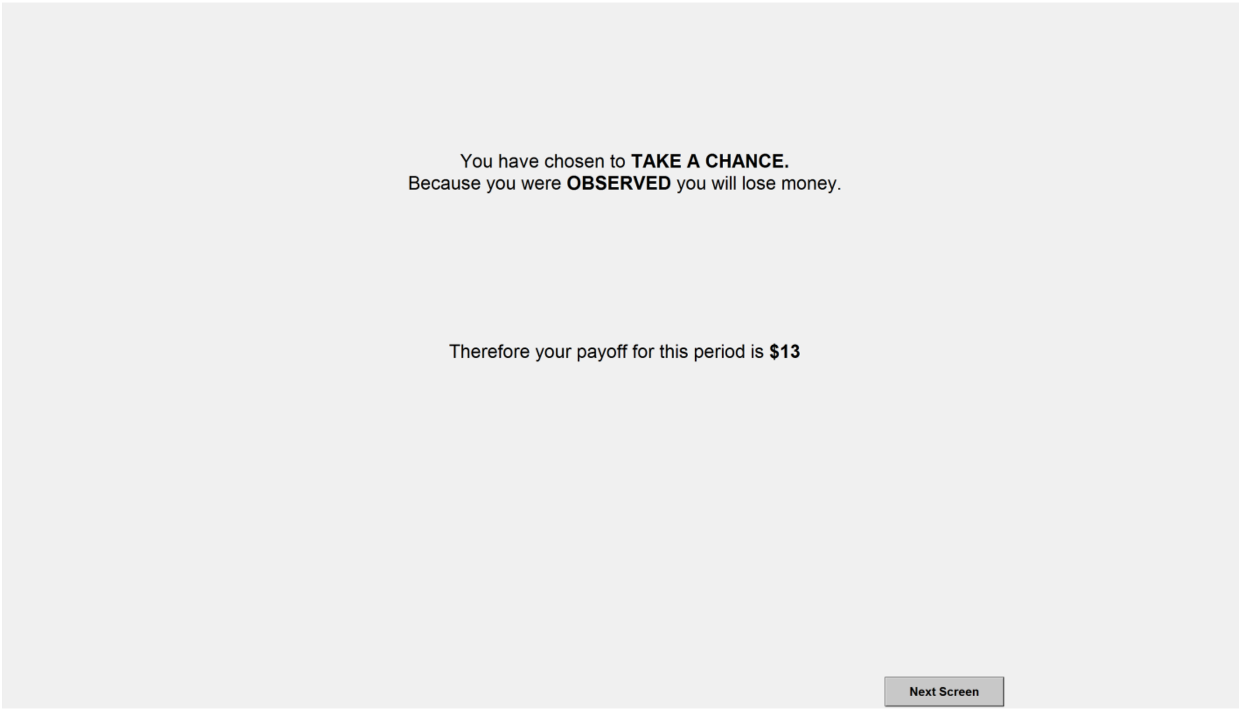
Submit

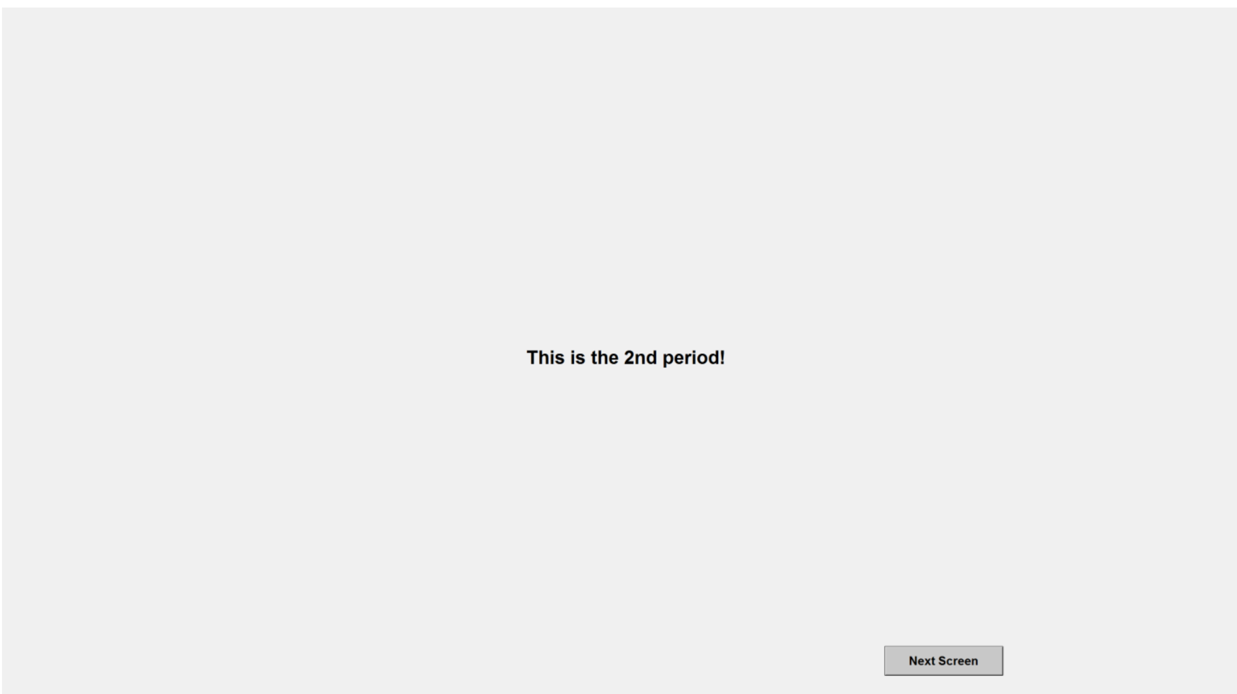

Period 1 - Stage 1
You have chosen to TAKE A CHANCE. Are you sure about your choice?
No, let's go back!
Yes, move on!


You have chosen to TAKE A CHANCE.
Because you were NOT OBSERVED you will not lose money.
Therefore your payoff is $10 + $2 = $12.
Next Screen


Period 1 - Stage 2
Once again, you must choose whether you want to TAKE A CHANCE or NOT TAKE A CHANCE. Every time you choose to TAKE A CHANCE you will receive an additional $2. There is a 1 in 3 chance of being OBSERVED. If you choose to TAKE A CHANCE and you are OBSERVED, then you will lose money as described below. If you choose to NOT TAKE A CHANCE and you are OBSERVED you will not lose money, but you will also not earn extra money.
If you choose to TAKE A CHANCE and are OBSERVED and it is the first time you have chosen to TAKE A CHANCE and have been OBSERVED in the 1st period, you will lose $1.
If you choose to TAKE A CHANCE and are OBSERVED and it is the second time you have chosen to TAKE A CHANCE and have been OBSERVED in the 1st period, you will lose $9.
PLEASE CHOOSE NOW
TAKE A CHANCE
NOT TAKE A CHANCE
Submit


Period 1 - Stage 2
You have chosen to TAKE A CHANCE. Are you sure about your choice?
No, let's go back!
Yes, move on!


You have chosen to **TAKE A CHANCE.**
Because you were **OBSERVED** you will lose money.
Therefore your payoff for this period is **$13**
Next Screen


This is the 2nd period!
Next Screen

Before we start the 2nd period, we would like to know what your strategy will most likely look like. The table below will help you understand the payoff that you will receive for different possible decisions.

You begin with an initial payment of **$10.**
If you are **OBSERVED** and it is the first time you have been **OSBERVED** in this practice period, you will lose **$3.**
If you are **OBSERVED** and it is the second time you have been **OBSERVED** in this practice period, you will lose **$7.**

In the 1st stage:

If you choose to **TAKE A CHANCE**

- and you are **OBSERVED,** you will have **$9** (= $10 + $2 - $3)
- and you are **NOT OBSERVED,** you will have **$12** (= $10 + $2)

If you choose to **NOT TAKE A CHANCE**

You will have **$10.**

In the 2nd stage:

If you choose to **TAKE A CHANCE** again

- and you are **OBSERVED** , you will have: **$4** (= $9 + $2 - $ 7) (if this is the **2nd** time you are **observed**) or **$11** (= $12 + $2 - $3) (if this is the **1st** time you are **observed**)
- and you are **NOT OBSERVED**, you will have **$11** (= $9 + $2) (if you were **observed** before) or **$14** (= $12 + $2) (if you were **not observed** before.)

If you choose to **NOT TAKE A CHANCE** you will have

$9 (if in the 1st stage you were **observed**) or **$12** (if in the 1st stage you were **not observed**).

If you choose to **TAKE A CHANCE**

- and you are **OBSERVED**, you will have **$9** (= $10 + $2 - $3)
- and you are **NOT OBSERVED**, you will have **$12** (= $10 + $2)

If you choose to **NOT TAKE A CHANCE** again

You will have **$10.**

Next Screen

Before we start the 2nd period we would like to know what your strategy will most likely look like.

In every stage, if you choose to **TAKE A CHANCE** you will always receive an extra **$2** but you face a **1 in 3** chance of being **OBSERVED.**

If you choose to **TAKE A CHANCE** and are **OBSERVED** and it is the first time you have chosen to **TAKE A CHANCE and** have been **OBSERVED** in the 2nd period, you will lose **$3.** If you choose to **TAKE A CHANCE** and are **OBSERVED** and it is the second time you have chosen to **TAKE A CHANCE and** have been **OBSERVED** in the 2nd period, you will lose **$7.**

In the 1st stage I would most likely choose to

- TAKE A CHANCE
- NOT TAKE A CHANCE

Submit

Before we start the 2nd period we would like to know what your strategy will most likely look like.

In every stage, if you choose to **TAKE A CHANCE** you will always receive an extra **$2** but you face a **1 in 3** chance of being **OBSERVED.**

If you choose to **TAKE A CHANCE** and are **OBSERVED** and it is the first time you have chosen to **TAKE A CHANCE** **and** have been **OBSERVED** in the 2nd period, you will lose **$3.** If you choose to **TAKE A CHANCE** and are **OBSERVED** and it is the second time you have chosen to **TAKE A CHANCE** **and** have been **OBSERVED** in the 2nd period, you will lose **$7.**

	If I was **OBSERVED** in the 1st stage, in the 2nd stage I would most likely choose to	If I was **NOT OBSERVED** in the 1st stage, in the 2nd stage I would most likely choose to
In the 1st stage you chose to **TAKE A CHANCE.**	○ TAKE A CHANCE ○ NOT TAKE A CHANCE	○ TAKE A CHANCE ○ NOT TAKE A CHANCE

Submit

Period 2 - Stage 1

Remember: You begin with an initial payment of **$10.**

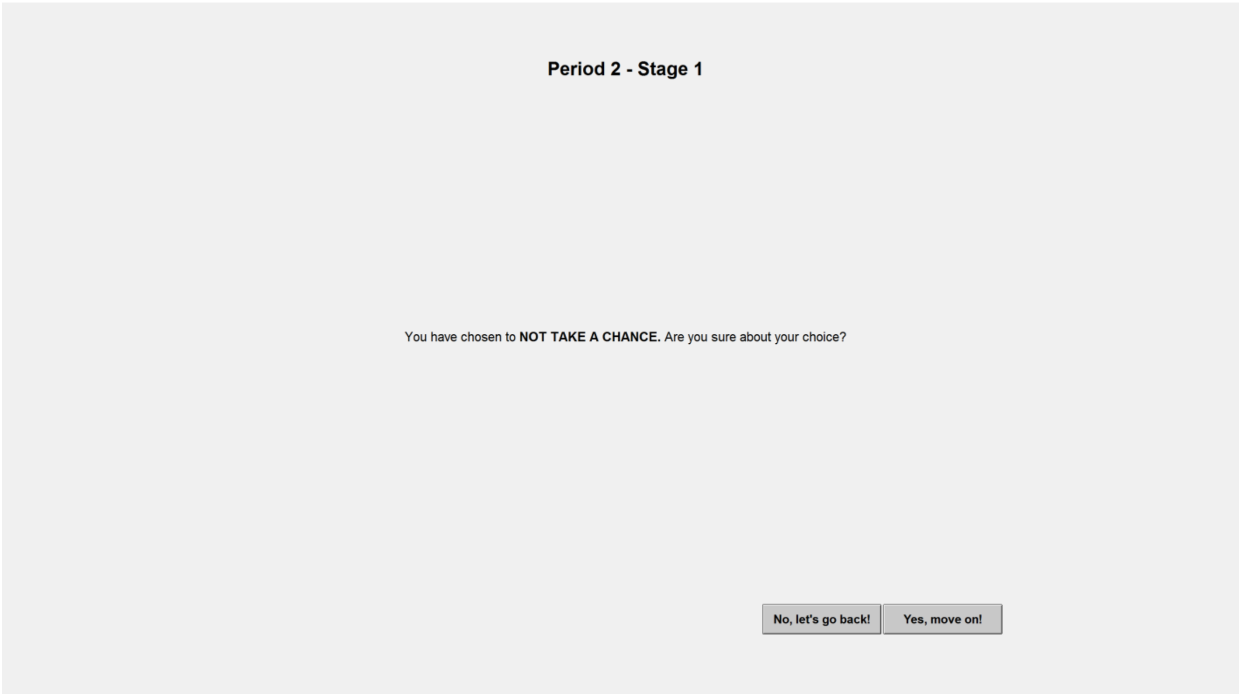
Every time you choose to **TAKE A CHANCE** you will receive an extra **$2.** In every stage you face a **1 in 3** chance of being **OBSERVED.** If you choose to **TAKE A CHANCE** and you are **OBSERVED,** then you will lose money as described below. If you choose to **NOT TAKE A CHANCE** and you are **OBSERVED,** then you will not lose money, but you also will not earn extra money. There is a possibility you will lose money if you choose to **TAKE A CHANCE** and are **OBSERVED.** (Note: In each stage you face the possibility of losing money **only** if you choose to **TAKE A CHANCE.** However, you will only earn extra money if you choose to **TAKE A CHANCE.**)

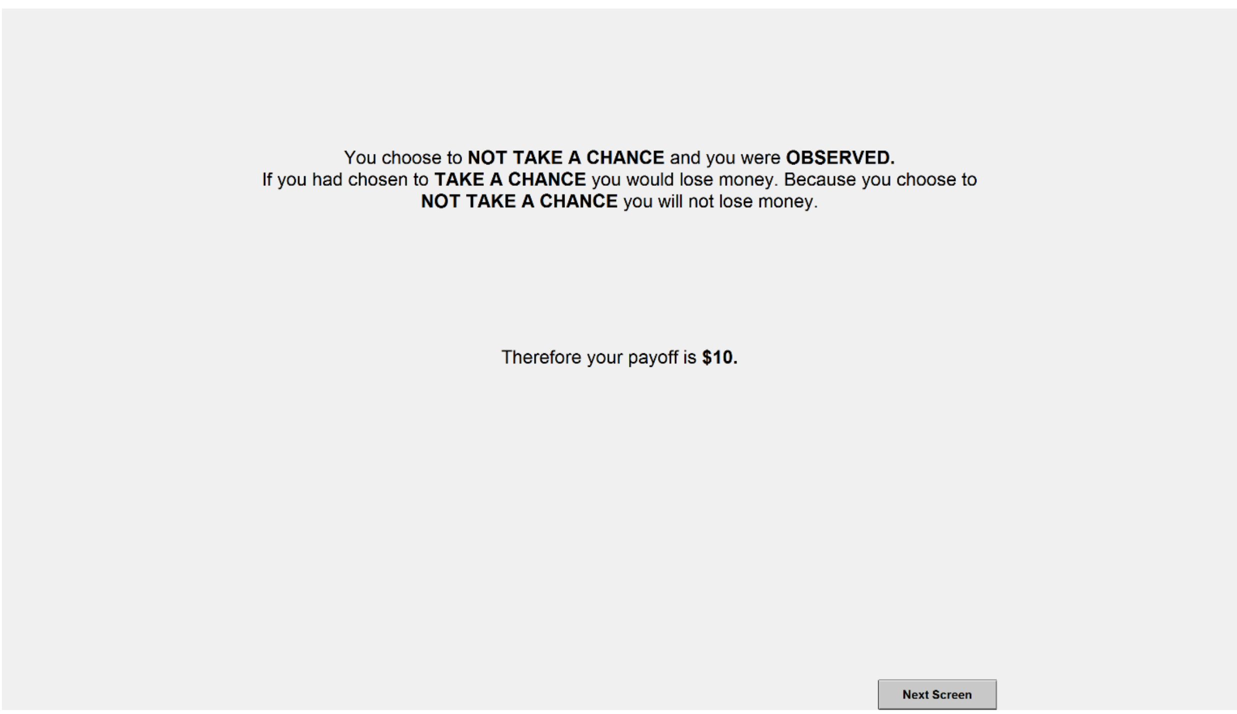
If you choose to **TAKE A CHANCE** and are **OBSERVED** **and** it is the first time you have chosen to **TAKE A CHANCE** and have been **OBSERVED** in the 2nd period, you will lose **$3.** If you choose to **TAKE A CHANCE** and are **OBSERVED** **and** it is the second time you have chosen to **TAKE A CHANCE.** and have been **OBSERVED** in the 2nd period, you will lose **$7.**

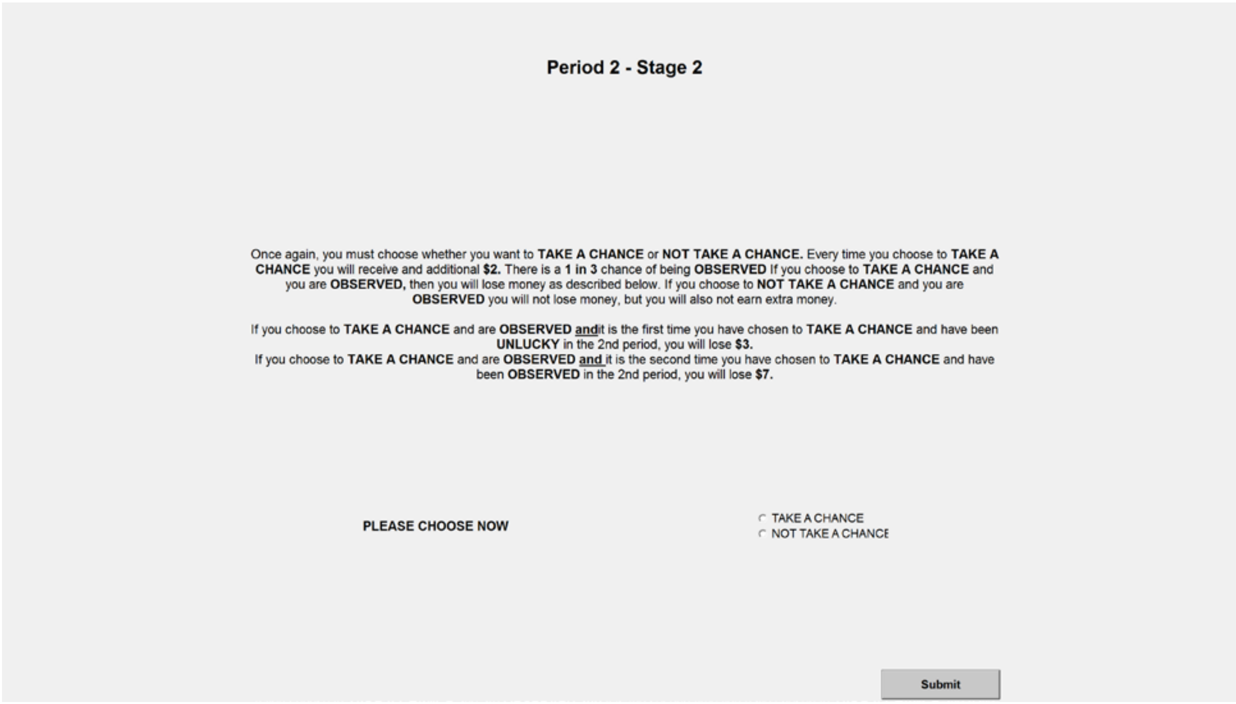
PLEASE CHOOSE NOW

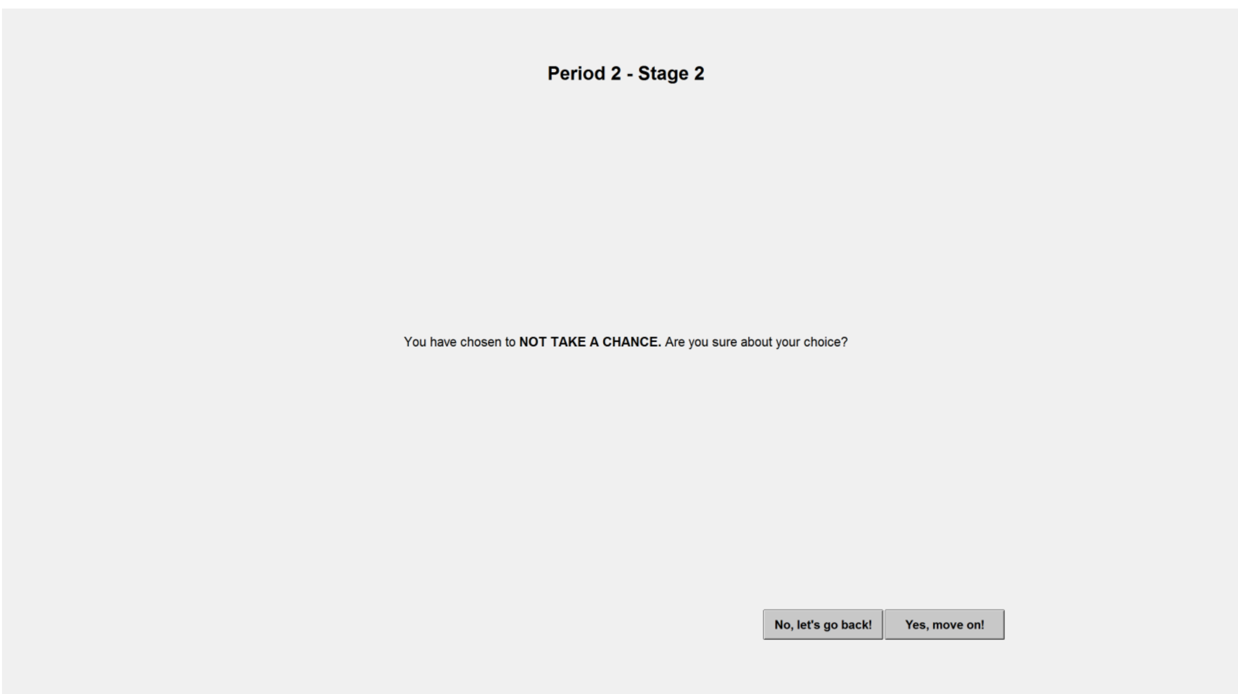
○ TAKE A CHANCE
○ NOT TAKE A CHANCE

Submit


Period 2 - Stage 1
You have chosen to NOT TAKE A CHANCE. Are you sure about your choice?
No, let's go back!
Yes, move on!


You choose to NOT TAKE A CHANCE and you were OBSERVED.
If you had chosen to TAKE A CHANCE you would lose money. Because you choose to NOT TAKE A CHANCE you will not lose money.
Therefore your payoff is $10.
Next Screen


Period 2 - Stage 2
Once again, you must choose whether you want to TAKE A CHANCE or NOT TAKE A CHANCE. Every time you choose to TAKE A CHANCE you will receive and additional $2. There is a 1 in 3 chance of being OBSERVED If you choose to TAKE A CHANCE and you are OBSERVED, then you will lose money as described below. If you choose to NOT TAKE A CHANCE and you are OBSERVED you will not lose money, but you will also not earn extra money.
If you choose to TAKE A CHANCE and are OBSERVED andit is the first time you have chosen to TAKE A CHANCE and have been UNLUCKY in the 2nd period, you will lose $3.
If you choose to TAKE A CHANCE and are OBSERVED and it is the second time you have chosen to TAKE A CHANCE and have been OBSERVED in the 2nd period, you will lose $7.
PLEASE CHOOSE NOW
TAKE A CHANCE
NOT TAKE A CHANCE
Submit


Period 2 - Stage 2
You have chosen to NOT TAKE A CHANCE. Are you sure about your choice?
No, let's go back!
Yes, move on!

You choose to **NOT TAKE A CHANCE** and you were **OBSERVED.**
If you had chosen to **TAKE A CHANCE** you would lose money. Because you choose to **NOT TAKE A CHANCE** you will not lose money.

Therefore your payoff for this period is **$10**

Next Screen