Increased risk-taking, not loss tolerance, drives adolescents' propensity to choose risky prospects more often under peer observation

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Abstract: Relative to adults, adolescents make more welfare-decreasing decisions, especially in the presence of peers. The consequences of these decisions result in substantial individual and societal losses in terms of lives lost, injury, hospitalization costs, and foregone opportunities. In this paper, we use laboratory within-subject and between-subject experiments with younger (12-17 years old) and older (18-24 years old) adolescents to identify which economic preference is affected by peer observation in adolescence — risk attitudes in gains, risk attitudes in losses, and/or loss aversion. We find that while observed by peers, older adolescents become more risk-tolerant both in gains and in losses but more loss averse. We discuss the potential mechanisms driving the result and its implications for policy.

Keywords: decision-making; adolescence; observation; loss aversion; risk attitudes

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1. Introduction

Being observed by others has been shown to change people's behavior in a wide range of settings. We know that, when observed, people tend to give more to their opponents in standard economic games (e.g. Charness et al., 2007) and generally engage in more prosocial behavior (Hoffman et al., 1994; Kurzban et al., 2007). People are also more likely to adhere to less articulated behavioral norms such as ambiguity aversion when observed (Baltussen et al., 2016; Curley et al., 1986; Trautmann et al., 2008). In the workplace, people work harder and put in more effort when observed by others (Guryan et al., 2009; Mas & Moretti, 2009). In all of these settings, observation is helpful. It either helps to enforce the norm, sustain cooperation, or make people more altruistic and productive. Unfortunately, at a certain age, observation by peers seems to have a dark side as well.

Statistics, research, and common wisdom all suggest that the presence of peers can have a detrimental effect on people at a specific time of our lives — adolescence. We know that adolescents engage in a range of activities that adults avoid, at an enormous cost to them and society as a whole (Jefferey Arnett, 1992; Gullone & Moore, 2000; Spear, 2010). Although they are healthier, stronger, and have better reasoning capabilities than younger children, adolescents' morbidity and mortality rates are twice to three times higher (Australian Bureau of Statistics, 2018; Center for Disease Control and Prevention, 2017). Unintentional injury, mostly attributed to their own incorrect decision-making, is the biggest cause of death and hospitalization among adolescents in the developed countries (Center for Disease Control and Prevention, 2017) resulting in tens of millions of dollars in medical costs each year (Florence et al., 2015; Mitchell et al., 2018; Polinder et al., 2010). Adolescents have the highest rates of sexually transmitted diseases (Gittes & Irwin, 1993), the highest frequency of criminal behaviors (Arnett, 1996), and are known to drive more recklessly than adults (Jonah, 1986).

These welfare-decreasing behaviors seem to be exacerbated in the presence of peers. Adolescents typically exhibit more risky and delinquent behaviors in peer groups, whereas adults more frequently do so alone (Albert & Steinberg, 2011). Relative to older age groups, adolescents commit more crimes in groups (Zimring, 1998), and have more car accidents when driving with passengers (Chen et al., 2000). In the past 15 years, these effects have been replicated in laboratory studies by developmental psychologists. An influential paper by Gardner & Steinberg (2005) presented evidence that, in a driving simulator game, adolescents are more likely to crash when observed by peers. Other studies in psychology have shown that, when observed or merely led to believe that they are observed by peers, adolescents gamble more (Smith et al., 2014), are less likely to wait for larger rewards (Silva et al., 2016; Weigard et al., 2014), and have diminished cognitive control to positive social cues (Breiner et

al., 2018). Animal studies revealed that this effect is not limited only to human adolescents. For example, adolescent rodents drink more alcohol when their peers are present (Logue et al., 2014). Research using functional magnetic resonance imaging (fMRI) revealed that in adolescence (but not in adulthood) the mere presence of a peer increases activity in the reward-processing areas such as the orbitofrontal cortex and ventral striatum (Albert et al., 2013; Weigard et al., 2014) and evokes strong physiological arousal (Somerville, 2013; Somerville et al., 2013). Adolescence is a period in our lives when our behavior and biology change in the presence of peers in ways that do not happen later in life.

Existing studies in developmental psychology have also begun to shed light on how to minimize these unwanted behavioral effects caused by peer presence. For example, the presence of an adult mitigates the negative effect of peers' presence on driving behavior (Silva et al., 2016), and working memory training decreases the laboratory risk-taking in the presence of peers (Rosenbaum et al., 2017). Behavioral economists can contribute to alleviating the burden of the welfare-decreasing behaviors in adolescence by providing a deeper understanding of these behaviors using the framework of the economic model of choice. Observational data and studies in developmental psychology often make this impossible because they do not allow for separate identification of different economic preferences. It is therefore impossible to tell whether the observed effects are driven by a change in risk preferences, time preferences, loss aversion, subjective probability distortions, mistakes, and/or randomness in choice. Two recent laboratory studies began to fill in this knowledge gap. Tymula (2019) used standard tasks from experimental economics to show that adolescents' risk attitudes and ambiguity attitudes in the domain of gains are not affected under peer observation. Instead, adolescents become more impatient when observed by a peer. Another study by Tymula & Whitehair (2018) found that, in the domain of gains, older adolescents (university students) are less likely to choose gambles with unknown odds of winning over a sure amount when observed by a peer, but observation does not affect the likelihood of choosing gambles with known odds of winning. Such findings are believed to be relevant because previous literature has established that people's real-life decisions are associated with their economic preferences measured in laboratory experiments (Breitkopf et al., 2020). For example, individuals with a higher tolerance for risks are more likely to misbehave in school and less likely to graduate (Castillo et al., 2018), more likely to invest in stocks, actively engage in sports, and smoke (Dohmen et al., 2011), are more likely to smoke, drink heavily, be overweight or obese, and not wear a seat belt (Anderson & Mellor, 2008).

The goal of this paper is to provide an economic understanding of the effect of peer observation on adolescents' behavior, specifically in the much less explored domain of making risky decisions that

involve losses. Even though the research on how the presence of peers affects adolescents' decisions is motivated by the negative outcomes of these decisions, existing laboratory studies predominantly focus on the gain domain or used tasks that make it impossible to separately identify risk preference and loss aversion. In the most closely related study, Smith et al. (2014) asked adolescent participants to make hypothetical choices between passing on or playing a gain-loss gamble with clearly stated probabilities. Participants who were led to believe that they were being watched by another adolescent were more likely to take the risk. Unfortunately, it is not clear whether this is because they become less loss averse or because they become more risk-taking, since there were no lottery choices purely in the gain domain and purely in the loss domain that would allow us to separate risk preferences from loss aversion. This is a crucial difference from theory, as well as from the policy intervention perspective.

To fill in this gap, we designed an experiment that allows us to separately estimate participants' loss aversion and risk attitudes in gains and losses in private and when observed by a peer sitting next to them. Our novel experimental design permits both within-subject and between-subject approaches to hypothesis testing, thus allowing us to access the advantages of both methods (Charness et al., 2012) within one experiment and the same sample. Consistent with Smith et al. (2014), we find that older adolescents (18-24 years old) are more likely to accept gain-loss gambles when observed. This effect is driven by an increased risk tolerance in both gain and loss domains, rather than reduced loss aversion. For younger adolescents (12-17 years old), neither their risk attitudes nor their loss aversion is affected by peer observation. We discuss the potential reasons for this age dichotomy in susceptibility to observation in the results and discussion sections of the paper.

2. Materials and Methods

146 (59 male) adolescents participated in two studies (mean age 18.175 with standard deviation 3.208, see age histogram in Figure 1). Sixty-two (28 male) 18 to 24 years old participants were recruited from the University of Sydney student database using ORSEE (Greiner, 2015) and participated in sessions during March 2018. Since 2016, the majority of participants have been recruited to the University of Sydney ORSEE database through Facebook and Instagram ads targeting University of Sydney students, with a smaller fraction of participants recruited via announcements on large units of study sites and via traditional flyers left at the library. Eighty-four (31 male) 12 to 17 years old participants (all high school students) were recruited using announcements placed on Facebook and Instagram and participated in sessions that took place in May 2018. Younger (12-17 years old) and older (18-24 years old) participants, while recruited using similar methods, took part in separate sessions and were never

mixed in one session. The experiment was programmed in z-Tree (Fischbacher, 2007). Each session finished within 60 minutes. All participants and, in the case of minors, also caregivers gave informed consent and the study was approved by the Human Research Ethics Committee at the University of Sydney. Before commencing the task, all participants read instructions (available in Appendix A).

2.1 *Experimental Task*

We used the same experimental task with younger and older participants to address the need for new studies that use the same experimental tasks with participants from a wide age range (Hartley & Somerville, 2015). To assess participants' risk attitudes and loss aversion, we asked them 120 questions where they could choose between a guaranteed amount of money and a lottery that offered a larger or smaller amount, each with 50% probability. Participants could also indicate indifference between the options. If they chose indifferent, the program would randomly allocate them to either the fixed option or the lottery with equal chance. Adding indifferent option allows us to test whether the propensity to leave the choice to chance is affected by peer observation. After indicating their choice, participants moved to the next trial without receiving any feedback. Participants knew that one of their choices would be randomly selected for payment at the end of the experiment. They were not allowed to skip trials. All questions were presented on a computer screen. The questions were presented in an order independently randomized for each participant. Figure 2 illustrates examples of how the questions were presented to participants.

The specific questions asked in the study were a subset of questions asked in Sokol-Hessner et al., (2013)[1]. To assess risk attitudes in the gain domain, 20 of the 120 questions (gain trials) featured a choice between receiving a fixed amount (that varied between $1 and $13 from trial to trial) and a lottery that offered a greater sum (that varied between $3 and $28 from trial to trial) or nothing. To assess risk attitude over the loss domain, 20 of the 120 questions (loss trials) featured a choice between losing a fixed amount and a lottery that offered a larger loss or nothing. In loss trials, the amounts were the same as in the gain trials but multiplied by -1. The remaining 80 questions (mixed trials) allowed

[1] The original Sokol-Hessner et al. (2013) task has 150 choices: 30 in the domain of gains and 120 mixed gambles. The authors assume that the curvature of the utility function is the same in gains and in losses to estimate loss aversion. Since the curvature for gains and losses is often different (e.g. Chung et al., 2019), we measure curvature in both gains and losses domain. This would result in 180 trials if we used the original set of questions. We reduced the number of trials by one-third. For all 30 gain trials, we calculated CRRA utility coefficients that imply indifference between the risky and safe option and eliminated 10 trials least informative of risk attitudes (for example, these included five trials where safe and risky option had the same expected value). The loss trials are the mirror image of the remaining 20 gain trials. In Sokol-Hessner et al. (2013), mixed gambles are constructed from 8 different gain amounts, each multiplied by 15 scalars for a total of 120 gambles. We eliminated 40 mixed trials constructed with five, less relevant scalars used to identify loss-seeking (-15/8, -14/8, -13/8. -11/8, -9/8).

us to assess the participant's loss aversion by presenting a choice between a guaranteed $0 and a mixed lottery offering a 50% chance of a gain (that varied between $2 and $12) and a 50% of a loss (that varied between -$0.5 and -$24). See Table C1 in Appendix C for all choice scenarios used in the experiment.

2.2 *Observation Implementation*

Upon arrival, each participant was seated at a computer station and randomly allocated to be either a Choice-Maker or an Observer. Choice-Makers completed the experimental task twice; once in private (*private condition*) and once under observation by an Observer (*observed condition*). Observers completed the task only once in private. The order of the private and observed conditions was randomized for each session. The timeline of the experiment is summarized in Figure 3A.

The experimental design allowed the use of a within-participant analysis of the effect of observation on decision-making by comparing the same Choice-Makers' decisions in private and under observation. The same effect could also be investigated through a between-participant comparison of the choices made only in Stage 2 by Choice-Makers in Order 1 (observed) and a different set of Choice-Makers in Order 0 (private).

Sessions were conducted at the University of Sydney School of Economics experimental laboratory, which consists of 32 computer stations, separated by tall partition walls on the sides and front. Figure 3B presents the seating map for the private and observed conditions. To enhance privacy for the private condition, participants were randomly allocated seats with unoccupied adjacent cubicle(s).

For the observed condition, each Observer moved to sit to the right of a Choice-Maker with whom they had been randomly partnered. Choice-Makers and Observers were not allowed to verbally communicate. The physical distance between the Observer and the Choice-Maker was controlled by strapping their chairs together. To incentivize Observers to pay attention to the Decision-Maker's choices, we told them that they would be asked to recall three randomly selected choices by the Choice-Maker and would receive $1 for each correct recollection (Stage 4 – Test in Figure 3A). Observers could not write down notes whilst observing. Payment opportunities were equalized by asking Choice-Makers to guess three of the Observer's choices. Participants were told that decisions during the observed condition would only impact the Choice-Maker's payment and that the Observer would not be informed of the Choice-Maker's final payment. To ensure that all Choice-Makers in the observed condition would have the same number of people surrounding them while making decisions, we made sure that there was only one pair of participants in each row on each side of the aisle that runs through

the middle of the laboratory. This resulted in there being one Choice-Maker – Observer pair per four seats (see Figure 3B Observed condition).

Given previously documented associations between state anxiety and performing tasks in public (Horwitz & McCaffrey, 2008) and associations between anxiety and risk tolerance (Peng et al., 2014; Raghunathan & Pham, 1999), we investigated state anxiety as a potential mediator of the behavioral change. To measure whether a participant's emotional state mediated the influence of observation on their decision-making, participants completed a state anxiety measure (Marteau & Bekker, 1992, available in Appendix B) twice during the session: before commencing the private condition, and before commencing the observed condition.

After the decision-making task was completed, all participants filled out a questionnaire about their demographics, perceptions of their partner and themselves, and the overall aims of the experiment (see full questionnaire in Appendix B).

2.3 *Payment*

Participants' final compensation consisted of three parts: $35 which they received at the beginning of the experiment,[2] the outcome from one randomly selected decision that they had made during the experiment, and the outcome from the test stage where each participant was asked to recall or guess their partner's choice for three randomly selected decision scenarios. If they chose the fixed option for the randomly selected decision, they received (or lost, in the case of a negative sum) that amount. If they chose the lottery, they rolled a 6-sided die to determine the lottery's outcome. Participants rolled the die themselves to avoid potential distrust in the payment procedure. If the dice came up as a 1, 2, or 3, the participant received the payoff presented on top of the lottery. If the dice came up as a 4, 5,

[2] When studying loss domain, researchers face a dilemma between satisfying ethical concerns (that is not exploiting financially study volunteers) and potentially biasing behavior due to a house money effect (Thaler & Johnson, 1990). Due to these complexities, some studies elicited utility curvature only in gains and assumed that it is a mirror image for losses (Sokol-Hessner et al., 2013). However, studies that elicited utility in both gains and losses found that the correlation between an individual's utility curvature in gains and losses is not strong or even opposite to what one would expect under Prospect Theory (Chung et al., 2019; Tymula et al., 2012) advising against the use of such simplification. Other researchers decided to provide endowments only in loss trials but not in gain trials (Bruhin et al., 2010), but this could lead to a systematic difference in house money effect between the gain and loss domains. We adopted losses from the initial endowment approach because Etchart-Vincent & l'Haridon (2011) found that behavior in the loss domain in "losses-from-an-initial-endowment" does not differ from "real-loss" conditions meaning that losses from endowment serve as a good approximation of real behavior. Their review of the literature also suggests that the findings on the house money effect in the literature are mixed. Another more recent study by Cárdenas et al. (2014) showed that the house money effect created by an endowment plays only a small role. Nevertheless, our design keeps the level of house money in both gain and loss trials constant, and importantly, even if a house money effect exists, this does not prevent us from identifying the effects of observation on behavior, which is the main objective of this study.

or 6, the participant received the payoff presented on the bottom of the lottery, meaning that they had a 50% chance of either outcome. All payments were made in cash.

2.4 *Econometric approach*

We used structural model-based analysis (Camerer & Ho, 1994; Harrison, 2008; Hey & Orme, 1994) to estimate the participants' preferences because this approach allows us to estimate loss aversion separately from risk attitudes in gains and losses. To check the validity of our results, given the concerns over the reliability of the estimates from such approach (Apesteguia & Ballester, 2018), in parallel for risk preferences we conducted the same analysis using ordinal logistic regressions and paired t-tests with a simple, descriptive measure of risk tolerance. To calculate this simple descriptive index of risk attitude, we calculated for each individual the proportion of risky choices in each trial type. We counted indifference as a half risky choice. Although we calculated this index for mixed trials as well, this is not a proper measure of loss aversion. We find the results of this analysis to be qualitatively in agreement with our structural estimation approach.

We modeled each option's utility using a power utility function, where the utility of a given outcome, x, is defined as:

$$U(x) = \begin{cases} x^{1+a^g}, & when\ x \geq 0 \\ -\lambda(-x)^{1-a^l}, & when\ x < 0 \end{cases}$$

where x is the lottery outcome, a^g is the individual's risk tolerance in gains, a^l is the individual's risk tolerance in losses, and λ is the individual's loss aversion parameter. $a > 0 (< 0)$ indicates risk-seeking (aversion). $a = 0$ for a risk-neutral chooser. $\lambda > 1$ indicates loss aversion.

To account for stochasticity in choice, we modeled the decisions as susceptible to an error $\varepsilon \sim (0, \sigma^2)$ and assumed that participants chose the risky lottery when $EU_R - EU_s + \varepsilon > 0$, where EU_R and EU_s denote the expected utilities of the risky and safe options respectively. We related this latent index to observed choice by a logistic function. The probability of choosing the risky lottery can then be expressed as:

$$\Pr(ChoseRisky) = \frac{1}{1 + \exp\left(-\frac{EU_R - EU_s}{\sigma}\right)}$$

In all the analysis, we clustered standard errors on the level of the participant. To investigate the effect of observation on preferences, we replaced the parameters of the utility function as follows:

$$1 + a^g = 1 + a_0^g + a_1^g \times observed + \sum_i a_i^g \times Z_i$$

$$1 - a^l = 1 - a_0^l - a_1^l \times observed - \sum_i a_i^l \times Z_i$$

$$\lambda = \lambda_0 + \lambda_1 \times observed + \sum_i \lambda_i \times Z_i$$

where Z_i is a set of control variables and $observed$ is an indicator variable of whether the participant is observed (=1) or not (=0). Unless mentioned otherwise, the analysis is based on the data from the 73 Choice-Makers who participated in the study.

3. Results

3.1 *Preliminary results*

Our participants were more likely to choose the lottery if it offered a higher expected profit, and less often, the more attractive the safe option was (Supplement - Table D1.1). Only 9 participants out of 146 (2 older adolescents and 7 younger adolescents) incorrectly answered more than 1 comprehension question (see Figure 4 for the distribution of comprehension scores), indicating that participants understood the task.

Choice-Makers subjectively felt observed, with 93.15% reporting that their partner had paid attention to at least half of their choices (see Figure 5A). This perceived attention is not significantly different between older and younger adolescents ($X^2 = 1.6863, p = 0.640$). An objective way to test whether Observers indeed paid attention to Choice-Makers' decisions is to check whether they scored higher when recalling their partner's choices (that they have observed) than Choice-Makers who did not have the opportunity to see their partner's choices but had to guess. Overall, Observers on average scored 2.274 out of 3 when asked to recall their partner's choices on 3 randomly selected questions, which is higher than the Choice-Makers' average score of 2 ($p = 0.041$) from guessing their partner's choices (see Figure 5B). This difference was more prominent for older adolescents (2.355 versus 1.936, $p = 0.061$) than for younger adolescents (2.214 versus 2.048, $p = 0.316$), although on average the recollection scores between the two age groups were not statistically different (2.145 for older and 2.131 for younger adolescents, $p = 0.919$). Overall, the evidence is consistent with the Observers paying attention to the Choice-Makers' decisions and Choice-Makers feeling observed.

Since our task involves making a total of 240 choices for Choice-Makers, we verified that participants do not become less attentive to the task as trials go by. As shown in Table C2, we find that the estimate of the noise parameter for older adolescents is not influenced by the trial number and that younger adolescents become less noisy as the trial number increases. This reassures us that participants paid attention to the task throughout its duration, despite a large number of trials.

We have checked for any order effects in our data (see Appendix D.1 for details) and found that younger adolescents (but not older adolescents) are less likely to choose lotteries, the more trials they have already completed (Table D1.1). Therefore, we control for the trial number in the analysis that follows.

In Appendix D.2, we compare preferences of all 146 participants who made decisions in private to samples studied previously. We also look more closely at the effect of age on all parameters of the model. Younger and older adolescents who participated in our study are generally very similar on all variables that we collected in the post-experimental questionnaire (see Table D3.4). A reader interested in the effect of observation on Observers' behavior should refer to Appendix D.1.4.

3.2 *Aggregate level analysis of the effect of observation*

3.2.1 Within-subject analysis of the effect of observation in older adolescents (18-24 years old)

To identify the impact of observation on risk attitudes and loss aversion, we structurally estimate preferences. As shown in Table 1 (models 1-5) and illustrated in Figure 6A, we find that 18- to 24-year-olds are more risk-tolerant in gains and losses and more loss-averse under observation. The size of the effect is substantial. Under observation, for 18-24-year-olds, the power utility curvature parameter increases by 0.5137 in gains, by 0.1612 in losses, and loss aversion increases by 0.3542. The effects are present both with and without age, gender, wealth, and trial number controls. Using simple proportions of lottery choices, we confirm that, when observed, compared to in private, older adolescents select lotteries more often. This effect is significant in gain trials (0.567 vs. 0.292, $p < 0.001$), in loss trials (0.206 vs. 0.106, $p < 0.001$), and in mixed trials (0.409 vs. 0.207, $p < 0.001$) (see Figure 6B).[3]

[3] Ordinal logit regressions presented in Table D1.1 (models 1-3) are consistent with these results. Note that the finding that participants choose lotteries more often in the mixed lotteries is not equivalent to saying that they are more loss tolerant when observed.

In addition to choosing the safe or risky option, participants could indicate that they were indifferent. The indifferent option was selected 5.74% of the time. Overall, the tendency towards indifference was not affected by observation (7.23% under observation vs. 4.25% in private, $p = 0.199$). When separating by trial type (see Figure 7), we find in mixed trials that older adolescents are more indifferent when observed than in private (5.65% vs 3.71%, $p = 0.010$) and that there are no significant differences in gain and loss trials.

3.2.2 Within-subject analysis of the effect of observation in younger adolescents (12-17 years old)

For younger adolescents, using structural estimation (Table 1, models 6-10, Figure 6A), we find that 12-17-year-olds do not change their risk attitude in gains and losses and loss aversion under observation. The result remains the same with and without gender, age, wealth, and trial number controls. Using simple proportions of lottery choices, we find that younger adolescents do not select lotteries significantly more often in private (0.339) compared to when observed (0.301) ($p = 0.437$). Additionally, we do not see any significant effects of observation when separating by trial type (see Figure 6B).[4] Younger adolescents selected the indifferent option 3.12% of the time, which is not statistically different from older adolescents ($p = 0.192$). The tendency to select indifferent was not affected by observation in general (2.82% under observation vs. 3.41% in private, $p = 0.749$) and in any of the trial types (Figure 7).

Our results point to a very different response to observation among older and younger participants. To assess whether the effect of observation gradually becomes stronger as adolescents age, or whether instead there is a sharp difference in how observation affects our younger and older adolescent participants, in Figure 8 we plotted the proportions of risky choices in observed (dark gray) and private (light gray) conditions by age. Our data suggest that the latter is true. An increasing effect of observation with age would manifest itself in a gradually increasing difference between the dark gray and light gray bars. We do not see such a pattern in our data. Instead, we find that older adolescents of all ages always make more risky choices (in gain, loss, and mixed trials) when observed, while we do not see such an effect for younger adolescents.

Exclusion of the trials in which participants selected indifferent does not change our key results (compare Table C3 and Table 1) and the noise term is not affected by observation (Table D3.5).

[4] Ordinal logit regressions presented in Table D1.1 (models 4-6) are in line with these results.

3.3 Mechanism

We tested several candidate mechanisms that could explain the effect of observation on the behavior of our participants — state anxiety, familiarity with the observer, the likelihood of interacting with the observer in the future, perceived observation intensity captured by the degree to which the Choice-Makers believed that the observer is paying attention to their choices, self-assessed relative wealth, and gender. None of these appears to be a mechanism which fully explains the effect of observation in our study (see Appendix D.3).

3.4 *Between-subject analysis of the effect of observation*

So far, our analysis was based on within-subject comparisons of choices made by the same participants under observation and in private. Our design allows us to additionally investigate whether similar effects are observed using a between-subject approach. Half of the Choice-Makers completed the decision-making task first in the private condition and the other half under observation (Figure 3, Stage 2). To investigate the effect of observation between-subjects, we focused only on this first set of decisions made in Stage 2 and compared the choices made by Choice-Makers in order 1 (36 participants in total, 17 18-24-year-olds and 19 12-17-year-olds), who made these decisions while observed, with those made by a different set of Choice-Makers in order 0 (37 participants in total, 14 18-24 year olds and 23 12-17-year-olds) who made these decisions in private.

To make the results directly and easily comparable to within-subject analysis, we combined data from Choice-Makers in both studies and captured the age-related difference in their behavior using an indicator (12-17-year-olds) and interaction variables (12-17 y.o. X observed), as justified by earlier analysis (Figure 8). We then run our analysis under the within-subject approach by using all of the data and comparing the same individuals' behavior when they are in private and when they are observed (Model (1) in Table 2). As a second step, we run the between-subject analysis by using only data from Stage 2 and comparing preferences and decisions of individuals who were in private to different individuals who were observed at that stage (Model (2) in Table 2).

We find that results across the two methods are qualitatively consistent, however, of strikingly different magnitude. Participants who are observed take more risks in both gains and losses are more loss averse than participants who make their decisions in private.[5] However, comparing the between- and within-subject approach, we discover that all the estimated coefficients are of the same sign, but

[5] We reach the same conclusion using ordinal logit regressions (see Tables C4 and C5).

generally the coefficients are bigger, and the results are more significant in the between-subject analysis. This especially stark difference holds for the estimated effects of observation on risk attitudes in losses and loss aversion, which are respectively 2.6 and 3.3 times larger using the between-subject approach. The effect of observation on risk attitudes in gains is 11.4% higher in the between-subject analysis than in the within-subject analysis. This comparison highlights that, when extrapolating from the laboratory findings to real life, it is important to consider whether the problem studied more resembles a within- or between-subject design.

For the analysis that follows, we return to the within-subject approach.

3.5 Individual-level analysis of the effect of observation

As the aggregate approach to data can often hide interesting patterns at the individual level, we also analysed our data at the individual level. We used a non-structural approach due to difficulties in estimating the structural model at the individual level. For this reason, this section does not discuss loss aversion.

As the first step in this analysis, for each individual in each trial type, we classified whether they became more risk-tolerant, less risk-tolerant, or did not change their risk attitude under observation (see Table 3). Consistent with our findings, the majority of 18-24 year olds became more risk-tolerant in gain (80.65%), loss (64.52%), and mixed trials (96.77%). Among younger adolescents, the findings are much more mixed, but the most common pattern is a decrease in risk tolerance under observation in each of the trial types.

To check whether individual participants consistently change their risk attitude under observation in the same direction in both gain and loss trials, we classified participants into four types: those who in both types of trials increase their risk tolerance, those who decrease their risk tolerance, those who increase their risk tolerance in one type of trial but decrease in the other, and those who do not change their risk attitude. We did not consider mixed trials because it is unclear whether the change in the frequency of risky lottery choices should be attributed to a change in risk attitude or a change in loss aversion. As shown in Table 4, 54.84% of the 18-24-year-olds are consistently more risk-tolerant when observed in both trial types and none of them are consistently less risk-tolerant. Again, among younger adolescents, the findings are mixed — 45.24% decrease and 23.81% increase their risk tolerance under observation. 38.71% of older and 30.95% of younger adolescents are mixed types, changing their preferences differently in gain and loss trials.

Finally, we checked whether any individual-specific characteristics make participants more likely to be of a certain type. For this purpose, we created three indicator variables that capture an individual's behavioral pattern: always increases risk tolerance, always decreases risk tolerance, and has a different response in gains and losses. There are only two participants who do not change their risky lottery choices for both gain and loss domains and thus we ignore this type. We then used logistic regressions to determine whether certain socioeconomic and demographic characteristics increase the likelihood of being a certain type. Table 5 shows that younger adolescents and those who expect to interact after the experiment are less likely to increase risk tolerance in response to the observation. Choice-makers who were paired with Observers of the same gender are less likely to decrease risk tolerance when being observed. Gender, wealth, partner's gender, familiarity with the Observer, popularity, and differences in these variables between the Choice-Maker and Observer did not contribute to explaining a participant's type.

4. Discussion

Children differ from adults. A better economic understanding of child and adolescent behavior is important for economic, scientific, and societal reasons (Brocas & Carillo, 2020; Sutter et al., 2019) and has an impact on how societies are organized. For example, recent discoveries in developmental psychology about the evolution of decision-making from childhood to adolescence have already had a substantial impact on jurisdiction in the US (Steinberg, 2017). Moreover, the decisions that adolescents make on their own, independent of their parents, have important consequences for future economic outcomes. For instance, studies show that misbehavior during childhood and adolescence, which is related to the type of risk preferences studied in this paper (Breitkopf et al., 2020; Castillo et al., 2018; Sutter et al., 2013; Sutter et al., 2019), has long term consequences on earnings (Heckman et al., 2006; Segal, 2013). Economists only recently began to more frequently expand the study of economic preferences to include children. Sometimes, the findings of these studies turn out to contradict common wisdom and often uncover important differences between children's and adults' behaviors (e.g. Apesteguia et al., 2018; Barash et al., 2019; Deckers et al., 2015; Tymula, 2019; Tymula et al., 2012). This stresses the importance of conducting scientific research specific to different age groups. With the aid of the new descriptive studies of children's preferences, economists are beginning to understand how to encourage children to make better decisions. For example, the study by Alan & Ertac (2018) presented a successful behavioral intervention that promotes more patient decision-making in elementary school children and improves their behavior at school. Sutter et al. (2016) demonstrated that interventions encourage girls to be more competitive. List & Samek (2015) found that incentives

have a large influence on children's food choices and consumption, suggesting that incentives can be used to combat childhood obesity. All of this new research is now beginning to impact how we view children and adolescents as economic agents who systematically make different decisions than adults and thus require a different policy approach. Behavioral interventions that target children and adolescents offer an especially good return on investment as they have proven efficient and beneficial for lifetime outcomes (Heckman, 2006; Kautz et al., 2014).

In this paper, using a laboratory experiment, we investigated how being observed by a peer affects adolescents' risky decision making in the monetary gain and loss domains. We focused on adolescents aged from 12 to 24 years old. Over this long transition period from childhood to adolescence, we have more and more opportunities to make important and impactful decisions. Over this period, we also experience substantial biological changes that make us more aware of our social surroundings and more susceptible to changing our behavior in the presence of peers.

Participants in our study repeatedly chose between a fixed amount of money and a lottery either in private or in the presence of an adolescent observer. We find that older adolescents (18-24 years old) choose the risky option more often when they are observed by a peer, compared to when they are in private. Unlike previous studies that investigated the effects of peer observation on choice, we can distinguish whether the behavioral change is due to changes in risk preferences or changes in attitudes towards losses (loss aversion). We find that the increase in risky lottery choices is driven by an increased risk tolerance in the gain and loss domains. In the gain domain, risk tolerance, estimated by the power utility curvature, increases by 0.5178 to 0.5229. In losses, under observation, risk tolerance increases by 0.2942 to 0.3118, an approximately two times smaller change in risk attitude under losses than under gains. If one wanted to explain the increased real-life "risk-taking" in adolescence in the presence of peers, such as an increase in careless driving, by changes in loss aversion, it would have to be that adolescents become less loss averse when observed. However, our study participants did not become more loss tolerant when observed. On the contrary, once we accounted for differences in risk preferences, loss aversion increased by 0.5152 to 0.6161 under observation. This suggests that desensitization towards losses relative to gains is unlikely to explain the adolescent real-life "risk-taking" behaviors in the presence of peers.[6]

We emphasize that these changes in risk tolerance manifest themselves even though our treatment of observation is completely payoff irrelevant. Choice-Makers' decisions did not influence the payoffs

[6] The average estimate of loss aversion across both treatments in our sample is low anyways (λ=1.282), in line with recent literature (Gal & Rucker, 2018).

of Observers and Observers could not explicitly affect Choice-Makers' payoffs with their actions (other than through mere observation). We decided to study this most basic type of observation as a starting point, since it is usually present in most environments where observation occurs and in environments where there are payoff interdependencies between observers and those being observed. Our approach allows us to identify the pure effect of observation that is unrelated to payoff interdependencies which could be added to our framework in future studies. Trautmann & Vieider (2011) provided a review and classification of the different ways that observation may matter in an economic context. Their insights may be useful in thinking of the extensions of our approach and what our results mean for other types of observation.

We demonstrated that our results are qualitatively the same whether we use between-subject or within-subject analysis. We designed our experiment in a way that allows us to compare the same participants when they make decisions in private and under observation as well as compare two different groups of individuals: a group that is under observation with a group that is making decisions in private. With both approaches, our conclusions are qualitatively the same. However, the strength of the result is remarkably different, with the between-subject analysis yielding much stronger results. The fact that our results are qualitatively the same but their strength remarkably differs under the two design approaches indicates that the choice of the between-subject versus within-subject method is a very important element of study design. Both of the methods have their pros and cons (Charness et al., 2012), and our paper by providing an example of how to combine the within-subject and between-subject approach in one experiment illustrates that it is possible to access the advantages of both methods in one experiment.

Our finding that older adolescents become more risk-tolerant in gains under observation contrasts with the results in our previous studies that used the same experimental design to implement observation. In Tymula & Whitehair (2018), we recruited 310 volunteers (mean age 22.28, standard deviation 3.95) to test whether their attitudes towards known risks (risk attitude) and unknown risks (ambiguity attitude) in the gain domain change under observation. We found that participants became more ambiguity averse when observed and their risk attitudes are not affected by observation. In Tymula (2019), we recruited 186 adolescents (12-24 years old, mean age 18.59, standard deviation 3.26) and found that under observation they become more impatient and more inconsistent but their risk attitudes in the gain domain do not change. Even though the structure of the experiment, recruitment, and the implementation of observation were the same in all three studies, we did not find risk attitudes to be affected by observation. The one difference is that, in the current study, we have also included negative

monetary outcomes, but it is not obvious how this could explain our result that risk tolerance in the gain domain increases under observation. Nevertheless, it is worthwhile to note that previous studies in developmental psychology which concluded that adolescents become more risk-tolerant under observation often included scenarios that can result both in gains and losses, such as in driving games where participants can either gain points or lose them (Gardner & Steinberg, 2005), or hypothetical gain-loss gambles (Smith et al., 2014) making them more similar to the current study than to Tymula (2019) and Tymula & Whitehair (2018).

Another notable finding in our data is the difference in results for older adolescents (18-24 years old and attending university) and younger adolescents (12-17 years old and attending high school). We considered some possible explanations unrelated to age for this phenomenon by investigating whether the control variables on which these two groups differ moderate the effect instead of age (Appendix D). None of these control variables account for this dichotomy in our results. There is a big difference between our younger and older adolescents in legal terms. In Australia, the legal age for drinking alcohol, smoking tobacco, and gambling is 18 years of age meaning that these activities are not (legally) accessible to younger adolescents but are accessible to older adolescents in our study. Ultimately, we cannot definitively conclude whether it is chronological age, graduating from high school to university, the recruitment method, or something else not captured by our study that renders older adolescents' response to observation so different from their younger counterparts. Readers should also be careful when generalizing the results of our study to the whole population, as we do not know how representative the adolescents in our sample are of the general population of adolescents. As is usual in the experiments, our sample is self-selected. First, recruitment would reach only adolescents who use social media. Second, conditional on adolescents seeing our recruitment ads, it is a certain type of adolescent that signs up and shows up to the study. Nevertheless, by recruiting 12-17-year-olds, our study contributes to what nevertheless remains a relatively small pool of laboratory studies that recruit participants from sources other than the usual convenience samples of university students.

Given how upsetting some of the statistics on adolescent decision-making are and the amount of the policy effort that specifically addresses behavior in adolescence, we still have relatively little economic understanding of why this group so often ends up in trouble. Among other things, to protect young people from their own choices, governments employ legal age limits for gambling, voting, driving, use of alcohol and tobacco. Many countries have restrictions for minors on transporting other teen passengers during the initial months of licensing and required hours of adult supervision. Billions of

dollars are spent each year on informational and educational campaigns aimed at adolescents. There have been attempts to mix as well as to separate high-risk and low-risk students in schools. All these interventions are supposed to improve adolescents' welfare but the findings on their effectiveness are mixed. Part of the reason for this is likely that these policies were designed without an in-depth understanding of the economic preferences of adolescents. For example, it would be tempting to think that, in the presence of peers, adolescents stop paying attention to the potential negative consequences of their actions. Our results show that this is not the case and that instead, in the presence of peers, adolescents' relative weighting of losses to gains (loss aversion) increases. This is good news for policy, since it suggests that appeals to loss aversion should be especially effective at reducing harmful behaviors of adolescents committed in the presence of peers.

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Figures

Figure 1. Distribution of age in the whole sample.

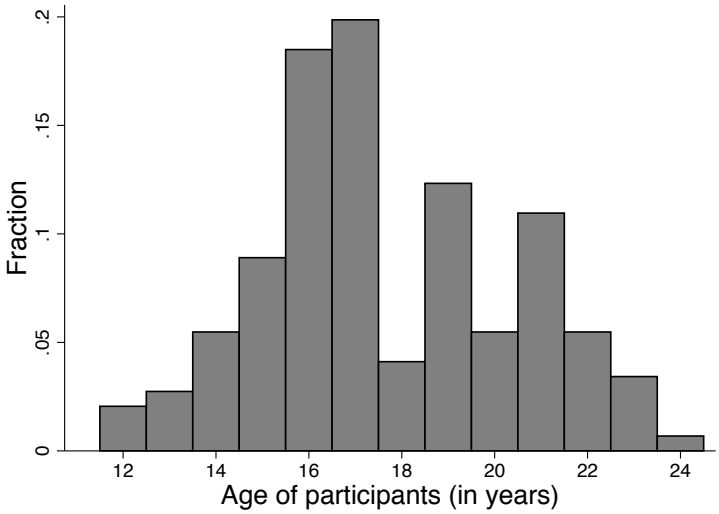
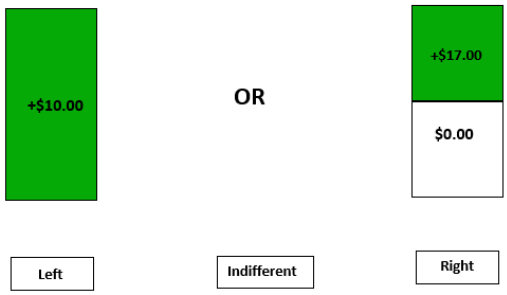


Figure 2. Examples of decision scenarios in A: gain trial, B: loss trial, C: mixed trial.

A.



B.

C.

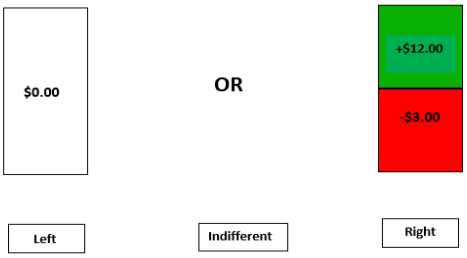


Figure 3. Experimental design. A: Timeline of the experiment. B: seating map in private and observed conditions. Each cell indicates a computer station. x indicates a student sitting at a computer station. xx indicates two students sitting at the same computer station.

A.

Session Structure				
	Order 1 (18-24 years old: 34 12-17 years old: 38)		**Order 0 (18-24 years old: 28 12-17 years old: 46)**	
Stage	Choice-Maker	Observer	Choice-Maker	Observer
1	Instructions			
2	Observed	Observer	Private	Private
3	Private	Private	Observed	Observer
4	Test			
5	Questionnaire			
6	Payment			

B. Private condition

x		x		aisle	x		x	
x		x			x		x	
x		x			x		x	
x		x			x		x	

Observed condition

xx				aisle	xx			
		xx			xx			
xx							xx	
xx							xx	

Figure 4. Task comprehension. Histogram of the number of correctly answered comprehension questions in the whole sample (out of three).

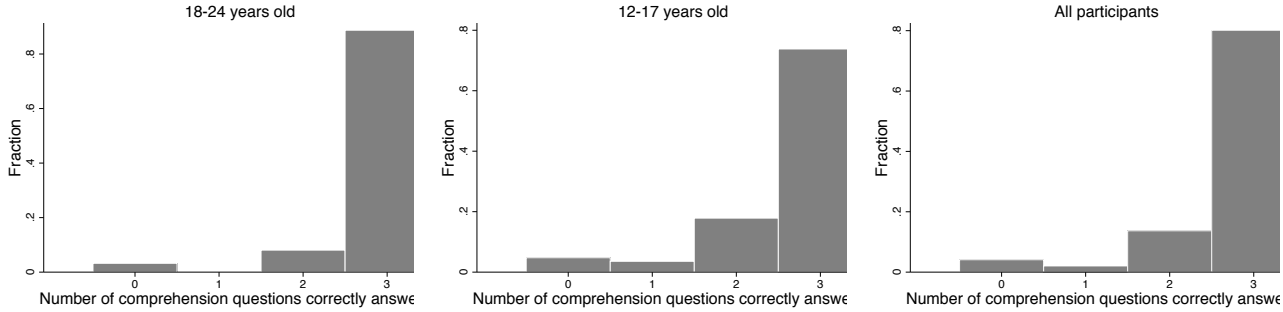
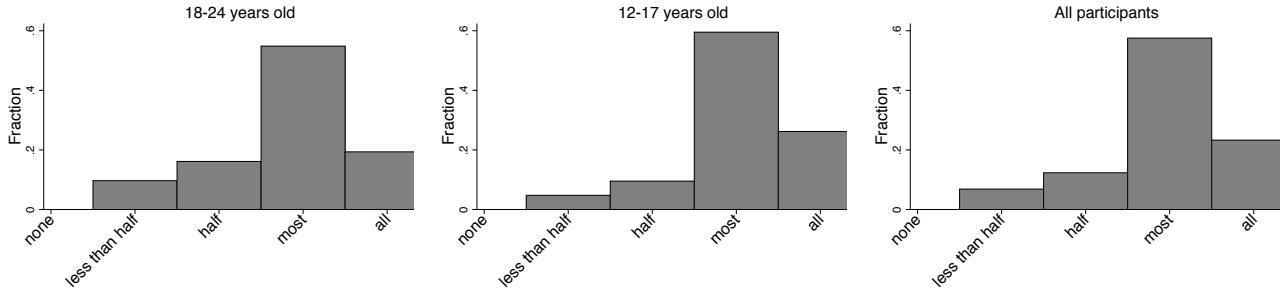


Figure 5 Observation intensity. A: Choice-Makers' answers to "*What proportion of your choices did the person observing you pay attention to?*". B: Observers' recollection of their partner's choices is higher than Choice-Makers', consistent with them paying attention to partner's choices. Error bars are 95% confidence intervals.

A.



B.

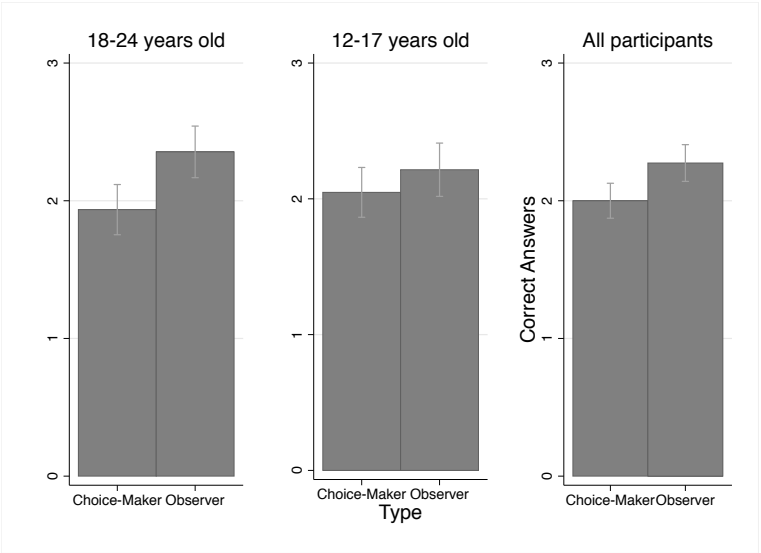
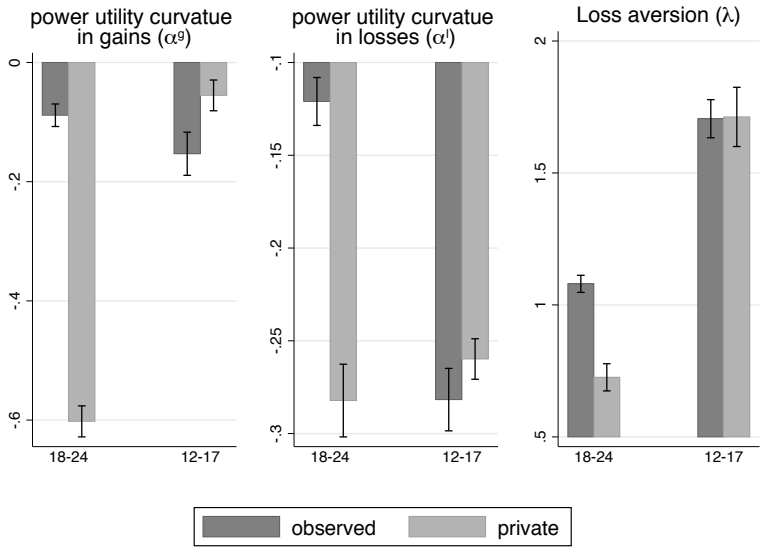


Figure 6. The effect of observation on preferences. Bars are 95% confidence intervals.

A. Structural estimates of the maximum likelihood estimates of risk in the gain domain (α^g), risk in the loss domain (α^l), and loss aversion (λ).



B. Proportion of risky choices

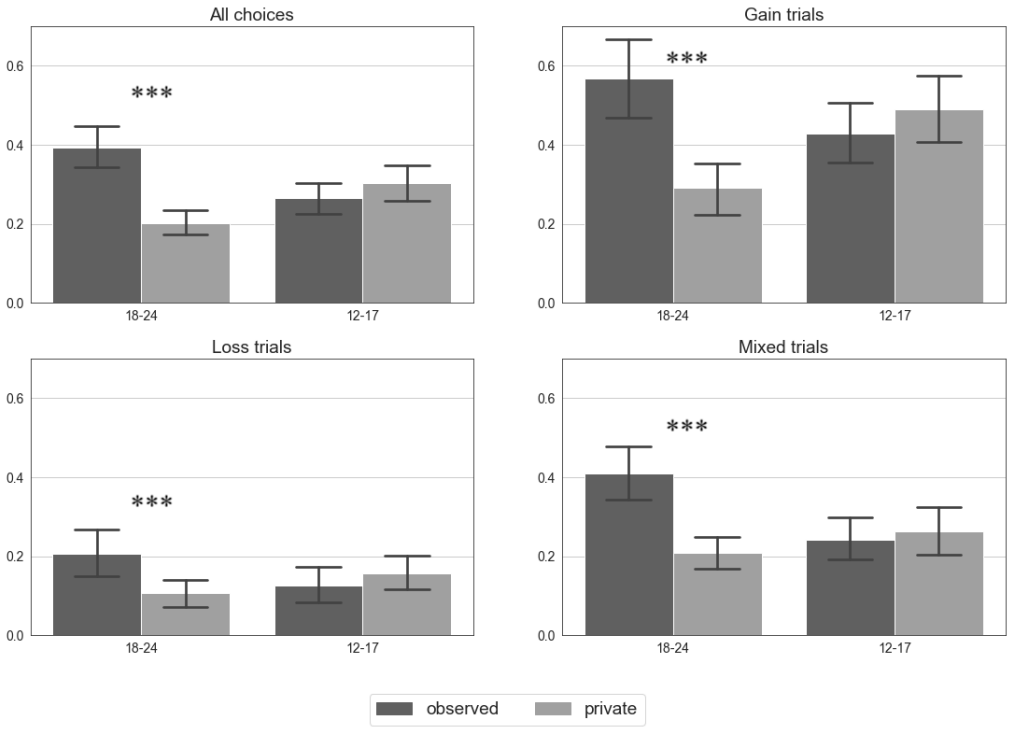


Figure 7. Proportion of risky/safe/indifferent choices made by Choice-Makers by treatment and trial type. In each trial type, P represents Private condition and O represents Observed condition.

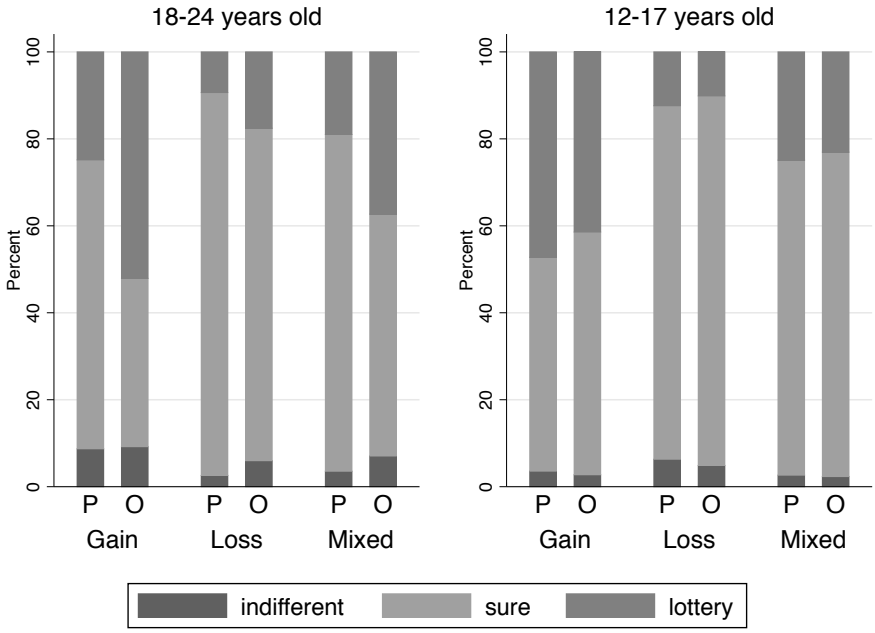
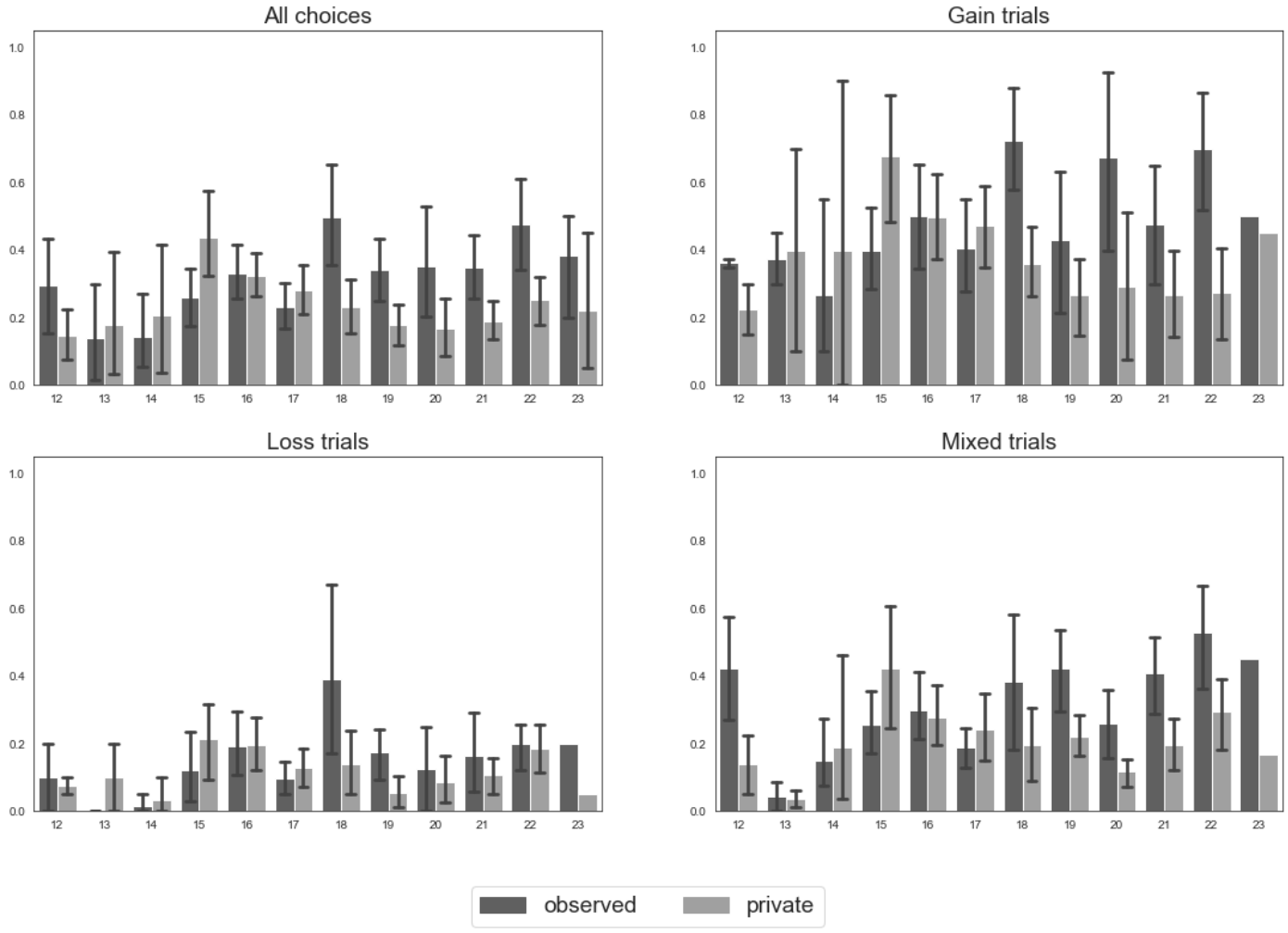


Figure 8. Proportion of risky choices made by Choice-Makers by age and treatment. Bars are 95% confidence intervals. There is only one participant aged 23 years old and thus the confidence interval for each trial type is omitted.



Tables

Table 1. Effect of observation. Maximum likelihood estimates of risk attitudes and loss aversion for all Choice-Makers. observed is equal to 1 if made decisions under observation, and 0 if made decisions in private; male is an indicator variable for male subjects; age is age in years; wealth is self-reported wealth on a scale from 1 (very poor) to 5 (very rich); trial number is from 1 to 240. Models (1) - (5) use data from older adolescents (18-24 years old) and models (6) - (10) use data from younger adolescents (12-17 years old).

	18-24 years old					12-17 years old				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Risk tolerance in gains (α^g)										
observed	0.5137***	0.5269***	0.5229***	0.5178***	0.5199***	-0.0979	-0.0908	-0.0882	-0.0911	-0.0808
	(0.0515)	(0.0737)	(0.0903)	(0.0862)	(0.0784)	(0.1162)	(0.0834)	(0.0761)	(0.0803)	(0.0949)
male			0.0519					0.2396**		
			(0.0974)					(0.0844)		
age				0.0042					0.0207	
				(0.0449)					(0.0235)	
wealth					0.0531					-0.0347
					(0.0657)					(0.0513)
trial number		0.0002	0.0000	0.0002	0.0002		-0.0027***	-0.0027***	-0.0026***	-0.0027***
		(0.0005)	(0.0006)	(0.0005)	(0.0005)		(0.0003)	(0.0003)	(0.0003)	(0.0003)
constant	-0.6022***	-0.6140***	-0.6361***	-0.6904	-0.7831***	-0.0552	0.1868**	0.0495	-0.1401	0.2993
	(0.0710)	(0.0881)	(0.0959)	(0.9633)	(0.2199)	(0.0828)	(0.0672)	(0.0938)	(0.3773)	(0.1984)
Risk tolerance in losses (α^l)										
observed	0.1612***	0.3118***	0.3096***	0.2942***	0.3080***	-0.0219	-0.0362	-0.0438	-0.0435	-0.0006
	(0.0352)	(0.0622)	(0.0595)	(0.0577)	(0.0630)	(0.0540)	(0.0511)	(0.0441)	(0.0511)	(0.0640)
male			0.0487					-0.0658		
			(0.0755)					(0.0733)		

age				-0.0283					0.0413*	
				(0.0278)					(0.0203)	
wealth					-0.0916*					-0.0021
					(0.0407)					(0.0635)
trial number		0.0015***	0.0014***	0.0015***	0.0014**		-0.0005*	-0.0005+	-0.0004+	-0.0005*
		(0.0004)	(0.0004)	(0.0004)	(0.0005)		(0.0002)	(0.0003)	(0.0003)	(0.0002)
constant	-0.2822***	-0.4753***	-0.4896***	0.0970	-0.1716	-0.2598***	-0.1796***	-0.1593**	-0.8383*	-0.1932
	(0.0534)	(0.0672)	(0.0797)	(0.5700)	(0.1092)	(0.0350)	(0.0371)	(0.0555)	(0.3263)	(0.2036)
Loss aversion (λ)										
observed	0.3542***	0.6067***	0.5828***	0.5152***	0.6161***	-0.0068	-0.1134	-0.1104	-0.1490	0.0139
	(0.0882)	(0.1562)	(0.1657)	(0.1298)	(0.1519)	(0.2316)	(0.2300)	(0.1956)	(0.2381)	(0.3404)
male			0.1289					0.6400*		
			(0.1812)					(0.3059)		
age				-0.0970					0.0642	
				(0.0732)					(0.0943)	
wealth					-0.0207					-0.2085
					(0.1194)					(0.2574)
trial number		0.0027*	0.0021+	0.0023*	0.0027*		0.0003	0.0002	0.0006	0.0003
		(0.0012)	(0.0012)	(0.0010)	(0.0012)		(0.0013)	(0.0011)	(0.0013)	(0.0011)
constant	0.7257***	0.4197***	0.3868**	2.4478	0.4762	1.7124***	1.5434***	1.1525***	0.5256	2.1872**
	(0.1404)	(0.1184)	(0.1383)	(1.5483)	(0.3799)	(0.3603)	(0.2637)	(0.2675)	(1.4868)	(0.8443)
noise										
constant	1.3414***	1.3458***	1.3239***	1.3495***	1.3066***	4.0756***	3.2075***	2.7071***	3.2406***	3.1588***
	(0.2603)	(0.2509)	(0.2513)	(0.2585)	(0.2220)	(1.0410)	(0.7253)	(0.5392)	(0.7486)	(0.7284)
N	7440	7440	7440	7440	7440	10080	10080	10080	10080	10080

Standard errors clustered on individual in parentheses
+p<0.1, *p<0.05, **p<0.01, ***p<0.001

Table 2. Comparison of the within and between-subject estimation of the effect of observation on preferences for all Choice-Makers. Maximum likelihood estimates of risk attitudes and loss aversion for Choice-Makers. observed is 1 if made decisions under observation, and 0 if made decisions in private; 12-17 y. o. is an indicator variable for participants who are 12 to 17 years old; trial number is from 1 to 240.

	(1) within	(2) between
Risk tolerance in gains (α^g)		
observed	0.3923**	0.5592***
	(0.1309)	(0.1393)
12-17 y.o.	0.3059	0.5491***
	(0.2069)	(0.1368)
12-17 y.o. X observed	-0.5068*	-0.6332***
	(0.2446)	(0.1587)
trial number	-0.0007	0.0004
	(0.0012)	(0.0004)
constant	-0.3866***	-0.5598***
	(0.0845)	(0.1340)
Risk tolerance in losses (α^l)		
observed	0.2153*	0.3525***
	(0.1064)	(0.0864)
12-17 y.o.	0.0860	0.2430***
	(0.1123)	(0.0723)
12-17 y.o. X observed	-0.2698	-0.3056*
	(0.1650)	(0.1250)
trial number	0.0006	0.0006
	(0.0009)	(0.0004)
constant	-0.3721***	-0.4465***
	(0.0722)	(0.0667)
Loss aversion (λ)		
observed	0.5977	0.8094**
	(0.4943)	(0.2999)
12-17 y.o.	0.1405	0.5322*
	(0.4642)	(0.2335)
12-17 y.o. X observed	-0.7529	-0.7150+
	(0.7207)	(0.4300)
trial number	0.0026	0.0024
	(0.0033)	(0.0016)
constant	0.7770**	0.6540***
	(0.2560)	(0.1910)
noise		
constant	2.1919***	2.0209***
	(0.3562)	(0.3381)

N	17520	8760

Standard errors clustered on individual in parentheses
+p<0.1, *p<0.05, **p<0.01, ***p<0.001

Table 3. Number of Choice-Makers who under observation show an increase/decrease/no change in risk tolerance by trial types.

A. All Choice -Makers

	gains	losses	mixed
↑ risk tolerance	42	32	49
↓ risk tolerance	26	26	23
no change	5	15	1
Total	73	73	73

B. 18-24 year old Choice-Makers

	gains	losses	mixed
↑ risk tolerance	25	20	30
↓ risk tolerance	2	4	1
no change	4	7	0
Total	31	31	31

C. 12-17 year old Choice-Makers

	gains	losses	mixed
↑ risk tolerance	17	12	19
↓ risk tolerance	24	22	22
no change	1	8	1
Total	42	42	42

Table 4. Classification of Choice-Makers' types based on responses to observation in both gain and loss trials. Data from mixed trials is not included in this classification.

	18-24 years old	12-17 years old	All subjects
↑ risk tolerance	17	10	27
↓ risk tolerance	0	19	19
no change	2	0	2
mixed response	12	13	25
Total	31	42	73

Table 5. Determinants of Choice-Maker's type. Logistic regression with dependent variable =1 if participants increase risk tolerance in both types of trials (=0 otherwise) in the second column; dependent variable =1 if participants decrease risk tolerance in both types of trials (=0 otherwise) in the third column; dependent variable =1 if participants increase risk tolerance in one type of trial but decrease in the other in the last column (=0 otherwise). 12-17 y. o. is an indicator variable for participants who are 12 to 17 years old ; wealth is self-reported wealth on a scale from 1 (very poor) to 5 (very rich); male is an indicator for male participants; familiar is the familiarity score between Choice-Maker and Observer from the post-experiment questionnaire; interact after is how likely Choice-Makers expect to interact with their Observers after the experiment on a scale from 1 (very unlikely) to 5 (very likely); popularity is the popularity score calculated as the sum of self-reported strength and attractiveness, each on a scale from 1 (not strong/attractive) to 5 (very strong/attractive); age difference is the difference between the Choice-Makers' and Observers' age; popularity difference is the difference between own popularity score and the perception of partner's popularity score; partner male is an indicator variable equal to one if partner's gender is male; same gender is an indicator variable equal to one if the Choice-Maker and the Observer are in same gender. 12-17 y. o. is omitted in the second column because no older adolescents decrease risk tolerance in both gain and loss trials.

	↑ risk tolerance	↓ risk tolerance	mixed response
12-17 y. o.	-1.3167*		-0.2956
	(0.5988)		(0.5774)
wealth	0.3028	-0.1045	-0.1298
	(0.4092)	(0.6036)	(0.3691)
male	0.7099	0.0078	-0.4485
	(0.5886)	(0.9420)	(0.5866)
familiar	0.6352	-0.2092	-0.3418
	(0.7675)	(0.7428)	(0.6384)
interact after	-0.6435+	0.2182	0.2337
	(0.3524)	(0.3193)	(0.2667)
popularity	-0.0517	0.1460	-0.1152
	(0.2985)	(0.4323)	(0.2805)
age difference	-0.0464	0.1162	0.0501
	(0.1518)	(0.2316)	(0.1475)
popularity difference	-0.1253	-0.3707	0.3271
	(0.2253)	(0.3132)	(0.2063)
partner male	0.3776	-0.1824	-0.0906
	(0.5996)	(0.8810)	(0.5961)
same gender	-0.0110	-1.9132*	0.9199
	(0.5903)	(0.8882)	(0.5917)
N	73	42	73

Marginal effects
Standard errors clustered on participant in parentheses
+ p<0.1, * p<0.01, ** p<0.05, *** p<0.001