

# Expectation Formation and Risk-Taking under Uncertainty: Evidence from Car Race Experiments

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## 1 Introduction

How do people form expectations about the outcome of an uncertain process, and how does this relate to their actual choice? Experimental results have established that people do not exhibit risk neutrality when making choices about uncertain outcomes. What is not known is whether people's actual expectations are correct or whether their individual proclivities (risk-aversion, optimism, savouring) directly affect their expectations. We thus wish to examine how people actually form expectations, how those expectations change as an event unfolds, and how important those conscious expectations are in determining risk-taking behavior.

This study exploits a novel experimental design to assess expectation formation during the unfolding of an uncertain event whose outcome matters. Participants were confronted with six animated car race games, where their payoff was linked to the outcome of one particular car. In each game, a participant chose how to divide a fixed amount of money—earned previously in a real effort task—into a wagered amount and an invested amount, where investment increased the chances that the participant's car would win (Figure 1). Each race lasted for ten laps and consisted of five cars in total, each of which ran according to a statistical process that consisted of a random-walk component and an exogenous downward shifter (denoting a temporary 'engine failure'), the latter of which was reduced in frequency for the participant's car in proportion to the invested amount. Participants were offered the choice to withdraw from their bet at each of three pitstops (after laps 3, 6, and 9) and retain a fraction of their initial bet with certainty (Figure 2). Participants' expectations about the likelihood of their car winning were solicited at the beginning of the race

as well as during the pitstops, by asking them how many times out of 1000 they thought their car would win, based on its current position relative to the other cars. One of the six races, chosen randomly, was paid out in cash at the conclusion of the experiment.

There were four distinct treatments, each of which affected the way the payoffs were structured. In the baseline treatment, participants received a \$5 show up fee, and 5 times the amount bet in the event that their car won and the given race was selected to be paid out. In the ‘wealth’ treatment, the payoffs from the races stayed the same, but the show-up fee was increased to \$20. In the ‘high-stakes’ treatment, the show-up fee was again \$5 but participants would win 15 times the amount bet if their car won and that race was selected to be paid out. Finally, in the ‘low-stakes’ treatment, participants received twice the bet if their car won, the wagered amount exactly if their car came second, and half of the wagered amount if their car came third.

In addition to the information about expectations and risk-taking provided by the race stage of the experiment, we asked participants to respond to a number of question batteries regarding their psychology and beliefs, and also collected demographic information. After the experiment had concluded, we also simulated the actual likelihood of a car winning the race from each pitstop, providing an objective picture of the future outcome against which we could compare participants’ expectations. In this paper, we use all of these diverse sources of data to model both expectation formation and risk-taking behavior.

## 2 Statistics

A total of 239 participants took part in the eight sessions of the experiment. All of them were recruited using the OrSEE system<sup>1</sup> from the UNSW ASBLab’s subject pool using a standard email. The average age of participants was 22 years, and 45.15% of the participants were female. The average earnings in the real effort task, which was then split into a wagered amount and an invested amount, was \$24.42. The average bet was \$7.23, and there was a steep winning curve: payoffs were highly volatile, ranging from \$5 to \$105.20, with an average of \$23.62 across all four treatments.

## 3 Approach

Our approach is very simple. To explore how expectations are formed, we regress participants’ expectations, reported at the pitstops, on four main sources of variation: (1) demographics; (2) actual, objective chances of the car winning (drawn from the simulations); (3) psychological factors; and (4) the amount wagered. From these results we can determine the extent to which participants’ expectations were driven by factors other than the true likelihood of winning,

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<sup>1</sup>Greiner, B. (2004). “An Online Recruitment System for Economic Experiments” MPRA Paper 13513, University Library of Munich, Germany.

and which amongst the sources of variation we consider seems to be most salient in driving expectations.

Secondly, we predict the likelihood of dropping out using both expectations and all other variables included in the model of expectations. This allows us to examine the strength of the link between expectations themselves, versus other attributes of the person, and actual risk-taking behavior.

We also employ participant fixed effects in an extension of both models, in order to determine how consistent people are over time in terms of their expectation formation and their actual risk-taking behavior.

## 4 Preliminary results

Preliminary results show that psychological variables can explain a significant amount of the variance in expectation formation. Specifically, savouring and optimism predict the level of expectations formed, but conditional on actual objective likelihood of success, self-esteem and locus of control do not matter to expectations formation. Our interpretation of this finding is that the results in previous studies linking self-esteem and/or locus of control to outcomes is not due to systematic differences in the way that reality is perceived across people with different psychological profiles. Rather, these findings are due to differences in reality or in responses to that reality, both correlated with self-esteem and locus of control, that are not proxied elsewhere in a given model.

We also find that expectations relate to drop-out behavior, over and above the contribution of other variables (including objective likelihood of success). We interpret our preliminary results as providing support for the contention that regardless of their psychology, people are alike in forming expectations in a manner that is inconsistent with reality, and that these unrealistic expectations are meaningfully linked to their risk-taking behavior. We also confirm prior results that men are more likely to take risks than women.

Finally, we exploit the information collected on our detailed demographics questionnaire and find that depression, medication, left-handedness, and information about beliefs (such as whether a person is superstitious or believes in a higher power) are strongly related to expectation formation, and that income and wealth are not. Most of the impact of these ‘alternative demographics’ on actual risk-taking behavior flows through expectation formation.

## Appendix

The experiment was structured in several stages. First, participants were asked to respond to a number of question batteries regarding their psychology. These included measures of self-esteem, locus of control, savouring (the ability to draw pleasure from the past, the present, and the future), and overall optimism. Then, there was a five-minute meditation phase where participants listened to

a relaxing voiceover, followed by wave sounds.<sup>2</sup> Next, participants had to earn their initial income in a real effort task, to generate ownership of the amount that would be bet or invested.





An extensive introduction into the car race procedure was then provided, with a voiceover guide through all screens and two test races in which participants could familiarize themselves with the process. This was followed by the actual car race phase. After six rounds of car races, participants' accuracy in predicting the outcome was again measured in an incentivized way, where more accurate predictions yielded higher payoffs. The experiment concluded with a detailed demographics questionnaire.

## Figures

### Race 1: Bet on your car

You can now choose how much you want to bet on your car and how much to invest into the engine. If your car wins, you will receive **5 times** what you have bet; if your car does not win and you have not dropped out of the bet during the race, then your initial bet is completely forfeited.

What colour would you like your car to be?

☐ 
☐ 
☐ 
☐ 

Choose how much you want to bet and how much you want to invest by selecting a value on this sliding scale:

0.001.192.383.574.765.957.148.339.5210.7111.90

You bet \$ ____	... and you do not drop out ...		... and you do drop out ...		
	... and your car wins	... and your car does not win	... at the 1st pitstop (3rd lap)	... at the 2nd pitstop (6th lap)	... at the 3rd pitstop (9th lap)
Your payout:	$5 \times \$ \_\_\_ = \$ \_\_\_$	<b>\$ 0.00</b>	$0.4 \times \$ \_\_\_ = \$ \_\_\_$	$0.25 \times \$ \_\_\_ = \$ \_\_\_$	$0.1 \times \$ \_\_\_ = \$ \_\_\_$
You invest \$ ____ in your engine. Thus on average your engine will stall ____ times per 5 laps. The standard engine will stall 2 times in 5 laps on average.					

Please also tell us your guess of the likelihood of your car winning:  
 Out of 1000 races, how often do you think your car would arrive first? ( out of 1000 times )

01002003004005006007008009001000

How confident are you that your guess is roughly right? ( out of a 100 % )

0102030405060708090100

Continue

Figure 1: Screenshot of the pre-race investment screen with sliders to choose the amount to bet and to enter the expectations about the outcome of the race.

<sup>2</sup>This phase was included in order to obtain a benchmark for the heart-rate variation of a subset of participants who were connected to portable heart-rate monitoring devices. The information collected by these devices is not used in the present paper.

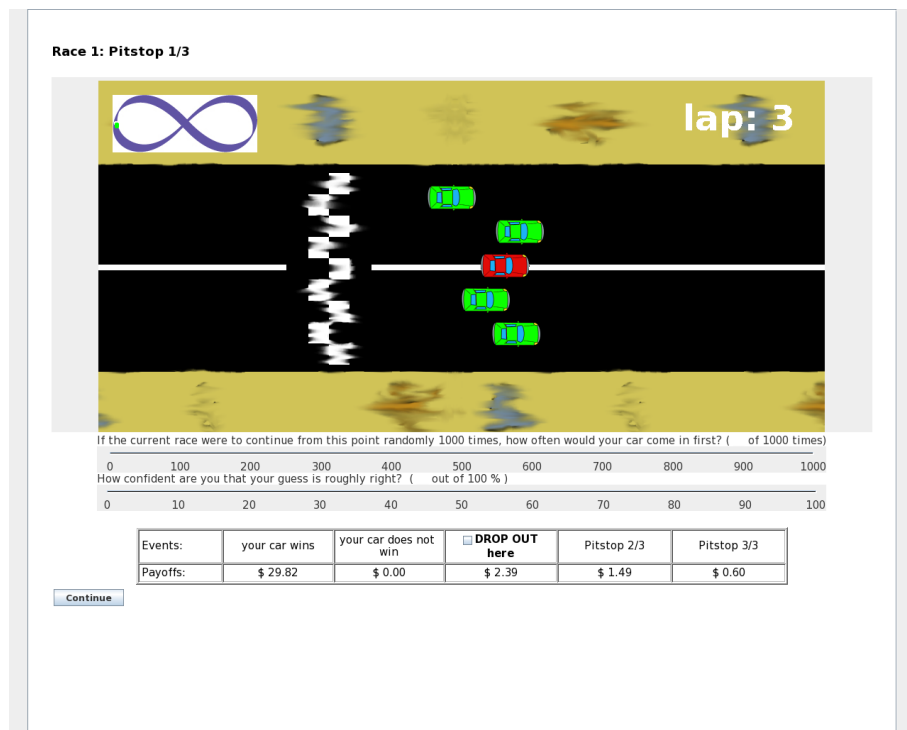


Figure 2: Screenshot of the car race at the first pitstop showing the positions of the cars and the payoffs for the respective events.