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The Impact of Losing in a Competition on the Willingness to Seek Further Challenges

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How do people react to setbacks and successes? I use a laboratory experiment to determine the effect of winning and losing in a competition on the willingness to seek further challenges. Participants compete in two-person tournaments in an arithmetic task and are then informed of their score and the outcome of the competition. Participants then have to decide on a performance target for a second round: the higher the target, the higher the potential reward, but participants who do not reach the target earn nothing. Conditional on the score, winning or losing is exogenous. I find that, conditional on first-round scores, losers go for a more challenging target. Losers also perform worse, leading to lower earnings and a higher probability of failure. These results are driven by gender-specific reactions to winning and losing: men react to losing by picking a more challenging target while women lower their performance. These findings could have important implications for our understanding of individual career paths. Early outcomes could alter the probability of success and failure in the long term.

Data, as supplemental material, are available at <https://doi.org/10.1287/mnsc.2015.2321>.

Keywords: competition; challenge seeking; career decisions; laboratory experiment; gender

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1. Introduction

How does people's willingness to seek further challenges react to setbacks and successes? The answer to this question could be important for our understanding of individual career paths. If success and failure have an impact above the rational incorporation of feedback, this could lead to path dependence whereby initial outcomes influence future decision making and therefore change the likelihood of future success. Events early in a professional career could then lead to exaggerated long-term consequences.

In this study, I specifically look at the case of winning and losing a skill-based, winner-takes-all competition. Competitive, tournament-like situations regularly occur along typical career paths. Entrance exams to good universities, competitive university degrees, application procedures for sought-after jobs, on-the-job promotions, and an entrepreneur's competition with rival firms are all essentially tournaments in which there are clear winners and losers.

Following the contribution of Lazear and Rosen (1981), studies of the properties of tournaments have been extensive, showing that tournaments often provide good incentives for performance. However, the economics literature on the effects of winning and losing in a tournament on subsequent decisions is small. Most relevant to this study is the work of Gill and Prowse (2014), who find that, in a series of two-person competitions, people tend to reduce their performance

following a loss. Apicella et al. (2014) are interested in the effect of testosterone changes following wins and losses in a rock-paper-scissors competition on subsequent risk taking in a lottery task. They find no direct effect of the competition outcome on subsequent willingness to take risk. In two papers looking into the effect of competition on social preferences, Chen (2010) finds that, relative to losers, winners are more likely to donate 10 cents to charity, and Buser and Dreber (2016) find that, relative to losers, winners are slightly more generous in a subsequent public good game played with a separate set of people.

I use a laboratory experiment to measure the impact of winning or losing a competition on the willingness to seek further challenges. In the first round, participants compete in a winner-takes-all competition in a simple arithmetic task against a randomly selected opponent. They then receive feedback both on their score and the outcome of the competition. I take advantage of the fact that, conditional on the score, the outcome of the competition is exogenously determined by the random allocation of opponent. In the second round, I measure participants' willingness to seek challenges. Participants are paid individually and have to pick a performance target. The higher the target, the higher the potential reward, but participants who do not reach their chosen target receive nothing. One of the two rounds is randomly chosen for payment. This design allows me to test whether, conditional on the

first-round score, the chosen challenge differs between losers and winners. I also look into differences in second-round performance, in the likelihood of success, and in earnings between losers and winners.

With a view on the aim of reaching a better understanding of individual career paths, this paper makes several contributions beyond the prior literature. In Gill and Prowse (2014), participants have no choice whether to enter a competition following a win or loss. Moreover, in both Gill and Prowse (2014) and Apicella et al. (2014), the outcome of the competition depends essentially on luck, not on effort and skill. I am interested in the effect of competition outcomes on subsequent willingness and ability to seek challenges and perform well in the same domain.

A sizeable literature in experimental economics finds that men and women differ both in their reaction to (Gneezy et al. 2003) and their preference for (Niederle and Vesterlund 2007) competition.¹ These gender differences have been shown to carry over to differences in career choices (Buser et al. 2014). Moreover, Niederle and Yestrumskas (2008) find that, conditional on performance levels, men are more likely to pick a hard task with higher potential rewards than an easier task. Finally, Gill and Prowse (2014) also detect a gender difference whereby following a loss, women reduce their effort independent of the size of the prize, whereas men only reduce their effort if the prize they failed to win was large enough. This suggests that there may be gender differences in the reaction to winning and losing in a competition.

The results show significant effects of the competition outcome. I find that, conditional on first-round scores, losers pick a more challenging performance target. Losers also perform significantly worse. The effects of winning and losing are highly gender specific: the positive effect of losing on challenge seeking stems exclusively from the reaction of men, whereas the negative effect on subsequent performance stems exclusively from the reaction of women. These effects lead to a lower probability for losers of successfully reaching the chosen target and to lower average earnings for losers in the second round.

There is an extensive literature on strategic momentum in dynamic contexts where the outcome of one round changes the incentives for the next. Relative to losers, winners might then be more likely to choose to compete again, not because of a direct impact of winning on decision making but because it is more

profitable to do so.² Such a mechanism is excluded by my experimental setup because the outcome of the first-round competition has no bearing on the payoff structure of the second round. Economists have also explored how the outcome of a risky gamble influences future risk taking. People show increased willingness to take risk both when they gamble with previously gained money (the house money effect) and when they have the chance to make up for a previous loss (the break-even effect) (Thaler and Johnson 1990). Although my design eliminates traditional income effects by randomly paying out one of two rounds, this introduces the possibility that first-round earnings could act as an expectations-based reference point (Bell 1985; Köszegi and Rabin 2006, 2007). To exclude this as an alternative explanation, and therefore demonstrate that my results indeed reflect effects of the competition outcome, I ran a supplementary experiment in which the first round is replaced by a random lottery. The results of this experiment are reported in §5.

The rest of this paper is structured as follows: §2 explains the experimental design, §3 describes the data, §4 presents the results, §5 discusses potential mechanisms, and §6 concludes.

2. Experimental Design

Participants were informed upfront that they would be paid for their performance in a simple task and that they would perform this task twice, whereby one performance would be randomly picked for payment at the end of the experiment. They were also told that the manner in which they were to be paid would be explained at the start of each round. The task consisted of adding five randomly generated two-digit numbers. The participants received one point for each correct answer; wrong answers were not penalized. The participants could attempt as many of these problems as they managed in a four-minute window. Before the two incentivized performances, participants received the opportunity to practice the task for four minutes.

In the first round, participants competed in a winner-takes-all competition against a randomly selected opponent. The winner would get two euros per correct answer whereas the loser would receive no payment for the task.³ After the performance, two-thirds of the subjects were informed about their score and whether they won or lost the competition, and one-third was informed only about their score.

Conditional on one's score, winning and losing is exogenous because it depends only on the performance

¹ These differences seem to be especially strong for male-connotated tasks such as the arithmetic task used here (Dreber et al. 2014, Niederle and Vesterlund 2011). The origins of these differences are still unclear, with both cultural (Gneezy et al. 2009, Cardenas et al. 2012) and biological (Buser 2012, Wozniak et al. 2014, Buser et al. 2015) determinants having been explored.

² See Konrad (2009) for a survey of the theoretical literature and Dechenaux et al. (2015) for a survey of the experimental literature on contests.

³ In the case of a tie, the winner was randomly chosen.

Table 1 The Challenge-Seeking Measure

How do you want to be paid for your performance?

1 euro if you score 1 or more, nothing otherwise
2 euros if you score 2 or more, nothing otherwise
3 euros if you score 3 or more, nothing otherwise

...

18 euros if you score 18 or more, nothing otherwise
19 euros if you score 19 or more, nothing otherwise
20 euros if you score 20 or more, nothing otherwise

of the randomly allocated opponent. Participants are consequently allocated to one of three “treatments”: losing, winning, and no information. Comparing the subsequent behavior of winners and losers, controlling for their performance therefore yields the causal effect of the competition outcome. Those who received no information on the outcome provide a benchmark, with the caveat that I do not measure beliefs and therefore do not know the expectations of the average participant in the no-information group.

In the second round, I use a simple and intuitive measure of challenge seeking (see Table 1). Participants had to decide how they would like to be paid for their performance in the task. Specifically, they had to choose a target amount of points for their performance. If their performance was at least as good as their target, they would receive the target amount of points in euros. If they did not achieve the target amount, they would receive nothing (so a participant choosing a target of 10 points would receive 10 euros for a score of 10 or more and nothing otherwise).

It is important to note that, conditional on beliefs about absolute ability, beliefs about relative ability have no bearing on the optimal choice of challenge. By focusing on an individual choice, the design eliminates the effect of beliefs about relative performance and the issue of ego-biased updating (Möbius et al. 2011, Eil and Rao 2011). Randomly paying out one of the two rounds eliminates income effects as a potential confounding factor. Also, the choice of performance target is a purely individual choice that does not affect anyone else’s payoff. An impact of the competition outcome on altruism (Buser and Dreber 2016, Chen 2010) should therefore not influence the results.

The second round was followed by a very brief questionnaire after which the participants were informed of their payment. The questionnaire elicited age and gender plus unincentivized measures of risk aversion and competitiveness. To elicit risk attitudes, I asked subjects “How do you see yourself? Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?” The answer was on a scale from 0 (“unwilling to take risks”) to 10 (“fully prepared to take risks”). Dohmen et al. (2011),

using representative survey data from Germany, find that this simple question predicts both incentivized choices in a lottery task and risky behavior across a number of contexts including holding stocks, being self-employed, participating in sports, and smoking.⁴ I elicit competitiveness with an analogous question: “How competitive do you consider yourself to be? Please choose a value on the scale below, where the value 0 means ‘not competitive at all’ and the value 10 means ‘very competitive.’”

The experiment was run at the Center for Research in Experimental Economics and Political Decision Making (CREED) laboratory at the University of Amsterdam, and all participants are students who enrolled in the mailing list of the laboratory. Participants earned 16.3 euros on average (including a 6 euro show-up fee). The experiment was run on computers using z-Tree (Fischbacher 2007). The online appendix (available as supplemental material at <http://dx.doi.org/10.1287/mnsc.2015.2321>) presents screen shots containing all experimental instructions and the questionnaire.

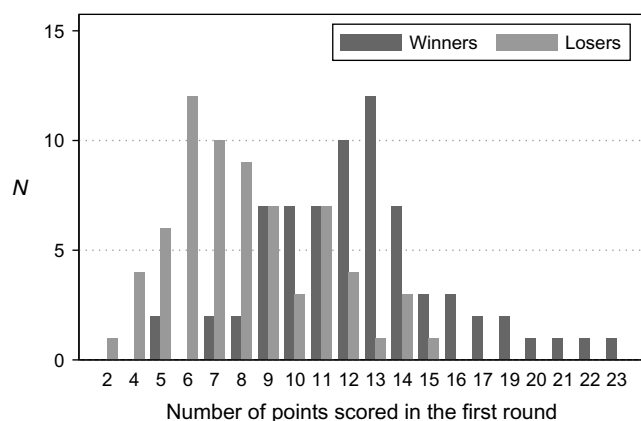
3. Data

The sample consists of 202 participants, 102 of whom are male and 100 of whom are female. Two-thirds of these (138) were randomly allocated to receive full feedback. For my estimation strategy to work, sufficient overlap in points scored between winners and losers is needed. Figure 1 shows the number of winners and losers who received full feedback by points scored. Participants scored a minimum of 2 and a maximum of 23 points. The lowest score for which there are both winners and losers is 5 and the highest is 15. The sample that I will use in my analysis therefore consists of participants who scored between 5 and 15 points, which leaves me with a sample of 178 participants (122 of whom received full feedback).

Table 2 shows further descriptive statistics. On average, participants scored 10.4 points in the competition round, chose a challenge of 9.3, and scored 10.5 points in the challenge round; 81% of subjects succeeded in their challenge, leading to average earnings in the challenge round of 7.3 euros (this was only paid out if the second round was randomly chosen for payment). There are no gender differences in average performance or challenge seeking. In particular, women scored a similar number of points, were equally likely to win the competition, and picked on average the same challenge. However, women see themselves as significantly less risk seeking and significantly less competitive.

A potential problem of the experimental design is censoring. The challenge menu only allowed for

⁴ Lönnqvist et al. (2015) find the question to be more stable over time than lottery measures for risk attitudes. See also Charness et al. (2013) for a comparison of elicitation methods for risk attitudes.

Figure 1 Number of Winners and Losers by First-Round Score

choices up to 20 points. This turned out not to be a problem, with only one subject choosing the maximum challenge of 20. Also, the analysis sample consists only of participants who scored 15 or less in the first round, which makes it unlikely that their choices were constrained by the available options.

4. Results

I will now turn to the main question of whether winners and losers who had the same performance in the competition round make different choices in the challenge round. The upper panel of Table 3 shows ordinary least squares (OLS) regressions of experimental outcomes on a loser dummy for the sample of participants who received feedback on the outcome

of the competition. The lower panel shows the same regressions but includes the sample of subjects who did not receive feedback on the competition outcome as a reference group. All regressions control for a third-order polynomial in the competition score.⁵ The table reports regressions with no further controls as well as regressions controlling for age, gender, and session fixed effects.

Columns (1) and (2) of Table 3 show regressions with the chosen second-round challenge as the dependent variable. The regressions show that, conditional on their performance in the competition round, losers pick a significantly higher target than winners. The effect is roughly equal to half a point. The regressions in the lower panel show that the average choice of winners is close to participants who received no feedback, whereas losers pick a higher target. This means that, rather than being discouraged by losing, losers go on to choose a more challenging option.

In columns (3) and (4) of Table 3, I analyze the effect of winning and losing on subsequent performance. These regressions show that, despite picking a higher challenge on average, losers actually perform significantly worse, scoring approximately 0.8 points lower than the winners. The results in the lower panel show that the winners improve their performance relative to the no-feedback sample, whereas the losers perform at the same level.

I will now investigate how the effects of winning and losing on challenge seeking and performance translate into the likelihood of success and earnings. The effect on earnings of choosing a more challenging target could be either positive (in the case of actually reaching the target) or negative (in the case of leading to a higher rate of failure). A lower performance should lead to a lower chance of successfully reaching the target and therefore lower average earnings. In columns (5) and (6) of Table 3, I regress a binary variable indicating failure in the competition on a binary variable indicating challenge success. The combination of losers picking a higher challenge and performing worse leads to a 17 percentage points lower chance of success compared to the winners. This translates into a reduction of 1.3 euros in expected earnings from the challenge round (columns (7) and (8)), which is equivalent to 19% of average earnings. This confirms that initial losses affect decision making in such a way as to increase the likelihood of more failure, whereas wins lead to more success in the future.

The simultaneous finding of a positive effect of losing on challenge seeking and a negative effect on

Table 2 Descriptive Statistics

	(1) All	(2) Men	(3) Women	(4) Gender <i>p</i> -value
<i>N</i>	202	102	100	
<i>N</i> feedback	138	72	66	
Competition score	10.41 (3.98)	10.67 (4.18)	10.14 (3.76)	0.46
Competition win	0.5 (0.50)	0.52 (0.50)	0.48 (0.50)	0.57
Chosen challenge	9.26 (3.22)	9.52 (3.34)	8.99 (3.10)	0.38
Challenge score	10.52 (3.86)	10.63 (3.68)	10.42 (4.06)	0.67
Challenge success	0.81 (0.40)	0.83 (0.37)	0.78 (0.42)	0.34
Challenge earnings	7.27 (4.56)	7.64 (4.51)	6.89 (4.60)	0.34
Age	22.59 (2.99)	22.45 (2.76)	22.74 (3.22)	0.65
Risk seeking	5.5 (2.35)	5.88 (2.23)	5.1 (2.41)	0.01
Competitiveness	7.16 (2.22)	7.61 (1.97)	6.71 (2.38)	0.01

Notes. *p*-Values in column (4) are from rank-sum tests. Standard deviations are in parentheses.

⁵ Controlling linearly for the competition score or for a second-order polynomial leads to the same conclusions. The online appendix presents alternative specifications, including OLS regressions controlling for score-fixed effects and probit and Poisson regressions that take into account the discrete nature of the outcome variables.

Table 3 OLS Regressions Controlling for Score Polynomial

	Challenge		Score		Success		Earnings	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Losers (vs. winners)	0.518** (0.252)	0.573** (0.269)	−0.818** (0.406)	−0.814** (0.402)	−0.170** (0.081)	−0.160* (0.082)	−1.381* (0.826)	−1.334 (0.839)
Female		−0.224 (0.249)		−0.230 (0.359)		−0.144** (0.059)		−1.388** (0.573)
Age		−0.023 (0.041)		−0.077 (0.073)		−0.003 (0.013)		−0.019 (0.140)
<i>N</i>	122	122	122	122	122	122	122	122
Losers (vs. no info)	0.357 (0.253)	0.345 (0.261)	0.027 (0.362)	0.008 (0.380)	−0.001 (0.078)	−0.007 (0.082)	0.179 (0.703)	0.122 (0.736)
Winners (vs. no info)	−0.088 (0.225)	−0.131 (0.238)	0.959** (0.372)	0.917** (0.372)	0.155** (0.074)	0.152* (0.079)	1.568** (0.749)	1.601** (0.795)
Female		−0.183 (0.200)		0.051 (0.296)		−0.086 (0.057)		−0.937* (0.543)
Age		−0.001 (0.034)		−0.060 (0.056)		−0.001 (0.011)		0.015 (0.109)
Winners vs. losers <i>p</i> -values	0.083	0.067	0.018	0.020	0.042	0.050	0.069	0.065
<i>N</i>	178	178	178	178	178	178	178	178
Third-order score polynomial	✓	✓	✓	✓	✓	✓	✓	✓
Session fixed effects		✓		✓		✓		✓

Notes. Robust standard errors are in parentheses. The sample in the upper-panel regressions consists of all participants who scored between 5 and 15 points in the competition round and received feedback on the competition outcome. The sample in the lower-panel regressions consists of all participants who scored between 5 and 15 points. The winners versus losers *p*-values are from postestimation Wald tests.

p* < 0.10; *p* < 0.05.

performance seems somewhat contradictory.⁶ Table 4 reports OLS regressions separately for male and female participants. The striking finding is that the positive effect of losing on challenge seeking stems exclusively from male losers, who, conditional on their performance, choose a target one point higher compared to male winners. The gender difference in the effect of the competition outcome on subsequent challenge seeking is marginally insignificant, with a *p*-value of approximately 0.1. The effect of the competition outcome on subsequent performance, on the other hand, stems exclusively from women. Female losers perform approximately 1.7 points worse than female winners. The gender difference in the effect of the competition outcome on performance in the challenge round is significant at the 5% level. This result is in line with Gill and Prowse (2014) who, using a series of competitions, find that the negative effect of losing in a competition on performance in a subsequent competition is stronger

for women. Although men react to losing by becoming more challenge seeking and women react by lowering their performance, there is no significant difference in the estimated effects on the likelihood of success and on expected earnings (although these effects are themselves statistically insignificant in the split sample regressions).

As the effect of the competition outcome on the chosen target stems exclusively from men and the effect on performance stems exclusively from women, we can use the other gender as a benchmark to judge whether it is winners or losers who differ from the average of the unaffected gender. OLS regressions controlling only for a third-order score polynomial and session fixed effects show that male losers choose a target 0.74 points higher compared to the one chosen by the average woman (*p* = 0.051), and male winners choose a target 0.29 points lower (*p* = 0.286). Female losers perform 1.1 points worse than the average man (*p* = 0.008), and female winners perform 0.56 points better (*p* = 0.293). This suggests that both the effect of the competition outcome on challenge seeking for men and the effect on performance for women are effects of losing, rather than effects of winning.

In the analyses above, I have used OLS regressions because of the straightforward interpretation of the estimated coefficients. However, given that all outcomes are either discrete or binary, it might be more

⁶ A large psychological literature on goal setting finds that when there is no financial incentive for reaching a goal, more challenging goals make people strive harder (see Locke and Latham 2002, for a survey). This is confirmed by Goerg and Kube (2012) who also use incentivised goals. Overall, the data do indeed show a positive correlation of the chosen challenge on performance. Regressing second-round performance on the chosen challenge controlling for a third-order polynomial in the first-round score, the coefficient on the chosen challenge is 0.30 (standard error of 0.10; *p* < 0.01).

Table 4 OLS Regressions Controlling for Score Polynomial (by Gender)

	Challenge		Score		Success		Earnings	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Men								
Losers (vs. winners)	0.950** (0.407)	1.150** (0.527)	−0.053 (0.439)	−0.101 (0.511)	−0.177 (0.111)	−0.162 (0.114)	−1.402 (1.128)	−1.231 (1.085)
Age		0.004 (0.068)		−0.100 (0.087)		−0.000 (0.010)		0.001 (0.127)
<i>N</i>	62	62	62	62	62	62	62	62
Women								
Losers (vs. winners)	0.095 (0.358)	0.112 (0.382)	−1.650** (0.708)	−1.308* (0.670)	−0.159 (0.119)	−0.141 (0.128)	−1.348 (1.255)	−1.367 (1.409)
Age		−0.040 (0.058)		−0.025 (0.120)		−0.002 (0.023)		0.014 (0.231)
<i>N</i>	60	60	60	60	60	60	60	60
Gender-interaction <i>p</i> -values	0.103	0.105	0.044	0.060	0.772	0.679	0.629	0.552
Third-order score polynomial	✓	✓	✓	✓	✓	✓	✓	✓
Session fixed effects		✓		✓		✓		✓

Notes. Robust standard errors are in parentheses. The sample in the upper-panel regressions consists of all male participants who scored between 5 and 15 points in the competition round and received feedback on the competition outcome. The sample in the lower-panel regressions consists of all female participants who scored between 5 and 15 points in the competition round and received feedback on the competition outcome. The gender interaction *p*-values come from regressions of the outcome on a loser dummy, a gender dummy, and the interaction of the two, plus added controls.

* $p < 0.10$; ** $p < 0.05$.

appropriate to use Poisson and probit regressions. In the online appendix, I include tables that demonstrate the robustness of the results to my modeling choices, reporting Poisson and probit regressions controlling for a third-order score polynomial. All results are robust to these alternative estimation methods. Controlling for score fixed effects (instead of a score polynomial) is a more complete way of controlling for first-round scores but it necessitates estimating a large number of additional coefficients. In the online appendix, I report OLS regressions, as well as Poisson and probit regressions, controlling for score fixed effects. Again, the estimated coefficients are very similar and the results are robust.

Although not the main point of interest, my data also serve to test whether there is an overall gender difference in challenge seeking independent of the outcome of the competition. Table 5 shows OLS regressions

Table 5 Gender and Challenge Seeking

	(1)	(2)	(3)
Female	−0.147 (0.186)	−0.169 (0.191)	−0.150 (0.187)
Age		−0.006 (0.031)	−0.008 (0.031)
<i>N</i>	202	202	202
Third-order score polynomial	✓	✓	✓
Session fixed effects		✓	✓
Treatment/success			✓

Notes. Coefficients are from OLS regressions with the chosen challenge as dependent variable. Robust standard errors are in parentheses.

of the challenge decision on a gender dummy plus controls. The main result is that men and women do not differ in their willingness to seek challenges. This is in contrast to the gender difference in picking a difficult high-reward task over an easy low-reward task in Niederle and Yestrumskas (2008), although they only find the difference when participants have to precommit for more than one round.

5. Discussion

A potential alternative explanation for my results is that, because only one of two rounds is randomly paid out, the outcome of the first round could act as an expectations-based reference point (Bell 1985; Köszegi and Rabin 2006, 2007). In the Bell (1985) model, for example, individuals faced with an uncertain payoff experience a loss of utility (“disappointment”) in that case that their realized earnings are below expected earnings and a utility gain (“elation”) in the case that their realized earnings are above expected earnings. Disappointment and elation are proportional to the difference between expected and realized earnings, whereby disappointment outweighs elation.⁷ A modified version

⁷ A decision maker who faces a lottery that yields x with probability p and y with probability $(1-p)$ (where $y < x$) compares the realized earnings to the expected outcome of the lottery $px + (1-p)y$. The decision maker then feels elation at winning and disappointment at losing, in direct proportion to the difference between the expectation and the actual earnings. Disappointment is equal to $d(px + (1-p)y - y) = dp(x - y)$, and elation is equal to $e(x - px - (1-p)y) = e(1-p)(x - y)$ with $d \geq e$.

of this model with noninstantaneous adjustment of the reference point could potentially explain the positive effect of losing the competition on the chosen target.⁸ The intuition is that participants form their earnings expectations at the beginning of the experiment, and these expected earnings then act as a reference point at the start of round 2. Participants assume that the expected earnings for the whole experiment are equal to the expected earnings in round 1 and that this reference point does not instantaneously adjust to winning and losing. When choosing their target, they compare their expected earnings given their target choice in round 2 to their reference point. Participants who lost in round 1 feel disappointment because their expected earnings dropped below their reference point. They may then choose a higher target to minimize the utility loss due to disappointment.⁹

⁸ Models of expectations-based reference points with instantaneous adjustment of the reference point could not explain the positive effect of losing on the chosen target. Depending on assumptions, they actually predict the opposite effect. For example, the model of Kőszegi and Rabin (2006) with instantaneous adjustment predicts that first-round winners aim higher in the second round compared to losers. The intuition is that winners have high earnings in the case that round 1 is paid and want to avoid disappointment in the case that round 2 is paid. For round 1 losers, on the other hand, potential disappointment increases with round 2 earnings. See also the experimental results of Abeler et al. (2011) and Gneezy et al. (2012) on the effect of a fixed expectations-based reference point on effort provision.

⁹ To illustrate how models of expectations-based reference points could be an alternative explanation for my results, in what follows I will show that a modified version of the Bell (1985) model with noninstantaneous adjustment of the reference point could explain the positive effect of losing the competition on the chosen target. Here, I assume that participants form their earnings expectations at the beginning of the experiment. I.e., their earnings expectation for the whole experiment is equal to expected earnings in round 1, and these expected earnings represent their reference point at the start of round 2. I also assume that participants feel disappointment but no elation ($e = 0$ and $d > 0$) and that disappointment is felt only over monetary outcomes and not, for instance, effort. For the average participant in my experiment, expected utility at the start of round 2, in the case of winning the competition, is then $U = \frac{1}{2}[22 + b(t)] - c(t)$, where 22 is roughly equal to the average round 1 payoff of winners, t is the chosen target, $b(t)$ is the expected monetary benefit from choosing target t (taking into account the risk of not reaching the target), and $c(t)$ is the cost of the expected effort spent in trying to reach the target. I assume that $c'(t) > 0$ and $c''(t) > 0$. I also assume that $b'(t) > 0$ and $b''(t) < 0$. If the same participant lost the first round competition, that participant's expected utility at the start of round 2 is $U = \frac{1}{2}[0 + b(t)] - c(t) - d[11 - \frac{1}{2}(0 + b(t))]$, where 11 is roughly equal to average round 1 earnings. This means that, in the case of having lost, the target choice not only influences the expected payoff but also the disappointment penalty. To understand why losers (and only losers) are assumed to be in the loss domain, note that it is virtually impossible for the average subject to earn twice their first-round expectation in the second round. The marginal utility of the chosen target is then $(d/dt)U = \frac{1}{2}b'(t) - c'(t)$ in the case of having won and $(d/dt)U = \frac{1}{2}b'(t) - c'(t) + \frac{1}{2}db'(t)$ in the case of having lost. Because $d > 0$ and $b'(t) > 0$, the marginal utility of the target, and therefore

To confirm that my results are due to an effect of winning and losing and not a consequence of differing expectations-based reference points, I conduct a supplementary experiment with 103 participants (44 women and 59 men).¹⁰ The second round of this experiment is identical to the second round in the main experiment: participants have to choose a performance target and perform in the task. Instead of the first-round competition, participants participate in a lottery where they have a 50% chance of winning 22 euros and a 50% chance of getting nothing (i.e., they only receive their show-up fee). The first option corresponds to the average earnings of the winners in the main experiment, whereas the second option reflects the first-round earnings of the losers. As in the main experiment, one of the two rounds was randomly paid out and participants only learned at the very end which one. Participants received feedback on the outcome of the lottery before the start of round 2. Models of expectations-based reference points would not predict a difference in the effect of losing a lottery versus losing a competition. If my results are due to expectations-based reference points rather than the effect of losing a competition, the effect of losing the lottery should therefore mirror the effect of losing the competition in the main experiment.

Table 6 reports OLS regressions of a dummy indicating that a participant lost the lottery on the outcome variables. Because there is no first-round task performance in this experiment, I control for the score achieved in the practice round.¹¹ The regression results for the whole sample show that expectations-based reference points cannot be at the root of my findings. The effect of losing the lottery is insignificant in all regressions. Moreover, the sign of the effect of losing the lottery on the chosen target is negative. The effect on the second-round score is negative but small. Splitting the sample by gender reinforces the result: the effect of losing the lottery on the chosen target for men is negative, whereas the effect on performance for women is positive and borderline significant. I.e., the effects of losing the lottery show the opposite sign of the effects of losing the competition in the main

the optimal target itself, is strictly higher in the case of having lost. I thank the anonymous associate editor for his or her substantial contribution to this discussion and the design of the supplementary experiment.

¹⁰ The experiment was run at the CREED laboratory at the University of Amsterdam and all participants were students who enrolled in the mailing list of the laboratory (individuals who participated in the main experiment were excluded from the registration). Participants earned 16.25 euros on average (including a 7 euro show-up fee). The experiment was run on computers using z-Tree (Fischbacher 2007). The online appendix presents screen shots containing all experimental instructions and the questionnaire.

¹¹ Participants were told to try their best in the practice round because their potential earnings in the experiment would depend on how well they knew their own performance level.

Table 6 Supplementary Experiment: OLS Regressions Controlling for Score Polynomial

	Challenge		Score		Success		Earnings	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
All								
Losers (vs. winners)	−0.608 (0.416)	−0.530 (0.423)	−0.177 (0.433)	−0.341 (0.452)	−0.006 (0.085)	−0.020 (0.085)	−0.067 (0.847)	−0.186 (0.857)
Female		0.517 (0.512)		−0.954** (0.469)		−0.033 (0.086)		−0.445 (0.877)
Age		−0.025 (0.058)		0.094 (0.080)		0.016 (0.011)		0.091 (0.116)
<i>N</i>	103	103	103	103	103	103	103	103
Men								
Losers (vs. winners)	−0.399 (0.414)	−0.386 (0.444)	−1.145* (0.577)	−1.184** (0.529)	−0.116 (0.112)	−0.129 (0.111)	−1.151 (1.029)	−1.287 (1.030)
Age		−0.002 (0.049)		0.229*** (0.047)		0.024** (0.012)		0.189 (0.134)
<i>N</i>	59	59	59	59	59	59	59	59
Women								
Losers (vs. winners)	−0.528 (0.855)	−0.428 (0.885)	0.951 (0.712)	1.301* (0.746)	0.122 (0.131)	0.128 (0.137)	1.190 (1.266)	1.383 (1.355)
Age		−0.107 (0.187)		−0.340* (0.173)		−0.010 (0.025)		−0.209 (0.279)
<i>N</i>	62	62	62	62	62	62	62	62
Third-order score polynomial	✓	✓	✓	✓	✓	✓	✓	✓
Session fixed effects		✓		✓		✓		✓

Notes. Robust standard errors are in parentheses. The score control consists of the score in the unincentivized practice round.

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

experiment.¹² This suggests that the results from the main experiment indeed represent the effects of losing a competition.

My experimental design does not explicitly test for mechanisms behind these results. However, findings from behavioral economics and psychology can give hints. In the rest of this section, I will discuss possible mechanisms behind my results and comment on their plausibility.

Kőszegi (2006) proposes a theoretical model of ego utility and task choice whereby agents derive utility from believing they are good at a certain task. Everything else being equal, agents who are satisfied with their belief in their own ability would shy away from challenging activities that could reveal their true ability to protect their ego utility. On the other hand, agents with low belief could engage in such activities, hoping to improve their beliefs and therefore increase their ego utility. Although my experimental design differs significantly from the theoretical setting, it is possible that losers suffer a loss of ego utility for which they try to compensate by going for a more challenging option. However, this cannot directly explain why only

men react in such a way and why women lower their performance after a loss.

Studies from psychology find that outcomes including task choice, effort expenditure, persistence, and intrinsic motivation are affected by fear of failure (Elliot and Thrash 2004). Individuals with a high fear of failure seek to avoid failure in achievement settings because they experience shame when they fail. Shame in turn may lead to the desire to mentally escape the threatening situation by withdrawing effort (Elliot and Church 1997). McGregor and Elliot (2005) find that women are more affected by fear of failure than men.

The psychology literature reveals a number of further plausible explanations for the gender differences in the reaction to competition outcomes. Men tend to attribute success to internal factors (such as talent) and failure to external factors (such as effort or lack thereof) whereas women tend to do the opposite (Dweck et al. 1978). This is especially true for mathematical tasks (Ryckman and Peckham 1987). Formulated in terms of expectations, a loss might lead men to positively update their performance expectations for the second round, because losing shows that a better performance is possible and that the first-round score might have been low because of bad luck. Women, on the other hand, might see their performance as a consequence of

¹² The significance of the effects of losing the lottery on second-round scores for men and women is not robust to using score fixed effects instead of a third-order score polynomial.

fixed ability and therefore would not expect to perform better following a loss. Psychologists find that, as a consequence, women are more likely to exhibit impaired performance after failure (Dweck and Gilliard 1975).

Another potential mechanism is an effect of the competition outcome on risk preferences. Some psychology studies find that individuals in a negative affective state are more risk seeking than those in a positive affective state (Isen and Geva 1987, Mittal and Ross Jr. 1998). However, the results of this literature are rather mixed¹³, and neither the competition nor the risk tasks are incentivized. The only properly incentivized study of which I am aware (Apicella et al. 2014) does not find an effect of losing in a competition on subsequent risk taking in a lottery choice task. The results of Schwerter (2013), who finds that social reference points can have an impact on the willingness to take risks, suggest a slightly different mechanism. Participants in his experiment are informed about the randomly assigned earnings of one other participant and then complete a lottery-choice task. Participants who observe high earnings choose riskier, higher-reward lotteries in order to catch up. However, this is unlikely to be the mechanism behind my results because I find that, first, expectations-based reference points have no effect and, second, losers actually reduce their performance instead of trying harder to catch up. It is also important to note that none of the studies on the impact of competition outcomes and reference points on risk preferences point toward the strong gender differences I find in the reaction to competition outcomes.

There is also an endocrinological literature that indicates that reactions to competition outcomes could be mediated by hormonal changes, in particular by the effects of the male sex hormone testosterone. Apicella et al. (2014) find that testosterone levels of winners increase relative to losers following a rock-paper-scissors competition and that testosterone predicts subsequent willingness to take risk. Mehta and Josephs (2006), using a nonincentivized competitive task, find that losers who experience an increase in testosterone are more willing to compete again. Carré et al. (2009) find that testosterone reactions following a nonincentivized competitive task predict subsequent aggressive behavior in men. Although it is important to note that none of these studies find a direct effect of winning and losing on subsequent behavior, their findings indicate that individual differences in hormonal reactions might be able to explain individual differences in the reaction to competition outcomes.

¹³ Lerner and Keltner 2001, for example, find that anger leads to more risk seeking whereas fear leads to less risk seeking.

6. Conclusions

My results demonstrate that success and failure in competitive situations can have an impact on subsequent choices such that success breeds further success and failure leads to further failure. Typical career paths are replete with both competition and situations where one has to decide whether or not to go for a challenging high-risk option. This is especially true at the top of the education and earnings distribution. My results indicate that studying how people react to success and failure might be useful for understanding individual career paths. If the findings translate to career decisions, such as the decision of which job to apply for, this would introduce an important element of luck and path dependence into individual careers.

Although my results show that losers subsequently do worse financially, it is encouraging that losing does not have a negative effect on the willingness to seek challenges. Actually, male losers pick a more challenging target on average while keeping up their performance levels. Although this leads in expectation to worse financial outcomes, it still means that high-ability men who are unlucky will keep trying after a temporary setback and therefore might still end up on top. The picture looks somewhat bleaker for women, who do not change their challenge-seeking behavior but who get discouraged in the sense of lowering their performance, potentially through providing less effort. If this finding translates to labor market behavior, it could be a partial explanation for the low number of women in competitive top positions (Bertrand and Hallock 2001) and among successful entrepreneurs (Klapper and Parker 2011). This extrapolation fits with a wider literature exploring psychological differences as an explanation for gender differences in labor market outcomes (Bertrand 2011, Buser et al. 2014, Reuben et al. 2013).

My results may also be relevant for the experimental literature on gender differences in competitiveness. Niederle and Vesterlund (2007), using the same arithmetic task used in this study, find that conditional on performance women are only half as likely as men to choose a competitive winner-takes-all tournament over a noncompetitive piece-rate payment scheme. This result has been replicated many times (Niederle and Vesterlund 2011). I find that the performance of women, but not of men, suffers after a loss. If women anticipate the impact of a potential loss on their future performance (or willingness to perform), this could sway their decision in the direction of a noncompetitive remuneration scheme.

The experimental design I use to tackle the question of the effects of success and failure has the advantage of credibly isolating the effect of losing from the effects of learning about one's relative ability and the resulting belief updating, as well as other confounding factors

such as income effects. The main disadvantage of using a lab experiment to tackle a question inspired by the aim of better understanding individual career paths is external validity. How far can we extrapolate these results to labor market decision making? Now that we know that there is a direct effect of winning and losing on subsequent decision making in the laboratory, a logical next step is to investigate whether similar patterns can be found in field data, such as labor market surveys, registry data on educational and professional careers, or sports data. An example of the latter approach is Legge and Schmid (2014), who analyze ski world cup data and find that skiers who narrowly miss a medal underperform in the next race. Another promising approach, and one that could cover step by step the loss of control that occurs as we move from the laboratory to using field data, is to run field experiments in companies or schools.

A logical and interesting direction for further laboratory-based research would be to investigate whether the effects of the competition outcome carry over to challenge seeking in different tasks and to other subsequent decisions. It would also be interesting to test whether setbacks and successes in noncompetitive settings (e.g., missing an individual target) have similar effects. Furthermore, it could be fruitful to study the mechanisms that lie behind the effect of competition outcomes. As mentioned, the psychology literature reveals a number of plausible mechanisms for the observed gender difference. Women are more likely to attribute failure to internal factors such as a lack of ability. It is therefore possible that male participants in the experiment attribute losing to bad luck or lack of effort and female participants think it reflects badly on their own talent for the task, leading to impaired performance in the challenge round. Higher fear of failure and the resulting shame reaction are a further potential explanation for why women lower their effort following a loss.

Supplemental Material

Supplemental material to this paper is available at <https://doi.org/10.1287/mnsc.2015.2321>.

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References

- Abeler J, Falk A, Goette L, Huffman D (2011) Reference points and effort provision. *Amer. Econom. Rev.* 101(2):470–492.
- Apicella CL, Dreber A, Möllerström J (2014) Salivary testosterone change following monetary wins and losses predicts future financial risk-taking. *Psychoneuroendocrinology* 39:58–64.
- Bell DE (1985) Disappointment in decision making under uncertainty. *Oper. Res.* 33(1):1–27.
- Bertrand M (2011) New perspectives on gender. Ashenfelter O, Card D, eds. *Handbook of Labor Economics*, Vol. 4B (Elsevier, Amsterdam), 1543–1590.
- Bertrand M, Hallock KF (2001) The gender gap in top corporate jobs. *Indust. Labor Relations Rev.* 55(1):3–21.
- Buser T (2012) The impact of the menstrual cycle and hormonal contraceptives on competitiveness. *J. Econom. Behav. Organ.* 83(1):1–10.
- Buser T, Dreber A (2016) The flipside of comparative payment schemes. *Management Sci.* 62(9):2626–2638.
- Buser T, Dreber A, Möllerström J (2015) Stress reactions cannot explain the gender gap in willingness to compete. Discussion paper, Tinbergen Institute, Amsterdam.
- Buser T, Niederle M, Oosterbeek H (2014) Gender, competitiveness and career choices. *Quart. J. Econom.* 129(3):1409–1447.
- Cardenas JC, Dreber A, von Essen E, Ranehill E (2012) Gender differences in competitiveness and risk taking: Comparing children in Colombia and Sweden. *J. Econom. Behav. Organ.* 83(1):11–23.
- Carré JM, Putnam SK, McCormick CM (2009) Testosterone responses to competition predict future aggressive behaviour at a cost to reward in men. *Psychoneuroendocrinology* 34(4):561–570.
- Charness G, Gneezy U, Imas A (2013) Experimental methods: Eliciting risk preferences. *J. Econom. Behav. Organ.* 87(March):43–51.
- Chen DL (2010) Markets and morality: How does competition affect moral judgment. Working paper, Duke University School of Law, Durham, NC.
- Dechenaux E, Kovenock D, Sheremeta RM (2015) A survey of experimental research on contests, all-pay auctions and tournaments. *Experiment. Econom.* 18(4):609–669.
- Dohmen T, Falk A, Huffman D, Sunde U, Schupp J, Wagner GG (2011) Individual risk attitudes: Measurement, determinants, and behavioral consequences. *J. Eur. Econom. Assoc.* 9(3):522–550.
- Dreber A, von Essen E, Ranehill E (2014) Gender and competition in adolescence: Task matters. *Experiment. Econom.* 17(1):154–172.
- Dweck CS, Gilliard D (1975) Expectancy statements as determinants of reactions to failure: Sex differences in persistence and expectancy change. *J. Personality Soc. Psychol.* 32(6):1077–1084.
- Dweck CS, Davidson W, Nelson S, Enna B (1978) Sex differences in learned helplessness: II. The contingencies of evaluative feedback in the classroom and III. An experimental analysis. *Developmental Psychol.* 14(3):268–276.
- Eil D, Rao JM (2011) The good news-bad news effect: Asymmetric processing of objective information about yourself. *Amer. Econom. J. Microeconom.* 3(2):114–138.
- Elliot AJ, Church MA (1997) A hierarchical model of approach and avoidance achievement motivation. *J. Personality Soc. Psychol.* 72(1):218–232.
- Elliot AJ, Thrash TM (2004) The intergenerational transmission of fear of failure. *Personality Soc. Psychol. Bull.* 30(8):957–971.
- Fischbacher U (2007) z-Tree: Zurich toolbox for ready-made economic experiments. *Experiment. Econom.* 10(2):171–178.
- Gill D, Prowse V (2014) Gender differences and dynamics in competition: The role of luck. *Quant. Econom.* 5(2):351–376.
- Gneezy U, Leonard KL, List JA (2009) Gender differences in competition: Evidence from a matrilineal and a patriarchal society. *Econometrica* 77(5):1637–1664.
- Gneezy U, Niederle M, Rustichini A (2003) Performance in competitive environments: Gender differences. *Quart. J. Econom.* 118(3):1049–1074.

- Gneezy U, Goette L, Sprenger C, Zimmermann F (2012) The limits of expectations-based reference dependence. Working paper, University of California, San Diego.
- Goerg SJ, Kube S (2012) Goals (th) at work: Goals, monetary incentives, and workers' performance. Technical report, Preprints of the Max Planck Institute for Research on Collective Goods, Bonn, Germany.
- Isen AM, Geva N (1987) The influence of positive affect on acceptable level of risk: The person with a large canoe has a large worry. *Organ. Behav. Human Decision Processes* 39(2):145–154.
- Klapper LF, Parker SC (2011) Gender and the business environment for new firm creation. *World Bank Res. Observer* 26(2): 237–257.
- Konrad KA (2009) *Strategy and Dynamics in Contests* (Oxford University Press, Oxford, UK).
- Kőszegi B (2006) Ego utility, overconfidence, and task choice. *J. Eur. Econom. Assoc.* 4(4):673–707.
- Kőszegi B, Rabin M (2006) A model of reference-dependent preferences. *Quart. J. Econom.* 121(4):1133–1165.
- Kőszegi B, Rabin M (2007) Reference-dependent risk attitudes. *Amer. Econom. Rev.* 97(4):1047–1073.
- Lazear EP, Rosen S (1981) Rank-order tournaments as optimum labor contracts. *J. Political Econom.* 89(5):841–864.
- Legge S, Schmid L (2014) Rankings, success, and individual performance: Evidence from a natural experiment. Working paper, University of St. Gallen, St. Gallen, Switzerland.
- Lerner JS, Keltner D (2001) Fear, anger, and risk. *J. Personality Soc. Psychol.* 81(1):146–159.
- Locke EA, Latham GP (2002) Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *Amer. Psychologist* 57(9):705–717.
- Lönnqvist J-E, Verkasalo M, Walkowitz G, Wichardt PC (2015) Measuring individual risk attitudes in the lab: Task or ask? An empirical comparison. *J. Econom. Behav. Organ.* 119(November): 254–266.
- McGregor HA, Elliot AJ (2005) The shame of failure: Examining the link between fear of failure and shame. *Personality Soc. Psychol. Bull.* 31(2):218–231.
- Mehta PH, Josephs RA (2006) Testosterone change after losing predicts the decision to compete again. *Hormones Behav.* 50(5): 684–692.
- Mittal V, Ross WT Jr (1998) The impact of positive and negative affect and issue framing on issue interpretation and risk taking. *Organ. Behav. Human Decision Processes* 76(3):298–324.
- Möbius M, Niederle M, Niehaus P, Rosenblat T (2011) Managing self-confidence: Theory and experimental evidence. Working Paper 11-14, Federal Reserve Bank of Boston, Boston.
- Niederle M, Vesterlund L (2007) Do women shy away from competition? Do men compete too much? *Quart. J. Econom.* 122(3): 1067–1101.
- Niederle M, Vesterlund L (2011) Gender and competition. *Annual Rev. Econom.* 3(1):601–630.
- Niederle M, Yestrumskas AH (2008) Gender differences in seeking challenges: The role of institutions. NBER Working Paper 13922, National Bureau of Economic Research, Cambridge, MA.
- Reuben E, Wiswall M, Zafar B (2013) Preferences and biases in educational choices and labor market expectations: Shrinking the black box of gender. Staff report, Federal Reserve Bank of New York, New York.
- Ryckman DB, Peckham PD (1987) Gender differences in attributions for success and failure. *J. Early Adolescence* 7(1):47–63.
- Schwerter F (2013) Social reference points and risk taking. Technical report, Bonn Econ Discussion Papers, University of Bonn, Germany.
- Thaler RH, Johnson EJ (1990) Gambling with the house money and trying to break even: The effects of prior outcomes on risky choice. *Management Sci.* 36(6):643–660.
- Wozniak D, Harbaugh WT, Mayr U (2014) The menstrual cycle and performance feedback alter gender differences in competitive choices. *J. Labor Econom.* 32(1):161–198.