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Risk, Uncertainty, and Entrepreneurship: Evidence from a Lab-in-the-Field Experiment

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Theory predicts that entrepreneurs have distinct attitudes toward risk and uncertainty, but empirical evidence is mixed. To better understand the unique behavioral characteristics of entrepreneurs and the causes of these mixed results, we perform a large "lab-in-the-field" experiment comparing entrepreneurs to managers (a suitable comparison group) and employees ($n = 2{,}288$). The results indicate that entrepreneurs perceive themselves as less risk averse than managers and employees, in line with common wisdom. However, when using experimental incentivized measures, the differences are subtler. Entrepreneurs are only found to be unique in their lower degree of loss aversion, and not in their risk or ambiguity aversion. This combination of results might be explained by our finding that perceived risk attitude is not only correlated to risk aversion but also to loss aversion. Overall, we therefore suggest using a broader definition of risk that captures this unique feature of entrepreneurs: their willingness to risk losses.

Keywords: entrepreneurs; managers; risk aversion; loss aversion; ambiguity aversion; lab-in-the field experiment
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1. Introduction

One of the most salient dimensions of entrepreneurship is risk and uncertainty. Economic theory predicts that entrepreneurs, as business-owning residual claimants, are less averse toward risk and uncertainty than others. Entrepreneurs assume business risks in uncertain environments. Their income, wealth, satisfaction, and social status are dependent on the outcomes of their decisions in uncertain situations (Cantillon 1755, Knight 1921, Kirzner 1973, Kihlstrom and Laffont 1979). On top of that, most of the entrepreneurs' investment portfolios are totally undiversified (Moskowitz and Vissing-Jorgensen 2002) as a result of capital constraints in the market for entrepreneurial finance (e.g., Evans and Jovanovic 1989; Holtz-Eakin et al. 1994a, b; Hvide and Møen 2010; Fairlie and Krashinsky 2012; Schmalz et al. 2013). Notwithstanding this theoretical prediction, the body of empirical evidence on risk, uncertainty, and entrepreneurship is rather mixed (see Holm et al. 2013 and Online Appendix A; online appendices available as supplemental material at http://dx.doi.org/10.1287/mnsc.2015.2249).

To reconcile these earlier findings we conduct a lab-in-the-field experiment among 910 entrepreneurs, 397 managers and 981 employees in the Netherlands. To obtain additional measures of loss aversion, we run an additional experiment among different samples of 697 entrepreneurs, 265 managers and 969 employees.

The recent study by Holm et al. (2013) is most related to ours. They also perform a large-scale lab-in-the-field experiment with incentives to determine how attitudes toward risk and uncertainty distinguish entrepreneurs from others. They distinguish between strategic and nonstrategic risk. Strategic risk covers measures of trust and competition. Nonstrategic risk is measured in terms of risk aversion and ambiguity aversion. They find that entrepreneurs are more willing to assume strategic risk but are not more willing to assume risks lacking a strategic, interactive character. Our study is distinct from theirs in three ways. First, we compare entrepreneurs (in a Western country as opposed to China) to managers as well as employees and not to the local population at large. Second, we use both a survey-based and an experimental, incentivized measure of risk aversion. Third, we also measure loss aversion and find that this is the most important difference between entrepreneurs and managers in the domain of risk and uncertainty.

More generally, our study can be characterized by the following four distinguishing features. First, we elicit peoples' risk attitudes using two different measures: one is an "objective" measure that is incentivized and experimental, based on a multiple price list (MPL) elicitation method (in the style of Holt and Laury 2002). The other is "subjective," i.e., survey based and self-assessed (Dohmen et al. 2011). Both are well established within their categories and have been extensively validated and used.[1] So far, studies testing differences in risk attitudes between entrepreneurs and others have either used an incentivized experimental measure in the Holt and Laury style, or a nonincentivized, self-assessed, survey-based measure in the spirit of Dohmen et al. (2011). Interestingly, all studies using experimental measures of risk aversion find no differences between entrepreneurs and the control group, whereas most of the other studies do find differences supporting the common wisdom that entrepreneurs are less risk averse. By using both measures we can contribute to the explanation of the mixed findings so far.[2]

Second, besides comparing entrepreneurs and others with respect to risk, we also try to understand in what related aspects entrepreneurs and managers are different. We consider both loss aversion, allowing an asymmetric effect of losses and gains on peoples' utility, and ambiguity aversion (i.e., probabilities are unknown and there is genuine uncertainty in the Knightian sense).[3] By relating the three incentivized experimental measures of uncertainty (risk aversion, loss aversion, and ambiguity aversion) to the survey-based self-assessed measure of risk aversion we can extend our understanding of the relationship between objective and subjective measures of risk. For instance, we find that subjects' views of what is risk aversion are in fact a mixture of what economists call risk aversion, loss aversion, and ambiguity aversion.

Third, we use a double control group. Instead of comparing entrepreneurs with the general population, we use two tightly defined control groups, namely managers and employees.[4] We are especially interested in the first control group. Behavioral characteristics of managers and entrepreneurs have been compared in various studies (e.g., Brockhaus 1980, Schere 1982, Begley 1995, Stewart et al. 1999), because the two groups are arguably very similar. Both are responsible for strategic and complex decisions and are managing the employees in their companies (if any). Therefore they are likely to be similar in terms of many observable aspects, such as education, age, and labor market participation. We indeed observe that the managers and entrepreneurs in our sample are very similar, whereas the differences in background characteristics with employees are sizeable. If these differences extend to unobserved characteristics, such as motivation, perseverance, or wealth, no fair comparison can be made between entrepreneurs and nonentrepreneurs. Therefore, employing two relatively similar control groups allows for a potentially cleaner test of behavorial differences between entrepreneurs and others. Admittedly, managers might also be more similar to entrepreneurs in terms of their attitudes toward risk and uncertainty. This can be inferred, for instance, from the fact that they are likely to self-select into positions with strong(er) incentive pay. In that sense, a comparison between entrepreneurs and managers might lead to underestimating the true differences between entrepreneurs and comparable others. It is thus important to use a more general control group, too. Using different control groups may then show to what extent differences are related to the control group used.[5]

[1] See Filippin and Crosetto (2014) for a meta-analysis of studies using the Laury measure to relate risk to gender. For a validity test of the Dohmen et al. (2011) measure, see Bonin et al. (2007), Caliendo et al. (2009), Beauchamp et al. (2012), and Lonnqvist et al. (2014). Overall, the Dohmen question scores highly on retest reliability within person and has been shown to be virtually stable over a retest interval of, e.g., one year (see Lonnqvist et al. 2014). However, a recent study by Brachert and Hyll (2014) shows that occupational choices may affect the Dohmen test outcomes.

[2] Examples of studies using elicitation of risk attitude in the style of Holt and Laury are Elston and Harrison (2006), Macko and Tyszka (2009), Sandri et al. (2010), Burmeister-Lamp et al. (2012), and Holm et al. (2013). Examples of studies on risk and entrepreneurship using nonexperimental measures of risk attitude are Brockhaus (1980), Hull et al. (1980), Caird (1991), Begley (1995), Koh (1996), Sarasvathy et al. (1998), Stewart et al. (1999), Van Praag and Cramer (2001), Uusitalo (2001), Cramer et al. (2002), Djankov et al. (2006, 2007), Caliendo et al. (2010), Hvide and Panos (2014), and Skriabikova et al. (2014). See also Online Appendix A or Astebro et al. (2014) for further reference.

[3] Gächter et al. (2010) is the only study we are aware of that also compares the degree of loss aversion across occupational groups. They find that entrepreneurs are less loss averse on average than others in the risky choice category. Moreover, managers appear less loss averse than blue-collar workers but not than white-collar workers. The degree of ambiguity aversion of entrepreneurs has been compared to that of students and nonentrepreneurs by Koh (1996), Macko and Tyszka (2009), and Holm et al. (2013) and with managers by Schere (1982). With the exception of Holm et al. (2013), who do not report a significant difference, the general finding seems to be that entrepreneurs are better able to cope with ambiguous situations than either managers or nonentrepreneurs are.

[4] Many studies have used rather unspecified control groups, such as Van Praag and Cramer (2001), Uusitalo (2001), Cramer et al. (2002), Elston and Harrison (2006), Djankov et al. (2006, 2007), Macko and Tyszka (2009), Caliendo et al. (2010), Sandri et al. (2010), Burmeister-Lamp et al. (2012), and Holm et al. (2013).

[5] Many studies that have compared entrepreneurs and managers are relatively old and rely on small samples and self-assessed measures of risk attitude. The overall findings are mixed, too.

Fourth, following the debate in the literature about who can be considered an entrepreneur (see, e.g., Parker 2009, Hurst and Pugsley 2011, Levine and Rubinstein 2013, Henrekson and Sanandaji 2014), we verify our main findings by using various alternative definitions of the entrepreneur. In our basic sample, an "entrepreneur" is someone who founded, inherited, or has taken over a company and is currently (co-)managing that company and has at least 5% of the shares.[6] We use alternative subsamples that are based on "stricter" definitions of entrepreneurship (see Lindquist et al. 2015), i.e., those that are arguably more successful and thus more similar to the "Schumpeterian" entrepreneur. Subsamples used include (i) incorporated entrepreneurs (Levine and Rubinstein 2013), making up almost half of the sample; (ii) entrepreneurs with an above-median number of employees; and (iii) entrepreneurs with above-median income. In comparable ways, we also use various more selective definitions of our control groups. Managers in the basic sample are defined as employees in firms not started up by the respondent and having at least two direct reports under their responsibility. The stricter definitions limit the sample to (i) CEOs (17%), (ii) managers with an above-median number of direct reports, and (iii) managers with above-median income. Finally, employees are the people who work in organizations and do not belong to the groups of entrepreneurs and managers (when using the baseline, i.e., least "strict," definitions for entrepreneurs and managers).

Our findings tell the following story. Entrepreneurs perceive themselves as more risk tolerant than managers who see themselves, in turn, as being more risk tolerant than employees. This ranking is consistent with most of the previous studies using subjective measures of risk. However, based on the objective MPL risk aversion measure, entrepreneurs and managers have similar risk attitudes but are both less risk averse than employees. When analyzing the differences in loss and ambiguity aversion across the three groups, we show that loss aversion is the missing piece. Whereas all three groups have similar degrees of ambiguity aversion, entrepreneurs have a significantly lower level of loss aversion than the two other groups. We reconcile these different findings by relating the subjective risk measure to all three experimental measures. All three appear to be strongly related to what people self-assess to be their risk attitude. Respondents thus have a notion of "risk" that is different from economists, and more a mixture of risk and uncertainty. Hence, not only could a distinct degree of risk aversion of managers and entrepreneurs explain the differences in their self-assessed risk attitude, but these differences may also relate to differences in loss aversion or ambiguity aversion.[7] All these results are independent of the various definitions we use of entrepreneurs and managers. In some cases, limiting the sample to more successful entrepreneurs even strengthens the results.

The loss aversion measure we use in our first experiment records subjects' willingness to accept (WTA) a small-stakes mixed prospect. This measure can be reasonably criticized on various grounds. We therefore test the robustness of our results in another large experiment ($n = 1{,}931$). Again it turns out that entrepreneurs are significantly less loss averse than both managers and employees are. The cleanest evidence comes from comparing gaps between WTA and willingness to pay (WTP) (for a fancy bread tray) among the three groups of interest. Here entrepreneurs also have the lowest loss aversion in riskless choices.

Our two main conclusions are basically two sides of the same coin. First, entrepreneurs do differ from managers and employees in their attitude toward risk and uncertainty, but in a rather subtle way. Second, subjective self-assessed measures of risk attitude measure more than the economists' strict notion of risk aversion alone. The distinguishing trait of entrepreneurs thus becomes apparent only after realizing that there is more to risk and uncertainty than risk aversion per se.

We think it is rather intuitive that entrepreneurs are indeed different from managers and employees in the way they deal with risk and uncertainty and that the difference is related to how losses loom larger than corresponding gains (Kahneman and Tversky 1979, 1984; Tversky and Kahneman 1992). The entrepreneur's position is one in which much more is at stake to be lost than in the manager's role. However, our study cannot reveal why entrepreneurs are found to be less loss averse than managers. Although the general consensus tends to be that preferences in the domain of risk and uncertainty are

Brockhaus (1980) finds no differences between the two groups, whereas Begley (1995) and Stewart et al. (1999) report lower levels of risk aversion among entrepreneurs than managers. Furthermore, a meta-analytical review by Stewart and Roth (2001) concludes that managers are more risk averse than entrepreneurs, although this conclusion is challenged by Miner and Raju (2004), who conclude that the role of risk propensity in entrepreneurship remains unresolved. In a comparison of managers and employees, Graham et al. (2013) show that managers have a lower risk aversion than employees.

[6] Five percent is the cutoff ownership that the tax authority calls "a substantial interest." In our sample, 88% (65%) of the entrepreneurs in our sample hold at least 30% (51%) of the company shares.

[7] An alternative explanation of the differential difference between subjective and objective risk measures across entrepreneurs and managers might be demand effects based on stereotypes, despite our careful wording in the surveys.

stable (see, e.g., Borghans et al. 2008, Sahm 2012, Fouarge et al. 2014), a recent study by Brachert and Hyll (2014) casts serious doubt on the stability of these preferences. Therefore, the descriptive nature of the study prevents us from drawing causal conclusions. Entrepreneurs might either be less loss averse types or might become less loss averse when becoming entrepreneurs. In a similar vein, a managerial context might also affect managerial loss aversion, considering the asymmetry in blame and credit within organizations (Swalm 1966, Kahneman and Lovallo 1993). We acknowledge that this is a limitation of our study. This limitation notwithstanding, we believe that our study not only contributes to the literature by further clarifying the unique behavioral features of entrepreneurs in comparison with managers and employees, but also by offering an explanation for the previous mixed results in this area.

In what follows, §2 first discusses design and measurement issues. Section 3 provides the descriptive statistics of our sample, and §4 reports the empirical findings, including those of our second experiment with alternative elicitations of loss aversion. Section 5 concludes.

2. Measurement and Sampling

2.1. Measurement of Risk Aversion, Loss Aversion, and Ambiguity Aversion

Entrepreneurship is associated with risk bearing, uncertainty, gains, and losses. Of the classic economists and philosophers who laid the foundation of thinking about entrepreneurship, all but Schumpeter defined the entrepreneur as a risk bearer (Cantillon 1755, Say 1803, Marshall 1930), an uncertainty bearer (Knight 1921), or as agents who are less inclined to avoid losses (Knight 1921, Marshall 1930).[8] Intuitively these three different concepts can be understood as follows.

[8] The earliest philosophic thinker about entrepreneurship, Cantillon (1755) defined the entrepreneur as a risk bearer as a consequence of buying and selling at uncertain prices. Say's entrepreneur (1803) is a risk bearer because of the risk of losing capital and reputation due to the likelihood of failure. Hence, Say defines entrepreneurship in terms of the risk of losses rather than of gains. Marshall's view on entrepreneurship (1930) is the most common one: entrepreneurs are responsible for assuming the business risks associated with their enterprise. Marshall also acknowledges that a few extremely high prices will have a disproportionately great attractive force (Marshall 1930, p. 554) "because risk lovers are more attracted by the prospects of a great success than they are deterred by the fear of failure." Thus, Marshall also pays particular attention to loss aversion. Knight (1921) was the first to explicitly distinguish between risk and true uncertainty (ambiguity). He defines the entrepreneur as a particular kind of individual who bears uncertainty because business decisions practically never concern calculable probabilities (Van Praag 1999, p. 322).

"Risk aversion" is a concept with a very specific meaning in economics. It is the willingness of people to sacrifice expected payoffs to circumvent taking risks. In other words, it measures the extent to which the utility of a guaranteed payoff (for instance 50) is higher than the utility derived from a proposition with the same expected reward obtained with risk (for instance 100 with 50% probability and 0 with 50% probability). Risk aversion is involved in decision-making situations where a probability can be assigned to each possible outcome of the situation.

"Loss aversion" refers to the notion that decision makers prefer avoiding losses over acquiring gains. Loss aversion was first demonstrated by Kahneman and Tversky in their prospect theory (Kahneman and Tversky 1979, 1984). Loss aversion implies that losing 50 will decrease utility or satisfaction by more than the increase in utility or satisfaction that is associated with a (windfall) gain of 50. Loss aversion explains the well-known endowment effect (Kahneman et al. 1990) that people value the goods and assets they own more highly than identical goods and assets they do not own.

"Ambiguity aversion" is also known as "uncertainty aversion" and refers to a preference for risks with known probabilities over and above risks with unknown probabilities (true Knightian uncertainty), e.g., Ellsberg (1961) and Holm et al. (2013). Ambiguous events have a greater degree of uncertainty than risky events because not only is the outcome uncertain, but also the probability of the realization of that outcome and, as a consequence, the expected payoff.

2.1.1. Risk Aversion. To measure risk aversion empirically, we rely on two measures. The first experimental, choice-based measure is obtained by using the multiple price list (MPL) format of Dohmen et al. (2010), which originates from Holt and Laury (2002). Participants are confronted with a list of ten decisions between two options: a risky one with known probabilities (option A) and a safe one (option B). In each of the ten cases, option A corresponds to gaining €300 with a 50% chance or gaining €0 with a 50% chance. The safe option B, on the other hand, gradually increases from €25 to €250 (see Figure 1 in Online Appendix G). Instead of asking each participant to reveal their preferences for every decision, we asked each participant to indicate their switching point (see, e.g., Dohmen et al. 2011, Gneezy and Pietrasz 2014). For example, a possible answer was "I prefer option A in decision 1 and option B in 2–10."

The second, survey-based measure of risk aversion is copied from Dohmen et al. (2011). Participants indicate their self-perceived willingness to take risks in general, as well as in the two subdomains of career and financial matters. We employed a 0–10 scale, where 0 stood for "Not at all willing to take risks"

and 10 for "Very willing to take risks." In the design of the questionnaire, this question was widely spaced from the incentivized risk measure, which came first. The question about willingness to take risk in general is of main interest; the ones about career and financial matters are used for robustness checks.

2.1.2. Loss Aversion. Loss aversion is measured by means of the MPL applied by Fehr and Goette (2007) and Gächter et al. (2010), which in essence is like the Holt and Laury price list but also includes negative payoffs. In this case, option A consists of a 50% probability of receiving €6 and a 50% probability of losing an amount between €1 and €10. When selecting the safe option B, participants receive €0 (see Figure 2 in Online Appendix G). Again, we are interested in the respondents' switching points.

Overall, the small stakes in these lotteries ensure that risk aversion cannot convincingly explain the choice behavior in these decisions, because risk aversion in such small-stakes lotteries would imply extreme degrees of risk aversion in high-stakes gambles (e.g., Rabin 2000, Wakker 2005, Fehr and Goette 2007, Wakker 2010). Rabin (2000) therefore argues that under expected utility theory, people should be risk neutral in such small-stakes gambles. We emphasize in our survey that selecting option A entails a real loss of money.

The benefit of the small-stakes mixed gamble is that it provides a simple proxy for loss aversion. Gächter et al. (2010) measure individual subjects' WTA/WTP ratios for a toy car and find that these are significantly and highly correlated with the small-stakes lottery choice we use in our experiment ($\rho = 0.635$). Loss aversion inferred from risky choices thus correlates strongly with loss aversion inferred from riskless choices, alleviating to some extent the concern that our loss aversion proxy might be confounded with risk aversion. Nevertheless, we acknowledge that there is still scope for criticism. In §4.3 we will therefore discuss two alternative elicitations of loss aversion that we used in a second experiment.

2.1.3. Ambiguity Aversion. Our measure of ambiguity aversion is taken from Fox and Tversky (1995) and Gneezy and Pietrasz (2014) and uses an MPL structure again. In each of the ten decisions, we present participants with an urn A with 50 red balls and 50 black balls, and an urn B with an unknown distribution of red and black balls. The selection of urn A pays off €300 if a red ball is drawn and €0 if it is black. If participants select urn B and a red ball is drawn, payments vary between €250 and €475; if a black ball is drawn, payment is €0 (see Figure 3 in Online Appendix G).

2.2. Sampling

According to Holm et al. (2013, p. 1676), obtaining a large-scale experiment involving hundreds of entrepreneurs and managers "…would be a demanding undertaking anywhere in the world. Owners and CEOs of established firms are rarely willing to devote their scarce time to time-consuming academic studies." They observe that some earlier studies solved this problem by studying the self-employed, others by using small (convenience) samples, whereas they themselves have gone to China to perform an incentivized experiment with affordable monetary awards. Their sample includes 700 private enterprises, excluding start-ups and small-scale household firms, and a random sample of 200 individuals as control group. They note that their control group is not ideal and that "…the ideal control group would be one that is identical to the entrepreneurs except that they are not entrepreneurs" (p. 1677).

We took a different route to obtain a large-scale sample in a Western country (the Netherlands), including a control group that is rather similar to the group of entrepreneurs. We decided to bring the lab to the field and obtain responses from participants online. This practice is not uncommon when aiming for a substantial response from the field (see, e.g., DeMartino and Barbato 2003, Block and Koellinger 2009, Graham et al. 2013). We were able to reach qualifying participants through the extensive network of the Amsterdam Center for Entrepreneurship (ACE). For entrepreneurs, we collaborated with Synpact, a company that has a "digital Rolodex" of a random selection of small and medium-sized enterprises, including 15,000 entrepreneurs in the Netherlands. The Rolodex is supported by frequent contacts through a wide variety of training programs and conferences. The 15,000 entrepreneurs all received an invitation to participate in the online research (see Online Appendix B for the translated letter). For managers, we collaborated with a large and highly reputable training center (De Baak), which is part of the largest influential employers' organization in the Netherlands (VNO-NCW, MKB-Nederland). The training center was willing to send our invitation to participate in the research to all managers they have on file, a total of 5,888. The same invitation was sent to a sample of 7,850 employees, who were recruited via a Dutch market research agency with access to over 70,000 Dutch employees.

Invitations to participate were sent out to the groups of entrepreneurs and managers on October 1, 2013 (round 1) and to the employees on November 4, 2013 (round 2). All groups had exactly 14 days to respond, and nonrespondents at that stage received a reminder after 7 days. Of all the people who

received the mailing, 910 entrepreneurs, 397 managers, and 981 employees completed the survey. Response rates were thus in the range of 6%–12%. These are comparable to the European response rates in, e.g., Graham et al. (2013) and were even high compared to earlier experiences of Synpact and De Baak with nonincentivized surveys. Finally, a comparison of respondents with nonrespondents based on the available observables (age and gender) yields no significant differences for entrepreneurs and managers. For the responding employees, however, females were slightly oversampled (53% versus 47%).

2.2.1. Incentives. Respondents were requested to first complete two parts of incentivized games and then fill out the survey, including the subjective measure of risk aversion and several background questions. This paper reports the results of the second part of the incentivized games only. All participants first received instructions about what to expect in general and about the reward structure. Instructions also included examples to familiarize the participants with the experimental setup. The total questionnaire took 14 minutes on average, including possible breaks that people took while online. Except for the general risk question, all decisions in our experiment were made incentive compatible and thus had real financial consequences if one was a selected as prizewinner. This was clearly communicated.

Incentives are such that participants can earn a maximum of €675 (€200 in part 1 and €475 in part 2) and a minimum of €90 (€100 in part 1 and −€10 in part 2), depending on their choices and luck. The luck component consists of three elements. First, decisions involve a random draw whenever a participant selects a risky or ambiguous option. Second, in each of the two parts, only one decision is randomly selected for payment. Such a procedure is quite common in the literature (see, e.g., Laury 2006, Dohmen et al. 2011) and is, according to Azrieli et al. (2012), the only incentive-compatible way to utilize the MPL method. Third, only a random selection of participants is selected as winners and actually paid. Given a limited budget and the income levels of the participants, we chose to pay out substantial (instead of very small) amounts to a few (instead of all) randomly selected participants. Bolle (1990), Starmer and Sugden (1991), Cubitt et al. (1998), and Laury (2006) all show that this payment procedure does not lead to different results compared to either the case where all participants are paid (Bolle 1990, Starmer and Sugden 1991, Cubitt et al. 1998) or the case where all decisions are paid (Laury 2006). In round 1 we randomly selected two winners from each day's completed participants' files in the first week and one winner per day in the second week. This resulted in 21 prizewinners in round 1 in total. In round 2, we paid five participants. Overall, chances of getting paid were 1/62 in round 1 and 1/196 in round 2. This was unknown to the participants (and ourselves) beforehand.

Our incentive structure has two potential drawbacks. First, although the prize structure was very transparent throughout, the probability of winning was unknown ex ante. Second, the realized probability of winning turned out to be low, because of unexpectedly high response rates, thereby diluted incentives. The unknown probability of winning might be problematic if entrepreneurs have systematically different beliefs about these probabilities. For instance, entrepreneurs might be more optimistic and therefore face stronger perceived incentives than nonentrepreneurs. We find an indicator that these differences in beliefs do not play an important role in a robustness test using data from a second experiment where the estimated probability of winning was communicated ex ante (see §4.3).

Because of the low probability of winning (ex post), some people might even believe that the probability of winning is so low, that they consider the decision hypothetical. This might weaken the validity of our approach, although hypothetical risk elicitations correlate with incentivized ones (e.g., Dohmen et al. 2011).

2.2.2. Draw and Payment Schedule. To foster trust, all prizewinners, as well as all other random draws, were performed by a civil law notary who also monitored a legitimate course of the payouts. The procedure at the notary was as follows. Before the start of the experiment, it was agreed that we would pay the 15th and 30th participant of each day in the first week and the 15th participant of each day in the second week. The daily rankings were established based on the registered end time of each survey. Furthermore, we also determined a payment schedule before the experiment that outlined the two winning choices in part 1 and part 2 for each prizewinner and whether the prizewinner was lucky when taking the risky option. The most involved part was to settle the ambiguity in our ambiguity aversion measure. Here we took two draws from two urns with 101 numbers (0–100). The first draw rendered a benchmark number that corresponded to the percentage of winning (e.g., 88 leads to an 88% chance of winning). The second draw from the other urn determined if a participant was lucky, which occurred whenever the second number was lower than or equal to the first number. Overall, these series of draws yielded a payment schedule that was accustomed to every choice a prizewinner could make. Participants were unaware of this procedure. The notary's official statement on the draws (in Dutch) is available upon request.

Table 1 Descriptive Statistics of the Measures of Risk Aversion, Loss Aversion, and Ambiguity Aversion

Panel A: Means

	Observations	Mean	SD	Minimum	Maximum
Risk aversion					
Survey measure[a]	2,288	3.67	1.79	0	10
Experimental measure	2,288	5.38	2.76	0	10
Loss aversion	2,288	5.05	2.65	0	10
Ambiguity aversion	2,288	5.74	3.64	0	10

Panel B: Correlations

Survey (S) or Experimental (E)	Risk aversion (S)	Risk aversion (E)	Loss aversion (E)	Ambiguity aversion (E)
Risk aversion				
Survey measure[a]	—			
Experimental measure	0.17***	—		
Loss aversion	0.12***	0.05***	—	
Ambiguity aversion	0.05***	−0.05***	−0.01	—

[a]Reverse coded measure of "willingness to take risks."
***Denotes statistical significance at the 1% level.

2.2.3. Default Definitions of Entrepreneurs, Managers, and Employees. The qualifying characteristics for inclusion in the entrepreneur sample were all people who have founded, inherited, or taken over a company that they are currently (co-)managing. We also classified participants as "entrepreneurs" who obtained firm ownership over a company within five years after start-up and who are currently its (co-)manager. Individuals qualify for inclusion in the sample of "managers" if they are employed by an organization that they did not start up themselves and have at least two subordinates for whom they are directly responsible. We also classify project managers as "managers" in the case that they have overall responsibility for their projects and at least two direct reporting lines. People belong to the group of "employees" if they are employed by an organization and do not belong to the first two groups.[9]

3. Descriptive Statistics

Panel A in Table 1 shows the sample descriptive statistics ($n = 2{,}288$) of the measures of risk aversion, loss aversion, and ambiguity aversion. Panel B reports the correlations between these variables. For ease of presentation we have reversely coded the survey measure of risk: a higher value implies a stronger aversion to risk. Note, however, that the levels of the different measures in panel A are not directly comparable. Furthermore, for the experimental measures of risk aversion, loss aversion, and ambiguity aversion, we worked with the number of safe options that a participant chose (in the case of ambiguity aversion, this was the number of risky (as opposed to uncertain) options). The more safe (or, in the case of ambiguity aversion, risky) options a participant preferred, the more averse the participant was.

Panel B shows that most of the correlations between the measures are rather low. The correlation with the highest absolute value is the one between the two measures of risk attitude. The survey-based measure of risk attitude is also correlated significantly with both loss aversion and ambiguity aversion, but to a lower degree. The low correlations between the three experimental measures support the idea that these measures capture distinct behavorial aspects of risk and uncertainty.

Table 2 shows the descriptive statistics of some characteristics that are used to define stricter subsamples of (more successful) entrepreneurs and managers. Panel A shows the income distribution of each of the three samples according to the answer categories used in the questionnaire.[10] Entrepreneurs are overrepresented in both tails of the income distribution relative to managers, which is a common observation (Hamilton 2000). We do not observe substantial differences between the average level of the entrepreneurial and managerial incomes, though. Both are higher than the income level of employees. For entrepreneurs

[9] Participants who are both entrepreneurs and managers or employees, and therefore eligible for multiple subsamples, were instructed to select the one generating most of their income. With the exception of 12 participants, these instructions were followed adequately.

[10] We allowed participants to keep their income level private, so panel A reports the distribution of the available data points. Overall, 656 entrepreneurs, 329 managers, and 820 employees were willing to share their income levels (which equal 72%, 83%, and 84%, respectively). Comparing responders and nonresponders on the income question with each other shows no differences in terms of average age, gender, education, and experience (in two-sample t-tests).

Table 2 Descriptives of Variables to Define Sample Splits

	Entrepreneurs (% of $n = 910$)		Managers (% of $n = 397$)	Employees (% of $n = 981$)
Panel A: Income		Panel A: Income		
<€25,000	23	<€25,000	2	26
€25,001–€50,000	20	€25,001–€50,000	17	58
€50,001–€75,000	19	€50,001–€75,000	34	12
€75,001–€125,000	20	€75,001–€125,000	36	3
€125,001–€200,000	11	€125,001–€200,000	8	1
€200,001–€300,000	4	€200,001–€300,000	2	0
€300,001–€400,000	1	€300,001–€400,000	0	0
>€400,000	2	>€400,000	1	0
Panel B: Entrepreneur characteristics		Panel B: Manager characteristics		
Founder	82	CEO	17	—
Business taken over	14	General manager	65	—
Joined the firm within 5 yrs	4	Project manager	18	—
Panel C: Firm age and legal structure		Panel C: Firm age and size		
Start-up phase (0–3 yrs)	20	Firm age ≤ 5 yrs	5	6
Survival phase (0–5 yrs)	38	Firm age 6–50 yrs	50	55
		Firm age > 50 yrs	45	39
Incorporated	49	Firm size ≤ 25 FTE	13	19
Sole proprietorship	38	Firm size 26–1000 FTE	53	50
Other	13	Firm size > 1000 FTE	34	31
Panel D: Firm size		Panel D: Management level		
No. of FTE in own firm:		Direct reports:		
0	17	2–5	45	—
1	26	6–10	30	—
2–5	25	11–25	19	—
6–10	10	26–50	4	—
11–25	11	More than 50	2	—
26–50	5			
51–100	4			
101–500	1			
More than 500	1			

Note. FTE, full-time equivalent employees.

and managers, the median income is in the category of €50,001–€75,000. For employees the median value falls in a lower category, i.e., €25,001–€50,000, which is in line with the modal income of €33,500 in the Netherlands in 2013. For all groups we will analyze subsamples of above median income earners.

Panel B shows that 82% of the entrepreneurs in our sample are the founders of their firms, a commonly used stricter definition of entrepreneurs. Of the firms, 14% were acquired through a takeover, and in 4% of the cases, the entrepreneurs have bought themselves into the business they currently (co-)manage within five years after its start-up. For managers we are interested in subsamples of CEOs (17%) and all managers except those who are responsible for projects rather than people (82%). Panel C shows that 20% (38%) of the entrepreneurs are currently managing and leading young firms in their start-up (survival) phase. Some studies define entrepreneurs exclusively as the owners/managers of start-ups (e.g., Brockhaus 1980), whereas other studies explicitly take them out (Holm et al. 2013). We shall use the same distinctions to test the robustness of our results against using various definitions of the entrepreneur. Panel C also shows that almost half of the entrepreneur sample consists of incorporated business owners. This enables us to limit the sample of entrepreneurs to incorporated business owners consistent with, e.g., Levine and Rubinstein (2013). The right-hand side of panel C shows the age and size distributions of the firms for which managers and employees work. As expected, these distributions are similar but different from the ones of entrepreneurial firms. The latter are younger (see panel C) and smaller (see panel D). As a robustness check, we split the sample of entrepreneurs and managers according to the age and size distribution of their firms. Managers in smaller and younger (i.e., more entrepreneurial) firms may be more similar to entrepreneurs.

Panel D of Table 2 shows the distribution of the number of employees employed by entrepreneurs and supervised by managers. Of the entrepreneurs, 17% have zero employees and 43% have at most one. We also consider a stricter definition of entrepreneurship based on the number of employees they employ (see, e.g., Tag et al. 2013) and perform a similar exercise for managers.

Table 3 Background Characteristics of Entrepreneurs, Managers, and Employees

	Entrepreneurs ($n = 910$)	Managers ($n = 397$)	Employees ($n = 981$)
Age	47.36[a]	46.45[b]	41.24[a, b]
Female (dummy)	0.25[a]	0.28[b]	0.53[a, b]
Education (highest degree)	[c]	[d]	[c,d]
High school (%)	4	2	3
Lower intermediate vocational degree (%)	12	11	34
College education (%)	46	42	42
University education (%)	38	45	21

[a]Significant difference between entrepreneurs and employees at the 5% level (two-sample *t*-test).
[b]Significant difference between managers and employees at the 5% level (two-sample *t*-test).
[c]Significant difference between entrepreneurs and employees at the 5% level (Kolmogorov–Smirnov test).
[d]Significant difference between managers and employees at the 5% level (Kolmogorov–Smirnov test).

Table 3 compares background characteristics of the three subsamples. Entrepreneurs and managers are similar in terms of the most commonly used background characteristics: their age and the percentage of females, as well as their experience and educational background. Employees are different in terms of their background characteristics compared to the other two groups: they are somewhat younger (mean age is 41), more likely to be female, and have lower educational degrees on average.

4. Results

4.1. Main Results

To get a first impression of our main findings, Table 4 shows the means of the four measures of risk and uncertainty for each of the three groups of interest. The first column in Table 4 shows that entrepreneurs subjectively assess themselves as less risk averse than managers. Managers, in turn, rate themselves as less risk averse than employees. Two-sample *t*-tests reveal that the differences between entrepreneurs and employees, entrepreneurs and managers, and managers and employees are all highly significant ($p < 0.001$ in all cases). Rank-sum and Kolmogorov–Smirnov tests confirm these results.

The second column of Table 4 shows that the experimental measure of risk aversion is not significantly lower for entrepreneurs when compared to managers, although both entrepreneurs and managers are significantly less risk averse than employees.[11]

Table 4 Raw Differences in Risk Aversion, Loss Aversion, and Ambiguity Aversion

Survey (S) or Experimental (E)	Risk aversion (S)	Risk aversion (E)	Loss aversion (E)	Ambiguity aversion (E)
Entrepreneurs ($n = 910$)	3.10[a, b]	5.03[a]	4.77[a, b]	5.88[a]
Managers ($n = 397$)	3.69[b, c]	5.17[c]	5.08[b]	5.90[c]
Employees ($n = 981$)	4.20[a, c]	5.78[a, c]	5.29[a]	5.54[a, c]

[a]Significant difference between entrepreneurs and employees at the 5% level (two-sample *t*-test).
[b]Significant difference between entrepreneurs and managers at the 5% level (two-sample *t*-test).
[c]Significant difference between managers and employees at the 5% level (two-sample *t*-test).

The rest of the table reveals that the raw differences in terms of loss aversion show a similar pattern: entrepreneurs are least loss averse, followed by managers and employees. Here the difference between entrepreneurs and managers is significant at the 5% level, whereas the difference between managers and employees is not ($p = 0.08$). The last column of Table 4 reveals an unexpected pattern: entrepreneurs and managers, who are equally ambiguity averse, are more ambiguity averse than employees. Finally, a closer examination of the cumulative distribution functions (CDFs) of the four measures for the subsamples of entrepreneurs, managers, and employees (see Figure 4 in Online Appendix G) shows that the differences in mean values are not driven by extreme values.[12]

In Table 5 the output of ordered probit regressions for each of the four behavorial variables is depicted. Control variables such as age, gender, education, experience, and income are included.

[11] In terms of the certainty equivalents (CEs) per group, we find that the average CE category is equal to €125–€150 for entrepreneurs and managers and equal to €100–€125 for employees. As expected, all average values are below the expected value of €150. The associated constant relative risk aversion (CRRA) coefficients would be approximately 0–0.21 for entrepreneurs and managers and 0.21–0.37 for employees, the latter being in line with the lower bound of the study of Holt and Laury (2002) among students (however, see Rabin 2000 for a criticism of this approach).

[12] The CDFs for ambiguity aversion reveal that a large fraction of participants (±30%) always refrained from the ambiguous option and preferred the risky one. These findings are roughly comparable to those in Gneezy and Pietrasz (2014), who find for their overall sample a percentage of 24% (30% for men) that never chose the ambiguous option. With hindsight, a potential drawback of our measure is that subjects could not choose the winning color in the case wherein they would opt for the uncertain urn themselves. Choosing the risky urn may then be guided by pessimistic beliefs about the success probability of the assigned winning color (red) in the uncertain urn, for instance sparked by a fear that we as experimenters would want to economize on our budget and stack the desk against them. This may explain the slightly higher percentage we find as compared to Gneezy and Pietrasz (2014), who properly do have subjects self-selecting their winning color. See Trautmann and Van der Kuilen (2015) for a general review of measuring ambiguity attitudes experimentally, including a brief discussion of the mixed evidence on subjects having such strategic perceptions.

Table 5 Risk Aversion, Loss Aversion, and Ambiguity Aversion of Entrepreneurs, Managers, and Employees

Dependent variable:	(1a) *Risk aversion*	(1b) *Risk aversion*	(2a) *Risk aversion*	(2b) *Risk aversion*	(3a) *Loss aversion*	(3b) *Loss aversion*	(4a) *Ambiguity aversion*	(4b) *Ambiguity aversion*
Survey (S) or Experimental (E)	(S)	(S)	(E)	(E)	(E)	(E)	(E)	(E)
Entrepreneur	−0.655***	−0.650***	−0.261***	−0.282***	−0.200***	−0.207***	0.104**	0.020
	[−12.43]	[−9.23]	[−5.05]	[−4.03]	[−3.89]	[−3.06]	[1.99]	[0.29]
Manager	−0.256***	−0.203***	−0.203***	−0.254***	−0.093	−0.018	0.120*	0.048
	[4.23]	[−2.63]	[−3.32]	[−3.29]	[−1.52]	[−0.23]	[1.88]	[0.59]
Age	0.030**	0.037**	−0.021	−0.027*	−0.013	−0.008	0.006	0.010
	[2.20]	[2.28]	[−1.51]	[−1.68]	[−0.98]	[−0.54]	[0.47]	[0.69]
$Age^2/100$	−0.002	−0.003	0.002	0.003*	0.002	0.001	−0.001	−0.002
	[−1.57]	[−1.59]	[1.60]	[1.81]	[1.03]	[0.69]	[−0.76]	[−0.95]
Female	0.234***	0.134**	0.031	−0.001	0.061	0.037	−0.002	−0.011
	[4.98]	[2.49]	[0.66]	[−0.02]	[1.31]	[0.66]	[−0.03]	[−0.21]
Education		0.087***		0.035		0.030		0.033
		[2.59]		[1.10]		[0.96]		[1.01]
Experience		0.004		−0.001		−0.001		−0.003
		[1.21]		[−0.11]		[−0.26]		[−0.94]
Ln(*income*)		−0.134**		0.008		−0.067**		0.047
		[3.74]		[0.24]		[−1.98]		[1.31]
Constant	1.598***	2.669***	2.370***	2.393***	1.535***	2.093***	0.995	0.412***
	[5.34]	[5.45]	[8.07]	[5.27]	[5.63]	[4.74]	[0.90]	[3.51]
Observations	2,288	1,805	2,288	1,805	2,288	1,805	2,288	1,805
Log likelihood	−4,235.25	−3,333.91	−5,055.4	−3,970.4	−4,920.8	−3,865.8	−4,919.7	−3,841.1
ENT = MAN[a]	<0.01***	<0.01***	0.31	0.60	0.06*	<0.01***	0.80	0.36

Notes. The categorical variables "education" and "income" have been summarized into one variable instead of using a set of dummies. The education variable takes on the value 0 if the highest attained level is high school or lower, 1 if secondary education is obtained at a higher level, 2 if a participant has college education, and 3 if the participant has a university degree. Income has been collapsed into one continuous variable of which the natural log (ln) has been taken, using the midpoints of the categories (and €1 million for the upper category). Experience measures the years of experience as entrepreneur, manager, and employee, respectively. Standard errors are robust.

[a]This reports the *p*-value of the Wald test *Entrepreneur* = *Manager*.

*, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Columns "a" show the results excluding some arguably endogenous variables (i.e., education, experience and income), whereas columns "b" include those as explanatory variables (analogous to, e.g., Dohmen et al. 2010). Note that the number of observations in columns "b" drops because some participants were unwilling to share their income levels.

Table 5 paints a similar picture as Table 4. The first estimation equation shows that entrepreneurs view themselves as less risk averse than managers (see the Wald test in the last row of Table 5), whereas both entrepreneurs and managers are less risk averse than employees. These findings are largely consistent with previous studies using survey-based measures of risk aversion. The second set of estimates supports the view arising from Table 4 that entrepreneurs are similar to managers when taking risky decisions in an experimental and incentivized environment, although they perceive themselves as more risk taking than managers. Again we find that both entrepreneurs and managers are less risk averse than employees with similar background characteristics. The third set of results shows that one behavioral characteristic is unique for entrepreneurs: a lower level of loss aversion. The fourth and final set of results indicates that the differences between employees on the one hand and entrepreneurs and managers on the other hand in terms of ambiguity aversion disappear when including more controls in the equation. Apparently, entrepreneurs, managers, and employees that are comparable in terms of their age, gender, education, income, and experience do not show differences in their attitudes toward ambiguity. This result was also obtained by Holm et al. (2013).

The control variables also have different associations with the survey-based measure of risk than with all three experimental measures. Older people claim to be less willing to take risks in general (consistent with Dohmen et al. 2011), but none of the three experimental measures is significantly associated with age. Females are less risk taking, according to the survey-based measure (also consistent with Dohmen et al. 2011), but the choice-based measures are no different for females than for males. The latter result is largely consistent with the conclusions from a recent meta-analysis about gender differences

Table 6 Relationship Between Subjective and Objective Measures

Dependent variable: Survey (S) or Experimental (E)	(1a) *Risk aversion* (S)	(1b) *Risk aversion* (S)
Risk aversion (E)	0.107***	0.088***
	[7.36]	[6.20]
Loss aversion (E)	0.072***	0.058**
	[4.71]	[3.90]
Ambiguity aversion (E)	0.032***	0.036***
	[3.03]	[3.56]
Entrepreneur		−1.005***
		[−12.64]
Manager		−0.448***
		[−4.51]
Constant	2.547***	3.175***
	[20.62]	[23.76]
Observations	2,288	2,288
Log likelihood	−4,522.4	−4,443.2

** and *** denote statistical significance at the 5% and 1% levels, respectively.

in risk attitudes elicited by this type of game (Filippin and Crosetto 2014). Surprisingly, for education we find a slightly positive effect using the survey-based Dohmen measure of risk appetite (as opposed to, e.g., Harrison et al. 2007), but no significant effect when using any of the experimental measures. People with higher incomes view themselves as less risk averse by comparison; in Dohmen et al. 2010 the effect of household income is the same but just insignificant. Interestingly, higher-income people are less loss averse according to the experimental measure but not less risk averse or ambiguity averse.

In an effort to reconcile the abovementioned findings, we have also directly compared the subjective and objective measures of risk and ambiguity (see also Ding et al. 2010 and Willebrands et al. 2012 for comparisons of subjective and objective risk measures). Table 6 shows that the subjective assessments of respondents' risk attitudes are not only correlated with the experimental risk measure, but also with loss aversion and ambiguity aversion. All three coefficients in the ordered probit regression on risk attitude are highly significant and have the expected positive sign. The measure of risk has the highest association with the self-assessed risk attitude, but both loss aversion and ambiguity aversion play a significant part in the explanation of the self-assessed value. The result is the same both without (column 1a of Table 6) and with (column 1b) controls for entrepreneurs and managers.

Overall, we conclude from Table 6 that subjective assessments of risk attitude serve as proxy for more than just risk aversion. This could explain why entrepreneurs perceive themselves as being less risk averse than managers although the objective measure of risk aversion has a similar value for entrepreneurs and managers. Entrepreneurs might perceive themselves less risk averse based on their lower level of loss aversion that they (rightly or wrongly) mix up with the economist's definition of risk aversion. An additional explanation for the larger differences between managers and entrepreneurs in the survey risk measure compared to the experimental measure might be experimenter demand effects based on stereotypes; according to common wisdom, entrepreneurs are expected to be more risk taking, and their own subjective assessment may partly reflect these general expectations. In our second experiment (see §4.3) we tried to reduce experimenter demand effects by being less upfront about the purpose of our study. We obtain the same results, however, which alleviates the concerns that demand effects might be the main driver.

4.2. Robustness Checks

In this section we will first test to what extent the results remain the same when using stricter definitions of entrepreneurs and managers. Table 2 shows that the samples of entrepreneurs, managers, and (to a lesser extent) employees are suitable for the creation of subsamples based on alternative and common definitions of entrepreneurs, managers, and employees. Table 7 displays the main result of Table 5, using various alternative definitions. Thus, each coefficient is obtained in a separate regression (see Table 5 for the specifics of these regressions).

For entrepreneurs we use a set of stricter definitions in congruence with the literature mentioned earlier in §3. We use the subsets of (i) entrepreneurs with an incorporated firm, thereby mainly excluding those self-employed by their own account; (ii) entrepreneurs with an above-median number of full-time equivalent employees in their company; (iii) entrepreneurs with above-median incomes; (iv) entrepreneurs that have founded their business, instead of obtaining it through takeover or buy-in; (v) entrepreneurs in the survival phase (firm age ≤ 5 years); and (vi) entrepreneurs past their survival phase (firm age > 5 years). Panel A of Table 7 shows the results of confronting the data with these alternative definitions of the entrepreneur. For managers and employees we employ the original samples. The last line in panel A shows the result of Table 5 again.

The panel shows a clear pattern consistent with the findings in Table 5. Whatever definition of the entrepreneur is used, entrepreneurs assess themselves as more risk taking than both managers and employees. Using objective measures of risk and uncertainty, the data show again that entrepreneurs and managers are equally risk averse, but less so than employees. The only notable and significant difference with

Table 7 Differences in Risk Attitude Using Stricter Definitions of Entrepreneurs and Managers

Dependent variable: Survey (S) or Experimental (E)	(1) *Risk aversion* (S)	(2) *Risk aversion* (E)	(3) *Loss aversion* (E)	(4) *Ambiguity aversion* (E)
Panel A: Subsets of entrepreneurs, all managers, and employees				
(i) Incorporated ($n = 446$)	$-0.702^{a,b}$ [−7.84]	$-0.442^{a,b}$ [−3.78]	$-0.400^{a,b}$ [−3.43]	0.077 [0.65]
(ii) Above-median no. of employees ($n = 401$)	$-0.730^{a,b}$ [−7.41]	-0.282^{a} [−2.59]	$-0.270^{a,b}$ [−2.46]	0.083 [0.75]
(iii) Above-median ent. income ($n = 377$)	$-0.613^{a,b}$ [−5.63]	$-0.404^{a,b}$ [−3.86]	−0.109 [−1.60]	−0.119 [−0.91]
(iv) Founder ($n = 757$)	$-0.598^{a,b}$ [−7.71]	-0.218^{a} [−2.81]	$-0.280^{a,b}$ [−3.68]	0.011 [0.75]
(v) In survival phase (firm age $\leq$ 5 yrs., $n = 347$)	$-0.640^{a,b}$ [−6.01]	-0.257^{a} [−2.54]	$-0.258^{a,b}$ [−2.65]	−0.042 [−0.39]
(vi) Not in survival phase (firm age $>$ 5 yrs., $n = 563$)	$-0.611^{a,b}$ [−7.44]	-0.239^{a} [−2.88]	$-0.249^{a,b}$ [−2.98]	−0.001 [−0.02]
β(Entrepreneur) in Table 5	$-0.650^{a,b}$	-0.282^{a}	$-0.207^{a,b}$	0.020
Panel B: Subsets of managers, all entrepreneurs, and employees				
(vii) CEO or general manager ($n = 324$)	$-0.218^{b,c}$ [−2.53]	-0.274^{c} [−3.27]	-0.044^{b} [0.52]	−0.006 [−0.08]
(viii) CEO ($n = 66$)	$-0.319^{b,c}$ [−2.40]	-0.367^{c} [−2.57]	-0.020^{b} [−0.40]	−0.087 [−0.55]
(ix) Above-median no. of direct reports ($n = 219$)	$-0.197^{b,c}$ [−2.31]	-0.259^{c} [−3.04]	−0.048 [−0.49]	0.083 [0.79]
(x) Above-median man. income ($n = 155$)	$-0.202^{b,c}$ [−1.97]	-0.370^{c} [−3.22]	-0.010^{b} [−0.06]	0.009 [0.07]
(xi) Manager in a firm that is $>$ 15 years old ($n = 316$)	$-0.195^{b,c}$ [−2.22]	-0.247^{c} [−2.86]	-0.033^{b} [−0.38]	0.125 [1.35]
β(Manager) in Table 5	$-0.256^{b,c}$	-0.254^{c}	-0.018^{b}	0.048
Panel C: Combinations of panels A and B				
(i) vs. (viii); p-values Wald tests	$<$0.01	0.57	0.01	0.67
(ii) vs. (ix); p-values Wald tests	$<$0.01	0.59	0.17	0.73
(iii) vs. (x); p-values Wald tests	$<$0.01	0.25	0.04	0.46
Control variables	Yes	Yes	Yes	Yes

[a]Significant difference between (subset of) entrepreneurs and employees at the 5% level (Wald test).
[b]Significant difference between (subset of) entrepreneurs and (subset of) managers at the 5% level (Wald test).
[c]Significant difference between (subset of) managers and employees at the 5% level (Wald test).

the benchmark appears when limiting the sample to incorporated entrepreneurs. They are significantly less risk averse than both managers and employees. We found similar results when considering only the sample of entrepreneurs (and adding dummies for the various groups); see Online Appendix C. All in all, loss aversion is the one behavorial feature that distinguishes entrepreneurs from managers; the results in Table 5 turn out to be robust against using various stricter definitions of (successful) entrepreneurship.

Panel B of Table 7 shows the results when varying the definition of a manager while keeping the baseline samples of entrepreneurs and employees. Again we find that the main results remain, irrespective of the definition used. We restrict the sample to (vii) CEOs or general managers (as opposed to project managers), (viii) CEOs exclusively, (ix) managers with more than the medium number of direct reports, (x) managers with above-median managerial income, and (xi) managers in firms that are older than 15 years. The stricter definitions used do not only restrict the sample to more successful managers but also, in some cases, to managers that can reasonably be expected to be more different from entrepreneurs than average, such as the ones employed in older firms. Again, the last line of the panel shows the result for managers copied from Table 5, i.e., the benchmark.

Panel C finally tests some of the alternative definitions against each other. Whether we compare

entrepreneurs of incorporated firms (i) with CEOs (viiii), or whether we compare entrepreneurs (ii) and managers (ix) with larger spans of control or higher than median incomes ((iii) versus (x)), the results remain very similar to the main findings, according to the Wald statistics in each of these cases.[13]

In Online Appendix D, we have run another set of regressions to further examine potential heterogeneous effects. First of all, we pooled the responses of managers and employees to see if and how entrepreneurs differed from all others. As might be expected, we find that entrepreneurs stand out from this pooled group in both risk aversion and loss aversion, but not in ambiguity aversion.[14] Second, to better understand the separate role of the organization they work for, we have restricted the sample to entrepreneurs and managers in young and small firms (i.e., at most 15 years old and at most 25 employees, respectively). Obviously, organizational size and age are lower for entrepreneurs than for managers and just adding controls for firm size and age to the general regression specification might be insufficient. The results are qualitatively similar to the main results, although some of the significance levels have dropped a bit (possibly because of the smaller samples).

Another check is based on the idea that many people are belonging to one of the groups at the time of measurement, but may have been part of another group in the past. In other words, the distinction among the three groups in terms of typology is not black and white. Possibly, the differences among the "pure" groups are larger when taking into account that some individuals belong to "gray" areas. Online Appendix E reports the results from analyses that take this into account. We first find that 71% of the entrepreneurs in the sample have been managers in the past, and 9% are currently wage employees or managers besides being business owners. Moreover, 17% (10%) of the managers (employees) are also entrepreneurs on the side, whereas 12% (9%) of the managers (employees) have been so in the past. Apparently, people move out of and especially into entrepreneurship in the course of their professional lives. Rerunning the same regressions, but now controlling for the gray areas, shows that the effects found in Table 5 (and Table 7) do not change when accounting for past and current positions in the other groups. The coefficients of the controls that distinguish the gray groups from the pure groups have the expected signs (diminishing the main effect), but they are not significant.

4.3. Second Experiment with Alternative Elicitations of Loss Aversion[15]

The loss aversion measure we employ in our first experiment records subjects' WTA a mixed prospect with small gains and losses. According to Rabin (2000), traditional risk aversion deriving from utility curvature cannot play a role with small stakes (see also Wakker and Deneffe 1996). Identifying loss aversion using small-stakes mixed prospects has some drawbacks, though. First, one may reasonably wonder whether losing €10 at most is something entrepreneurs and managers truly worry about. Second, choices in mixed prospects may be affected by probability weighting and utility curvature as well, potentially confounding loss aversion with other drivers of decisions under risk. In December 2014, we therefore ran a second experiment in which we elicited loss aversion in two alternative ways. This second survey was sent to the same databases of entrepreneurs, managers, and employees as described in §2.2.

The first alternative measure is based on riskless choices and compares subjects' WTA with their WTP for a given good. We employ a between-subjects design similar to Kahneman et al. (1990). Gächter et al. (2010) measure individual subjects' WTA/WTP ratios for a toy car using a within-subjects design and compare the results to those obtained from a between-subjects control treatment. They find no systematic differences in the WTA and WTP valuations. Reliable estimates of individual WTA/WTP ratios require sufficient time between the WTA and WTP elicitations, as well as the use of the strategy method (see Gächter et al. 2010). Both of these features are unattractive for our purposes, because our subject pool requires that we keep the experiment as short and simple as possible. This motivates our choice for a between-subjects design.

Each of the three occupational groups is randomly cut in halves: either we elicit their WTP or their WTA for a fancy bread tray. Half of the sample is offered the opportunity to buy the tray from us (for a price between €0 and €20, in steps of €2) using their prize money, whereas the other half is offered the opportunity to sell the tray (that they obtained as part of their prize money) back to us. Following Gächter et al. (2010), we employed an incentive-compatible elicitation procedure where subjects indicate their willingness to trade at a randomly drawn price (see Figures 5 and 6 in Online Appendix G). We take the midpoint of

[13] We also employed a stricter definition of employees by limiting that subsample to above-median income earners. Again the results were the same.

[14] Here we have just pooled all managers and employees together, but obviously in practice the distribution of managers and employees is much different. This would lead to even more distinct results.

[15] This experiment was suggested by the handling editors and reviewers.

Table 8 Raw Differences in Risk Aversion and Loss Aversion (Second Experiment)

Survey (S) or Experimental (E)	Risk aversion (S)	Risk aversion (gain) (E)	Risk aversion (loss) (E)	Loss aversion (E)	Willingness to accept (WTA) (E)	Willingness to Pay (WTP) (E)
Correspondence with first experiment	Exact	Exact	—	Times 50	—	—
Entrepreneurs ($n = 697$)	2.88[a, b]	5.16[a]	3.86	2.68[a, b]	€9.46[a, b]	€5.73
Managers ($n = 265$)	3.33[b, c]	5.09[c]	3.97	3.51[b]	€11.56[b]	€6.21
Employees ($n = 969$)	3.79[a, c]	6.07[a, c]	3.74	3.70[a]	€10.53[a]	€5.27

[a]Significant difference between entrepreneurs and employees at the 5% level (two-sample t-test).
[b]Significant difference between entrepreneurs and managers at the 5% level (two-sample t-test).
[c]Significant difference between managers and employees at the 5% level (two-sample t-test).

the resulting reservation price interval as the inferred reservation price (either WTA or WTP). For instance, when a participant buys the bread tray at a price of €4 but not at a price of €6, we take the midpoint of €4 and €6, i.e., €5, as the participant's reservation value. Conversely, when a participant in the WTA treatment is willing to let go of the bread tray for €12 but not for €10, we work with a reservation price of €11.

The second alternative measure of loss aversion we obtain is (again) a measure of loss aversion in risky choices, but now with much higher stakes. More specifically, we confront subjects with three lottery choice tasks: one in the gain domain, one in the mixed domain, and one in the loss domain. The one in the gain domain exactly matches our risk aversion measure in experiment one. Subjects choose between option A, which gives a 50% chance of winning €300 (and a 50% chance of winning €0), and option B, which yields a given fixed amount for sure, where the fixed amount ranges from €25 to €250 (in steps of €25). The lottery used in the mixed domain corresponds to our original loss aversion measure scaled up by a factor of 50. Thus, option A now gives a 50% chance of winning €300 and a 50% chance of losing a given amount, where the loss ranges from €0 to €350 (in steps of €50).[16] Finally, the lottery choice task in the loss domain is the mirror image of the gain domain. Subjects then choose between a 50% chance of losing €300 (option A) and a sure loss of a given amount (option B, with the loss ranging from €25 to €250). By adding this third lottery we can investigate whether entrepreneurs are especially different in how they cope with (unavoidable) losses, or rather in how they trade off potential gains against potential losses.

[16] Overall, the setup was almost equal to the first experiment and very similar to, e.g., Eckel and Grossman (2008). That is, all participants earned a base fee of €375 by completing the other parts of the survey (which are not in scope of this paper), and all gains and losses made were added to/subtracted from this base payment. We made it very explicit that making losses entailed really losing money. The maximum loss was capped at €350 (instead of €500) such that a participant's earnings could not go negative.

Finally, we also include the subjective unincentivized risk attitude measure again.

We also improved on our first experiment in other ways. To avoid differences in beliefs about winning probabilities potentially confounding our results, we now explicitly informed subjects of the expected likelihood of being selected as a prizewinner. Subjects were told beforehand that, on the basis of our previous experience, their chances of becoming a prizewinner were approximately 1 in 100. Moreover, this time we were also less upfront about the purpose of our study. In the first experiment we mentioned in our cover letter that our study aims to explore "...differences in decision making between entrepreneurs, managers and employees" (see Online Appendix B). We did so in the hope that it would increase response rates. Yet a potential worry might be that this leads to unwanted experimenter demand effects based on stereotypes. In our second experiment we therefore just mentioned that our research "...aims to study decision-making processes." Finally, based on our desire to minimize response times (and the measured response times in the first experiment for this specific part), we used a bisection procedure that led subjects to their switching point via three to four binary choices (see Abdellaoui 2000, Abdellaoui et al. 2007, and Abdellaoui et al. 2008 for illustrations).

The final sample is again large. Overall, 697 entrepreneurs, 265 managers and 969 employees participated ($n = 1{,}931$). Only 18% of them participated in both research waves. Furthermore, in terms of individual and company characteristics, the three samples proved rather similar to the first experiment. For instance, for each occupational group we find no differences in gender and education and small differences in age.

The results of the second experiment are shown in Tables 8 and 9. They confirm that entrepreneurs are indeed less loss averse than both managers and employees. The cleanest piece of evidence comes from examining loss aversion in riskless choices, i.e., our first alternative measure of loss aversion,

Table 9 WTA–WTP Gaps of Entrepreneurs, Managers, and Employees (Second Experiment)

Dependent variable:	(1) *Price*	(2) *Price*	(3) *Price*
WTA	9.652***	9.719***	9.104***
	[16.35]	[16.55]	[14.46]
Entrepreneur	1.113*	2.026***	2.293**
	[1.72]	[2.82]	[2.57]
Manager	1.519*	2.546***	1.829*
	[1.73]	[2.74]	[1.74]
Entrepreneur × *WTA*	−3.014***	−3.173***	−3.993***
	[−3.38]	[−3.57]	[−3.84]
Manager × *WTA*	−0.970	−0.992	−0.533
	[−0.78]	[−0.81]	[−0.41]
Age		−0.211*	−0.281*
		[−1.69]	[−1.92]
$Age^2/100$		0.163	0.245
		[1.19]	[1.51]
Female		0.941**	1.237**
		[2.20]	[2.47]
Education		−0.831***	−0.938***
		[−3.41]	[−3.29]
Experience		−0.009	−0.009
		[−0.32]	[−0.29]
Ln(*income*)			0.595*
			[1.76]
Constant	2.322***	10.15***	5.981
	[5.40]	[3.59]	[1.33]
Observations	1,931	1,931	1,492
Log likelihood	−5,224.6	−5,210.3	−4,072.5
ENT × *WTA* = *MAN* × *WTA*[a]	0.11	0.09*	0.01**

[a]This reports the *p*-value of the Wald test *Entrepreneur* × *WTA* = *Manager* × *WTA*.

*, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

because there (by definition) risk motivations cannot play a role. The final column in Table 8 shows that the WTP for the bread tray does not differ among the three groups. Entrepreneurs, however, have a significantly lower WTA than both managers and employees. When we use the WTA/WTP ratio based on group averages as a proxy for loss aversion, entrepreneurs score lowest at 1.65, followed by managers at 1.86 and employees at 2.00. These values are in line with those obtained in previous studies that elicited WTA and WTP in a between-subjects design (see, e.g., Kahneman et al. 1990, Gächter et al. 2010; see Horowitz and McConnell 2002 for a review of WTA/WTP studies). A more rigorous comparison of the first alternative measure of loss aversion follows from the Tobit regressions in Table 9 that aim to explain the respondents' inferred reservation prices. Here, employees' WTP serves as the benchmark category. The dummy *WTA*, equal to one if the observed reservation price belongs to a subject in the seller role rather than in the buyer role, captures the WTA–WTP gap. The main variables of interest are the interaction terms *Entrepreneur* × *WTA* and *Manager* × *WTA*. The former appears to be highly significant in all three specifications, and the latter is always insignificant. The final row in Table 9 compares these two interaction terms using a Wald test, showing that for entrepreneurs the WTA–WTP gap is significantly lower than for managers.[17]

The second alternative measure of loss aversion based on risky choices corroborates our earlier findings, too. The scaled-up version of the mixed prospect (labeled "Loss aversion") gives the same findings as before.[18] In addition, we again find that entrepreneurs subjectively believe that they are more willing to take risks than managers, although their incentivized lottery choices in the gain domain again reveal no differences in risk attitude (see the first two columns in Table 8). We find this for the pure loss domain not studied in the first experiment; see the third column in Table 8. Entrepreneurs thus differ from managers (only) when directly trading off potential gains against potential losses.[19]

Combining this latter combination of findings with prospect theory actually lends further support to our finding that entrepreneurs are less loss averse than managers and employees. Prospect theory predicts that choices between risky prospects are governed by a combination of utility curvature, subjective probability weighting, and loss aversion. By definition, loss aversion only plays a role for mixed prospects. In contrast, utility curvature and probability weights affect choices for all types of prospects. The fact that we observe no differences between entrepreneurs and managers for the two nonmixed prospects (i.e., the gain domain and the loss domain), but do observe differences in the mixed domain, strongly suggests

[17] A potential concern might be that (for whatever reason) the 18% overlap in participants of the two experiments biases our conclusions. If we run the Tobit regressions on the 1,561 novice participants, we get exactly the same results (in terms of significance of the relevant coefficients).

[18] Note, however, that the average number of safe choices in each group is lower than the averages observed in the first experiment (see Table 4). This can be either due to the higher stakes in the second experiment or the lower range of possible values resulting from our capping at a loss of €350 (0–8 versus 0–10).

[19] In Online Appendix F we comprehensively report the equivalent analyses of Tables 1–7, as well as the heterogeneity checks of the previous subsection, for the second experiment. Overall, we obtain the same conclusions as before. Perhaps the most notable additional finding is that, within the sample of entrepreneurs, incorporated entrepreneurs are less risk loving in the loss domain, whereas founders are more risk loving in the case of unavoidable losses (see Online Appendix F8). Taken together with the fact that incorporated entrepreneurs are also less risk averse in the gain domain, this suggests that they have risk preferences that are closer to risk neutrality.

that loss aversion is the driver for why entrepreneurs behave differently.

By making parametric assumptions, some insights can be obtained in the extent of loss aversion. Assuming (piecewise) linear utility and a common specification of loss aversion as in Köbberling and Wakker (2005), the choices in the gain and loss domain identify probability weighting. These can thus be used to isolate the effect of probability weighting on the mixed prospect. Correcting for individual heterogeneity in probability weighting in this way, we calculate the inferred value of loss aversion coefficient λ for each individual (see Online Appendix F4 for a more detailed elaboration). The observed differences across occupational groups keep standing, and the median λ—equal to 1.71 for entrepreneurs, 1.87 for managers, and 1.82 for employees—compares reasonably well with other findings in the literature (see, e.g., the median value of 2.61 found in Abdellaoui et al. 2008, and of 2.25 in Tversky and Kahneman 1992).[20] Overall, we conclude that our main finding from the first experiment is not just a false positive or due to an arguably confounded measure of loss aversion. Also, for the two alternative loss aversion measures used in the second experiment, we find that, when comparing entrepreneurs with managers, much of the action comes from loss aversion and not simply risk aversion.

5. Conclusion

Common wisdom and economic theory alike portray entrepreneurs as a truly distinct breed. Most notably, the stereotype is that entrepreneurs, as business-owning residual claimants, are more willing and better able to cope with risk and uncertainty. Existing empirical studies that ask entrepreneurs and nonentrepreneurs to subjectively self-assess their attitude toward risk and uncertainty by and large confirm this conventional wisdom; entrepreneurs see themselves as more willing to take risks than nonentrepreneurs. Other studies that employ incentivized choice-based measures of risk aversion, however, find little difference between entrepreneurs and the comparison group employed. These opposing findings immediately raise the question of whether entrepreneurs' more positive attitude toward risk is merely a common (mis)perception, or whether they have truly distinct preferences.

In this paper we report the results from a lab-in-the-field experiment that sheds light on this matter. Our experiment has a number of distinguishing features. First of all, it is relatively large in size with 2,288 respondents overall, including 910 entrepreneurs. Second, we compare entrepreneurs with two well-defined control groups, namely managers and employees. Entrepreneurs and managers are very similar in terms of background characteristics and arguably also in terms of the professional decisions and tasks they face, including managing the employees they direct. Yet, as residual claimants, only entrepreneurs directly feel the financial consequences of the decisions they take. This difference especially is thought to draw people with distinct risk preferences into entrepreneurship. Differences between entrepreneurs and employees (both in terms of background characteristics and professional activities) are more pronounced. Third, we collect a large variety of background characteristics and measures of individual "success." This allows us to zoom in on particular subsamples, using more stringent definitions of both entrepreneurs and managers based on being "more successful." Last, we include both a subjective, survey-based measure of risk attitude, as well as incentivized, choice-based measures of risk-related preferences. This allows us to compare subjective perceptions of risk attitude with objective measures based on actual choices with true financial consequences. Besides a standard measure of risk aversion, we also include measures of loss aversion and ambiguity aversion.

In line with previous studies and conventional wisdom, the entrepreneurs in our sample on average perceive themselves as being more risk tolerant than the other respondents. This not only holds with respect to the employees in our sample but also to the more comparable control group of managers. Based on the incentivized choice-based measure of risk aversion, however, entrepreneurs are equally risk averse as managers (with employees being significantly more risk averse). The different perceptions of entrepreneurs and managers thus cannot be explained by differences in risk aversion as narrowly defined by economists. Rather, our results show that these different perceptions mainly result from significant differences in attitudes toward losses; managers are significantly more loss averse than entrepreneurs are (with employees in turn being more loss averse than managers, although not significantly). The three groups do not differ in terms of ambiguity aversion. These findings are largely independent of the definition of who is an entrepreneur and who is a manager. If anything, limiting the sample to more successful entrepreneurs somewhat strengthens our results.

Moreover, the results presented here also do not appear to be a false positive. In a large independent additional experiment across a predominantly new sample of entrepreneurs, managers, and employees in

[20] In line with Booij and Van de Kuilen (2009), we also find that females are significantly more loss averse than males. Unlike them, however, we find no effect of education on loss aversion.

which we elicit two additional measures of loss aversion, we find again that all of the action comes from loss aversion and not from risk aversion. This result is perhaps most affirmed when examining the WTA–WTP gaps of the three groups of interest. Consistent with loss aversion in risky choices, entrepreneurs also appear to have the lowest loss aversion in riskless choices, followed by managers and employees.

In an effort to reconcile all findings, we find that when self-assessing their "willingness to take risks in general" on a 0–10 scale, respondents appear to have a broader notion of "risk" in mind than the narrow risk aversion measure of economists (assuming experimenter demand effects away). Besides risk aversion, also ambiguity aversion and loss aversion play an important role in shaping individual perceptions. For the perceived difference between entrepreneurs and managers, loss aversion turns out to be key. Managers are on average more inclined to avoid losses than entrepreneurs are, leading to a lower self-assessed willingness to take risks.

Overall we conclude that, when it comes to attitudes toward risk and uncertainty, entrepreneurs are different but in a rather subtle way. The Merriam-Webster dictionary website defines an "entrepreneur'' as "...a person who starts a business and is willing to risk loss in order to make money." In terms of their willingness to risk losses, entrepreneurs indeed appear to be distinct.

Supplemental Material

Supplemental material to this paper is available at http://dx.doi.org/10.1287/mnsc.2015.2249.

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