# Overconfidence and Excess Entry in Entrepreneurship

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## Abstract

Entrepreneurs excessively enter the market and persist in their businesses despite high rates of failure and low rates of return. To investigate this phenomenon, we employ an interactive experiment to simulate market entry decisions. We have three major findings. First, overconfidence increases market entry. Second, overconfidence reduces market profit. Third, knowing more information about the market increases market profit by reducing overconfidence and excess entry.

## I. Introduction

Frank Knight (1921) argue that entrepreneurship should not be simply conceived as investment under risk with a known distribution of returns because market entry would eliminate any profit if such information can be objectively learned. Rather, he argued that entrepreneurs face highly uncertain returns and are more skilled than others in perceiving profitable opportunities. Knight (1921) thereby ushered in a new field that studies what qualities enable entrepreneurs to earn above average market profits. Despite these arguments, empirical studies of entrepreneurial profits often find the opposite. Hall and Woodward (2010) find that 75 percent of all startups deliver zero exit value, while only a tiny fraction of entrepreneurs receive more than $100 million. This inflates the average exit value to $5.8 million. Given the highly skewed returns of startups, Hall and Woodward (2010) imputed that the expected utility of starting a business for individuals with normal risk aversion is negative. Nevertheless, over 500,000 individuals in the United States start firms with at least one employee every year according to

Parker (2009). As a result, those who constantly generate losses persist in running businesses for a suboptimally long time (Hamilton 2000).

Our paper aims to examine the relationship between oversaturation in the entrepreneur market and profits. This is achieved through an interactive experiment that simulates market entry decisions. We argue that entrepreneurs excessively enter the market because they overestimate their relative skills among their competitors and therefore inflate their expected profit. This phenomenon, which we'll refer to  as overplacement, is well established in psychology literatures (Neil D. Weinstein, 1980; Shelly E. Taylor and J.D. Brown, 1988).

Our paper proceeds as the following. In section II, we summarize three major theories that explain excess entry in the entrepreneur market. In section III, we elaborate on our experimental design. In section IV, we describe the data collected. In section V, we introduce the specifications we use to test our hypothesis. In section VI, we discuss our regression results. In section VII, we present the implications of our study. In section VIII, we conclude with some final remarks.

## II. Three Major Theories on Entrepreneur Excess Entry

Although our argument exclusively focuses on overplacement, a subcategory of overconfidence, it helps to contextualize our theory within the broader literature. Firstly we will discuss the three major entrepreneur motive theories: expected utility theory, overconfidence theory and non-pecuniary reward theory. Then, we will elaborate on overconfidence theories and one of it subcategories, overplacement, which is the focus of our paper.

*A. Overview of three entrepreneur motive theories*

Given the same distribution of returns, expected utility theories dictate that individuals who are more risk seeking have greater certainty equivalents of risky outcomes and thus are more likely to gamble. Given the extremely skewed distribution of startup exit values, Hall and Woodward (2010) calculate that for a risk-neutral individual, the certainty equivalent is $5.8 million. With mild risk aversion, the amount is only $0.6 million and with normal risk aversion, the certainty equivalent is slightly negative. Thus, Hall and Woodward (2010) conclude that risk seeking individuals perceive greater values in risky investments and are therefore more likely to become entrepreneurs. This argument is further corroborated by Astebro, Herz, Nanda and Weber (2014) who compare the earnings distribution of self-employed entrepreneurs and employees using income data from the Danish Labor Market Research database. The persistent higher income variance of the self-employed indicates that entrepreneurs are more risk tolerant than employees. Although theoretically tenable, the relationship between entrepreneurship and risk attitudes has yielded conflicting empirical results. (Parker 2009, Ahn 2010).

Overconfidence, an alternative entrepreneurial motive theory, argues that individuals enter the entrepreneur market because they evaluate the return distributions of their projects more favorably than is objectively the case. Surowiecki (2014) argues that individuals who become entrepreneurs are not more risk-seeking than everyone else. Rather, they are more confident about their profit-generating skills. Further, because entrepreneurs are "incurably optimistic" about their abilities, they always enter the market excessively, thereby driving down the market profit. Cooper, Woo and Dunkelberg (1988) substantiate the overconfidence theory with empirical evidences by asking 3,000 entrepreneurs the simple question: "What are the odds of your business succeeding?" 80% of the respondents answered greater than 70%; 33% predicted a 100% chance of success, while in reality 75% of startups fail within 3 years.

Non pecuniary utility theory denotes that entrepreneurs create a business not as a means to obtain monetary profits, but as an end in itself. One aspect of the non pecuniary theory is the founder's dilemma, whereby entrepreneurs maintain control over the business they created at the expense of reduced management efficiency and lower monetary profits according to Wasserman (2008). Additionally, Wasserman (2008) finds that entrepreneur founders persistently receive 20% less in cash compensation than non-founders who performed similar roles, implying that entrepreneurs derive non-pecuniary utilities from creating and controlling a business.

*B. Overconfidence theories and overplacement*

Overconfidence, generally speaking, happens when individuals rate their chances of success too favorably. However, it has 3 distinct psychological origins: overestimation, overplacement and overprecision (Moore and Healy 2008). Overestimation refers to overrating one's actual ability, performance, level of control or chance of success. Overplacement refers to rating one's ability above others'. For example, people often rate themselves above the average, without noticing that others share the same belief. Overprecision refers to excessive certainty about the accuracy of one's beliefs.

Our paper exclusively focuses on overplacement, the type of overconfidence whereby people rate themselves more favorably than others within their peer group. When asked to assess how they perform among the general population on positive traits such as earnings prospects, longevity and driving ability, a majority of people rate themselves above the median, whereas, theoretically, only half of the population can achieve this (Svenson 1981). The connection between entrepreneurship and overplacement is well documented in previous literatures. When asked two questions, “What are the odds of your business succeeding?” and “What are the odds of any business like yours succeeding?”, entrepreneurs rated an 81% chance of success for themselves on average but only 59% for other businesses like their own (Cooper, Woo, Dunkelberg 1988). Camerer and Lovallo (1999) implement an experiment to test the relationship between overplacement and market entry. They find that participants enter the market more frequently when the payoff is based on their skills among their peers rather than pure luck.

## III. Past Empirical Researches

## III. Experimental Design

We model our experimental design after Camerer and Lovallo (1999). In this section, we first list the steps of our experimental design. Then, we highlight three key differences between our design and that of Camerer and Lovallo (1999) and justify our changes.

### *A. Assumptions*

Our experimental design has four key assumptions. First, aggregate market profit is maximized when the number of entrants is equal to the market capacity. If the number of entrants is lower than the capacity, entrants can’t capture the entire market. If the number of entrants exceeds the capacity, excess entrants generate losses and the aggregate market profit declines. Second, the more skilled an entrepreneur is relative to his or her peers, the larger profit he or she earns. Third, entrepreneurs receive market feedbacks and can adjust their decisions subsequently. Fourth, individuals don't know *objectively* how skilled they are among their peers, but rather base their market entry decisions on how they *subjectively* rank themselves among their peers. This assumption allows overconfidence to skew entry decisions.

The first two assumptions produce a payoff table shown below in Table 1. The first row denotes the market capacity and the first column denotes the skill rank of an individual. The first assumption is satisfied by setting the maximum market profit to $20 and the excess entry profit to negative $10. The second assumption is satisfied by assigning higher profits to higher ranked individuals.

**Table 1--Payoff Table**

| **Rank\Capacity** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
|---|---|---|---|---|---|---|---|---|
| **1** | 20 | 13 | 10 | 8 | 7 | 6 | 5 | 4 |
| **2** | -10 | 7 | 7 | 6 | 5 | 5 | 4 | 4 |
| **3** | -10 | -10 | 3 | 4 | 4 | 4 | 4 | 3 |
| **4** | -10 | -10 | -10 | 2 | 3 | 3 | 3 | 3 |
| **5** | -10 | -10 | -10 | -10 | 1 | 2 | 2 | 2 |
| **6** | -10 | -10 | -10 | -10 | -10 | 1 | 1 | 2 |
| **7** | -10 | -10 | -10 | -10 | -10 | -10 | 1 | 1 |
| **8** | -10 | -10 | -10 | -10 | -10 | -10 | -10 | 1 |

*B. Steps of the experiment*

Now we would elaborate on each step of our experiment:

1. After consenting, a group of 8-10 experiment participants each receive an anonymous ID, the experiment instruction (Appendix A) and the experiment answer sheet (Appendix B). The paper instruction is accompanied by a 5-minutes lecture instruction. Each participant has to finish a comprehension quiz before proceeding (Appendix C). The best performer of the experiment will receive $20 in cash. The incentive is communicated to all participants.
2. The experiment has two treatments: the random treatment and the skill treatment. In the random treatment, participants are randomly assigned a rank using a random sequence generator. In the skill treatment, participants' scores in a 5-minute quiz determine their rank. In both treatments, the rank is *not* disclosed until the end of the experiment. This satisfies the fourth assumption that participants don't know their objective ranks among their peers.
3. The experiment has 16 rounds (8 for each treatment). Each round is exactly the same: First, the market capacity is announced. Second, each participant privately forecast how many people will enter the market. Each correct forecast is rewarded with $2 hypothetical earning. Incorrect forecast receives $0. Third, each participant privately chooses to enter or not enter the market. Payoffs for entrants are determined by Table 1.[1] Everyone else receives $0. Fourth, participants are asked to close their eyes and raise their hands if they entered the market. Finally, the researcher counts the number of entrants of the round and discloses the number to all participants.

[1] The rank in the payoff table is not the absolute rank assigned to the participants in random or skill treatments but relative to other entrants. For example, if only rank 3 and rank 6 enter the market, rank 3 corresponds to rank 1 and rank 6 corresponds to rank 2 in the payoff table.

4. The skill treatment is exactly the same as the random treatment, except that the ranks are determined by participants' score in the quiz rather than randomly assigned. For experiment 1-4, participants do the quiz after the skill treatment. For experiment 5-8, participants do the quiz before the skill treatment. The quiz is a 12 questions logic test.[2] (Appendix D)

Three points are worth noting: First, the rank of each participant remains the same throughout each treatment. Second, the only feedback from each round is the number of entrants. Third, the only information participants can use to make entry decisions are: the market capacity, the number of entrants and the subjective self-assessment of their ranks.

*C. Key changes to Camerer and Lovallo (1999)*

Our experiment design differs from Camerer and Lovallo (1999) in three aspects:

First, we improve the incentive structure. Whereas Camerer and Lovallo (1999) award each participant the amount he/she earned in one randomly chosen round, we only award the participant with the highest cumulative earnings. Therefore, participants are incentivized to perform well throughout the game. Besides, since winning the reward requires outcompeting all other people in the group, participants are incentivized to assess their ranks more accurately among their peers.

Second, we measure the participants' general overconfidence. Whereas Camerer and Lovallo (1999) inform the participants about the type of quiz (trivia questions or logic puzzles)

[2] The quiz is composed of 12 questions chosen from the "Mensa Workout", a 30-questions problem set designed by Mensa International, the largest high IQ society in the world. The original test has a time limit of 30 minutes for 30 questions whereas we scaled up the difficulty by condensing it to 5 minutes for 12 questions, to differentiate the participants' performance.

and provide them sample questions before the experiment, we intentionally did neither. Therefore, we measure the participants' general overconfidence rather than their overconfidence in trivia questions and logic puzzles.

Third, we added another variable to Camerer and Lovallo's (1999) design. That is, experiments 1-4 take the quiz *before* the skill treatment whereas experiments 5-8 take the quiz *after* the skill treatment. Note that in *both* arrangements the skill rank is *not* disclosed to the participants till the end of the experiment. By adding this variable, we test whether participants' knowledge about their absolute performance in the quiz *prior* to the skill treatment increases or decreases market entry. Or in other words, we test whether entrepreneurs' knowledge about their absolute performance in the market enhances or diminishes their overconfidence. We hypothesized that this can go both directions. An easy quiz might enhance overconfidence and increase market entry. A hard quiz might diminish overconfidence and decrease market entry.

## IV. Data

**Table 2--Description of Experiments**

| Experiment # | Sample Size (n) | Experiment Order |
|---|---|---|
| 1 | 9 | R-S-Q |
| 2 | 8 | R-S-Q |
| 3 | 8 | R-S-Q |
| 4 | 8 | R-S-Q |
| 5 | 10 | R-Q-S |
| 6 | 8 | R-Q-S |
| 7 | 8 | R-Q-S |
| 8 | 7 | R-Q-S |

***Note: In the experiment order column, R stands for random treatment, S stands for skill treatment and Q stands for quiz.***

Table 2 summarizes the data we collected. We conducted 8 experiments in total. Sample sizes are listed in the second column. The third column denotes the treatment order. We always conducted the random treatment before the skill treatment and the quiz. In experiment 1-4, the participants did the quiz after the skill treatment. In experiment 5-8, the participants did the quiz before the skill treatment.

The total number of participants is 66, all of whom are Macalester College undergraduates. A quarter volunteered to participate and the rest three quarters were randomly invited by the researchers. Although subtle self-selection biases might exist, we believe that those who volunteered or accepted our invitation didn't exhibit significantly higher or lower degrees of overconfidence than other undergraduates. However, our research can't address the bias that college undergraduates might behave differently from the general population.

## V. Specification

The key question of our study is whether overconfidence increases market entry. In other words, whether participants enter the market more frequently when the earnings are based on their skill rank rather than a random assigned rank. Here, the random treatment serves as a control group that measures individuals' entry decisions when the expected random rank is the group average. If overconfidence exists, individuals will expect their skill ranks to be higher than their random ranks and thus enter the market more frequently in the skill treatment. The specification that tests this hypothesis is:

$$\textbf{Entry decision}_{itj} = \beta_0 + \beta_1 \textbf{ capacity}_{it} + \beta_2 \textbf{ expected profit}_{itj} + \beta_3 \textbf{ skill}_{it} + \beta_4 \textbf{ QS}_i + \beta_5 \textbf{ skill}_{it} {*}\textbf{QS}_i + \gamma \textbf{ round}_t + \varepsilon$$

Where *entry decision*$_{itj}$ is a dummy variable that equals to 1 if subject *j* enters the market in round *t* of experiment *i* and equals to 0 if the subject doesn't enter the market. *capacity*$_{it}$ is the market capacity in round *t* of experiment *i*. *expected profit*$_{itj}$ is subject *j*'s expected profit for round *t* of experiment *i*, calculated from their forecast according to the Table 1. For example, if $capacity_{it} = 2$ and $forecast_{itj} = 5$, then $expected\ profit_{itj} = 13 + 7 - 10 - 10 - 10 = -10$. *skill*$_{it}$ is a dummy variable that equals1 if round *t* of experiment *i* is in the skill treatment and equals to 0 if it's in the random treatment. $QS_i$ is a dummy variable that equals 1 if the quiz is before the skill treatment in experiment *i* and equals to 0 if the quiz is after the skill treatment. $skill_{it}*QS_i$ is the interaction term between $skill_{it}$ and $QS_i$. $round_t$ is a vector of dummy variables that equals 1 for round *t* and equals to 0 otherwise. It's included in the specification to control for round fixed effects. $\gamma$ is a vector of coefficients for $round_{t.}$ The table below lists the expected sign of each variable and their justifications:

**Table 3--Expected Signs and Justifications for Variables**

| **Dependent Variable: Entry Decision** | | |
|---|---|---|
| **Variable Name** | **Expected Sign** | **Justification** |
| capacity | positive | Higher market capacity allows more people to enter the market with a positive return and thus induces market entry. |
| expected profit | positive | The more profit people expect, the more likely they enter the market. |
| skill | positive | If overconfidence exists, people will enter the market more when the earnings are based on their skill ranks. |

| | | |
|---|---|---|
| QS | indeterminate | Taking the quiz before the skill treatment either increases or decreases market entry depending on the difficulty of the quiz. |
| skill*QS | indeterminate | Same as above |
| round | N/A | Round is a vector of dummy variables that controls for round fixed effect, irrelevant to our theory. |

## VI. Results

### *A. Does overconfidence increase market entry?*

Since *entry decision*$_{itj}$ is a dummy dependent variable, we use the logit maximum likelihood estimator (MLE). Table 4 shows the coefficients and t-statistics of the 3 models we estimated. Significant coefficients are marked by asterisks.

**Table 4--Logit Estimation of Entry Equation (Experiment 1-8)**

| **Dependent Variable: Entry Decision ( = 1)** | | | |
|---|---|---|---|
| **Variables** | **Model 1** | **Model 2** | **Model 3** |
| **capacity** | 0.471***<br>(7.95) | 0.470***<br>(7.95) | 0.467***<br>(7.95) |
| **expected profit** | -0.015**<br>(-2.38) | -0.015**<br>(-2.44) | -0.016***<br>(-2.66) |
| **skill** | 0.594***<br>(2.99) | 0.691***<br>(3.96) | 0.350**<br>(2.57) |
| **QS** | -0.195<br>(-1.03) | | |
| **skill*QS** | -0.462*<br>(-1.69) | -0.655***<br>(-3.30) | |

| | | | |
|---|---|---|---|
| **observations** | 1,056 | 1,056 | 1,056 |
| **log-likelihood** | -622.8 | -623.3 | -628.8 |
| **percent correct** | 69.2% | 68.9% | 68.8% |
| **chi-square** | 147.5 | 146.5 | 135.4 |
| **p-value of $X^2$** | 0.0000 | 0.0000 | 0.0000 |
| **T-statistics are in parentheses. ***p<0.01, **p<0.05, *p<0.1** | | | |

The coefficient of the skill treatment dummy (*skill*) is positive and significant at 0.01 across all three models, implying that people enter the market more frequently when the earnings are based on their skill ranks. Overconfidence *does* increase market entry.

On whether taking the quiz before the skill treatment *(QS=1)* increases or decreases market entry, the coefficients of the *QS* dummy and the *skill*QS* interaction dummy are negative but *not* significant in Model 1. The *QS* dummy, however, doesn't make theoretical sense: it is equal to one for *both* treatments, and thus models the effect of taking the quiz before the skill treatment on *both* treatments. The quiz, however, can't affect entry decisions in the random treatment, which is always before the quiz. Therefore, in Model 2, we dropped *QS* and *skill*QS* became negative and significant at 0.01 level, indicating that taking the quiz before the skill treatment decreases market entry. This implies that knowing more market information before making entry decisions dampens overconfidence.

To test whether *skill*QS* is necessary in our specification, we dropped it in Model 3. The coefficient of the skill treatment dummy (*skill*) dropped from 0.691 to 0.350 and lost its significance at the 0.01 level. Therefore, omitting *skill*QS* pushes the overconfidence-dampening effect to the skill treatment dummy, reducing both its coefficient and significance. This evidence suggests that *skill*QS* is a necessary variable and that taking the quiz before the skill treatment significantly reduces overconfidence.

Another noteworthy result is that the coefficient of the expected profit is negative and significant in all three models, contradicting our expectation that higher expected profit increases market entry. Camerer and Lovallo (1999) obtained the same results. Currently, we can't rigorously test why this happened. Camerer and Lovallo (1999) speculated that reverse causality might be the reason: "when subjects plan to enter, they also forecast a lot of entry, so the expected profit is lower when they enter".

*B. Blind spot hypothesis: do people expect more profit in the skill treatment rather than being overconfident?*

An alternative interpretation of more frequent market entry in the skill treatment is the blind spot hypothesis, which states that people enter the market not because they are overconfident about their skills, but because they expect more profit from the market. In other words, people are "blind", or misinformed about the market in their expectations.

To test this hypothesis, we calculated each individual's average expected profit in the random rounds and in the skill rounds, according to their forecast and the payoff table. If the blind spot hypothesis is true, we would observe higher expected profit in the skill rounds, where people enter the market more often.

**Table 5--Average Difference in Expected Profits per Entrant per Round Between Random and Skill Treatments**

| Measure | Experiment 1 | Experiment 2 | Experiment 3 | Experiment 4 | Experiment 5 | Experiment 6 | Experiment 7 | Experiment 8 |
|---|---|---|---|---|---|---|---|---|
| $\pi_r$-$\pi_s$ | 6.34 | 7.81 | 1.57 | 0.88 | 0.47 | 0.39 | 3.97 | -1.85 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| # of subjects with $\pi_r$-$\pi_s$>0 | 8/9 | 7/8 | 6/8 | 3/8 | 4/10 | 6/8 | 5/8 | 3/7 |
| percent | 89% | 88% | 75% | 38% | 40% | 75% | 63% | 43% |
| # of subjects with $\pi_s$<0 | 1/9 | 5/8 | 0/8 | 3/8 | 6/10 | 1/8 | 3/8 | 0/7 |
| percent | 11% | 63% | 0% | 38% | 60% | 13% | 38% | 0% |

In Table 5, we used three measures to compare the expected profit in random and skill rounds. In the first row, $\pi_r$-$\pi_s$ denotes the average difference in expected profits per entrant per round between random and skill treatments. In 7 out of 8 experiments, $\pi_r$-$\pi_s$ is positive, indicating that people on average expect more profits in the random rounds. This contradicts the blind spot hypothesis. In the second and third row, we calculated the number and percent of individuals who expect more profits in the random rounds. In 6 out of 8 experiments, the percentage is above 50%, contradicting the blind spot hypothesis. In the fourth and fifth row, we calculated the number and percent of individuals who on average expect negative profits in the skill rounds. 19 out of 66 participants expected negative profits in the skill rounds.

These three measures suggest that people expect *less* profit in the skill rounds but still choose to enter the market more frequently, thereby rejecting the blind spot hypothesis and substantiating the overconfidence effect. However, overconfidence is not strong enough such that most people enter the market more frequently with negative expected profits in the skill rounds.

*C. Does overconfidence reduce market profit?*

Another important phenomenon to address is whether overconfidence and greater entry in the skill rounds reduce market profit, defined as the sum of individual profits in each round. Greater entry doesn't necessarily reduce market profit. Recall that according to the payoff table, if entry is below market capacity, market profit increases as more people enter. If entry is above market capacity, market profit decreases as more people enter.

In table 6, we calculated the market profit of all 128 rounds (64 random, 64 skill) and aggregated the market profit of each experiment. In the random treatment, 41 out of 64 rounds (64%) have positive market profit but only 9 out of 64 rounds (14%) have negative market profit. In contrast, in the skill treatment, only 24 out of 64 rounds (38%) have positive market profit but 21 out of 64 rounds (33%) have negative profit. The average market profit of the random rounds is $7.63 whereas that of the skill rounds is only $0.66. Considering the maximum market profit of $20, this difference of $6.97 is pretty large. Overconfidence and greater entry in the skill rounds reduce market profit.

**Table 6--Market Profit by Round**

**Profit for random-rank treatment**

| Experiment | Sample Size | Round 1 | Round 2 | Round 3 | Round 4 | Round 5 | Round 6 | Round 7 | Round 8 | total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 9 | 10 | 10 | 0 | 10 | 10 | 10 | 20 | 0 | 70 |
| 2 | 8 | -10 | 10 | 10 | 10 | -10 | 0 | -10 | -10 | -10 |
| 3 | 8 | 20 | 10 | 10 | 0 | 19 | 20 | 20 | 20 | 119 |
| 4 | 8 | 0 | 20 | 20 | 10 | -20 | -10 | 10 | -10 | 20 |
| 5 | 10 | 0 | 0 | 10 | -10 | 0 | 0 | 0 | 19 | 19 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 8 | 10 | 13 | 0 | 10 | 10 | 0 | 0 | 20 | 63 |
| 7 | 8 | 20 | -10 | 0 | 10 | 10 | 10 | 20 | 18 | 78 |
| 8 | 7 | 20 | 10 | 20 | 10 | 20 | 20 | 19 | 10 | 129 |

**Profit for skill-rank treatment**

| Experiment | Sample Size | Round 1 | Round 2 | Round 3 | Round 4 | Round 5 | Round 6 | Round 7 | Round 8 | total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 9 | 0 | -30 | -10 | 0 | 0 | -20 | 0 | 0 | -60 |
| 2 | 8 | 18 | -10 | 20 | -20 | 0 | 10 | -10 | -10 | -2 |
| 3 | 8 | 0 | 10 | -20 | 13 | 0 | -20 | 10 | -10 | -17 |
| 4 | 8 | -20 | 0 | 10 | -10 | 0 | -10 | 0 | -10 | -40 |
| 5 | 10 | -20 | 0 | -10 | 0 | 10 | -10 | 20 | 17 | 7 |
| 6 | 8 | -20 | 10 | 20 | -10 | 10 | 20 | -20 | 10 | 20 |
| 7 | 8 | 0 | 0 | 10 | 0 | 10 | 0 | -10 | 0 | 10 |
| 8 | 7 | 14 | 20 | 17 | 13 | 20 | 0 | 19 | 20 | 124 |

Alternatively, to formally test whether skill rounds has significantly lower profits than the random rounds, we conducted a *matched pairs test*. First, we paired up rounds with identical market capacity, location in the treatment and quiz/skill order, *only* differing in whether the round is in the random or skill treatment. Thus, we controlled for most differences between the two rounds in each pair. Second, we calculated the differences between the random round and the skill round in each pair. Third, we divided the mean of the differences by the standard error of the differences, to yield the t-statistic of the difference. The 64 pairs we matched yielded a skill round minus random round market profit difference t-statistic of -3.55, significant at 0.001 level. The matched pairs test suggests that overconfidence and excess entry reduce market profit in the skill rounds.

Furthermore, we tested whether taking the quiz before the skill treatment increases the market profit. We conducted another matched pairs test that matches rounds with identical treatment, market capacity and location in the treatment while only differing in the quiz/skill order. The 64 pairs we matched yielded a quiz/skill minus skill/quiz market profit difference t-statistic of 2.84, significant at 0.01 level. This suggests that knowing more market information before making entry decisions increases the market profit by dampening the overconfidence effect.

## VII. Discussion

### *A. "Inside View" v.s. "Outside View"*

We found that excess entry is caused by overconfidence, especially overplacement, whose psychological origin merits discussion. Kahneman and Lovallo (1993) argue that conflicts between the "inside view" and the "outside view" induce overplacement. Whereas the "inside view" induces people to subjectively perceive familiar subjects as unique and superior, the "outside view" enables people to objectively evaluate unfamiliar subjects by comparing it to similar subjects. In the context of startups, entrepreneurs are biased by the "inside view". They attach too much uniqueness and superiority to the opportunities they identify and the businesses they create, thereby neglecting the outcomes of past similar businesses that would have enabled them to forecast their chance of success more accurately (Koellinger, Minniti, Schade 2007). In other words, the subjective story the "inside view" tells blinds the objective statistic the "outside view" observes (Camerer and Lovallo 1990).

Therefore, the “inside view” causes reference group neglect. It happens when people are overconfident about their skills without noticing that others share the same belief, thereby entering the market excessively with false expectations.

*B. Overconfidence v.s. Underconfidence*

We found that taking the quiz before the skill treatment reduces overconfidence and decreases market entry. However, this overconfidence-dampening effect might depend on the difficulty of the quiz. To differentiate performances, we deliberately designed a hard quiz. None of the 66 participants finished the quiz and the average score was 54%. Had we designed a easier quiz, we might have observed a weaker overconfidence dampening effect and even enhanced overconfidence.

This relationship between difficult tasks and underplacement is well documented: people routinely rate themselves below average on hard tasks such as juggling or unicycle riding (Moore and Healy, 2008). The greater the perceived difficulty of a task is, the bigger the effect of underplacement is.

This implies that the perception of entrepreneurship as a easy or hard task may lead people to underplace or overplace their skills. Therefore, future researches can dive into the relationship between entry rates and the perceived difficulty of starting a business in different industries. Entrepreneurs might overenter in reputedly difficult industries while underenter in reputedly easy industries, implying that market inefficiency can happen in both directions.

*C. Is entrepreneur excess entry bad?*

The high rate of failure, low rate of return and cognitive limitations such as overconfidence, "inside view" and reference group neglect all imply that entrepreneur excess entry is bad. However, is it necessarily detrimental to the society?

Entrepreneur excess entry harm the society by driving down social returns. Unsuccessful ventures incur negative externalities by forcing stakeholders such as the government to absorb their failure. Peter Thiel, a prolific investor and entrepreneur who created PayPal, argues against entrepreneur excess entry in zero-sum industries (Thiel 2014). These industries are either declining or have a clear winner/incumbent that dominates. For example, excess entry into the newspaper industry is not beneficial due to its declining demand. Additionally, excess entry into the online search engine industry is a waste of resources because incumbents such as Google already dominates the market and possesses the best technology. However, entrepreneur excess entry and business failures accumulate valuable knowledge that improves future businesses. Besides, new entrants in a market improve efficiency by pressuring the incumbents to evolve and improve productivity (Koellinger, Minniti, Schade 2007).

## VIII. Conclusion

To investigate the phenomenon that entrepreneurs excessively enter the market and persist in their businesses despite high rates of failure and low rates of return, we designed an experiment to simulate market entry decisions. We have three major findings. First, overconfidence, particularly overplacement, increases market entry. Participants enter the market more frequently when the earnings are based on their skill ranks rather than randomly assigned ranks, even if they expect less profit in the skill treatment. Second, overconfidence reduces market profit. According to the matched pairs test, participants earn significantly less in the skill rounds than in the random rounds. Third, knowing more information about the market increases market profit by reducing overconfidence and excess entry. The matched pairs test shows participants who took the quiz before the skill treatment enter the market less frequently and earn greater profits.

In the discussion section, we posited the "inside view" and reference group neglect as the origin of overplacement. We hypothesized that perceived difficulty of tasks can generate both overconfidence and underconfidence. Furthermore, despite all the negative evidences, entrepreneur excess entry is not necessarily detrimental to the society.

Besides investigating the rationales of entrepreneur excess entry, our paper has further policy implications. For example, the government can reduce irrational exuberance and excess entry by sharing the "outside view" of similar past ventures with potential entrepreneurs, thereby improving the quality and success rate of new ventures.

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## Appendix

### (A) Instructions for Experiment

*Participant Information*
ID Number:
Sex:

Gender:
Class Year:
Major:
Ethnicity:

*Instructions*

There are 8 rounds in the first treatment. You would be randomly assigned a "rank" that's not disclosed to you till the end of the experiment.

At the beginning of each round, we will announce the market capacity "c’, the number of entrants that can enter the market with positive earnings.

Then we ask you to forecast the number of people who enter the market. We award each correct forecast with $2 (hypothetical earning). We do not penalize incorrect forecasts.

After that, you can decide whether to enter the market or not.

If the total number of entrants is less or equal to the market capacity "c", everyone would get a positive earning. Higher ranked entrants would earn more than lower ranked entrants, according to the payoff table.

If the total number of entrants is greater than the market capacity "c", the highest ranked "c" entrants would get a positive earning according to the payoff table, while entrants ranked below "c" would get a negative earning.

If you choose not to enter the market, your earning is $0 for the round.

After everyone made the entry decision, we would announce the total number of entrants for the round. Note that neither your randomly assigned rank nor your earning for the round would be announced till the end of the experiment.

The second treatment has another 8 rounds. Everything is the same except that your rank is based on your performance on a logic quiz which you will do at the end of the treatment.

After the experiment, individual with the highest hypothetical earning would obtain a $20 cash prize.

**(B) Answer Sheet (Same Sheet for Skill Rank as well)**

*Random Rank Treatment Answer Sheet*

Round 1
Market Capacity is __
I forecast __ people would enter the market.
I choose to (enter/not enter) the market. (circle one)
Actual number of entrants is __

Round 2
Market Capacity is __
I forecast __ people would enter the market.
I choose to (enter/not enter) the market. (circle one)
Actual number of entrants is __

Round 3
Market Capacity is __
I forecast __ people would enter the market.
I choose to (enter/not enter) the market. (circle one)
Actual number of entrants is __

Round 4
Market Capacity is __
I forecast __ people would enter the market.
I choose to (enter/not enter) the market. (circle one)
Actual number of entrants is __

Round 5
Market Capacity is __
I forecast __ people would enter the market.
I choose to (enter/not enter) the market. (circle one)
Actual number of entrants is __

Round 6
Market Capacity is __
I forecast __ people would enter the market.
I choose to (enter/not enter) the market. (circle one)
Actual number of entrants is __

Round 7
Market Capacity is __
I forecast __ people would enter the market.
I choose to (enter/not enter) the market. (circle one)
Actual number of entrants is __

Round 8
Market Capacity is __
I forecast __ people would enter the market
I choose to (enter/not enter) the market. (circle one)
Actual number of entrants is __

## (C) Comprehension Quiz

1. Do you know your rank when making entry decisions?
    a. Yes
    b. No

2. Do you know the market capacity when making entry decisions?
    a. Yes
    b. No

3. If the market capacity is 2 and 3 people entered the market, how much rank 1 and rank 3 respectively earns according to the payoff table?
    a. $13, -$10
    b. $7, -$10
    c. $13, $7

## (D) Skill Quiz

ID Number:
*Make sure to circle the correct answer. Write in the answer where necessary. This quiz will take 5 mins.*

(1) Which number comes next in this series of numbers?
**2 3 5 7 11 13 ?**

- o 14
- o 15
- o 16
- o 17
- o 18

(2) There are 1200 elephants in a herd. Some have pink and green stripes, some are all pink and some are all blue. One third are pure pink. Is it true that 400 elephants are definitely blue?

- o Yes
- o No

(3) What is the following word when it is unscrambled?
**H C P R A A T E U**

(4) If a circle is one, how many is an octagon?

- o 2
- o 4
- o 6
- o 8
- o 12

(5) Fill in the missing number:

**0,1,1,2,3,5,8,13, ___ ,34,55**

(6) Which letter comes next in this series of letters?

**B A C B D C E D F __ ?**

(7) How many four sided figures are in this diagram?

- o 10
- o 16
- o 25
- o 28

(8) What is the number that is one half of one quarter of one tenth of 400?

- o 2
- o 5
- o 8
- o 10
- o 40

(9) If it were two hours later, it would be half as long until midnight as it would be if it were an hour later. What time is it now?

- o 18:30
- o 20:00
- o 21:00
- o 22:00
- o 23:30

(10) Look at the drawing. The numbers alongside each column and row are the total of the values of the symbols within each column and row. What should replace the question mark?

- o 23
- o 25
- o 28
- o 30
- o 32

(11) If two typists can type two pages in two minutes, how many typists will it take to type 18 pages in six minutes?

- 3
- 4
- 6
- 12
- 36

(12) Two men, starting at the same point, walk in opposite directions for 4 meters, turn left and walk another 3 meters. What is the distance between them?

- 2m
- 6m
- 10m
- 12.5m
- 14m