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Competition and Personality in a Restaurant Entry Game

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Abstract: We explore the question of whether personality traits as measured by standard psychological tests are significant explanators of behavior in an entry game. The experimental data and psychological test results come from classroom experiments designed to teach the concepts of short and long run equilibrium in a competitive market. These experiments were conducted in 42 classroom sessions, each with about 35 students.

Keywords: market entry, competitive equilibrium, personality, Myers-Briggs, classroom experiment

Approximately one fourth of all new restaurants fail within the first year of opening, and only about half survive for at least three years. Similar failure rates are found for new independent businesses in a wide variety of industries.

It is possible that the payoff to success is high enough to make these high failure rates consistent with rational assessment of the probability of success. But evaluating the likelihood of one's success in a new business venture is a highly complex and idiosyncratic matter. Knight (1921) observed that "Business decisions... deal with situations which are far too unique, generally speaking, for any

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¹ Parsa et al. (2005) estimated that 27.5% of newly opened independently-operated restaurants in Columbus, Ohio either disappeared or changed ownership in the first year of operation and that 61% were gone within three years of opening. A study by the Cline Group (2003) estimated that 23% of new restaurants closed in the first year after opening and 44% closed within three years.

² Knaup (2005) finds failure rates of startups to be about 20% per year in each of the first four years of life for firms in several U.S. industries. A study of manufacturing plant entrants by Dunne, Roberts, and Samuelson (1988) estimated that 61.5% of new entrants exited within five years.

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sort of statistical tabulation to have any value for guidance. The conception of an objectively measurable probability or chance is simply inapplicable."

The complexity of the determinants of success means that people are likely to differ widely in their assessments of the prospects of a new enterprise. Projects will be undertaken by those who are most optimistic. As happens with the winners' curse in common value auctions, the most optimistic investors may include not only those with the best prospects, but also those who are most deluded about their prospects. In a paper titled "The borrower's curse: optimism, finance, and entrepreneurship", de Meza and Southey (1996) present a formal dynamic model in which naive optimists fool themselves into becoming new entrepreneurs despite a persistently negative expected return. They suggest that this theory explains the observed high failure rate of new firms and the prevalence of self-finance and highly secured loans as sources of funds for new enterprises.

Camerer and Lovallo (1999) conducted laboratory experiments in an entry game where players simultaneously chose whether or not to enter a market. Expected payoff to any player depended negatively on the number of entrants and positively on the player's "rank". (Players only learned their rank after they have decided whether to join the market.) In one treatment, players' ranks were determined randomly. In another treatment, rank was determined by skill at answering trivia questions. The authors found that there were more entrants when subjects knew that rank was determined by test results than when rank was determined randomly, and that there was usually excess entry, with negative returns for low-ranked entrants. They suggested this result is consistent with explaining the high failure rate of small businesses by the entry of overconfident aspiring entrepreneurs. Karelaia and Hogarth Robin (2010) conduct similar entry experiments in which payoffs are determined partially by skill (at multiplying two-digit numbers) and partially by luck. They find that there is more excess entry when the payoff depends on both skill and luck than when it depends on skill alone, and they suggest that participants seem to confuse luck with skill. Madiès, Villeval, and Wasmer (2013) conducted a version of the Camerer-Lovallo experiment where the subjects were employees of a Swiss bank. They found that subjects whose age was 49 years or more were more likely to enter than those who were younger than 49. A version of the Camerer-Lovallo experiment conducted by Lindner (2014) offers some evidence that males were more likely to be overconfident in their performance abilities than females.

The Camerer-Lovallo procedure differs from ours by having simultaneous rather than sequential entry and also by making a player's payoff from entry depend on an externally determined ranking. In our experiment, a player's payoff may depend on the player's skill at choosing prices and attracting customers. In fact, it turns out that even when there is excess entry, some buyers pay more than the short run equilibrium price and thus some sellers sometimes

do not suffer losses. However, when there is excess entry, so long as no buyer pays more than her buyer value, *at least some* sellers must lose money.

If decisions to start new ventures are not well explained by rational assessment of probabilities, it is valuable to seek other predictors. Caplan (2003) proposed that a promising way to explore differences in human preferences may lie in the use of psychological personality measures. He argues that psychological research indicates that preferences among economic agents may differ on just a few well-defined dimensions and that these can be measured by psychological tests. A recent survey of literature in personality psychology and economics by Almlund et al. (2011) also suggests that measured personality traits may be good predictors of economic behavior.

This paper explores the relation between personality traits as measured by the Myers-Briggs personality test and willingness of students to "open a restaurant" in a classroom market entry game. We find that two traits matter. Those who score low on the sensing-intuition scale and those who score high on the thinking-feeling scale are more likely to open a restaurant. However, we found no statistically significant relation between the personality traits that are measured by the "Big Five" personality scale and behavior in this experiment.

1 The Restaurant Entry Experiment

Our results are based on experiments conducted in Principles of Economics classes at the University of California, Santa Barbara in 2006 and 2007. Market experiments were conducted in section meetings. There were a total of 42 sections, each with approximately 35 students. Students received grade credit for class attendance and market winnings, and attendance rates were approximately 90%.

The restaurant entry experiment was taken from the textbook *Experiments with Economic Principles* by Bergstrom and Miller (2000). The experiment is designed to teach the concepts of short and long run equilibrium in a market with free entry and exit in the long run.³

We induce a demand curve for restaurant meals by assigning a "buyer value" to each student in class and allowing each student to buy at most one meal. If the number of students in class is divisible by four, then equal numbers of students are assigned buyer values of \$24, \$18, \$12, and \$8. If the number is

³ The experimental instructions are included in the Appendix to this paper, along with a set of "warm-up" questions designed to help students to understand the experimental environment.

not divisible by four, any leftover students are assigned values of \$8. We report the distribution of buyer values to all participants and draw the corresponding demand curve on the blackboard before the experiment begins.

Students are informed that they will be given a chance to open a restaurant, but in order to open a restaurant, one must pay a fixed cost of \$20. A restaurant, once opened, has a capacity of four customers, and there is a constant marginal cost per meal sold.

The experiment includes two sessions, each of which has two rounds. The second round of each session is a repetition of the first round. The sessions differ only in the marginal cost of producing a meal, which is \$5 in the first session and \$8 in the second session.

Each round of a session consists of two stages. In Stage 1, students decide whether to open a restaurant. In Stage 2, customers shop among restaurants and decide whether and where to purchase a meal.

In Stage 1, players are asked sequentially (in a randomly determined order) whether they want to open a restaurant. When a student is asked, she knows the number of restaurants that have been opened and the number of players who remain to be asked. A decision to open a restaurant is irreversible. Stage 1 ends when all students have declared their intention to open or not to open a restaurant.

In Stage 2, restaurant owners post prices and customers shop for meals. Restaurant owners may change their posted prices and customers may bargain over the price. Each restaurant is limited by its capacity to sell at most four meals, and each customer can buy at most one meal. The competitive equilibrium price for Stage 2 is found at the intersection of the demand curve and the "short run supply curve," which has a horizontal segment at a price equal to marginal cost and then becomes vertical at industry capacity, which is four times the number of restaurants that were opened.

In the first session of this experiment, the marginal cost of a meal is \$5. Since fixed costs are \$20, and capacity is 4 meals, restaurants that operate at capacity can make a profit only if they sell 4 meals for an average of at least \$10 per meal. If the number of demanders willing to pay at least \$10 is less than four times the number of restaurants, the short run supply curve will intersect the demand curve at a price below \$10 and in competitive equilibrium all restaurants would lose money.

In the second session of the experiment, marginal costs are increased from \$5 to \$8. In this case, total costs of selling 4 meals are \$52, and a restaurant selling 4 meals will break even or make a profit only if the price per meal is at least \$13. Given the distribution of buyer values in this session, only about two-thirds as many restaurants can be profitably sustained as in the first session.

2 The Myers-Briggs Personality Inventory

Students in our classes were asked to take an online personality test, known as the Myers-Briggs Type Indicator exam, or MBTI. Taking the test was voluntary, however, about 97% of the students who participated in the class experiments also completed the MBTI exam.

The Myers-Briggs test is widely used by practicing psychologists and career counsellors to match workers and jobs. It is also used by marriage counsellors to identify sources of conflict, and by educators to assess the relationship between personality and learning styles.

The MBTI assigns personality scores on four separate dimensions. These are:

- Extraversion-Introversion. Extraverts are said to be energized by social contact. Introverts are said to be more private and reflective. Examples of test questions that are used to distinguish extraverts from introverts are the following: "Do you find being around a lot of people a) gives you more energy, or b) is often draining?" and "Would you say it generally takes others a) a little time to get to know you, or b) a lot of time to get to know vou?"
- Sensing–Intuition. A sensing individual is said to be stimulated by details and specifics. An intuitive individual focuses on the big picture, preferring logical patterns and concepts to details. Examples of test questions that are used to distinguish sensing types from intuitive types are the following: "If you were a teacher, would you rather a) teach fact courses or b) courses involving theory?" and "Would you rather be considered a) a practical person or b) an ingenious person?"
- Thinking-Feeling. Thinkers are said to make decisions objectively, linking ideas through logical connections. Feelers are more likely to be attuned to the values of others. Examples of test questions used to distinguish thinking types from feeling types are "Do you more often let a) your head rule your heart or b) your heart rule your head?" and "Which is a higher complement, to be called a) competent or b) compassionate?"
- Judging-Perceiving. Judging types prefer an orderly environment. They are goal oriented and prefer to have plans for achieving their goals. Perceiving types tend to be spontaneous, curious, and adaptable, open to new events and changes. Examples of test questions used to distinguish judging types from perceiving types are "When you go somewhere for the day would you rather a) plan what you will do and when or b) just go?" and "In your daily work, do you a) rather enjoy an emergency that makes you work against time, or b) usually plan your work so you won't need to work under pressure?"

The MBTI questionnaire was originally developed by Myers (1975) as a practical method of implementing theories of personality type advanced by Jung (1971). The developers and early advocates of the MBTI Myers (1975), Keirsey (1998) conceived of this test as "typology", dividing the population into discrete groups. Thus everyone is either an introvert or an extravert, a thinker or a feeler, and so on. This typology classifies each person as a member of one of 16 distinct categories, defined by one's type on each of the four dimensions, Extraversion-Introversion (EI), Sensing-Intuition (SN), Thinking-Feeling (TF), and Judging-Perceiving (IP). The Myers-Briggs test devotes about twenty questions to determining a subject's position on each of the four scales. Each question has two possible answers, with one of two answers assigned to each end of the scale. A subject is classified as belonging to one of the two possible types, depending on which of these types is indicated by the majority of his answers. For example, the examination has twenty-one questions directed toward extraversion-introversion. Someone who gives the "extravert answer" to eleven questions and the "introvert answer" to ten questions is classified as an extravert.

Modern psychometricians take a dim view of this dichotomization of types. Pittenger (2005) concludes that statistical evidence does not support dichotomous scoring of any of the personality dimensions of the MBTI. Partitioning the population into distinct types on each scale might be warranted if the distribution of the population were bimodal, with a majority of the population close to one extreme or the other. But, typically the sample distribution of responses on each of the personality scales is unimodal with greater concentrations near the middle, and smaller concentrations near the extremes. Cohen (1983) showed that forced dichotomization of a continuous variable results in a loss of statistical power equivalent to throwing away 38-60% of the data. McCallum et al. (2002) conclude that dichotomization of quantitative measures in psychological tests is "rarely defensible" and often yields misleading results, particularly in cases where multiple indicators are simultaneously dichotomized. A study in which subjects were retested (Howes and Carskadon 1979) a few weeks after their first test shows that, about 30 per cent of the time, the results of retesting would reverse the trait classifications of subjects whose scores were near the middle of the scale for that trait.

Although a dichotomous interpretation of the MBTI lacks empirical support, there is considerable evidence supporting the use of continuously-scaled MBTI scores. Tzeng et al. (1984) and Gary, Ralph, and Friedt (1985) applied principal components analysis to MBTI responses in sample populations. They found empirical factors that coincide reasonably well with the four MBTI scales. Tzeng and his coauthors conclude that the resultant empirical factors "almost perfectly matched" the scales used by the MBTI. Sipps and his coauthors found six significant factors, four of which corresponded quite closely to the four MBTI scales.

Myers and McCaulley (1982) examined results from tests administered to about two hundred different samples of workers in various occupations. They find striking differences in the distribution of personality scores across occupations. Most of these differences are consistent with general preconceptions. Not surprisingly, people engaged in sales tend to be extraverts while librarians, scientists, and computer programmers tend to be introverts. Steelworkers, police, and nurses tend to be sensing types, while scientists, journalists, and artists tend to be intuitive types. Bank officers, scientists, and lawyers tend to be thinking types, while dental hygienists, clergy, and elementary school teachers tend to be feeling types. Managers, engineers, judges, and school administrators tend to be perceiving types, while social scientists, writers, and restaurant workers tend to be perceiving types.

3 Experimental Results

3.1 Personality Characteristics by Race and Sex

Our sample includes a total of 1,291 introductory economics students who took the Myers-Briggs personality test and participated in the restaurant experiment. Table 1 reports the mean value of students' scores on each of the four Myers-Briggs personality dimensions. Standard deviations of these scores all lie within the range of 0.21 to 0.28.

Table 1: Mear	ı personality	scores	by race.
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	All Races	White	Black	Asian	Hispanic	Other
Extraversion-Introversion	0.58	0.60	0.57	0.54	0.60	0.58
Sensing-Intuition	0.47	0.46	0.49	0.46	0.50	0.44
Thinking-Feeling	0.47	0.50	0.50	0.41	0.46	0.49
Judging-Perceiving	0.47	0.44	0.53	0.49	0.48	0.51
Number of observations	1,291	681	34	255	209	112

Our samples of Asians, Hispanics, and Whites are large enough to examine differences in average personality traits between sexes for each race. These results are presented in Table 2.

⁴ The continuous measure of position in a personality dimension is the fraction of answers that are deemed consistent with the first-listed trait in that dimension. For example, one's extraversion-introversion score is the fraction of one answers to questions related to extraversion-introversion that are characteristic of extraverts.

	Asian			Hispanic	White		
	ASIdII			inspanic	wille		
	Male	Female	Male	Female	Male	Female	
Extraversion-Introversion	0.48	0.61	0.57	0.63	0.57	0.64	
Sensing-Intuition	0.49	0.43	0.50	0.50	0.45	0.48	
Thinking-Feeling	0.48	0.32	0.53	0.40	0.56	0.40	
Judging-Perceiving	0.46	0.52	0.46	0.50	0.39	0.52	
Number of Observations	139	116	109	100	400	281	

Table 2: Mean personality scores by race and gender.

3.2 Entry and Equilibrium

The experiments were conducted in 42 section groups of approximately 35 students each. Each student participated in two rounds of each of two sessions.

We define the long run equilibrium number of restaurants in any round of the experiment to be the largest number of restaurants that can be profitably sustained in short run competitive equilibrium. Since each restaurant has a capacity of four, the long run equilibrium number of restaurants is the largest number n such that there are at least 4n demanders whose buyer values are at least as high as average costs for a restaurant that sells four meals. The number of "excess entrants" in a round of the experiment is the difference between the actual number of entrants and the long run competitive equilibrium number.

Table 3 reports the distribution of excess entrants in each round, for the 42 different class sections in which the experiment was performed. Excess entry was especially common in the first round of Session 1. The median difference between the number of entrants and the number of restaurants that could operate profitably

Table 3: Number of sections with exce

Excess	:	Session 1	:	Session 2
Entrants	Round 1	Round 2	Round 1	Round 2
0	1	12	9	5
1	6	13	8	22
2	10	6	9	12
3	9	7	13	3
4	11	3	3	-
5	3	1	-	-
6	1	-	-	-
7	1	-	-	_

was 3. In round 2, as students gained experience, excess entry was much reduced, with zero or one excess entrants in slightly more than half of the sections. In Session 2, marginal cost was increased from \$5 to \$8 and consequently the number of restaurants that could operate profitably decreased by about one-third. In the first round of Session 2, many students seemed to overestimate the number of firms that could be sustained and the excess entry increased somewhat. However, by the second round of Session 2, painful experience has diminished the number of excess entrants to either zero or 1 in about two thirds of the sections.

If there are no excess entrants in Session 1, then any price between \$10 and \$12 is a short run competitive equilibrium price. In Session 2, any price between \$12 and \$18 is a short run equilibrium price. In either session, if there is no excess entry, then all entrants will make non-negative profits in short run equilibrium. If there are excess entrants in either session, then the short run competitive equilibrium price for meals is equal to marginal cost \$5 in session 1 and \$8 in session 2. In each case, the price is below average costs, which are \$10 in Session 1 and \$13 in Session 2. Thus in short run equilibrium, everyone who opened a restaurant would lose money.

In this experiment, each session consisted of only two rounds. Thus, subjects had limited experience on which to base their actions. Trading was decentralized, with restaurants operators scattered in different corners of the room, and buyers and sellers able to negotiate prices individually. Demanders with high buyer values often failed to find the lowest available price. Thus, when there were excess entrants, not all prices were driven to marginal cost, with some meals being sold for more than average cost and with some restaurants managing to make a profit. Table 4 reports on the distribution of prices at which meals were sold, given the amount of excess entry.

Ta	ble	4:	Excess	entry	and	percentil	le	distri	bution	of	meal	prices.
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Excess	Session 1, Round 2			Session 2, Rou				
Entrants	25th Percentile	50th Percentile	75th Percentile	25th Percentile	50th Percentile	75th Percentile		
0	\$10	\$11	\$11.5	\$13.5	\$14	\$14		
1	\$9	\$10	\$11	\$11.5	\$13	\$14		
2	\$7	\$8	\$10	\$11	\$12	\$13		
3	\$7	\$8	\$10	\$10	\$11	\$14		
4	\$6.5	\$7	\$9	_	_	_		
5	\$6	\$7	\$9	-	-	_		

We see from Table 4 that in both Sessions, when there were no excess entrants, almost all transactions fell within the range predicted by competitive theory. With excess entrants, prices fell, but not all the way to marginal cost, as would

be predicted by competitive equilibrium theory. However, when the number of entrants exceeded the competitive number, strong forces operated to reduce the number of entrants in any future rounds of play. When there was one excess entrant, about 60% of those who opened restaurants lost money, with two excess entrants, more than 80% lost money, and with three or more excess entrants, almost all entrants suffered losses.

3.3 Relating Entry to Personality Other Factors

For each round of each session, we estimated a probit regression of the decision to open a restaurant (yes=1, no=0) where the independent variables include continuous measures of each of the four Myers-Briggs personality dimensions as well as one's gender, race/ethnicity, and rank in class examinations. These regressions also included a fixed effect variable for the section group in which the experiment was performed. The results appear in Table 5.

Table 5: Characteristics and decision to enter: probit estimates, with marginal effects and standard errors in parenthesis.

		Session 1		Session 2
	Round 1	Round 2	Round 1	Round 2
Extraversion-Introversion	0.011	0.006	0.008	-0.053
	(0.046)	(0.041)	(0.035)	(0.048)
Sensing-Intuition	-0.054	-0.076	-0.049	-0.096
	(0.053)	(0.054)	(0.041)	(0.042)
Thinking-Feeling	0.034	0.044	0.134	0.124
	(0.059)	(0.048)	(0.039)	(0.045)
Judging-Perceiving	-0.031	-0.008	-0.020	-0.009
	(0.053)	(0.051)	(0.043)	(0.041)
Class Rank	0.114	0.145	0.101	0.060
	(0.057)	(0.059)	(0.047)	(0.037)
Male	0.002	0.012	-0.013	-0.014
	(0.031)	(0.028)	(0.025)	(0.027)
African American	0.042	0.060	0.049	-0.004
	(0.081)	(0.086)	(0.073)	(0.057)
Asian	-0.031	-0.026	0.011	-0.007
	(0.035)	(0.023)	(0.031)	(0.030)
Hispanic	-0.072	-0.047	-0.066	-0.063
	(0.035)	(0.030)	(0.024)	(0.021)
Other Race	0.005	0.023	0.017	-0.020
	(0.046)	(0.036)	(0.044)	(0.035)

Note: Regression includes section fixed effects with s.e. clustered by section.

In the first round of the first session, personality traits had little effect on the likelihood that a student would open a restaurant. The sensing-intuition characteristic has the largest effect. A one standard deviation increase (0.24) in the measure of that characteristic decreases the likelihood of opening by one percentage point. As students become more familiar with the game, the effects of personality traits seem to emerge. In the second round of the second session, the effect of the sensing-intuition characteristic is twice as high as the first round of the first session. The thinking-feeling characteristic has an even large effect. An increase of one standard deviation (0.26) increases the likelihood of entering by three percentage points. The standard errors of these marginal effects are relatively high, ranging from 0.035 to 0.059. Nevertheless, using a likelihood ratio test, the null hypothesis that all personality effects are zero can be rejected at the 5% significance level. The t-ratios resulting from the estimates in Table 3 point to a similar conclusion. Examining each ratio in isolation is misleading because the absolute value of at least one ratio is likely to exceed the critical value even if all marginal effects are zero. As shown by Dunn (1961), an appropriate correction for a multitude of t-tests is to increase the critical value for each test. With this more stringent test, the absolute value of the t-ratio for the thinking-feeling characteristic in session 2, round 1, exceeds the critical value associated with the 5% significance level.

Separate regressions for each round fail to take account of the persistence of individual behavior across rounds. More than half of the students (53%) never opened a restaurant, while about 80% of them opened restaurants in at least three rounds. To capture this persistence, we estimated an ordered probit relation in which the dependent variable is the number of times that a student opened a restaurant.

As Table 6 shows, two of the Meyer-Briggs personality dimensions are associated with a substantially higher likelihood of opening a restaurant. Those who open restaurants tend to have low scores on the sensing-intuition scale and high scores on the thinking-feeling scale. The expected number of restaurants opened by a person who scores at the 25th percentile on the sensing-intuition scale is about 15% higher than that for someone at the 75th percentile. The expected number of restaurants opened by someone who scores at the 75th percentile on the thinking-feeling scale is about 18% higher than that for those who score at the 25th percentile. For both characteristics, the t-ratio has an absolute value more than twice its standard error. Using a likelihood ratio test, the hypothesis that personality does not matter can be rejected at the 5% level.

Two other control variables are also important. Those whose class rank on examinations is at the 75th percentile are expected to open about 31% more

Table 6: Characteristics and number of decisions to enter: ordered probit regression.	Table 6:	Characteristics	and numb	er of	decisions	to enter	ordered	probit regression.
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	Coefficient estimate	Standard Error
Extraversion-Introversion	-0.005	0.143
Sensing-Intuition	-0.324**	0.131
Thinking-Feeling	0.384**	0.155
Judging-Perceiving	-0.108	0.134
Class Rank	0.506**	0.177
Male	-0.027	0.083
African American	0.105	0.210
Asian	-0.079	0.094
Hispanic	-0.293**	0.078
Other Race	0.024	0.119

Note: Regression includes section fixed effects with s.e. clustered by section.

restaurants than those who score at the 25th percentile. The expected number of restaurants opened by a non-Hispanic is about 39% higher than that for Hispanics.

Recall that persons with low scores on the sensing-intuition scale tend to focus on the big picture rather than on details, while those on the high end of the thinking-feeling scale tend to seek logical connections and to be less concerned about the feelings of others. It is not so surprising that those willing to undertake an entrepreneurial venture in an unfamiliar environment would tend to be intuitive types. It is less apparent that "thinkers" would be more likely to open restaurants than "feelers" or that people with higher examination scores are more likely to do so. It may be that those who are relatively unskilled at reasoning about economic situations find the experimental environment confusing and thus take the safe, passive option of not opening a restaurant. The fact that Hispanics are less likely to open a restaurant suggests that there may be an interesting cultural difference.

We were surprised by two "dogs that didn't bark." We expected to find that extraverts would be more likely than introverts to open a restaurant, since in the experiment restaurant operators must engage in face-to-face transactions with customers and potential customers. Our results show no such effect.

We also expected to find that men would be more likely to open restaurants than women. A survey article by Rachel Croson and Uri Gneezy reviews a large number of experimental and field studies suggesting that men are typically more overconfident and less risk averse than women and hence more willing to try risky endeavors.(Croson and Gneezy 2009) In experiments where subjects were given the option of being paid piece rates or by tournament outcomes, Niederle

^{**}Differs from zero at 5% significance level.

and Vesterlund (2007) and Balafoutus and Sutter (2010) find that men are more overconfident than women about their relative performance in a test of adding numbers, and hence are more likely to enter competitive tournaments. But in our study, this dog held its peace. We found no significant difference between the sexes in propensity to open a restaurant, with men slightly less likely to do so than women.⁵ There is some fragmentary evidence that overconfidence of males relative to females is less universal than might guessed from sampling the peer-reviewed experimental literature. For example, an unpublished study by Price (2010) replicated the Niederle-Vesterlund study using Purdue students as subjects, and found no significant difference in behavior of males and females. In another unpublished study, Stenman and Nordblom (2010) conducted an ingenious field experiment on student's beliefs about their ability to correctly answer multiple-choice examination questions, and found no more overconfidence among men than among women.

3.4 External Factors and Decision to Enter

If all students believed that they would make profits by entering, if and only if there is no excess entry, and if they were certain that all others shared this belief, then the entry game would have a simple solution. Where k is the maximal number of restaurants that can operate profitably and the entrance of an additional restaurant would cause all to lose money, the first k students called on would choose to open restaurants and the remaining students would choose not to.

But as Table 3 shows, not all meals sell for the same price, and some restaurants make profits even if there is excess entry. Furthermore, students are not told the number of restaurants that can be profitably sustained, though they are given sufficient information that they could deduce this number. Those who make this calculation and act accordingly are soon relieved of the impression that all of their classmates will make a similar calculation. We often hear expressions of exasperation from those who opened restaurants because there was not excess capacity when their turn arrived, only to find that some who were asked later chose to open restaurants after the number of open restaurants reached the largest number who could operate profitably.

⁵ Not only is the coefficient on gender insignificant when we control for other characteristics, but it is also insignificant in a simple regression including only a male dummy and section fixed effects.

In an environment where one can not be confident that other potential entrants will act "rationally", one's decision about opening a restaurant is likely to be influenced both by the number of restaurants that are open and the number of persons who remain to be asked when his turn to decide arrives. Table 7 shows the results of probit regressions of a student's decision to open a restaurant on the variables "Order in Roll Call" which is normalized on a scale from zero (first student called) to one (last student called) and on "Restaurants Open" which is the number of restaurants that have already been opened when one is called upon to decide.

Table 7: External conditions and decision to enter probit estimates, marginal effects.

		Session 1		Session 2
	Round 1	Round 2	Round 1	Round 2
Order in Roll Call (Standard Error) Restaurants Open (Standard Error)	0.799** (0.191) -0.098** (0.022)	0.683** (0.135) -0.095** (0.016)	0.895** (0.113) -0.133** (0.015)	1.010** (0.073) -0.171** (0.013)

Note: Regression includes section fixed effects with s.e. clustered by section.

We see that, holding constant the number of restaurants already open, students are more likely to enter as the roll call proceeds and that, adjusting for order in the roll call, students are less likely to enter if the number of restaurants already open is larger.

Despite the fact that these external variables affect entry probability, the regression reported in Table 6 did not include the variables "Order in Roll Call" and "Number of Restaurants". Excluding these variables does not bias our estimates of the effect of personal characteristics on entry decisions because they are uncorrelated with personal characteristics. A student's order in the roll call was randomly chosen for each round. The number of restaurants open when it is a student's turn is determined by the decisions of students earlier in the roll call, a group whose members have also been randomly determined.

It may be, however, that students with different characteristics react differently to different external conditions. For example, it might be that students with high class rank or with personality scores at the "think" end of the thinking-feeling spectrum would respond more sharply to changes in competitive conditions. We therefore ran probit regressions with the external conditions and interaction terms between personal characteristics and external conditions in each of the four rounds of play. These regressions did not find consistently significant interaction effects.

3.5 Personality and Profits

Opening a restaurant in this experiment was not in general a profitable action. In a simple regression of profits on personality traits, personality traits that promote opening of restaurants turn out to have negative coefficients. But not everyone who opens a restaurant in the same round of play makes the same profits. Therefore it is possible that personality traits that incline individuals to open restaurants are also indicators of unusual skill in selling meals once one has opened a restaurant.

A regression of profits on personal characteristics would address this issue, but interpretation of the results would be confounded by the well-known problem of sample selection bias. We address this problem using a method proposed by Heckman (1979). For this method to be effective, we need to have some variables that influence entry but that are uncorrelated with profits conditional on entry. The two variables, "Order in Roll Call" and "Restaurants Open" that we examined in Table 7 serve this role. Both affect the probability of entry, and since each is randomly determined, neither is correlated with profit-making ability conditional on entry.

When we regress personal characteristics on profits conditional on entry, using the Heckman correction, we find that none of the personal characteristics have coefficients significant at the 10% level. Thus there is no evidence that those with traits that attract them into opening experimental restaurants tend to be either better than or worse than average at operating their restaurants profitably.

4 The Big Five Personality Measure

Our experiments were conducted in section meetings for three large classes in the fall and winter terms of 2006 and in the winter term of 2007. After we had administered the Myers-Briggs personality test to students in the two classes that met in 2006, we discovered that the current consensus among academic personality researchers (Goldberg 1993; Bouchard 1992; McCrae and Costa 1989) seems to favor an alternative personality scaling, the Five Factor or "Big Five" Model. This led us to administer both the Myers-Briggs and the Big Five personality test to the class that met in 2007. A recent survey by Almlund et al. (2011) also features the Big Five factors as the central measure of noncognitive personality traits.

The Big Five test measures five nearly orthogonal personality factors, which are known as *conscientiousness*, *openness to experience*, *extraversion*, *agreeableness*, and *neuroticism*. The Big Five factors are assessed by means of a test called the Revised NEO Personality Inventory.(Goldberg 1993) A series of studies of

identical and fraternal twins raised together or apart have shown "substantial heritability" of the Big Five personality traits as measured in adults. Jang, John Livesley, and Vernon (1996), Bouchard (1992), Bouchard and Hur (1998) applied similar methods to investigate the heritability of the continuously scaled MBTI personality traits. They found the heritability of MBTI traits to be very similar to that of the Big Five traits.

Several studies (McCrae and Costa 1989; Furnham 1996; Furnham, Moutafi, and Crump 2003) have found strong correlations between the four Myers-Briggs (MBTI) factors and four of the NEO Big Five factors. NEO Extraversion was correlated with extraversion on the MBTI Extraversion-Intraversion scale. Openness was negatively correlated with sensing and positively correlated with intuition on the MBTI Sensing-Intuition scale. Conscientiousness on the NEO scale was positively correlated with judging on the MBTI Judging-Perceiving scale. NEO Agreeableness was negatively correlated with thinking on the MBTI thinking-feeling scale. Neuroticism as measured by NEO had only a slight negative correlation with MBTI Extraversion (Furnham, Moutafi, and Crump 2003). McCrae and Costa (1989) interpret these results to mean that "The five-factor model provides an alternative basis for interpreting MBTI findings within a broader, more commonly shared conceptual framework."

In the winter quarter of 2007, the last quarter of our study, we asked students to take both the Myers-Briggs test and the Revised NEO Personality test, which measures the Big Five factors. In total, 335 students took both tests. For this sample, we re-estimated the model in Table 4 using the Myers-Briggs factors. We also estimated this model with the Big Five factors in place of the Myers-Briggs factors. The results with the Myers-Briggs factors are similar to those found in Table 4 for the larger sample used previously. Using a likelihood ratio test, we can reject the null hypothesis that all four personality coefficients are zero. However, when the Myers-Briggs factors are replaced by the Big Five factors, we cannot reject the null hypothesis that all personality coefficients are zero. When both the Myers-Briggs and Big Five factors are included in this model, the coefficient on thinking-feeling continues to be significant, and none of the Big Five factors have statistically significant coefficients.

5 Conclusion

Two questions addressed by our experiment are: (1) How well does competitive theory work in explaining behavior in an environment where firms make entry and pricing decisions? (2) Is personality, as measured by standard psychological tests, systematically related to behavior in this experimental market?

The experiment was designed to instruct students about the standard economic model of competitive entry. The broad predictions of competitive theory are reasonably well supported by the experimental results. In the short run, entrants lose money when there is excess entry and either break even or make profits when there is not excess entry. As Table 1 shows, in successive rounds of play, the amount of excess entry decreased significantly. Time constraints in the classroom environment prevented us from running more rounds of play. If the experiment had been iterated several more times, it is likely that as students gained experience, the dispersion of prices would have been reduced, and excess entry would have been greatly reduced or perhaps eliminated.

For the purposes of our investigation, however, study of early rounds of play, in which outcomes are highly unpredictable to the participants is advantageous. Real world decisions about whether to start a new firm are loaded with uncertainty. New entrants can not know whether they will have to compete with new entry or expansion by others, nor can they assume that potential competitors will act in a predictable way. Thus there is a reasonable chance that the personal characteristics that are associated with starting a restaurant in our experiment might be related to those associated with real world entrepreneurship.

We found that two of the four Myers-Briggs personality measure have substantial effects on the likelihood that an individual will open a restaurant. Persons who measure closer to the intuition end of the sensing-intuition scale and those who measure closer to the thinking end of the thinking-feeling scale are more likely to open restaurants in our experiment. We found that, in this experiment, those who score well on classroom examinations are more likely and Hispanic students are less likely to choose to open a restaurant.

It is interesting to note some things that we *did not* find, though we searched for them in the data. We found no significant effects of observed personal characteristics on expected profits, conditional on opening a restaurant. We did not find extraverts to be more likely to open a restaurant than introverts, nor did we find any significant difference between the entrepreneurial behavior of males and of females.

Perhaps most surprisingly, although the Briggs-Myers traits had a significant effect on entry decisions, we were unable to reject the hypothesis that collectively the Big Five factors were uncorrelated with behavior in our experiment. Of course this result applies only to behavior in one specific economic experiment. In order to determine whether personality, as measured by either scale, is a significant explanatory of economic behavior it would be necessary to relate behavior in a variety of economic environment to alternative measures of personality traits. We hope that this paper has been a step in that direction.

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Appendix – Experimental Instructions

Before coming to class, students are encouraged to read the following instructions and to answer the "Warm-up Questions" that follow.

The Ins and Outs of the Restaurant Business

Have you ever wondered what it would be like to open a restaurant? In this experiment, even if your cooking is so bad that your dog won't eat it, and even if you are too surly to wait tables, you will have your chance.

Restaurants, like most other businesses, have some costs that are the same no matter how many units they sell and some costs that depend on the number of units sold. The former are known as **fixed costs** or equivalently as **overhead costs**, and the latter are known as **variable costs**. A firm's **total cost** is the sum of its fixed costs plus its total variable costs.

Examples of fixed costs for a restaurant include the cost of renting the building in which it locates, the cost of kitchen equipment, booths and tables, the cost of advertising, and the cost of employing a chef. A restaurant will have to pay these costs regardless of how many meals it sells. In contrast, the cost of the ingredients used in meals will vary with the number of meals sold, and thus is a variable cost.

In the real world anyone is free to open a restaurant, but it clearly wouldn't be profitable for everyone to do so. If very few people open restaurants, demand for meals at most restaurants will be high and profits will be high, but if too many people open restaurants, then demand at each restaurant will be lower and competition will cause at least some of them to lose money. In this experiment, we study the way that competitive forces determine the number of restaurants that open.

Instructions

In this market, anybody who wants to open a restaurant can do so. The restaurants are small (intimate, as they say in the restaurant guides). If you open a restaurant you can serve up to four customers. Restaurant operators must pay a *fixed cost* of \$20 no matter how many customers they get. In addition to its fixed

costs, each restaurant has a *variable cost* of \$5 per customer. A restaurant's *total cost* is the sum of its \$20 fixed cost plus the total of its variable costs for all the meals it sells.

In this experiment, a restaurant will have a total cost of \$20 if it sells no meals, \$25 if it sells one meal, \$30 if it sells two meals, \$35 if it sells three meals, and \$40 if it sells four meals. We can describe a restaurant's total cost by a **total cost function** C(n) as follows: for n customers, where n is between 0 and 4, total cost is C(n) = \$20 + 5n.

Everyone in the class is a potential customer for any of the restaurants. Everyone gets a Personal Information Sheet with his or her Buyer Value for each market session. If you choose to buy a meal, the market manager will pay you your Buyer Value, so that your profit ("consumer's surplus") from buying a meal will be your Buyer Value *minus* the price you pay for the meal. If you own a restaurant, you can still buy a meal either in your own restaurant or in somebody else's. Of course, if you buy a meal in your own restaurant you will be counted as one of your four customers and the variable cost of your own meal will be \$5, like anyone else's.

Stage 1 - To Open or Not to Open a Restaurant?

Each round of each session has two stages. In the first stage, everyone must decide whether to open a restaurant. Before anyone has to make a decision, the market manager will give you a rough idea of the distribution of Buyer Values by asking for a show of hands for each possible Buyer Value. The market manager will then publicly ask class members, in succession, whether each intends to open a restaurant. When it is your turn to decide, you will know how many people are already committed to opening restaurants. If you choose to open a restaurant you will be charged \$20 in overhead cost, no matter how many meals you sell, and you will be given a customer list that has spaces for four names, since you have a "seating capacity" of four customers. If you decide not to open a restaurant, you will have no overhead cost and will not be allowed to sell meals.

Stage 2 - Posting Prices and Selling Meals

In the second stage of any round, restaurant operators post prices at which they are willing to sell meals to any buyer (until they fill up their restaurants). These posted prices should be clearly visible to buyers and to other sellers. If it is convenient, each restaurant will be assigned a location next to the blackboard,

where its owner can post a price. Customers can either choose a restaurant and buy a meal at a currently posted price or wait for the posted prices to change. Firms can change their posted prices at any time. When a customer buys a meal at a restaurant, the owner must record the price that the customer paid for the meal and the customer's identification number and Buyer Value.

Later Rounds of Trading in Session 1

At the end of the first round of trading the market manager will report the profits of each restaurant. The market manager may also choose to present the market demand curve on the blackboard. After this information has been made available, another round of trading begins.

In all rounds of trading in the first session, customers' Buyer Values are the same as in the first round. In each new round, class members are given another chance to decide whether or not to enter the restaurant industry. The market manager proceeds exactly as in the first round, asking class members whether they intend to open a restaurant. Those who choose to open a restaurant are charged \$20 in overhead cost, and those who choose not to open a restaurant have no overhead cost and are not allowed to sell meals. In the second stage of each round, prices are posted and purchases made, just as they were in the first round. At the end of the round, results are reported to the class.

Session 2 - Introducing a Sales Tax

In Session 2, the distribution of Buyer Values is the same as in the first session, though Buyer Values of individuals may be different. As in the first session, the market manager asks class members in turn, whether they want to open a restaurant. Overhead cost remains at \$20. In this session the government initiates a sales tax of \$3 per meal sold, which increases each restaurant's total variable cost to \$8 per meal (the original \$5 plus the \$3 tax). Thus a restaurant that serves n meals will have a total cost, including the sales tax, of C(n) = \$20 + 8n. In all other respects the market procedures are as in Session 1.

Warm-up questions

In order to prepare for this experiment, please answer these warm-up questions before you come to class.

-	You have opened a restaurant and find that you can sell up to 4 meals at a price of \$15 per meal, but that at any higher price you would be unable to
	sell any meals. In order to maximize your profit (or minimize your losses),
	how many meals should you sell? \$ What would be your
	total profit (or loss)? \$
_	You have opened a restaurant and find that you can sell up to 4 meals at a
	price of \$7 per meal, but that at any higher price you would be unable to
	sell any meals. In order to maximize your profit (or minimize your losses),
	how many meals should you sell? \$ What would be your total
	profit (or loss)? \$
_	You have opened a restaurant and find that you can sell up to 4 meals at a price of \$3 per meal, but that at any higher price you would be unable to
	sell any meals. In order to maximize your profit (or minimize your losses),
	how many meals should you sell? What would be your profit
	(or loss)? \$
-	If you have already opened a restaurant, what is the lowest price at which
	you will be willing to sell meals? \$
-	Let \$P be the average price at which you expect to sell meals, and suppose
	that you believe you will be able to sell 4 meals at this price. What is the
	smallest value of P such that you would be willing to enter the industry? \$
	In Session 2, Buyer Values are the same as in Session 1, and hence the
	demand curve remains the same as before. All firms have to pay a sales tax
	of \$3 for each meal sold.
-	In Session 2, is the sales tax a variable cost or a fixed cost for a restaurant?
-	In Session 2, including the sales tax, a restaurant has variable costs of \$ and fixed costs of \$
-	In Session 2, if you have already opened a restaurant, what is the lowest price at which you would be willing to sell meals? $\$$

References

Almlund, M., A. L. Duckworth, J. J. Heckman, and T. D. Kautz. February 2011. Personality Psychology and Economics. NBER Working Paper No. 16822.

Balafoutus, L., and M. Sutter. 2010. "Affirmative Action Policies Promote Women and Do Not Harm Efficiency in the Laboratory." Science 335 (6068):579-82.

Bergstrom, T. C., and J. H. Miller. 2000. Experiments with Economic Principles: Microeconomics, 2nd edn. Boston: Irwin McGraw-Hill.

- Bouchard, T. J. 1992. "Genetic and Environmental Influences on Adult Personality: Evaluating the Evidence." In *Foundations of Personality*, edited by J. Hettema and I. J. Deary, 15–44. Amsterdam: Kluwer.
- Bouchard, T. J., and Y. -Mi. Hur. April 1998. "Genetic and Environmental Influences on the Continuous Scales of the Myers-Briggs Type Indicator: An Analysis Based on Twins Raised Apart." *Journal of Personality* 66 (2):135–49.
- Camerer, C., and D. Lovallo. March 1999. "Overconfidence and Excess Entry: An Experimental Approach." *American Economic Review* 89 (1):306–18.
- Caplan, B. April 2003. "Stigler-Becker Versus Myers-Briggs: Why Preference-Based Explanations Are Scientifically and Empirically Important." *Journal of Economic Behavior and Organization* 50 (4):391–405.
- Cline Group.2003. *Restaurant Start-up and Growth Study*. Technical Report. Dallas,Tx: The Cline Group for Specialized Publications.
- Cohen, J. 1983. "The Cost of Dichotomization." *Applied Psychological Measurement* 7 (3):249–53.
- Croson, R., and U. Gneezy. 2009. "Gender Differences in Preferences." *Journal of Economic Literature* 47 (2):448–74.
- de Meza, D., and C. Southey. March 1996. "The Borrowers Curse: Optimism, Finance and Entrepreneurship." *The Economic Journal* 106 (435):375–86.
- Dunn, O. J. 1961. "Multiple Comparisons Among Means." *Journal of American Statistical Association* 56 (293):52-64.
- Dunne, T., M. J. Roberts, and L. Samuelson. Winter 1988. "Firm Entry and Postentry Performance in the U.S. Chemical Industries." *The RAND Journal of Economics* 19 (4):495–515.
- Furnham, A. August 1996. "The Big Five Versus the Big Four: The Relation Between the Myers-Briggs Type Indicator (MBTI) and NEO-PI Five Factor Model of Personality." *Personality and Individual Differences* 21 (2):303–7.
- Furnham, A., J. Moutafi, and J. Crump. 2003. "The Relationship Between the Revised NEO-Personality Inventory and the Myers-Briggs Type Indicator." *Social Behavior and Personality* 31 (6):577–84.
- Gary, S., A. Ralph, and L. Friedt. 1985. "Item Analysis of the Myers-Briggs Type Indicator." Educational and Psychological Measurement 45:789–96.
- Goldberg, L. R. 1993. "The Structure of Phenotypic Personality Traits." *American Psychologist* 48:26–34.
- Heckman, J. 1979. "Sample Selection Bias as a Specification Error." *Econometrica* 47 (1):153–61. Howes, R. J., and T. G. Carskadon. 1979. "Test-Retest Reliabilities of the Myers-Briggs Type
- Indicator as a Function of Mood Changes." Research in Psychological Type 2:67–72. Jang, K. L., W. John Livesley, and P. A. Vernon. September 1996. "Heritability of the Big Five Personality Dimensions and Their Facets." Journal of Personality 64 (3):577–91.
- Jung, C. G. 1971. *Collected Works of C.G. Jung, Volume 6: Psychological Types*. Princeton, NJ: Princeton University Press. Original work published in 1921.
- Karelaia, N., and M. Hogarth Robin. 2010. "The Attraction of Uncertainty: Interactions Between Skill and Levels of Uncertainty in Market-Entry Games." *Journal of Risk and Uncertainty* 41 (2):141-66.
- Keirsey, D. 1998. Please Understand Me II. Del Mar, CA: Prometheus Nemesis.
- Knaup, A. E. 2005. "Survival and Longevity in the Business Employment Dynamics Data." Monthly Labor Review 128:50–5.
- Knight, F. 1921. Risk, Uncertainty, and Profit. New York: Houghton Miflin.

- Lindner, F. 2014. "Decision Time and Steps of Reasoning in a Competitive Market Entry Game." Economics Letters 122:7–11.
- Madiès, T., M. C. Villeval, and M. Wasmer. 2013. "Intergenerational Attitudes Towards Strategic Uncertainty and Competition: A Field Experiment in a Swiss Bank." *European Economic Review* 61:153–68.
- McCallum, R. C., S. Zhang, K. J. Preacher, and D. D. Rucker. 2002. "On the Practice of Dichotomization of Quantitative Variables." *Psychological Methods* 7 (1):19-40.
- McCrae, R. R., and P. T. Costa. 1989. "Reinterpreting the Myers-Briggs Type Indicator From the Perspective of the Five-Factor Model of Personality." *Journal of Personality* 57:17–40.
- Myers, I. 1975. Manual: Myers-Briggs Type Indicator. Palo Alto, CA: Consulting Psychologists Press.
- Myers, I., and M. McCaulley. 1982. *Manual: A Guide to the Development and Use of the Myers-Briggs Type Indicator*. Palo Alto, CA: Consulting Psychologists Press.
- Niederle, M., and L. Vesterlund. August 2007. "Do Women Shy Away From Competition? Do Men Compete Too Much?" *Quarterly Journal of Economics* 122 (3):1067–101.
- Parsa, H. G., J. T. Self, D. Njite, and T. King. August 2005. "Why Restaurants Fail." *Cornell Hotel and Restaurant Administration Quarterly* 46 (3):304–22.
- Pittenger, D. 2005. "Cautionary Comments Regarding the Myers-Briggs Type Indicator." Consulting Psychology Journal: Practice and Research 57 (3):210–21.
- Price, C. R. January 15 2010. Do women shy away from competition? Do men compete too much?: A (failed) replication. Working paper, Krannert School of Management, Purdue University.
- Stenman, O. J., and K. Nordblom. August 2010. Are men really more overconfident than women? A natural field experiment on examinations. Working papers in Economics, University of Gothenburg.
- Tzeng, O. C. S., D. Outcalt, S. L. Boyer, R. Ware, and D. Landis. 1984. "Item Validity of the Myers-Briggs Type Indicator." *Journal of Personality Assessment* 48 (3):255–6.