A Step Ahead? Experienced Play in the p-Beauty Game*

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Abstract: In the "p-beauty" contest, contestants choose a number between zero and 100 and the winner is the player who has selected the number that is closest to some fraction p of the average chosen by the group. The decision process in this game is widely viewed as representative of the decision process in financial markets, because both require the ability to successfully anticipate and react to average opinions faster than the general public. This study examines how players who are experienced with the game behave when competing against opponents who they know have never seen the game before. The results show that experienced players correctly anticipate the choices of inexperienced players and react accordingly.

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I. Introduction

In his *General Theory*, John Maynard Keynes wrote that

> professional investors and speculators … are, in fact, largely concerned, not with making superior long-term forecasts of the probable yield of an investment over its whole life, but with foreseeing changes in the conventional basis of valuation a short time ahead of the general public. … Thus the professional investor is forced to concern himself with the anticipation of impending changes, in the news or in the atmosphere, of the kind by which experience shows that the mass psychology of the market is most influenced. (pp. 154-55)

Keynes further likened investment decision-making to a newspaper beauty contest in which the winner is the contestant who chooses the set of photographs that most closely replicates the choices of all of the contestants. He noted that

> It is not a case of choosing those which, to the best of one's judgment, are really the prettiest, nor even those which average opinion genuinely thinks the prettiest. We have reached the third degree where we devote our intelligences to anticipating what average opinion expects the average opinion to be. And there are some, I believe, who practise the fourth, fifth and higher degrees. (p. 156)

The idea that such a contest replicates financial market decision-making has more recently captured the attention of game theorists and experimental economists. Moulin (1986) dubbed a modified version of this contest the "p-beauty" game; in his version, contestants choose a number between 0 and 100 and win by being closest to some fraction, p, of the average of all of the numbers chosen. And following the seminal work of Nagel (1995), numerous experiments have been run using the p-beauty game (PBG) to determine the levels of reasoning used by players in such contests. (See also Ho, Camerer and Weigelt (1998), Duffy and Nagel (1997), Holt (1999).)

Those results suggest that the modal player uses first-level thinking when asked to choose a number in a PBG: they choose numbers around 33 when trying to be close to 2/3 the average, an indication that they are taking 2/3 of the average of 50 that would arise if everyone chose randomly. Economists and PhD grad students tend to go one level deeper, exhibiting second-level thinking by guessing numbers near 22 in an attempt to beat others who are using the previous logic and guessing 33. (See Camerer (1997) in addition to Nagel (1995).) Still, when the game is repeated, all players tend to learn from experience. Data from iterated PBGs in which players who have never played before choose numbers in a succession of rounds show a convergence toward the Nash equilibrium choice of zero.[1] Camerer, Ho and Chong (2003) identify such belief learning as a special case of their more general "experience-weighted attraction" model of learning by game players (see Camerer and Ho, 1999).[2]

Of course, as Thaler (1997) noted, "the only way to really play the number game, or the beauty contest, is to think exactly one level deeper than the average contestant." From the perspective of financial markets, he notes that this result implies that stocks are "a good investment (or potential short sale) … [only if] other people will figure this out as well and soon enough to do some good." So players of the PBG who exhibit thinking that is one level deeper than the average are exactly the type of people that could do well investing in the stock market.[3]

What economists have not yet investigated is how experienced PBG players make decisions when playing against inexperienced neophyte opponents. To our knowledge only one other paper directly addresses the role of experience in PBG games that also include inexperienced players. Slonim (2005) hypothesizes that players respond optimally to their beliefs about other players and that their beliefs are conditioned on how much experience those other

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[1] Nagel (1995), Alba-Fernandez et. al. (2006), Guth et. al. (2002), and Ho, Camerer and Weigelt (1998) are among the papers that have presented evidence on this issue.

[2] Many other interesting questions related to PBG games are also discussed in the literature. See Kocher and Sutter (2006), Kocher et. al. (2007), and Sutter (2005).

[3] Sonnemans and Tuinstra (2008) suggest that experimental results from the PBG are more relevant for investment behavior in value, rather than growth, stock markets. They argue that investor behavior in speculative, high-yield, markets may be better captured by behavior in positive expectations feedback experiments.

players have. His work looks at players with varying levels of experience and generates results that suggest that experience does matter as does information about the experience level of those one is playing against. His work uses a version of the PBG in which players target 2/3 of the *median* (not mean) guess, however, and does not compare an individual player's inexperienced versus experienced choices. Further, he offers only a cursory examination of the level of thinking pursued by the players. A number of other papers investigate non-PBG games with both experienced and inexperienced players, such as Keser and Gardner (1999), Johnson et. al. (2002), List (2003), and Dufwenberg et. al. (2005).

The existing literature suggests that players do better when they are at least a step ahead of others in their level of thinking. In this study, our goal is to examine specifically whether experience in playing the game can help players achieve that additional level of thinking relative to inexperienced opponents. We conduct an experiment where players gain experience in a session of six rounds of the PBG, and then have them play in another session against opponents who they know have never played the game before. We then examine whether these experienced players correctly anticipate the choices made by their inexperienced opponents and play best responses to those choices. From a financial markets perspective, this work investigates how older seasoned investors might behave in a market populated by younger greener folk.

The remainder of our analysis proceeds as follows. Section II presents the experimental design. Section III describes the data obtained from the experiments, presents our strategy for analyzing the data, and describes the results of our analysis. Section IV concludes by outlining possible extensions of this line of research.

II. Experimental Design

Subjects were recruited from among students at Bentley University, where the experiments were conducted. We conducted 32 sessions over two days, each consisting of a group of six players playing a total of six consecutive rounds of a PBG. Within each round of play, subjects attempted to guess a number closest to 2/3 of the mean guess, choosing from numbers between 0 and 100, inclusive. Payment was made in the form of a $5 participation payment, paid to all players in each session, and a $3 winner's payment, paid to the winner of each round in each session. The games were run by computer using the web-based version of the PBG provided by Charles Holt's Veconlab. As students arrived, they checked in at a table that was on a different floor than the computer lab where the experiments took place. Each student was given a notecard with an ID number, and they were instructed to log into the website using this ID so that their choices would be anonymous. They were also given a hard copy of the experiment instructions at the registration table (see Appendix A). Once all of the subjects had logged in, the instructions were read aloud. Subjects were then asked if they had any questions. Once any questions were answered, they were instructed to begin the game.

Every 20 minutes four sessions were played concurrently. Thus, 24 players were in the room simultaneously, minimizing the possibility that players could become aware of the identity of their opponents (except for the first set of sessions where two sessions were played). In the initial two sessions run on each day, all players were inexperienced. At the end of these sessions, the players returned to the registration table to receive payment. At this point, four randomly selected players were invited to participate in an additional session with the knowledge that he or she would be competing against five opponents who had never seen the game before. Thereafter, four more players were randomly selected from among the new inexperienced players to participate in the next set of sessions. This process allowed us to generate "experienced" players for each successive set of four sessions. Including the initial four all-inexperienced-player sessions, we conducted a total of 32 sessions.[4]

III. Data and Results

Our analysis focuses on the difference between the choices made by inexperienced and experienced players in various rounds, as well as on the choices made by experienced players in their initial (inexperienced) and latter (experienced) play. Summary statistics of the plays in each round are presented in Table 1.[5] The average guesses chosen in each round by all players together, by inexperienced players, by experienced players, and by experienced players in their initial play (before they gained experience) are presented in columns 1 through 4 respectively.

The raw data support several conclusions. First, as found by Nagel (1995), players of all experience levels learn from the experience they gain from each successive round, and their choices converge towards the Nash Equilibrium play of 0. The average guess chosen by all players falls from 33.85 in round one to 24.41 in round two and continues to decline from round to round until it reaches 6.39 in round six. This learning appears to be driven by first-level thinking: the average guess in each round is close to two-thirds of average play in the previous round. On average in each round, players appear to assume that the other subjects will continue

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[4] There were some difficulties with some of the sessions due to subjects logging in to an incorrect session. Three sessions ran with only five players, and two of these did not include an experienced subject. One session ran with six inexperienced subjects. One session ran with two experienced subjects and four inexperienced subjects. Data from these sessions is included in the analysis below, but doing so has no impact on the qualitative results.

[5] The summary statistics presented here (and the analysis that follows) were calculated after dropping seven observations from round 4 or later where a subject appeared to intentionally disrupt the results by playing 100. These observations include one inexperienced player and one experienced player from round 4, one inexperienced player and two experienced players from round 5, and two inexperienced players from round 6. However, the qualitative results of all of the analysis is unchanged if these observations are included in the sample.

to play the numbers they chose in the previous round, and the average of their new guesses is a best response under this assumption.

Second, despite the fact that the experienced players have observed the logical conclusion of the game, they do not play the Nash Equilibrium choice in the initial rounds of their second session. Rather, their average choices in each round are close to the best response to the average choice of their inexperienced opponents. In each round, the average guess of the experienced players is close to 2/3 of the average guess of the inexperienced players, suggesting that the experienced players are a step ahead of the inexperienced masses. The experienced players correctly anticipate when the group as a whole will choose numbers consistent with n^{th}level thinking, and respond with a guess consistent with $n+1^{st}$level thinking. For example, in round 1, the average choice of inexperienced players is 35.14, close to the play of 33 that we would predict from players using first-level thinking. The choice of experienced players however is 25.01 on average, roughly consistent with second-level thinking and one step ahead of the inexperienced players. This advantage to experience extends through five rounds of play; by round six, guesses converge sufficiently close to equilibrium that the experienced players no longer have any advantage over their inexperienced competition.

While experienced players appear to be one level of thinking ahead of inexperienced players through five rounds, it is not clear whether these differences are statistically significant. To investigate this question, we performed a series of Wilcoxon rank-sum tests to examine the hypothesis that the choices of our experienced players and our inexperienced players are drawn from the same distribution. The results are presented in Table 2. The differences between the choices made by the experienced players and the inexperienced players are statistically significant at the 5 percent level for the first three rounds, supporting the conclusion that experienced players do in fact exhibit one level of thinking deeper than inexperienced players.

This pattern of statistical significance is confirmed by a series of regressions of player guesses in a particular round, controlling for player type and session fixed effects. The following equation is estimated:

$$G_{is} = \alpha + \beta_1 \mathrm{EXP}_{is} + \beta_2 \mathrm{FIRST}_{is} + \beta_3 \mathrm{SESSION}_s + \varepsilon_{is}$$

where G_{is} is the guess made by player i in session s, EXP_{is} is a dummy variable that equals one if the player is experienced and FIRST_{is} is a variable that equals one if player i in session $s$was selected to return but was playing for the first time (leaving inexperienced players as the omitted category), and $\mathrm{SESSION}_s$ is a vector of dummy variables indicating the session of the experiment, so that the player type effects are estimated using within-session variation. The results are presented in Table 3. In the first three rounds, the guesses made by experienced players are statistically significantly lower than the guesses of their inexperienced opponents at the one percent level, and the magnitudes of these differences is close to what one would expect if experienced players are employing one level of thinking deeper than inexperienced players. The differences are significant at the five percent level for rounds four and five, and at the ten percent level for round six. So, the results suggest that players do learn from their earlier experience, and that they are able to correctly anticipate the choices of the inexperienced players and optimally respond to those choices.

One possible objection to this interpretation is that the experienced players' superior strategies may not be a result of their experience, but rather due to inherent intelligence or skill at playing the game. To control for this possibility, the experienced players' choices are compared to the choices made in their initial play, before they had gained any experience. The average choices they selected before gaining experience are displayed in column 4 of Table 1. If their superior play was due to innate skill rather than to experience, we would expect the choices made by experienced players in their initial play to be similar to their choices the second time around. But this is not the case. The numbers chosen by the experienced players before they gain any experience are substantially higher than what they choose in their second play. As reflected in the results of the Wilcoxon tests presented in column 2 of Table 2, these differences are statistically significant at the one percent level for the first round of play, at the 5 percent level for the second round, and narrowly miss being significant at the 10 percent level for the third round.

The evidence thus far showsthat the mean plays of experienced subjects are statistically significantly lower than the plays of their inexperienced opponents in the first three rounds. While it appears that the estimated magnitude of these differences is consistent with the hypothesis that experienced players think one level deeper than inexperienced players, we do not yet have any statistical confirmation that this is the case. Further, this examination of central tendencies may mask variation in player choices that can only be captured by looking at the entire distribution of responses.

In order to overcome these deficiencies, following Nagel (1995), we construct "neighborhood intervals" around the choices that are consistent with each level of thinking and investigate whether experienced players are more likely to select a number in the interval that represents one level of thinking deeper than what most other players select. Each interval has the boundaries $50(2/3)^{i+1/4}$ and $50(2/3)^{i-1/4}$, where *i* represents the level of thinking, rounded to the nearest integer. Accordingly, the interval [45, 50] is assumed to represent level zero thinking,[6] the interval [30, 37] represents first-level thinking, the interval [19, 25] represents second-level thinking, the interval [13, 16] represents third-level thinking and the interval [9, 11] represents fourth-level thinking. Nagel (1995) calls intervals between these neighborhood intervals "interim intervals," and uses the geometric mean to determine the boundaries of adjacent intervals.

Table 4 displays the percentage of players who selected numbers in each of these intervals, by round. The raw data show that the modal choice is in the first-level interval in round one; most players select a number that would be optimal if the typical player selected their choice randomly. Thereafter, players most often advance one level of thinking in the next round in an attempt to play the best response to what they observed in the previous round. The most common selection is a second-level choice in round two and a fourth-level choice in round four. The only exception is in round three, where second-level choices remain the most common; however, third-level choices are selected much more often than in round two. By round 5, choices converge close to the Nash equilibrium play of 0, clustering in the final interval of 8 or less.

While the modal choice is consistent with first-level thinking in round one and drops one level in each subsequent round, experienced players largely stay one level ahead of these choices. Figures 1 through 4 display relative frequency distributions of the choices made by both inexperienced players and by experienced players, for round one through round four respectively. In round one, while the choices of inexperienced players cover the entire range of possible choices, the most common category is the first-level thinking category (30 to 37). 22

[6] This interval is bounded from the right by 50 since choices above 50 are strictly dominated by choices below 50.

percent of inexperienced players select a number in this category, while another 20 percent select a number above 50. However, among the experienced players, 38 percent select a number in the second-level thinking category, and another 31 percent select a number in the interim interval just below the first-level thinking category.

In round two, inexperienced players typically attempt to play a best response to the modal play of the previous round. Their most common choice is in the second-level thinking category, which would be successful if other players had typically continued to play a first-level choice. Experienced players, however, anticipate the choices of inexperienced players. While 27 percent also played a second-level choice, another 27 percent selected a number in the third-level category.

In round three, most inexperienced players either advance their thinking to level three (17 percent) or remain behind in level two (19 percent), though some do choose fourth-level numbers (14 percent). Experienced players again stay ahead, selecting a fourth-level choice 35 percent of the time. Finally, by round four, inexperienced players catch on and the advantage to experience disappears. The most common selection of both types of players is overwhelmingly a number in the lowest category (zero to eight), which is roughly consistent with convergence to the Nash equilibrium play of zero.

To test whether these differences in behavior are statistically significant, we next estimate a series of multinomial logistic regressions where the dependent variable is the interval that contains the player's choice. There are *m* = 11 possible choice intervals. The strictly dominated interval, over 50, is treated as the base category. The model is estimated separately for each round, and takes the following form. For m = 2 to 11,

$$\ln \frac{\Pr(INTERVAL_i = m)}{\Pr(INTERVAL_i = 1)} = \alpha_m + \beta_m EXP_i = Z_{mi}$$

where $INTERVAL_i$ is the guess made by player i, EXP_i is a dummy variable that equals one if player $i$is experienced; in this case, the omitted category consists of all inexperienced players whether or not the player was invited back.[7,8] The predicted probabilities of each outcome are then calculated as follows. For the base interval of choices over 50,

$$\Pr(INTERVAL_i = 1) = \frac{1}{1 + \sum_{h=2}^{11} \exp(Z_{hi})}$$

and for the other ten intervals, m = 2,...,11

$$\Pr(INTERVAL_i = m) = \frac{\exp(Z_{mi})}{1 + \sum_{h=2}^{11} \exp(Z_{hi})}.$$

The estimated marginal effects of having previous experience on the probability of choosing a number in each interval are reported in Table 5. Columns 1 through 6 report the results for rounds one through six respectively. Experienced players exhibit more advanced thinking throughout the game. In round one, the modal choice of all players is a number in the first-level thinking category, making a number in the second-level interval an optimal play. Experienced players are 24.9 percentage points more likely than inexperienced players to choose a number in this interval, and 26.5 percentage points more likely to choose a number in the interim interval just below the first-level thinking category; these differences are statistically significant at the five percent level and at the one percent level, respectively.

In round two, the modal choice of all players is a number in the second-level thinking category, making a number in the third-level interval an optimal play. While the estimated

[7] If the initial choices made by the players who were invited back are instead treated as a separate category, the qualitative results are unchanged.

[8] We were unable to control for session effects in these regressions because the estimation failed to converge when they were included in the specification.

marginal effect of experience on the probability of selecting a third-level number is not statistically significant, the point estimate does suggest that experienced players are 11.5 percentage points more likely to select a number in the third-level interval than inexperienced players. Also, experienced players are 12.2 percentage points less likely than inexperienced players to lag behind and continue to select a number in the first-level interval, and less likely to select a number in any of the intervals that include even higher numbers.

In round 3, the modal choice remains a number in the second-level thinking category, although a substantial number of players advance beyond this level and select a third-level number or a fourth-level number. Experienced players are 20.4 percentage points more likely than inexperienced players to select a number in the level four interval, and 8.6 percentage points less likely than inexperienced players to lag behind and select a number in the first-level interval.

Finally, in rounds four through six, the modal play was in the Nash equilibrium interval of 8 or less, and the percentage of players selecting a number in this interval increased in each round as players converged closer and closer to the equilibrium play of 0. In each of these rounds, the estimates suggest that experienced players are more likely to select a number in the equilibrium interval. In round four, experienced players are 7.3 percentage points more likely than inexperienced players to select a number in this interval, although this estimate is not statistically significant. In rounds five and six, the differences are statistically significant at the five percent level. Experienced players are 18.5 percentage points more likely than inexperienced players to select a number in the Nash equilibrium interval in round five, and 14.1 percentage points more likely in round 6.

V. Conclusion

The evidence collected during our experiments is consistent with our hypotheses regarding the value of experience in PBG games. When paired with subjects they know have never played the PBG before, experienced players often correctly anticipate the choices that their inexperienced opponents will make and play a number that is in the neighborhood of the best response to this average choice. In the spirit of Thaler (1997), they successfully think one level deeper than the average contestant.

This initial investigation into the role of experience in PBG games does raise additional questions that we intend to address in future work. For example, we plan to study whether players who initially exhibit a better understanding of the game gain more from experience than players who initially exhibit a poor understanding of the game. To do so, we plan to use specific (rather than random) subjects as our experienced players, bringing back those who make either very poor choices or very good choices in their initial plays.

In addition, we are interested in whether players who are initially exposed to more rounds of the PBG gain a better understanding of the game than players who have only a limited exposure to the game and whether players who initially exhibit a better understanding of the game gain greater benefits to increased exposure to the game than players who initially exhibit a poorer understanding of the game. A further research question involves testing whether subjects with different demographic characteristics gain different benefits from experience.

While the results of these studies will be of interest to economists and behavioral game theorists, the study will also have broader impacts. As noted above, the kinds of decisions that are made in the PBG is widely regarded as being reminiscent of the kinds of decisions that are made in financial markets, since both require correct assessments of the average behavior of others. Accordingly, our findings regarding how well different amounts of experience aid people of different ability levels will benefit society by enhancing our understanding of what leads to success in financial markets.

Table 1: Summary Statistics: Guesses by round and player type

round:	all players (1)	inexperienced (2)	experienced, second play (3)	experienced, initial play (4)
1	33.85	35.14	25.01	35.98
	(18.36)	(20.01)	(8.39)	(13.90)
2	24.41	25.68	18.08	24.15
	(14.32)	(15.51)	(6.56)	(11.83)
3	17.09	18.18	12.17	16.32
	(13.26)	(14.27)	(5.84)	(12.24)
4	11.39	11.64	8.67	12.61
	(10.52)	(11.28)	(5.22)	(9.92)
5	8.11	7.91	5.68	11.49
	(8.27)	(7.64)	(4.68)	(12.42)
6	6.39	5.92	4.51	10.65
	(8.82)	(7.24)	(5.00)	(15.73)

Standard deviations in parentheses.

Table 2: Wilcoxon rank-sum tests

round:	experienced vs. inexperienced	experienced vs. their first choice
1	0.0122***	0.0010***
2	0.0118***	0.0315**
3	0.0249**	0.1033
4	0.3805	0.2811
5	0.2871	0.0634*
6	0.7356	0.1699

p-values of each test are displayed
*** significant at the 1% level; ** significant at the 5% level;
* significant at the 10% level

Table 3. Do experienced players guess lower numbers than inexperience players?

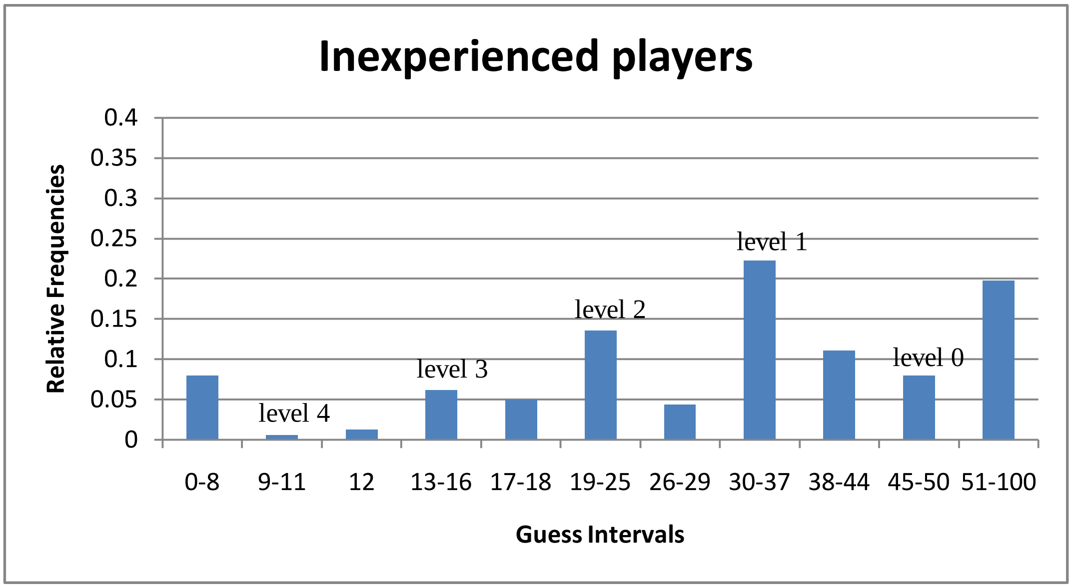
	round one (1)	round two (2)	round three (3)	round four (4)	round five (5)	round six (6)
Experienced, second play	-10.28*** (2.614)	-7.79*** (1.748)	-5.71*** (1.658)	-3.07** (1.297)	-1.63** (0.708)	-1.15* (0.610)
Experienced, initial play	-0.65 (2.866)	-2.88 (3.014)	-2.78 (2.437)	-1.47 (1.199)	2.05 (1.535)	3.13 (2.401)
Constant	35.37*** (0.584)	25.89*** (0.530)	18.26*** (0.439)	12.00*** (0.274)	8.05*** (0.265)	6.11*** (0.345)
Observations	166	166	166	163	164	164
R-squared	0.054	0.037	0.032	0.015	0.040	0.048

Regressions also control for session fixed effects
Robust standard errors in parentheses
*** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level

Table 4. Percentage of plays in each neighborhood interval, by round

Guess:	Round 1 (1)	Round 2 (2)	Round 3 (3)	Round 4 (4)	Round 5 (5)	Round 6 (6)
51 to 100	15.43	4.79	2.13	2.17	1.08	0.54
45 to 50 (level 0)	9.04	3.72	1.06	0.00	0.00	0.54
38 to 45	9.57	6.38	1.60	0.00	0.00	0.54
30 to 37 (level 1)	21.28	14.36	7.45	2.72	1.08	0.54
25 to 29	7.98	7.45	2.13	2.17	0.00	0.54
19 to 25 (level 2)	17.02	23.40	18.62	9.78	6.45	4.84
16 to 18	4.26	6.91	6.38	3.80	3.76	2.15
13 to 16 (level 3)	5.85	17.02	15.96	9.24	9.14	4.30
11 to 12	1.06	2.13	7.45	4.89	3.76	0.00
9 to 11 (level 4)	1.06	6.91	17.02	17.39	10.75	9.68
Less than 9	7.45	6.91	20.21	47.83	63.98	76.34

Figure 1. Relative Frequency Distributions of Neighborhood Interval Choice, Round 1



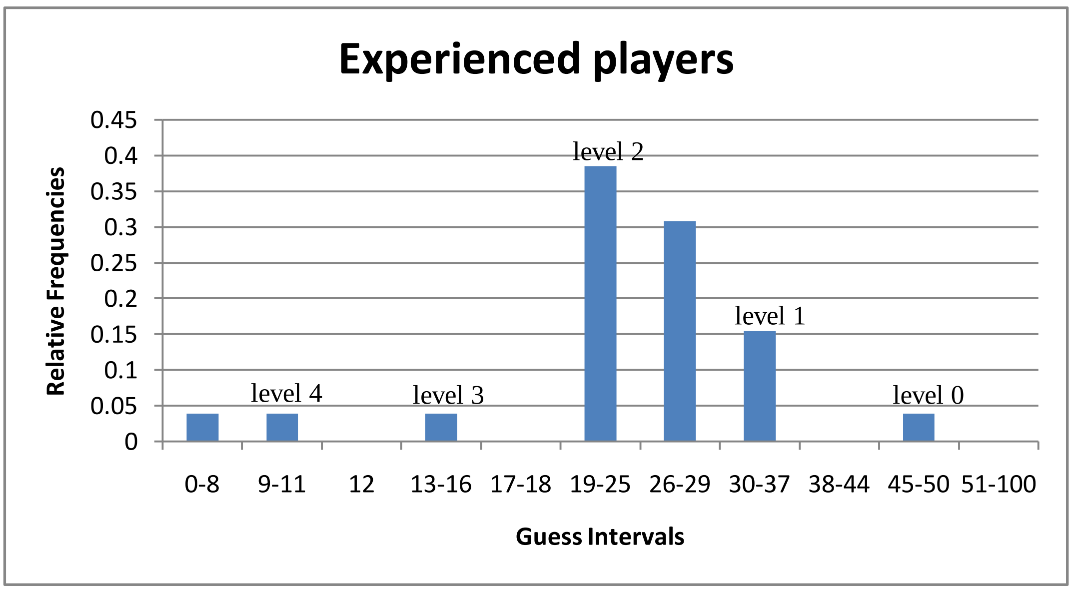
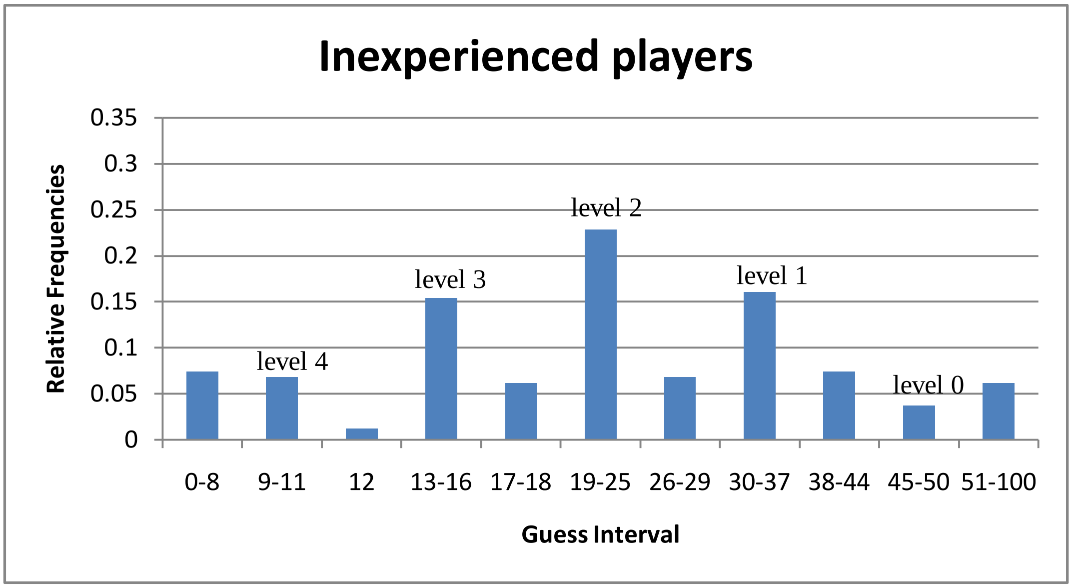


Figure 2. Relative Frequency Distributions of Neighborhood Interval Choice, Round 2



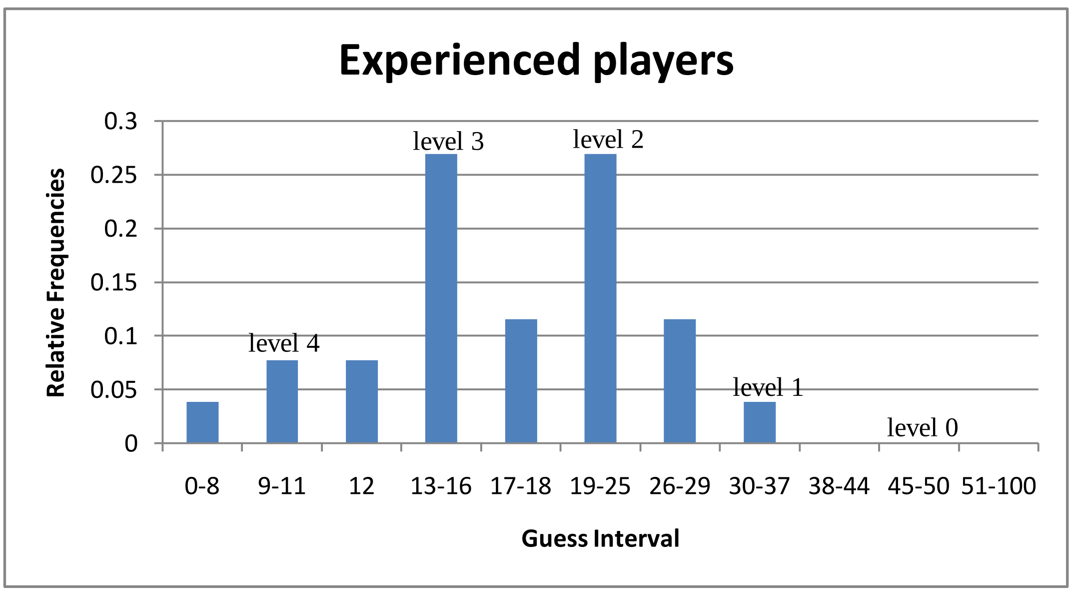
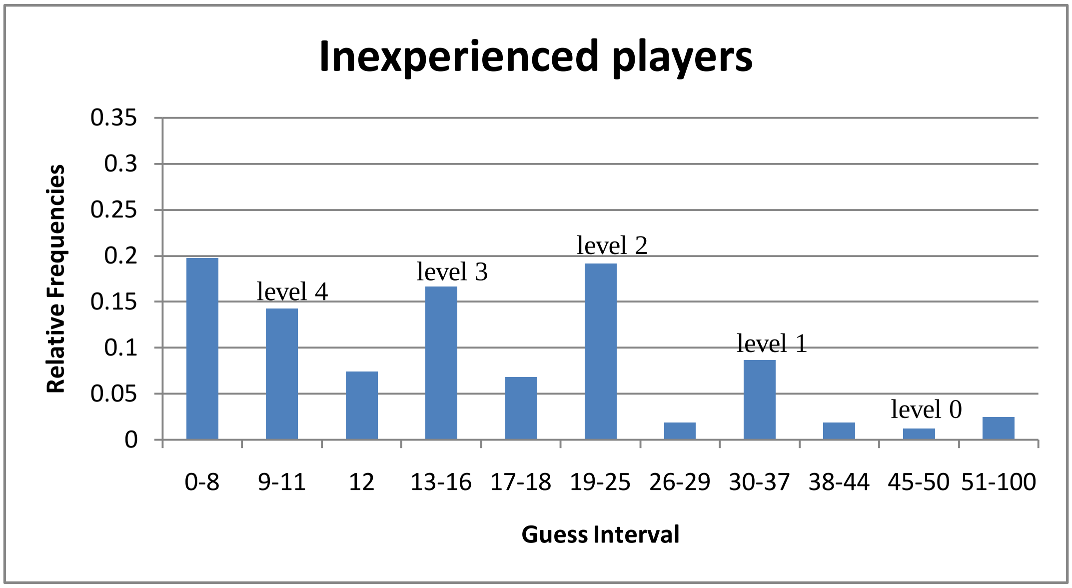


Figure 3. Relative Frequency Distributions of Neighborhood Interval Choice, Round 3



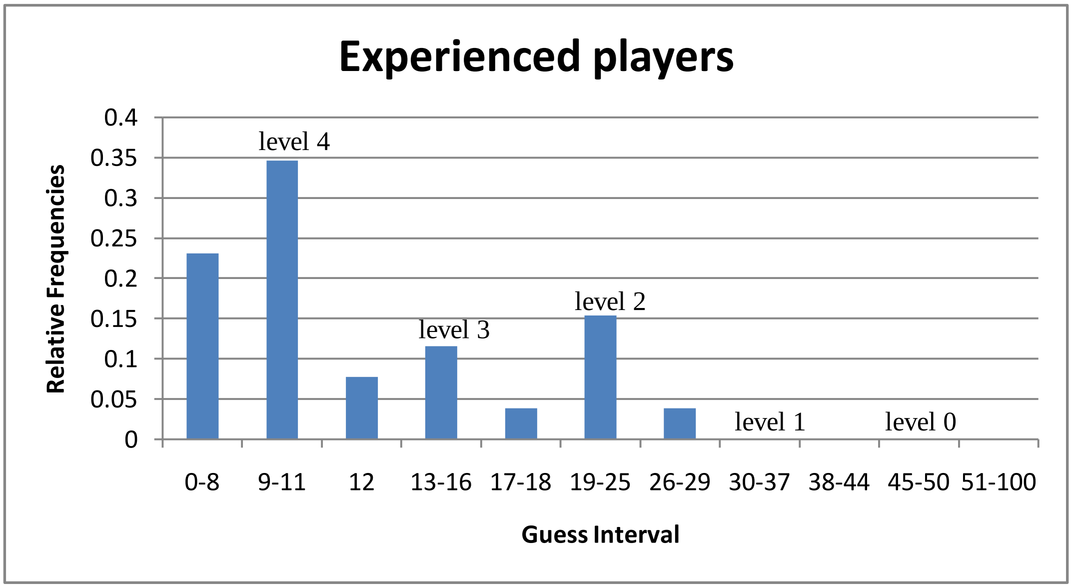
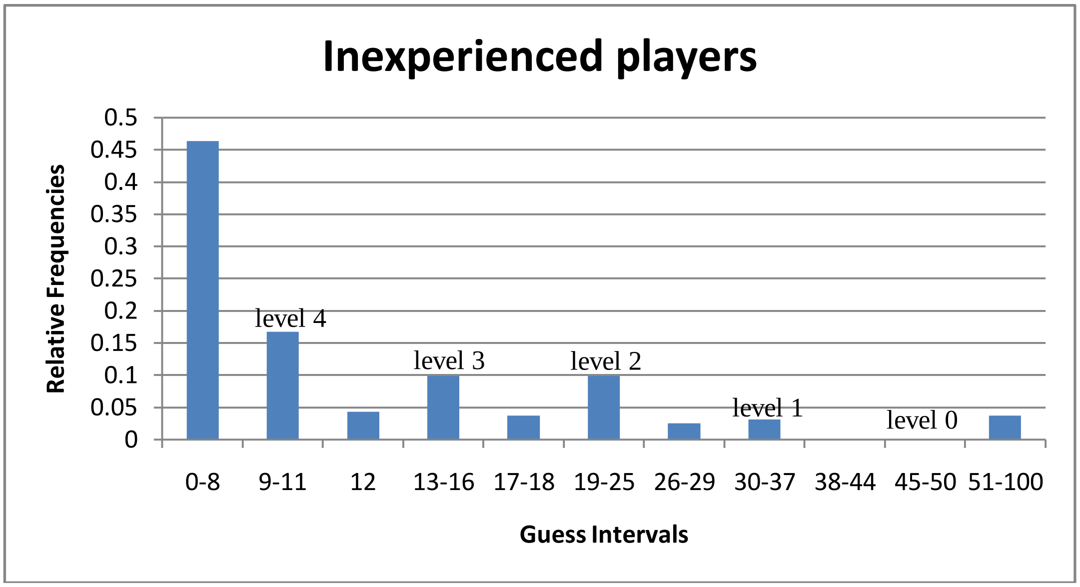


Figure 4. Relative Frequency Distributions of Neighborhood Interval Choice, Round 4



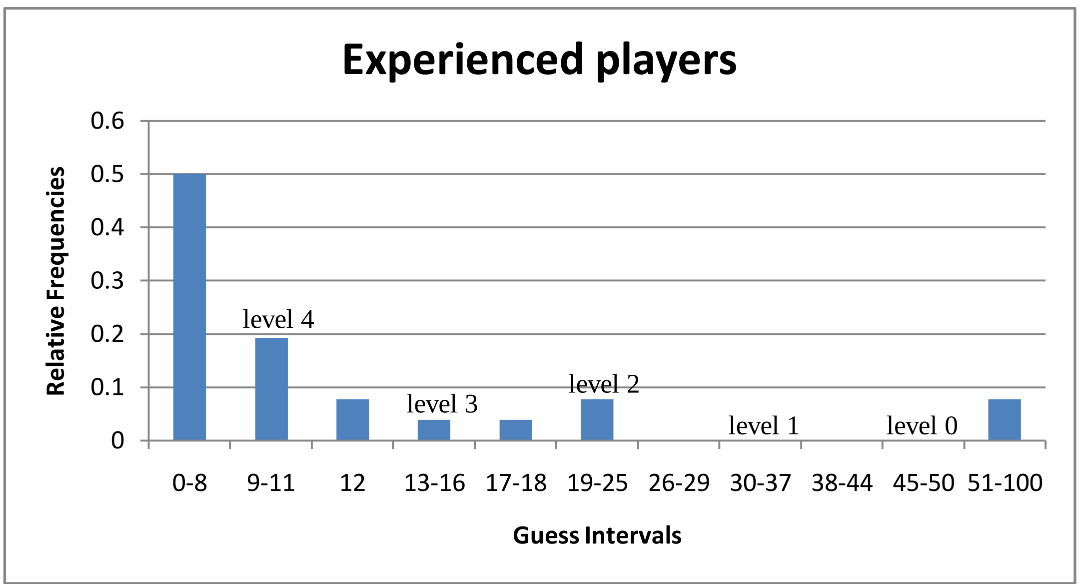


Table 5. Do experienced players play one level deeper than inexperienced players?

Guess:	Round 1 (1)	Round 2 (2)	Round 3 (3)	Round 4 (4)	Round 5 (5)	Round 6 (6)
51 to 100	-0.179*** (0.000)	-0.056*** (0.002)	-0.025** (0.043)	0.025** (0.043)	-0.012 (0.155)	-0.006 (0.316)
45 to 50 (level 0)	-0.060 (0.174)	-0.043*** (0.007)	-0.012 (0.155)			-0.006 (0.316)
38 to 45	-0.111*** (0.000)	-0.074*** (0.000)	-0.019* (0.080)			-0.006 (0.316)
30 to 37 (level 1)	-0.068 (0.380)	-0.122*** (0.010)	-0.086*** (0.000)	-0.031** (0.023)	-0.012 (0.155)	-0.006 (0.316)
25 to 29	0.265*** (0.004)	0.047 (0.470)	0.020 (0.611)	-0.025** (0.043)		-0.006 (0.316)
19 to 25 (level 2)	0.249** (0.012)	0.041 (0.661)	-0.038 (0.627)	-0.017 (0.785)	-0.028 (0.519)	-0.012 (0.780)
16 to 18	-0.049*** (0.004)	0.054 (0.412)	-0.019 (0.489)	0.004 (0.924)	-0.043*** (0.007)	0.020 (0.615)
13 to 16 (level 3)	-0.023 (0.581)	0.115 (0.209)	-0.051 (0.458)	-0.058 (0.216)	-0.013 (0.823)	-0.050*** (0.004)
11 to 12	-0.012 (0.155)	0.065 (0.223)	0.002 (0.960)	0.040 (0.500)	-0.043 (0.007)	
9 to 11 (level 4)	0.032 (0.398)	0.009 (0.872)	0.204** (0.036)	0.040 (0.653)	-0.032 (0.593)	-0.068 (0.131)
Less than 9	-0.042 (0.335)	-0.036 (0.407)	0.033 (0.707)	0.073 (0.504)	0.185** (0.037)	0.141** (0.049)

Appendix A. Instructions

Experiment Instructions

This is an experiment in economic decision-making. The experiment consists of a series of six (6) rounds. You will play against a group of 5 other people in each round. The decisions that you and the 5 other people make will determine the dollar winnings for each of you. Each player will be paid $5 for participating.

At the start of each round, you will be asked to choose a number between 0 and 100, inclusive. 0 and 100 are possible choices. Your number can include up to two decimal places, such as 12.34 or 56.78. At the same time, each of the other 5 people will also choose a number between 0 and 100. None of you will be able to see anyone else's number until after your decision is submitted.

The numbers selected by all 6 people in your group will be averaged, and then the number that is two-thirds (0.67) of that average will be calculated and announced at the end of the round.

The person whose number is closest to two-thirds of the average will win $3 for that round. The 5 other people will earn $0.

If more than one person ties for having a number closest to two-thirds of the average, then the payment of $3 will be divided equally among those who tied and the others will earn $0.

The website will keep track of the choices of each player in each round. It will also calculate the target number (two-thirds of the average of the numbers chosen by the 6 participants), identify the winner or winners of each round, and keep track of each player's winnings over the six (6) rounds of play.

After the end of the final round, you will be required to complete a short online survey. Upon completing the survey and logging out of the website, you will present your code card at the table upstairs near the main door of Smith and collect your winnings. At that time, you will also need to sign a receipt confirming the amount of the payment that is made to you.

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