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Original Paper

How Overconfidence Influences the Herding Behavior in a Modified Information Cascade Game

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Abstract

Humans are social animals. In everyday life, people rarely make important decisions solely based on their personal opinions. Most human decisions are made in a social context. People seek help from relatives, peers, experts, and more to make decisions. To mimic this fact, Anderson and Holt (1997) devised an experiment design, the information cascade game, in which players guess the actual state of the world based on their private signals and others' prior choices. On another side of the picture, Michailova (2010) defines overconfidence as the act of a person overestimating his or her skill, knowledge, and precision of information. According to Camerer and Lovallo (1999), subjects exhibit overconfidence when placing bets on their relative performance. In this experiment, the baseline treatment of the information cascade game is modified so that subjects' overconfidence actively participates in subjects' guesses about the actual state of the world. Under this modified experiment design, subjects' confidence level is negatively correlated with the herding frequency.

Keywords

information cascade, overconfidence, herding, over-estimation, over-placement

1. Literature Review

Since Anderson and Holt first introduced this experiment, many subsequent studies have been done. Lisa and Charles (1997) introduce payment to the information cascade game. As part of their experimental setup, participants get compensation for correctly identifying the urn from which the private signal is drawn. Sebastian, Christoph, and Axel (2018) discover that in an information cascade game, herding is encouraged by a shared identity. A group with the same identities tends to herd more frequently than those with mixed identities.

There are also studies on how overconfidence and information cascade experiments intertwine. In an information cascade experiment, Alessandra and Jacopo (2010) use eye-tracking technology to monitor the attention process. They find a statistically significant correlation between the subjects' initial fixations and their actual choices. More specifically, when signals are revealed, overconfident subjects first pay attention to their private signals and choose to follow them, whereas herding subjects do the opposite. Antonio and Ivo (2001) argue that overconfident behavior communicates vital private information to the group. A group with too few overconfident members makes poor information aggregation across individuals and makes wrong decisions too rapidly (in which case the entire crowd follows the wrong path). A group with too many overconfident members suffers from high attrition because overconfident members tend to rely solely on their own knowledge and thus make frequent mistakes.

The need for this research is stimulated by the fact that in previous economic experiments, subjects' overconfidence level was an isolated element in the information cascade game. Previous researchers tend to first test subjects' overconfidence level and then observe how overconfidence could influence the herding pattern in the information cascade game. In this experiment, we change subjects' perception of how the private signals are assigned so that subjects' overconfidence is actively involved in their decision-making process.

2. Research Question

This paper investigates how overconfidence in one's general knowledge influences cascade formation in a laboratory experiment. We induce overconfidence in the informational cascade setting of Anderson and Holt (1997) by allowing each subject's private signal accuracy to vary with their level of general knowledge. Specifically, subjects participate in a general knowledge trivia quiz, and the scores of that quiz determine their private signal accuracy.

3. Experimental Design

3.1 What to do with Subjects

1. Let all subjects read through the experimental instruction for the quiz. Handle any questions from the subjects.

2. Let the subjects do the printed version of the general knowledge trivia quiz (which could be found in the experiment instruction). In the quiz, subjects will answer fourteen general knowledge trivia questions ranging from biology, geography, history, everyday-life related, entertainment industry, sports, and art. These questions are from https://www.triviawell.com/questions/general. These questions could be swapped with any other general knowledge trivia questions without affecting the experiment outcome. All questions are multiple-choice questions with three options each. This part is incentive-compatible because one correct answer is worth one experimental point. Subjects will try their best to correctly answer as many questions as possible. If the subject is unsure about a question, their optimal strategy is to take a random guess. According to the Theory of Probability, the probability of guessing correctly is one-third. For every three guesses made, a subject could expect to get one

question correct, corresponding to one extra experimental point. This reasoning would be explained to all subjects in the experiment instruction. Therefore, no question would be left blank. After all subjects hand in the quiz, we calculate every subject's quiz accuracy. However, we will not reveal any information about the quiz, including how the subjects do and the accurate answers at this stage. If subjects are interested in knowing the correct answers or their quiz performance, that information is available upon request after the whole experiment ends.

3. Let all subjects read through the experimental instruction for the modified-information-cascade experiment. Let the subject do a test round of the modified-information-cascade experiment. Handle any questions from the subjects.

4. Randomly assign all twenty subjects into two groups of ten. Then ask the subjects to do the modified-information-cascade game. The subjects' goal is to predict most balls' color correctly. Subjects indicate their predictions of the color of the majority of balls by submitting signals. If a subject correctly predicts the color of most balls, that subject gets ten extra experimental points. If a subject fails to predict the correct color, that person will not get any reward in this step.

- Subjects could know the previously submitted signals like the traditional information cascade experiment. My only modification from the baseline treatment is that subjects' private signal accuracy rate is the same as their real accuracy rate in the general knowledge quiz. The private ball's color that a subject gets is still a random draw from a mental urn containing some red balls and some blue balls. The subject's goal is to predict the color of most balls in the urn. There are two possible states of nature, red ball dominance, and blue ball dominance, which are equally likely. Each subject's private signal is a random and independent draw from an urn. The only two possibilities of the private signals are a red ball or a blue ball. However, a subject's private signal may not be correctly delivered. The probability of subjects seeing the correct signals on their game screens is the same as the real accuracy rate of their general knowledge trivia quiz. For example, if a subject got every question correct in the quiz, and his or her authenticated private signal is a blue ball, then this private signal is guaranteed to be fully delivered. The signal they will see on the game screen is for sure the correct private signal, a blue ball. On the other extreme, however, if a subject gets zero questions correct in the quiz, no matter what their authenticated private signal is, the signal shown to the subject will be randomly delivered. Random delivering means that the subject will see a red ball with a probability of fifty percent and a blue ball with a probability of fifty percent. In this case, the signal the subject sees on the screen is not an informative indicator of their actual private signal. Imagine that a subject gets sixty percent of questions correct in the quiz, and the authenticated private signal is a red ball, then that this subject has a sixty percent probability of seeing a red ball as the signal and forty percent probability of seeing a blue ball as the signal. The signal the subject sees on the game screen is sixty percent informative of their actual private signal. All subjects' signals will all be assigned this way. Therefore, private signals' accuracies should vary for different subjects based on their performance in the knowledge trivia quiz.

- Here is another way to understand my modification to the traditional information cascade experiment. Imagine that there is a veil in front of the accurate private signal. This correct signal (either red or blue) is a random draw from a mental urn containing some blue balls and some red balls. For a subject who correctly answered all the questions, the veil is transparent, and he or she could completely (a hundred percent) identify the correct private signal. For a subject who failed to answer questions in the quiz correctly, the veil is opaque, and the private signal does not convey any useful information. For example, if a subject correctly answered sixty percent of questions in the quiz, then the veil is transparent sixty percent of the time and opaque forty percent of the time. In other words, this private signal could be a correct signal with p=60% or a wrong signal with p=40%. However, subjects do not know their exact private signal quality. They only know that the signal accuracy is the same as their quiz's accuracy rate. It is left for them to imagine, recall, or predict their quiz accuracy rate. Different subjects could perceive this probability division of a private signal being right or wrong differently. Overconfident subjects tend to believe that their private signals are correct with a large probability. Low confidence individuals tend to believe that their private signals are more likely incorrect.

5. After both groups finish doing the modified-information-cascade experiment, we tell the subjects that the experiment is over. We calculate the accumulated experimental points for each subject and pay them accordingly using cash on the spot. Then subjects are free to leave.

3.2 What to do after Subjects Left

1. For both groups, we sum up each subject's over-placement indicator across the whole group and label the result as the group over-placement score. We do not care about any individual's over-placement level; we only care about the aggregated group over-placement score. We call the group with a higher group over-placement score the overconfidence group. We call the group with the lower group over-placement score the low confidence group. Enter all useful information we acquired from the subjects into the following table. Each row in the table represents the information of one subject. Our twenty subjects correspond to twenty rows in the table. There are two types of overconfidence behavior that we are considering in this experiment: over-estimation and over-placement. Over-estimation (columns B, C, D) represents the overconfidence behavior in which subjects falsely believe they did better in the quiz than they actually did. Over-placement (columns E, F, G) represents the overconfidence behavior that subjects who falsely believe that they perform better in the quiz than more subjects than they actually do.

	Over-estimation indicator			Over-placement indicator		
A	B	C	D = B - C	E	F	G = E - F
Subject No.	Self-predicted number of correct answers [0-14]	Actual number of correct answers [0-14]	"Accuracy off-indicator" [0-14]	Self-predicted position in the accuracy rate ranking [0-20]	Actual position in the accuracy rate ranking [0-20]	"Ranking off-indicator" [0-20]
1						
2						
…						
20						

2. Information in the table could be interpreted as follows:

- Column B: Self-predicted number of correct answers [0-14]

Column B represents the subjects' self-reported number of correct answers. This information could be obtained by checking each subject's answer to the General(1) question in the general knowledge trivia quiz. For example, if subject 2 self-report in the general knowledge trivia quiz question General(1) that he or she believes in getting ten quiz questions correct, then the (2, B) entry in the table should be 10. Given that there are fourteen questions, the predicted number of correct answers should take an integer call between 0 and 14 (boundary values included.)

- Column C: the Actual number of correct answers [0-14]

Column C represents the actual quiz accuracy, meaning how many questions out of fourteen questions a subject got correct. We use the computer algorithm to check the actual quiz accuracy of each subject to eliminate any possible false artificial data input. For example, if subject 1 got twelve quiz questions correct, the (1, C) entry in the table should be twelve. Given that there are fourteen questions, the actual number of correct answers should take an integer call between 0 and 14 (boundary values included.) Moreover, we do not care about which questions the subjects got right; we care about the total number of questions that a subject got correct.

- Column D: "Accuracy off-indicator" [0-14]

Column D represents how "off"/deviated the self-reported accuracy is from the actual accuracy. For each subject, we subtract the corresponding entry in column C from column B and name the result as the "accuracy off-indicator." The value of the "accuracy off-indicator" shows by how many questions a subject is overestimating to get correct in the quiz compared to his or her actual accuracy. We subtract column C from column B because we want to use the self-reported value as a benchmark to compare to the actual value accordingly. The "accuracy off-indicator" being positive means that a subject is over-estimating his or her accuracy (being overconfident.) The "accuracy off-indicator" being negative means that a subject is under-estimating his or her accuracy. For example, if subject 3 self-reported that he or she got ten questions correct but actually just got four questions correct, the (3, D) entry should be 10-4=6. This means that subject 3 self-reported answering six more questions correctly than his or her actual accuracy. The "accuracy off-indicator" should only be taking an integer value from 0-14 (boundary values included.) The best-case scenario is that a subject correctly predicts the number of correct answers, corresponding to an "accuracy off-indicator" of zero. The worst-case scenario is that a subject got all questions wrong but predicted to get all questions correct or vice versa, resulting in an "accuracy off-indicator" of fourteen.

- Column E: Self-predicted position in the accuracy rate ranking [0-20]

Column E represents subjects' self-reported position in the general knowledge trivia quiz's accuracy rate ranking. This information could be found as the answer to General Question(2) in the general knowledge trivia quiz. General Question(2) asks subjects to rank their performance among the twenty participants. For example, if subject 4 self-report in the general knowledge trivia quiz General Question(2) that he or she believes in ranking the last among twenty individuals, then the (4, E) entry in the table should be twenty. This self-predicted position should take on an integer value from 0-20 (boundary values included.) The best-case scenario is that a subject predicts to get every question correct and rank the 1st in the accuracy ranking. The worst-case scenario is that a subject predicts to get every question wrong and rank the 20th (the last) in the accuracy ranking.

- Column F: the Actual position in the accuracy rate ranking [0-20]

Column F represents a subject's actual position in the general knowledge trivia quiz's accuracy rate ranking. We could obtain this information by sorting all the entries in column C in ascending order and entering the ranking information for every subject accordingly into column F. For example, if subject 5 got all fourteen questions correct, then he or she should rank number 1 among all subjects. Therefore, the (5, F) entry should be one. In case of a tie, we keep the tied subjects at the tied ranking, and the ranking of the next best subject will not be affected. For example, if subjects 2 and 3 answer all fourteen questions correctly and tie at top one, then they both remain in the top 1, and the next best subject who gets thirteen questions is top three.

- Column G: "Ranking off-indicator" [0-20]

Column G represents how "off"/deviated the self-reported position in the quiz accuracy ranking is from the actual position. Each subject's "ranking off-indicator" value equals subtracting his or her column F entry from column E entry. The "ranking off-indicator" suggests how many positions a subject is overconfident about his or her ranking. We subtract the column F entry from the column E entry because we use the self-reported position in the ranking as a benchmark to compare to the actual position. The "ranking off-indicator" being positive means that a subject rank himself or herself higher than reality (over-placement.) This number being negative means that a subject ranks himself or herself lower than reality (low confidence.) For example, if subject 6 self-reported to rank at the 4th but actually ranked at the 8th, the (6, G) entry should be 8-4=4. This means that the subject 4 positions himself or herself four positions ahead of reality in the accuracy ranking.

3. We look at the modified-informational-cascade experiment data and count the frequency of herding and breaking-the-heard behaviors for both the overconfidence and low confidence groups. Herding refers to the action that individuals ignore their private signals and follow the established pattern. Breaking-the-herd refers to when a herding behavior of length two or more is established, a subject chooses to reveal his or her private signal when the private signal disagrees with the established pattern. In one round of the modified-information-cascade game, there are nine possible positions to herd (except the first position); therefore, the herding frequency in one round should be an integer value between [0,9]. In one round of the modified-information-cascade game, there are eight possible positions to break the herd (except the first two positions); therefore, the breaking-the-herd frequency should be an integer value between [0,8]. We count the number of herding predictions and the number of breaking-the-herd predictions. We then compare the number of herding and breaking-the-herd frequencies across the overconfidence and low confidence groups.

3.3 Clarification Questions and Answers

1. How is your modified information cascade experiment different from the traditional information cascade experiment?

- My only modification to the traditional information cascade experiment is that subjects' private signal accuracy is now the same as their quiz accuracy. The more quiz questions answered correctly, the more accurate a subject's private signal. However, subjects could be overestimating or underestimating their quiz performance. Therefore, they could be overly confident or not so confident in their private signals.
- Like the traditional information cascade experiment, a subject here could make his or her prediction based on the private signal and previously submitted signals (if any.)

2. What is the purpose of the general knowledge trivia quiz?

- The general knowledge trivia quiz aims to assess subjects' overconfidence levels correctly. By comparing the self-reported and the actual quiz accuracy, we could know each individual's overconfidence score. We then sum up each individual's overconfidence score to get the group overconfidence score.
- By checking each subject's quiz accuracy rate, we could accordingly vary his or her private signal accuracy.
- The actual quiz content can be swapped for any other set of general knowledge trivia questions without decreasing the plausibility of this experiment.

3. How do you measure overconfidence? How do you define the overconfidence group and the low confidence group?

The "ranking off-indicator" (column G in the table) measures an individual's overconfidence level. The "ranking off-indicator" shows by how many positions a subject overestimates himself or herself in the ranking. A subject with a higher “ranking off-indicator” value will be more overconfident than a subject with a lower “ranking off-indicator” value. For each group, summing up each subject’s “ranking off-indicator” across the whole group gives the group “ranking off-indicator.” The overconfident group has a higher “group ranking off-indicator” value, which is the group where subjects’ are more overconfident about their overall performance. The low confidence group is the group with a lower “group ranking off-indicator” value.

4. There are two types of overconfidence that you are discussing in this paper: over-estimation and over-confidence. How do you make use of them differently?

- Over-estimation is not directly used in this experiment. Over-estimation occurs in the background of subjects’ decision-making process in the information cascade game. With over-estimation, subjects mistakenly perceive their private signals to be more accurate than they truly are. Accordingly, over-estimation makes subjects base their predictions more on their private signals and less on previously submitted signals.
- The group sum of the over-placement score (summing up column G’s value across the group) is used to designate the high confidence (overconfidence group) and the low confidence group.

5. Why will subjects correctly self-report their confidence level? Is your experimental design incentive compatible?

It is an incentive-compatible design that any subjects with all possible confidence levels find that the optimal strategy is always to tell the truth. Using this experimental design, we can correctly identify the confidence levels of all subjects. Imagine a subject who is highly knowledgeable and knows every answer for sure. This subject’s best strategy to earn the most income is to answer every question correctly and indicate to perform the best among the peers (rank the first/ outperform nineteen peers.) In this case, the off-indicator is zero, and this subject earns a maximum income of eighty in this step. Specifically, twenty yuan as the show-up fee; twenty yuan for getting all fourteen questions correct; twenty yuan for making a precise prediction about his or her ranking; twenty yuan for correctly identifying that he or she gets all questions correct. This subject will have no incentive to do otherwise. On the other extreme, imagine that a subject knows no answer for sure and answers every question by random guess. When random guessing every question, according to the Theory of Probability, he or she has a one-third chance to get each answer correct. Therefore, after guessing fourteen times (fourteen questions in total), he or she could expect to get 14*(1/3)=4.7 experimental points. He or her best bet is to indicate to answer five questions correctly (round 4.7 to the nearest integer.) His or her best bet is to indicate that he or she performs the worst among the peers (rank the last/ outperform zero peers) due to the fact of pure random guessing. When a subject random guesses, he or she should consistently rank the last because there is no way to get even worse than just random guessing. In this case, the off-indicator is as small as possible, and this subject earns as much income as possible. This subject will have no incentive to do otherwise. In both extreme cases and any scenarios in between, the optimal strategy is always to report honestly. By these measures, we could calculate subjects' overconfidence levels.

4. Prediction and Justification

I predict that the overconfidence group herds less than the low confidence group. I predict that overconfident subjects value their private signals more, so they herd less and are more likely to reveal their own private signals. In other words, the overconfidence level and frequency of herding behaviors are negatively correlated. The higher the confidence level, the more a subject values his or her private signal, and the less likely he or she will herd. Conversely, the lower the confidence level, the more likely a subject will herd.

According to Bar-Hillel (2001), those who are P percent certain that they have answered a question correctly are accurate on average fewer than P percent of the time. In general, people tend to overestimate their accuracy when answering questions. To apply this rule to our experiment, imagine when a subject claims that he or she is sure to get seven questions correct (fifty percent accuracy), that claim is correct for less than fifty percent of the time. In other words, subjects tend to have an inflated estimation of their accuracy rate of the quiz (over-estimation.) All subjects know that their signal accuracy is assigned based on their scores in the knowledge trivia quiz. The overconfidence subjects overestimate their quiz accuracy rate and, in turn, their signal accuracy. As a result, overconfident subjects put the most weight on their private information when making predictions.

According to Ola Svenson (1981), the majority of participants believed they were more skillful and less risky than the typical driver in each category. To put it more generally, the majority of people claim to be more skillful than average, even though only half can be when they evaluate their position in the distribution of peers on positive attributes. The same logic could apply to this experiment. Subjects tend to believe that they score above average in the general knowledge trivia quiz (over-placement.) For example, if a subject believes that he or she scores among the top thirty percent, then this subject will perceive that seventy percent of other peers' private signals are of inferior quality. Therefore, overconfident subjects tend to discriminate against previous subjects' signal accuracy. As a result, overconfident subjects put little weight on previously submitted signals when making predictions in our experiment.

To sum up, overconfident subjects tend to overestimate their quiz scores and then overestimate their signal accuracy. Moreover, overconfident subjects overestimate their performance in comparison to others, so they underestimate previous subjects' signal accuracy. Therefore, when overconfident subjects could make predictions based on their private and previously submitted signals, they tend to rely more on their private signals.

Another prediction is that with the same group of subjects, herding is less frequent in my experiment design than in the traditional information cascade experiment. In the traditional setting, overconfident subjects do not trust previous subjects' ability to make correct predictions based on their private signals. In this modified experiment setting, overconfident subjects neither trust previous subjects' private signals' accuracy nor their ability to make correct predictions based on their not fully informative private signals. Therefore, by varying the signal accuracy for every subject, there will be less herding behavior observed in this experiment setting compared to the traditional information cascade setting when using the same group of subjects.

5. Limitations and Discussions

There are yet several limitations to my experiment.

To start with, Behavioral Economics theories suggest that quantifying subjects' overconfidence levels based on self-reported information could be problematic. The first aspect is that subjects could exhibit the probability-weighting phenomenon. Probability weighting means that people fail to perceive probabilities correctly. They tend to overweight small probabilities and underweight large probabilities. This theory could apply to our experiment. When subjects do poorly on the quiz, they tend to overestimate their quiz accuracy rate. When subjects do very well on the quiz, their self-predicted accuracy tends to be lower than the actual accuracy. The second aspect is that subjects could exhibit the inattention phenomenon. For example, the number 19 has a 1 in the tens digit and a 9 in the single digit. The opaque information that doesn't attract enough attention is the 9 in the single digit. People could correctly assess the 1 in the tens digit, but not necessarily the 9 in the single digit. In other words, people feel like 19 is closer to a 10, which has a 1 in the tens digit, than a 20, which has a 2 in the tens digit. This is exactly why stores prefer pricing of $19.99 to $20. In the context of our experiment, if a subject predicts to get 12 questions correct, he or she may not pay enough attention to the 2 in the single-digit and submit a predicted score of 10 instead. Because no subjects are likely aware of their probability weighting and inattention problem, trying to make precise predictions cannot eliminate this problem.

Moreover, using comparison (of groups' aggregated over-placement value) to differentiate the overconfidence group from the low confidence level group could be problematic. There is no clear cutoff value to distinguish between the two. For example, we don't specify that only groups with over-placement values above a certain cutoff point could be overconfident groups. In this experiment, overconfidence is a relative concept generated by comparison. The experiment result could be vastly different when experimental subjects change, making vertical comparisons among different experiment rounds difficult. Consider the following extreme scenario:

Experiment round 1:

Group 1: every subject gets no question correct in the quiz, predicting to get 12 questions right.

Group 2: every subject gets 1 question correct in the quiz, predicting to get 12 questions right.

By comparison, group 1 is the overconfidence group, and group 2 is the low confidence group.

Experiment round 2:

Group 3: every subject gets 10 questions correct in the quiz, predicting to get 12 questions right.

Group 4: every subject gets 11 questions correct in the quiz, predicting to get 12 questions right.

By comparison, group 3 is the overconfidence group, and group 4 is the low confidence group.

We can make a vertical comparison between these two rounds and find that group 2 is more overconfident than group 3. However, group 2 is considered a low confidence group, and group 3 is considered an overconfidence group in corresponding rounds. This could make vertically comparing results conducted on different subjects extremely difficult.

In addition, all measures we care about in this experiment are on the aggregated group level but not on the individual level. For example, we only care about the aggregated group confidence level but not the individual one. If a group has a high overall confidence level, we cannot be sure if it's due to a few highly overconfident individuals or many mildly overconfident individuals. Further researchers could study how these two different group compositions affect herding frequency and pattern in our experiment setting.

Finally, we pay more attention to herding frequency and little attention to the corresponding position information. We care less about overconfident subjects' position in a group. Future studies could explore the link between overconfidence subjects' position in a group and the herd-breaking behaviors' positions. Also, how different positioning of overconfident individuals could affect the overall cascading frequency, length, and direction is pending to be studied by further extensions and modifications of this experimental design.

6. Conclusion

This paper investigates how overconfidence in one's general knowledge influences cascade formation in a laboratory experiment. In this paper, in addition to the traditional information cascade experiment setting of Anderson and Holt (1997), I add a new element that a subject's private signal accuracy is the same as his or her accuracy in a general knowledge trivia quiz. My prediction is that overconfident subjects tend to overestimate their quiz scores and accordingly overestimate the accuracy rate of their private signals. Therefore, overconfident subjects herd less and tend to reveal their personal signals more frequently than low-confidence individuals. In other words, subjects' confidence level is negatively correlated with the herding frequency in my experimental design.

7. Appendix

7.1 Experimental Instruction for the Quiz

Thank you for participating in this experiment of economic decision-making. When reading through the experiment instruction, feel free to raise your hand at any time if you cannot comprehend any part. Complete comprehension of the experiment rules is vital for you to earn as much money as possible during this experiment. To earn as much money as possible, please carefully follow these directions.

You will get twenty yuan as the show-up fee to participate in the experiment. Besides, you can earn more money during the experiment. Your income in the experiment will be calculated based on the number of experimental points you earn during the experiment. At the end of the experiment, you will get the corresponding cash income at the exchange rate of "one experimental point equal to one yuan."

There are two components to this experiment. The first component of this experiment is a quiz. The instruction that you are reading now is the quiz instruction. After reading this instruction, you will answer a general knowledge trivia quiz, including fourteen questions about biology, geography, history, everyday-life related, entertainment industry, sports, and art. A sample question is as follows:

How much does the largest pumpkin ever record in U.S. history weigh?

A. 1,528 pounds B. 2,528 pounds C. 3,528 pounds

Notice that this sample question will not appear on the actual quiz. There are, in total, fourteen general trivia knowledge questions. You should try to choose the correct answer for each question from the three given alternatives. Your goal is try to get as many questions correct as possible. The income you can get for each question depends on whether you correctly answer that question or not. Each question is worth one experimental point. If you correctly answer a question, you will get one point. If you incorrectly answer a question, you will get zero points. You should indicate your answer to a question by circling your intended option. No communication with your peers is allowed during your taking the quiz. Please ask questions if the meaning of the question is unclear to you. Even if you do not know some answers for sure, you should always take a guess. According to the Theory of probability, you have a 33% chance to get a question correct based only on randomly guessing.

After you answer all the fourteen general knowledge trivia questions, you need to reflect on your answers and reflect upon how you did. The two questions that we will ask are as follows:

(1) Based on your answers to the previous questions, how many questions do you believe you got correct for sure?

______ out of 14 questions

(2) Look back on all of your answers to the quiz questions. Did you do best? Did you do worst? How many subjects do you believe that you did better than? Rank your performance among all 20 subjects.

I rank the _____th among the 20 participants.

For question (1), the closer your prediction to your real accuracy rate, the more you can earn. If you correctly predict the number of questions that you got correct, you get twenty experimental points. If your predicted accuracy deviates from your actual accuracy by X questions, you get 20-X experimental points. For question (2), you need to estimate how well you did in comparison to others. There are in total twenty subjects who will take this quiz. Therefore, you need to indicate by how many subjects you believe you outperform. Your payment depends on how well you can precisely predict your ranking among peers. The closer you are to being correct, the more experimental points you will get. If you correctly predict your actual ranking among all subjects, you get twenty experimental points. If your predicted ranking deviates from your actual accuracy by X positions, you get 20-X experimental points.

If you have questions about any part you have read so far, feel free to raise your hand, and our staff will answer your questions. If not, you could start taking the quiz now. If any questions pop up during the quiz, feel free to raise your hand, and our staff will answer your questions.

7.2 Experimental Instruction for the Modified-Information-Cascade Game

There are two components to the experiment. The quiz you just finished is the first part of the experiment. Now you are reading through the experimental instruction of the second part of the experiment, a decision-making experiment. You will be using a computer to indicate your decisions in this experiment.

There are in total 20 subjects, and you are one of them. You will be randomly assigned to one of two groups of ten. Then you will be randomly assigned a position of one to ten in that group. Your identity and your position will not be revealed to any other participants.

Then, we proceed to the decision-making experiment setup. There are two possible states of nature, red ball dominance, and blue ball dominance, which are equally likely. Each subject's private signal is a random and independent draw from an urn. The only two possibilities of your private signal are a red ball or a blue ball. However, the content of your private signal may not be correctly delivered. The probability of you seeing the correct signal on your game screen is the same as the real accuracy rate of your general knowledge trivia quiz. For example, if you got every question correct in the quiz, and your authenticated private signal is a blue ball, then your private signal is guaranteed to be fully delivered. The signal on your game screen is your actual private signal, a blue ball. On the other extreme, however, if you get 0 questions correct in the quiz, no matter what your actual private signal is, the signal shown to you will be randomly delivered. Random delivering means you will see a red ball with a probability of 50% and a blue ball with a probability of 50%. In this case, the signal you see on your screen is not an informative indicator of your actual private signal. Imagine that you get 60% of the questions correct in the quiz, and your actual private signal is a red ball; then, you have a 60% probability of seeing a red ball as your signal and a 40% probability of seeing a blue ball as your signal. The signal you see on your game screen is 60% informative of your actual private signal. Keep in mind that the accuracy of you seeing your actual private signal is the same as the real accuracy rate of your knowledge trivia quiz. The real accuracy is how you actually perform in the quiz, not how you perceive how you perform. All other subjects' signals will be assigned this way. Therefore, private signals' accuracies should vary for different subjects based on their performance in the knowledge trivia quiz. Your real accuracy in the quiz will not be revealed to you before or during this decision-making experiment. It is available to you upon request after this experiment ends.

Your position within a round is displayed as a red number on top of your screen. After the game begins, you should first check your position in the group. If you are in position number 1, then you only make a prediction of the occurring state based on your signal in the middle of your screen. If you are at a later position, you shall predict the occurring state based on your private signal and the existing public information. All ten subjects in a group predict the occurring state in sequence. Subjects who correctly predict the color of the majority of balls gain ten experimental points. Subjects who make wrong predictions get no extra reward for this step.

On your game screen, you could see your signal in the middle (which might not be fully informative of the true signal you got) and all the previously submitted predictions in a table at the bottom of your screen. Regarding the information in the table, remember that you are not seeing the actual colors of previous balls but only the predictions made by previous individuals. Based on these information, you are required to submit your prediction of the dominant color of the balls to be either red or blue. Once you have a prediction, click on either the “red” button or the “blue” button in the lower part of your screen. Your selected button will then become larger. If you are sure about your choice, you can click the “submit” button in the lower right part of your screen to submit your prediction. Your submission is final. Once your prediction is submitted, it becomes public information, and later subjects could take your submitted prediction into their decision-making process.

During the decision-making process, no communication is allowed, or you will be disqualified for the experiment and only get the show-up fee of 20 yuan. The experiment is over as soon as all ten participants in your group have made their decision. You will be paid according to the number of experimental points you accumulated in both rounds of the experiment.

Before you may earn money with your prediction, you will first complete one unpaid test round of this “predicting color of majority balls” part to become more familiar with the procedures. In this test round, you will be playing with nine AI robots. You can ask questions at any moment during the test round. Your earnings in the experiment closely depend on your understanding of the experiment procedure. Therefore, it’s crucial for you to fully understand how the decision-making process works through this test round.

If you have any questions now, feel free to raise your hand, and our staff will answer your questions. If any questions pop up during the test round, please raise your hand and ask them. The experiment will start after all twenty participants have no more questions.

7.3 General Knowledge Trivia Quiz

Your personal data will be treated confidentially.

Name:

Gender:

Age:

Biology

(1) How many pairs of ribs are in a typical human body?

A. 10 B. 12 C. 14

(2) What is the largest crocodilian in the world?

A. Saltwater Crocodile B. Freshwater Crocodile C. American Crocodile

Geography

(1) What is the driest continent on Earth?

A. Antarctica B. Africa C. Asia

(2) What country is bordered by Germany, the Czech Republic, Slovakia, and the Ukraine?

A. Monaco B. Poland C. Greece

History

(1) On October 11, 1999 the world population hit a milestone of how many?

A. Four Billion B. Five Billion C. Six Billion

(2) During which Chinese dynasty was the Great Wall of China built?

A. Han Dynasty B. Qin Dynasty C. Song Dynasty

Everyday life-related

(1) What are the ball-shaped decorations that go on a Christmas tree called?

A. Christmas Ball B. Sparkling Ball C. Ornaments

(2) Who was the inventor of Coca-Cola?

A. Dr. John Styth Pemberton B. Dr. John Pemberton C. Dr. Satoshi Nakamoto

Entertainment Industry

(1) Who won Outstanding Lead Actor in a Comedy Series at the 2018 Emmy Awards?

A. Bill Bader B. Emma Stone C. Christian Bale

(2) In what year was Tom Hanks born?

A. 1955 B. 1956 C. 1957

Sports

(1) Who was drafted after LeBron James and ahead of Carmelo Anthony?

A. Darko Milicic B. Kobe Bryant C. Jimmy Butler

(2) In what year did judo become an Olympic sport?

A. 1963 B.1964 C. 1965

Arts

(1) What are the colors obtained by mixing equal amounts of two primary colors called?

A. Inferior color B. Secondary color C. Mixed Color

(2) What is Pablo Picasso's daughter's name?

A. Paloma Picasso B. Casi Picasso C. Tiffany Picasso

General Reflection

(1) Based on your answers to the previous questions, how many questions do you believe you got correct for sure?

______ out of 14 questions

(2) Look back on all of your answers to the quiz questions. Did you do best? Did you do worst? How many subjects do you believe that you did better than? Rank your performance among all 20 subjects.

I rank the _____th among the 20 participants.

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