Economics Honors Program:
Herd Behavior and Group Identity

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I. Introduction

Individuals do not always make decisions based solely on their individual preferences and private information. Often, they are influenced by the decisions of others. Quite simply, individuals engage in social learning. *Social learning* occurs when an individual makes a particular choice based on the experiences of others because he believes that the choices of others he observes provide a strong indication as to what the correct course of action is. For instance, an out-of-town traveler arrives in Williamstown in search of a meal. When walking down Spring Street, he notices two restaurants: Sushi Thai Garden and Spice Root. Let us suppose that the traveler has a slight preference for Indian food, so his private information is minimally in favor of Spice Root. However, the signal that he receives from each restaurant will also factor into deciding where to eat. A full restaurant emits a positive signal because the traveler assumes that at least a few seated customers hold private information in favor of the restaurant. Conversely, an empty restaurant emits a negative signal because the traveler supposes that local residents hold private information in opposition of the restaurant. Therefore, the traveler may prefer to eat at the restaurant with the most customers because he expects that the busier restaurant generates the most revealing private information. If Sushi Thai Garden is particularly busy as the traveler passes by, the strong and positive signals of its customers will persuade him to eat Thai food instead of Indian food.

Since the traveler decides to follow the choices of others by eating at the Thai restaurant, he also engages in herd behavior.[1] *Herd behavior* occurs when a series of individuals make an identical decision. It often requires people to balance their private

[1] By definition, social learning leads to herd behavior because it induces people to imitate the choices of others.

information with the decisions of others in order to maximize the probability of obtaining a desired outcome. Furthermore, herd behavior can be entirely rational even if a person acts against their private information or the decisions of others when making a decision. As shown by the hungry traveler in our previous example, it is rational for him to follow the actions of others and eat at Sushi Thai Garden because his private information is not decisive enough to induce him to eat at Spice Root. Consequently, the traveler places more weight on the customers in the busy Thai restaurant relative to his private information.

While the weight that the out-of-town traveler places on the decisions of others is interesting, situations similar to this are even more captivating when the previous decisions of others are made by peers. A *peer* can be defined as any person that relates to another person, and is often someone that shares something in common with someone else, including demographic characteristics, interests, or preferences. In the context of groups, individuals often view others as peers when the group is bounded by solidarity. Furthermore, when an individual is attached to a group, and thus exhibits *group identity*, he is more likely to consider group members as peers and his behavior is subject to peer effects.

Peer effects exist when an individual's behavior is affected by his peers and are often present throughout a person's life. From educational attainment at a young age to retirement planning as an elder, peer effects can have a major impact on the important decisions that people make. In general, peer effects can lead people to behave in two ways: conforming to the decisions of others and caring for the outcomes of others. For example, Zafar (2009) finds clear evidence of the former as peer effects led individuals in his experiment to make choices that are correlated with those of their peers. Moreover, Zafar determines three rational reasons why individuals conform to their peers: social learning – the observed choices of peers provide a stronger indication as to what the best decision is; *social comparison* – simply making the same choice as peers gives people utility; and *social influence* – sticking to the norm allows people to avoid the discomfort of being different from their peers. However, Chen and Li (2009) find evidence that peer effects cause people to care more about the welfare of their group. In their experiment, following the herd essentially forces others to do so as well because the previous signals others see are likely to outweigh their private information considerably. Therefore, if a person has private information that plausibly offsets the previous signals, they may act in a contrarian way in order to be helpful to their peers and to increase the likelihood of Social Welfare Maximizing actions, which would improve payoffs for all group members.

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The purpose of my research is to explore what effect, if any, group identity, has on herd behavior. The specific hypothesis addressed is that group identity affects the weight that individuals place on their private information relative to the weight placed on the choices of others when making a decision. For example, if a person sees two people make the same choice before him and he has private information that tells him to make the other choice, will he be more or less likely to do so if he identifies the two people who chose before him as peers? Through my research, I will not only be able to determine if peer effects are strong enough to change individual behavior, but also if peer effects cause people to conform to their peers and engage in more herd behavior, or to care about the outcomes of peers and engage in less herd behavior. Furthermore, human-subject experimentation is a particularly useful method for this study because, unlike in the real world, I am able to devise an experiment that is more effective in identifying the specific explanations why peers influence or do not influence individual behavior.

To investigate my central hypothesis, I create an experiment where test subjects are assigned to groups in 1 of 3 treatments (Baseline, Induced, and Natural), each of which is constructed to have a varying amount of group identity. In my Baseline, test subjects have the lowest level of group identity because hardly any steps are taken to increase it.[2] However, in my Induced and Natural treatments I introduce a number of procedures to strengthen group attachment and thus increase the likelihood of peer effects. In Induced, test subjects are assigned to groups based on color preferences, there is another group in the room, and test subjects are able to chat with own-group members during part of the experiment. In Natural, test subjects are assigned to groups based on student organization affiliation. Aside from this modification, Natural test subjects experience the same group identity building procedures as Induced test subjects. Nevertheless, group attachment in Natural is likely stronger than in Induced because Natural group members have preexisting relationships with one another.

To explore how individuals balance their private information with the decisions of others, test subjects in all treatments participate in a herding game and are asked to make a binary decision based on their private information and the actions of others. Regardless of treatment, there is a rational weight that subjects should place on the actions of others. Consequently, social learning is the primary component of the decision making process

[2] Despite the fact that I took no measures to increase group identity, it is still possible that Baseline group members considered each other as peers. Therefore, peer effects may have influenced test subject behavior, which would make it harder to find a difference in behavior across treatments.

in the herding game. However, all test subjects face the same social learning environment as the private information and actions of others are invariable, so there is no obvious reason why social learning should differ across treatments. In addition, the herding game is constructed in such a way that many other common explanations for peer effects are largely controlled for. For example, player performance is kept hidden throughout the game, which renders social comparison and social influence unrealistic explanations as to why subjects would act differently. Furthermore, there is no monetary incentive for test subjects to perform in the best interest of the group or to conform to decisions of group members. Thus, if a significant change in individual behavior is observed in the herding game across my 3 treatments, I can conclude that peer effects are quite strong and may occur for no entirely rational reason – a conclusion that would certainly be unexpected based on the assumptions of homo economicus.

In the aggregate results, I do not find a significant difference in the frequency of herd behavior across treatments. Similarly, I find that test subjects do not weigh their private information to the signals of group members any differently across treatments when looking at all observations of the herding game. However, when analyzing only simple decisions in which a test subject sees that all the previous actions are the same, both Induced and Natural test subjects behave differently than Baseline test subjects. In particular, in simple decisions, Induced and Natural subjects overweigh the decisions of others relative to Baseline members. Therefore, in situations where previous actions are most conclusive, individual behavior significantly and irrationally changes due to peer effects.

II. Literature Review

In this section I review some literature on herd behavior, peer effects, and group identity. In addition, I link previous literature to my study in an attempt to highlight my own contributions to these fields.

Herd Behavior

Banerjee (1992) presents an overview of herd behavior and the effects of information on rational choices. In an *imperfect information situation*, in which subjects have a limited history of previous actions, they do not have access to the decisions of all of their predecessors. Therefore, subjects make decisions based mainly on their own private information. In contrast, in a *perfect information situation*, in which subjects have a complete history of previous actions, they observe the decisions of all of their predecessors and take these decisions into account when choosing their own actions.[3] Banerjee suggests that the very act of taking into account the decisions of others causes each person's decision to become less responsive to his or her own private information. However, in his model, an individual who takes into account the decisions of others, in addition to his or her own private information, acts rationally because previous signals reflect information that an individual does not possess. As a result, the additional information a person gains through the choices of others increases the likelihood of social learning and herd behavior.

While simply incorporating the decisions of others is rational and increases the probability of herd behavior, there still exists the possibility that people incorrectly weigh the decisions of others when herding. Celen and Kariv (2004) conduct a study on herd

[3] A perfect information situation is ideal for my study because observing all previous decisions of group members allows test subjects to choose how heavily to weigh the decisions of their peers.

behavior in a perfect information situation and seek to explore the accuracy with which individuals weigh their private information to the decisions of others. This accuracy is determined by the rationality of test subjects, which is measured with an equation that calculates the minimum weight a test subject should place on the decisions of others for choosing one of two actions. In addition, rational behavior is determined under certain assumptions, such as test subjects have a clear objective, are able to process the information presented to them, and make decisions in order to reach the best outcome. This provides Celen and Kariv with a theoretical benchmark with which they compare their results.[4] In their experiment, they find that individuals both under weigh and overweigh the previous actions of others relative to the perfectly rational weight, and consequently engage in herd behavior that is not completely correct. Furthermore, Celen and Kariv observe a few situations where subjects herd on the entirely wrong action. They conclude that test subjects change the relative weight they place on the decisions of others during their experiment due to social learning.

In some cases, the decisions of others can provide an extremely informative signal, making it rational for test subjects to completely ignore their private information when making a decision. Specifically, individuals can engage in informational cascades. Bikhchandani, Hirshleifer and Welch (1992) distinguish between herd behavior and informational cascades. They state that an *informational cascade* occurs when an infinite sequence of individuals ignore their private information when making a decision. In an informational cascade, they explain, an individual considers it optimal to follow the behavior of his predecessors without regard for his private information, since his belief is so strongly held that no signal can outweigh it. Moreover, individuals become more and

[4] I also consider Celen and Kariv's rational framework when examining subject behavior across treatments.

more likely to imitate their predecessors, disregarding their own private information. Anderson and Holt (1997) examine informational cascades in a laboratory experiment. They observe informational cascades in the majority of rounds when initial decisions coincide, which demonstrates that informational cascades are particularly frequent when test subjects are confronted with simple decisions in which all previous actions are the same. Furthermore, they classify the observed informational cascades as rational because, in rounds where an initial decision imbalance occurs – that is, when the majority of actions are the same, the most profitable strategy for subsequent decision makers is to follow the established pattern.

Since in a herd, individuals may but do not necessarily ignore their own private information, an informational cascade implies a herd. However, a herd does not imply an informational cascade. In my herding game, while a test subject can be presented with situations in which it seems optimal to ignore his private information and strictly follow his group members, there is always a private value strong enough to persuade him to choose the contrarian action. Therefore, rational informational cascades are impossible by the construction of my experiment.

Peer Effects

As Celen and Kariv (2004) made explicitly clear, herd behavior is often explained by social learning. Moreover, social learning offers an important and rational reason why peer effects exist. However, both the theoretical and experimental literature on herd behavior have neglected to explain herd behavior by other peer effect avenues.

As previously mentioned, peer effects can lead people to conform to the decisions of others. Zafar (2009) distinguishes between three ways in which individuals' choices are correlated with those of their peers: social learning, social comparison, and social influence. To examine the extent to which peer effects induce conformity, Zafar conducts an experiment to measure subject behavior in a charitable contribution game. Similar to my study, Zafar's charity game assigns each individual to a group, and each individual's payoff only depends on the choices that he or she makes. He finds that individuals only respond to the contributions of their friends – those who are the strongest peers. In addition, he finds that individuals engage in social comparison and change their actions in the directions of the social norm, even when their identities remain unknown. In my experiment, while the identity of test subjects is revealed, player performance is kept hidden; therefore, it would be unlikely for test subjects to partake in social comparison or social influence. Nonetheless, more social comparison and social influence in my Induced and Natural treatments, relative to my Baseline treatment, would still signify the presence of peer effects.

Falk and Ichino (2006) also measure conformity through human-subject experimentation. Specifically they examine the extent to which social comparison influences the behavior of workers. In order to do this, they conduct an experiment with two treatments: a "pair" treatment, in which subjects work at the same time in the same room; and a "single" treatment that they use as a control, where subjects work alone in a room. They find clear and unambiguous evidence for the existence of social comparison in their pair treatment. Moreover, they find that average output in the pair treatment largely exceeds output in the single treatment even though economic incentives are identical. In my experiment, individual payoffs are also independent of group performance, but I still expect individuals in highly cohesive groups will act differently if they identify group members as peers, based on Falk and Ichino's results.

Aside from conformity, peer effects can also cause individuals to care about the welfare of others. Chen and Li (2009) offer evidence of this as people in their experiment care more about the welfare of their group if they view group members as peers. Specifically, their results suggest that the presence of peers induces people to be more helpful to each other, and to increase the likelihood of Social Welfare Maximizing actions, which would improve payoffs for all relevant parties.

Group Identity

In order to strengthen peer effects in a group setting, group members must identify with one another. To highlight how group identity affects subject behavior and is manipulated in the laboratory, I review key elements of the literature that are relevant for my study.

Akerlof and Kranton's (2005) present a broad overview on social identity. They use a theoretical model to examine the effects of firm identity on employer behavior. They define an *insider* to be an employee who identifies with his or her firm, whereas an *outsider* is an employee who does not identify with his or her firm. In their model, insiders gain utility when acting in agreement with the expectations of their firm and lose utility when diverging from these expectations. They find that identifying with a firm increases an employee's motivation to perform well. In relation to my study, Akerlof and Kranton's findings suggest that individuals will conform to the decisions of their group members if they identify with their groups.

However, before determining whether group identity does, in fact, influence subject behavior in my experiment, group identity must be manipulated in a laboratory setting. One way to manipulate group identify is through the use of social categories. *Social categories* are groups determined by distinguishing characteristics such as gender, race, religion, hobbies, etc. An individual that belongs to a particular social category can but must not necessarily identify with that social category. Chen and Li (2009) distinguish between individuals who identify with a social category – *ingroup members* – and those who do not – *outgroup members*.[5] If individuals identify with a particular social category, it is highly likely that they will view group members as peers.

To explore the effects of social categories on group attachment, Chen and Li design an experiment in which they create groups based on both random assignment according to the *minimal group paradigm*, the minimum requirements needed for intergroup discrimination, as well as subject preferences (a version of social categories). They find that pure categorization of groups is sufficient to create group effects. However, they also find that participants act more favorably towards ingroup members when groups are assigned by subject preferences. In addition, they discover that group problem-solving activities, such as online chatting sessions, significantly increases group attachment. In both my Induced and Natural treatments, I follow Chen and Li's procedure in order to create groups based on individual preferences and interests, use 2 groups per session to strengthen ingroup membership and weaken outgroup membership among test subjects, and employ chatting sessions to build group attachment.

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[5] Chen and Li use the terms *ingroups* and *outgroups* analogously with Akerlof and Kranton's insiders and outsiders. Throughout my paper, I will refer to Chen and Li's terminology of ingroups and outgroups.

Charness, Rigotti, and Rustichini (2007) study whether group membership and degree of salience of this membership affects the behavior of the test subjects. There experiment shows that people who are members of a group and identify with it behave differently from people who perceive themselves as isolated individuals. Specifically, they find a strong and significant effect of group membership on behavior. In addition, they find that this effect increases as group membership becomes more salient. Even though I am not primarily testing what effect group salience has on herd behavior, Charness, Rigotti, and Rustichini's results will be important when analyzing the differences in performance between Natural and Induced treatments. In my experiment, Natural groups will have slightly stronger saliency than Induced groups, which may cause Natural test subjects to place greater (lesser) weight on the previous decisions of group members in the herding game.

Building off of Charness, Rigotti, and Rustichini's findings, Sutter (2009) compares the effects of group membership on individual behavior to team decision making. By using an investment experiment, Sutter determines that individual's decisions with salient group membership are indistinguishable from those made by teams. In addition, his research relates to Chen and Li's study as he explores whether the findings of Charness, Rigotti, and Rustichini apply to non-strategic decisions even in situations where no outgroup exists. He shows that simply being in a group changes individual behavior, regardless of whether an outgroup exists. This finding will be considered in my experiment, where I construct treatments with varying levels of group identity. If simply being in a group changes behavior, the ingroup outgroup dynamic that is used in two of my treatments may not have as strong an effect on individual behavior as predicted by Akerlof and Kranton.

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Previous literature shows that peer effects influence people's behavior, especially when peers identify with each other in groups. In addition, previous literature shows that herd behavior occurs in settings where groups with no sense of group attachment are constructed. Furthermore, in Celen's research on herd behavior, he "assumes away any heterogeneity that you can call group identity."[6] However, to the best of my knowledge, this is the first study related to the effects of group identity on herd behavior. Thus, my study differs from the previous literature and contributes to the field of economics by combining group identity and herd behavior into a single experimental design.

[6] Bogachan Celen in email.

III. Experiment Design

In all sessions, test subjects were first allocated into groups. The process of group allocation depended on the treatment that subjects participated in: in Baseline, no group allocation procedures were necessary as all participants formed one group of 8; in Induced, 16 test subjects formed two groups of 8 based on color preferences;[7] in Natural, two groups of 8 were formed based on student organization affiliation. All test subjects remained in the same group for the entire session. Once test subjects were allocated to groups, they were instructed to sit at a computer terminal to answer a series of Trivial Pursuit questions. In the Induced and Natural treatments, group members had access to an own-group chat function while answering these questions. After answering the Trivial Pursuit questions, all test subjects completed 5 unpaid practice rounds and 15 paid rounds of a herding game, which was a social learning game that I used to compare subject behavior across treatments. Following the herding game, all test subjects completed a survey, which asked basic demographic questions and questions about group attachment. Once this survey was completed, all test subjects were paid in private for both the Trivial Pursuit questions and the herding game.

Treatments

Before answering Trivial Pursuit questions and playing the herding game, test subjects were be placed into groups for all 3 treatments – Baseline (the control treatment), Induced, and Natural. Each treatment was constructed to have a different amount of group identity so that peer effects would also vary across treatments.

[7] Importantly, members of each group chose the same color.

Treatment 1: Baseline

My first treatment –Baseline – serves as my control treatment for all subsequent treatments and was constructed to have a low sense of group identity. This treatment required 8 test subjects per session. All test subjects formed one group, but to keep group cohesion to a minimum, the experimenter did not explicitly inform subjects that they were in fact part of a group. Instead, the experimenter told them that only the seven other people sitting in the room with them were participating in the experiment. Test subjects could see what other people were in their group, so the identities of all group members were known before the experiment began. Test subjects were then instructed to sit at a computer terminal in one of two rows of desks in the same room, listen to the instructions that were read aloud at the same time, and start the Trivial Pursuit task and the herding game at the same time.

Treatment 2: Induced

The goal of treatment 2 was to increase group identity relative to the Baseline treatment. Therefore, many procedures were implemented to strengthen group attachment. First, group assignment was based on color preference as each participant independently, and in random order, chose either a purple or yellow slip, which determined whether subjects were placed in the "Purple" group or the "Yellow" group, both of which had 8 test subjects.[8] Test subjects did not know the color choices of people who chose before them.[9] In addition, test subjects were only informed what groups they

[8] Induced sessions required 16 test subjects.

[9] Only in the event that the first 8 subjects choose the same color would a subject know the choices of an earlier chooser. However, this did not occur in any Induced session. In addition, almost all test subjects chose their own group.

were in after all had chosen a color. Moreover, subjects were not told anything about splitting the test subject pool into two groups prior to choosing a color.

Second, by separating subjects into 2 separate groups in each Induced session, group identity was also strengthened due to the presence of the other group in the room. To ensure that Purple (Yellow) group members identified with their group and disassociated with the Yellow (Purple) group, several steps were taken. For example, the experimenter told test subjects that their groups were determined by the color slip each had. In addition, test subjects could see what other people were participating in the experiment, so the identities of ingroup members and outgroup members were known.[10] Moreover, each group was asked to sit together in the same area of the room ("Purple" members sat in 2 rows and "Yellow" members sat in 2 different rows). Finally, the experimenter informed all test subjects that they were to remain in their groups throughout the entire session. After these announcements were made, test subjects listen to the instructions and started the experiment.

Third, after the experiment began, treatment 2 included chatting sessions, which were also used to build group identity. Guided by Chen and Li's (2009) experimental design, all subjects were given 2 minutes per Trivial Pursuit question to voluntarily exchange information with own-group members via a chat program to help one another obtain correct answers. Separate chat channels were used so information could be shared only within a group. Test subjects were allowed to discuss any information during each 2 minute session, but focused primarily on the Trivial Pursuit questions. The experimenter monitored and saved the chatting process from the server. Once each chatting session

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[10] Knowing the identities of ingroup members was important in the Induced and Natural treatments because Baseline members also knew the identity of their group members.

ended, all test subjects were asked to submit answers individually. After answering all Trivial Pursuit questions, test subjects in treatment 2 followed the same herding game procedure as treatment 1.

Treatment 3: Natural

The goal of my Natural treatment was to increase group identity relative to Induced. Therefore, instead of group assignment by color preferences, each Natural group was determined by preexisting social categories. Specifically, I recruited test subjects from the Williams Cross Country team, Ultimate Frisbee team, and Elizabethan musical group and used 8 members of each organization to form groups.[11] These organizations were targeted for the experiment because they are mixed gendered and have reasonably diverse blend of members. Aside from this difference in group formation, Natural was exactly the same as the Induced: both consisted of 16 subjects with 2 groups of 8 and both used the same group identity building procedure – online chatting sessions during the Trivial Pursuit task. Additionally, Natural groups followed the same herding game procedure as Induced.

Treatment Design Considerations

Repeated Interaction Instead of Random Rematching Approach for Baseline

I did not use a random rematch approach, which calls for changing the composition of the group after each decision problem round, in my control treatment because it would have eliminated repeated interaction among test subjects. Repeated interaction is necessary for this treatment primarily because the ingroups of Induced and

[11] Two groups of 8 cross country members were used for the Natural treatment. However, the two cross country groups did not participating in the same session. Had they participated in the same session, the difference between ingroup and outgroup membership would have been substantially diminished compared to other sessions.

Natural treatments were fixed throughout each session; therefore, Baseline groups also had to remain fixed. If my Baseline treatment did not have any repeated interaction, internal validity concerns would have undoubtedly arose because one could argue that a change in results from Baseline to Induced or Natural could be attributed to repeated interaction instead of group identity. Moreover, repeated interaction is useful to have across all treatments because it allowed economically relevant factors to also spread across all treatments. For example, repeated interaction let test subjects make inferences about the rationality of group members because they were able to observe group member's actions. However, the ability to make inferences about test subjects' behavior was limited because player performance was kept hidden.

Trivial Pursuit Questions

Once the experiment started, each test subject was asked to answer 6 Trivial Pursuit questions, one from each of the game's six categories: geography, entertainment, history, arts & leisure, science & nature, and sports & leisure. These questions were selected by the experimenter and the same questions were asked in all sessions. For each question, test subjects were given 4 multiple choices (1 correct answer and 3 incorrect answers) and were instructed to choose the correct choice.[12] All test subjects were asked to submit answers individually and the answers submitted were not shared with any other test subjects. After all 6 questions were answered; the computer displayed the correct answers of each question to all test subjects. In addition, the computer randomly selected a predetermined number of questions to be tabulated for payoffs. The number of questions selected for payoffs varied across treatments. Specifically, in Baseline, 4 out of the 6 questions were selected by the computer for payoff. In Induced and Natural, only 2

[12] The 6 Trivial Pursuit questions, accompanied by the 4 multiple choices, are listed in the appendix.

out of the 6 questions were selected for payoff. The last two treatments had a lower number of questions chosen for payoff because group members were allowed to chat with each other about the questions, thereby increasing the likelihood of selecting correct answers. Moreover, the specific questions selected for payoffs varied across test subjects within each treatment. After the computer determined which questions were selected, test subjects were rewarded $.50 for each correct answer and $0 for each incorrect answer.

Herding Game

After completing the Trivial Pursuit task, test subjects in all sessions were asked to participate in a herding game. The herding game followed Celen and Kariv's (2004) framework, consisted of 5 unpaid and 15 paid decision problem rounds, and allowed me to identify herd behavior. In all rounds, the computer selected eight random numbers (one for each member of the group) from the set of real (including decimals) numbers [-10,10], which were uniformly distributed. The numbers selected in each decision problem round were independent of each other and of the numbers selected for any other round. These random numbers corresponded to each participant's *private value*. In all decision problem rounds, subjects were asked to choose one of two actions: A or B. Action A was correct when the sum of the eight private values of group members was greater than or equal to zero. Conversely, action B was correct when the sum of the eight private values of group members was negative. Correct answer yielded a payment of $1.50 for paid rounds and incorrect answers yielded nothing.

All decision problem rounds started by having the computer randomly assign the decision order of each participant, labeled 1,2,...,8, according to their position along the line of participants. For example, if a test subject was the third person randomly chosen by the computer in a decision problem round, he or she would be the third subject to choose action A or B and would only be known to all other group members as 'Chooser 3.' Therefore, test subjects did not know the identity of those who chose in a particular position. The decision order in each round was independent of each other and of the decision order for any other round.

Once the decision order was set, subjects sequentially decided between action A and B, with the decision order corresponding to the line of participants that was randomly decided by the computer. Before choosing between actions A and B, participants observed all previous decisions made by group members. Specifically, once a participant chose between A and B, this decision was revealed to all subsequent group members in real time. Moreover, subsequent group members only saw action A or B; they were not aware of the chooser's private information. For example, once Chooser 2 made a choice, Choosers 3-8 were immediately informed whether Chooser 2 chose A or B. Thus, only Chooser 1 did not observe any previous decisions in a given round.[13]

Up to this point in the herding game, the procedures for the unpaid practice rounds and the paid rounds were identical. However, when the time came to make a decision, test subjects followed different procedures for the practice rounds and the 15 paid rounds. I will first describe the decision making process in the 5 practice rounds, then explain the decision making process in the15 paid rounds.

Practice Rounds Decision Making Process

In the first two practice rounds, when the time came to make a decision, test subjects saw their private values as well as the choices of their group's members who had

[13] After having made a decision, the computer informed participants in real time about subsequent decisions made in the round as well.

previously chosen in that round, then were asked to make a choice between actions A and B. In the third and fourth practice rounds, test subjects saw their private values and the choices of group members who had previously chosen, and made a choice between actions A and B. After choosing an action, test subjects were then asked to enter a *threshold value*, the value between -10 and 10 for which they would have chosen the other action. Thus, if a participant chose action A, he was asked to enter the lowest private value for which he still would have chosen action A. Conversely, if he chosen action B, he was asked to enter the highest private value for which he sill would have chosen action B. Subjects were not able to proceed to the next round unless the threshold value they entered agreed with the choice they made. For instance, if a subject was given a private value of -3 and chose action A but also stated a threshold value of -1 for choosing action A, the computer would not allow her to continue on until the threshold value stated was less than or equal to -3. In the last practice round, when the time came to make a decision, test subjects followed the same decision making process as in the 15 paid decision problem rounds.[14]

Paid Rounds Decision Making Process

When the time came to make a decision in the 15 paid decision problem rounds, instead of choosing between A and B directly, participants stated the threshold value between -10 and 10 for which they wished to choose action A.[15] Only after submitting the threshold did the computer inform participants of their private value. The computer

[14] The decision making process in this round is described in the *Paid Rounds Decision Making Process* section.

[15] For an explanation why test subjects did not choose an action directly in the paid rounds, see *Herding Game Design Considerations* on the next page. In general, having subjects enter a threshold value allowed me to measure the exact weight that they placed on the decisions of others relative to their own private information.

recorded the action as A if one’s private value was equal to or greater than the threshold value he or she stated. Otherwise, the computer recorded the action as B. For example, suppose a test subject enters a threshold value of 2.5. If his private value is 5, the computer records his action as A. On the other hand, if his private value is -1, the computer records his action as B. In both cases, the computer reveals his private value and the action taken immediately after he enters a threshold value. Participants only learned of group member’s actions that went before them, but not group member’s private values or the threshold value they selected to choose action A.

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In all rounds, after all participants made decisions, the computer displayed the sum of the eight private values and whether each participant’s decision was correct. In paid rounds, correct decisions yielded participants $1.50. This marked the completion of a decision problem round and a new decision problem round began until all rounds were completed. The total profit in the herding game was the sum of profits made in all paid decision problem rounds. The total profit of the entire session was the sum of profits made in the herding game rounds and the Trivial Pursuit questions.

Herding Game Design Considerations

Use of the Strategy Method Instead of the Game Method

In order to make conclusions about the effect that group identity has on individual behavior, I needed to construct an experiment that allowed me to see how rationally test subjects behaved. Therefore, in the paid rounds, subjects were asked to state a threshold value (*the strategy method*) rather than pick an action directly (*the game method*) because subject rationality was easily measureable. Specifically, since subjects were asked to state a threshold for choosing action A, I was able to use these numerical values to quantify how rational each subject's behavior was based on the previous actions of group members. For instance, suppose Chooser 1 selects action A. If Chooser 2 has a private value of 10 her choice is trivial and her choice of A provides limited information about the rationality of her choice. However, it is clear that she should choose A for any private value ≥ -5 because we assume Chooser 1's choice of A is rational if her private value > 0 and therefore associated with an expected value of 5, thus any private value ≥ -5 will cause the sum of informed private values to be ≥ 0, making choice A the profitable, correct, and rational action. Using the strategy method, I can measure how far from the rational cutoff each test subject's behavior is.

In addition, my experiment needed to be designed in such a way that I could see how test subjects weighed their private information to the previous choices of group members. Compared to the game method, the strategy method provides more information about how subjects balanced private and public signals. For example, if Chooser 3 sees that Choosers 1 and 2 both selected A and assumes that the choices of Choosers 1 and 2 are rational, then enters a threshold value of -9, the implication is that Chooser 3 places less weight on his private information and more weight on the choices of Choosers 1 and 2. Since it is highly likely that Chooser 3's private value will be greater than -9, his threshold value demonstrates that he is almost willing to choose action A regardless of his private information. Conversely, if in the same scenario, Chooser 3 enters a threshold value of 0, it signifies that he is placing more weight on his private information and less weight on the decisions of Choosers 1 and 2. Since his private value could easily be less than 0, his threshold value provides evidence that he is basing his choice on his private information. If the game method was used instead of the strategy method, I would not be able to measure the weight that test subjects place on private information and the previous decisions of group members. Consequently, the game method may not allow me to determine if the presence of peers changes the behavior of test subjects.

Use of Practice Rounds

While the strategy method helped measure rational behavior and the weight that subjects placed on their private information and the signals of group members, it was an unnatural way of presenting the decision problem. Arguably, the game method is more transferable to the real world because people usually take into consideration both the decisions of others in addition to their own private information before making a decision. Furthermore, holding constant knowledge of previous actions, making a choice after considering private information is more natural than asking test subjects how strong their private information must be in order to choose one of two actions. Therefore, the use of the strategy method may have created confusion for test subjects.[16] In order to decrease the likelihood of subject confusion, I instructed test subjects to partake in practice rounds in order to get accustomed to the herding game.

The first two practice rounds (see private value and choose an action) allowed subjects to gain a better understanding as to what the relationship was between their private values and actions A and B. The third and fourth practice rounds (see private value, choose an action, then enter threshold value for choosing the other action) gave test subjects a better understanding of the relationship between private values and actions

[16] In our pilot study, Cristina Diaz-Dickson – the coauthor of my research paper for Professor Gazzale's *Economics 465: Behavioral and Experimental Economics* – and I noticed some odd behavior that was evidence of subject confusion, as did Celen and Kariv (2004). For example, Celen and Kariv and Cristina and I both noticed a threshold value of 10 for participant 1 in multiple decision problems, which demonstrates a fundamental lack of understanding the herding game.

A and B, and introduced them to the concept of the threshold. The last practice round (same as paid rounds) allowed test subjects to be accustomed to all unique and unnatural concepts of using the strategy method and showed them what the format of making a decision in the paid rounds would look like.

Seeing Previous Actions in Real Time During the Herding Game

In any herding experiment, the ordering of actions is extremely important because herd behavior can only exist if a series of individuals make identical decisions. For example, in my experiment, if Chooser 1 selects A and Choosers 2 and 3 select B, and Chooser 4 is aware of the exact order that these actions take place, he may be more likely to join the herd and choose action B because Choosers 2 and 3 both emit informative signals. However, if Chooser 4 is less conscious of the ordering of these actions and only recognizes one A and two B's, he may be less likely to choose B and follow the herd.

If test subjects only learn about the actions of group members shortly before they are asked to make a decision or only see all previous actions of group members at once, the ordering of actions in my herding game could be negatively impacted in 3 ways. First, test subjects may be more inclined to focus on the total number of A and B actions taken by group members, rather than the ordering of these actions. Second, presenting all previous actions to test subjects shortly before they are asked to make a decision may increase the potential for informational overload issues, which would be especially detrimental to my experiment given its complexity. Third, by only seeing all previous decisions at once and shortly before having to make a decision, subjects may be less engaged in the experiment and consequently care less about the ordering of actions.

Therefore, to maximize the ordering effect of actions A and B in my experiment, I allowed test subjects to see the decisions of group members in real time.

Summary

All 3 treatments were conducted between February and April, 2010 in Jesup Hall at Williams College. There were a total of 112 test subjects, all of whom were undergraduate or graduate students at Williams College. Of the 112 test subjects; 32 participated in four sessions of the Baseline treatment; 48 participated in three Induced treatment sessions; and an additional 32 took part in two Natural treatment sessions. Before test subjects got placed into groups, each was told that they would receive a $5 participation fee, which was given to them at the end of the experiment. For treatments 1 and 2, the experiment was advertised on campus and prospective test subjects were able to sign up online to participate in the experiment. For treatment 3, the experimenter recruited test subjects from particular student organizations on campus. Test subjects were only allowed to participate in one session of one treatment. Consequentially, no test subject participated in multiple sessions. The experiment was programmed and conducted with the software z-Tree (Fischbacher 2007). After the Trivial Pursuit task and herding game were completed, all test subjects filled out a post-experimental survey, which asked basic demographic questions and questions about group attachment. Sessions of the Baseline treatment lasted approximately 1 hour, while sessions of treatments 2 and 3 lasted approximately 1 and a half hour. Average earnings per Baseline subject equaled $21.04; average earnings per Induced subject equaled $21.93; average earnings per Natural subject equaled $20.79.

IV. MAIN HYPOTHESIS

In this section, I identify the important hypothesis that will be analyzed in the results section of my paper. In addition, I motivate both the null and alternative hypothesis.

***Hypothesis 1*:** group identity and the weight that subjects place on their private information and the choices of others.

> H_0: *There is no difference in the weight placed on private information and the choices of others between individuals who belong to a group with high amounts of group identity and those who are in a group with less group identity.*
>
> H_{A1}: *Individuals who belong to groups with high amounts of group identity will place more weight on the choices of others than individuals who belong to groups with less or minimal group identity.*
>
> H_{A2}: *Individuals who belong to groups with high amounts of group identity will place less weight on the choices of others than individuals who belong to groups with less or minimal group identity.*

Hypothesis 1 Motivation

$H_{0:}$ It is possible that group identity had no significant effect on the weighing of private information to the decisions of others in the herding game because there was no obvious reason why many rational peer effects should have differed across treatments. For example, while social learning was the primary component of the decision making process in the herding game, the private information and actions of others were invariable, so all test subjects faced the same social learning environment. In addition, player performance was kept hidden throughout the game, so social comparison and social influence should not impact subjects differently across treatments. Furthermore, there was no monetary incentive for test subjects to perform in the best interest of the group or to conform to decisions of group members. Therefore, since subjects in groups with stronger identity may not have gained or lost utility from behaving differently than Baseline subjects, it is possible that all subjects weighed their private information to the decisions of others similarly.

$H_{A1:}$ While the experimental design may have minimized the likelihood that many rational peer effects differed across treatments in the herding game, group identity may still have caused individuals to place more weight on the previous actions of group members. Zafar (2009) shows that individual decisions are heavily influenced by peers even when monetary and conformity benefits are constant. Specifically, he determines that individuals gain utility by make the same decision as peers (social comparison) and change their actions in the direction of the social norm (social influence) when profits are determined by individual performance and identities remain unknown. In relation to my experiment, Zafar’s result shows that test subjects who felt connected to a group might have overweighed the actions group members when making a decision because acting in accordance with peers is generally a good rule to abide by, even if there is no apparent benefit to doing so. Following this logic, if a test subject saw that the majority of previous actions were similar (making it clear what the consensus action and norm was) then he may have been more prone to overweigh these actions and follow his group members if he considered them as peers. Thus, peer effects resulting from group identity, could cause individuals to make decisions primarily based on the decisiveness (indecisiveness) of the previous signals of group members.

$H_{A2:}$ On the contrary, group identity may still have caused test subjects to place less weight on the previous actions of others relative to their private information in the herding game if they cared about the success of other group members. Chen and Li's (2009) research shows that peer effects induce people to care more about the welfare of the group, even when they have no monetary incentive to do so. In the context of my experiment, Chen and Li's finding suggests that if a test subject who was more attached to his group had private information that plausibly offset the previous signals of others, he may have acted in a contrarian way in order to be helpful to his peers and to increase the likelihood of Social Welfare Maximizing actions, which would improve payoffs for all group members.

For example, suppose Chooser 1 selects action B. The rational threshold for Chooser 2 is 5 because he assumes Chooser 1's choice is rational and therefore that Chooser 1's expected private value is -5. Thus, if Chooser 2's private value is any number less than 5, the sum of private values will be less than 0, so action B is profitable. If Chooser 2 enters B, then Chooser 3 will essentially be forced into choosing B as well because both previous signals tell him to pick B, which likely outweigh his private information. However, if Chooser 2 identifies with his group, he may wish to help his group members by giving them the opportunity to place more weight on their private information when making a decision, therefore Chooser 2 may enter a threshold that is slightly less than 5, increasing the likelihood that he will select action A. If Chooser 2 selects action A, Chooser 3 is not forced into choosing action B and can place more weight on his private information when making his decision.

***

My two alternative hypotheses suggest that peer effects may influence subject behavior in two ways. On the one hand, peer effects resulting from group identity, could cause individuals to make decisions primarily based on the decisiveness (indecisiveness) of the previous signals of group members. On the other hand, peer effects could cause individuals to care more about the welfare of group members, which would persuade them to weigh their own private information more heavily than the previous signals, and consequently choose contrarian actions whenever necessary in order to benefit the outcomes of subsequent players. If there is a difference in behavior across treatments, I expect that one of these two predictions will be most prevalent.

V. PRIMARY RESULTS

V.I: AGGREGATE RESULTS

In this section of the primary results, I look at the aggregate results of Baseline, Induced, and Natural treatments to determine whether group identity led to differences in the behavior of groups across treatments. Behavior at the individual subject level is examined in Section V.II.

Result 1: Comparing the Number of Herds Across Treatments

In this section I compare the frequency of herds across my three treatments. Following Celen and Kariv (2004), I consider meaningful herds to be comprised of a number of subjects greater than half of the total number of participants in a given round. Thus, I define a herd as a situation in which at least 5 subjects make a sequentially identical decision because there were a total of 8 participants in each round of the herding game. Therefore, I observe 5, 6, 7, and 8 person herds and compare the frequency of each across treatments.

In the Baseline sessions, herd behavior occurred in 22 of the 60 paid rounds (37 percent). In the Induced sessions, herd behavior appeared in 44 of the 90 paid rounds (49 percent). Finally, in the Natural sessions, herd behavior took place in 25 of the 60 paid rounds (42 percent).[17] These percentages indicate that herd behavior occurred more often in the two treatments with high amounts of group identity compared to the low group identity Baseline treatment. However, after using a Wilcoxon-Mann-Whitney test, I did not find a statistically significant difference in the number of herds between any two treatments.

---

[17] There were 20 unpaid rounds in both the Baseline and Natural treatments, as well as 30 unpaid rounds in the Induced treatment. However, these rounds were merely practice rounds used to get test subjects accustomed to the experiment, and are not included in any of the results of this research.

TABLE 1 – FREQUENCY OF HERDS

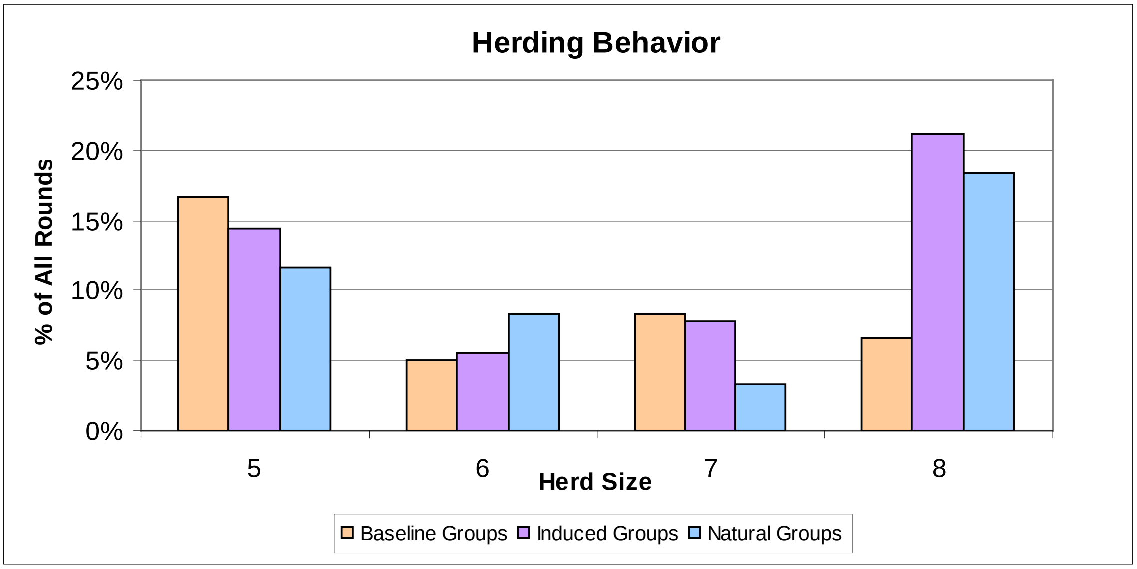


Table 1 shows the percentage of 5, 6, 7, and 8 person herds that were observed in all paid rounds of each treatment. Interestingly, 5 person herds occurred most often in the Baseline treatment. Moreover, Baseline 5 person herds were more prevalent than Baseline 6, 7, or 8 person herds. However, in both the Induced and Natural group treatments, 8 person herds (also known as complete herds) occurred most often. In addition, Table 1 shows that 5 person and complete herds were far more common than 6 person and 7 person herds in both Induced and Natural groups.

TABLE 2 – PERCENTAGE OF HERD SIZES BY ALL HERDS

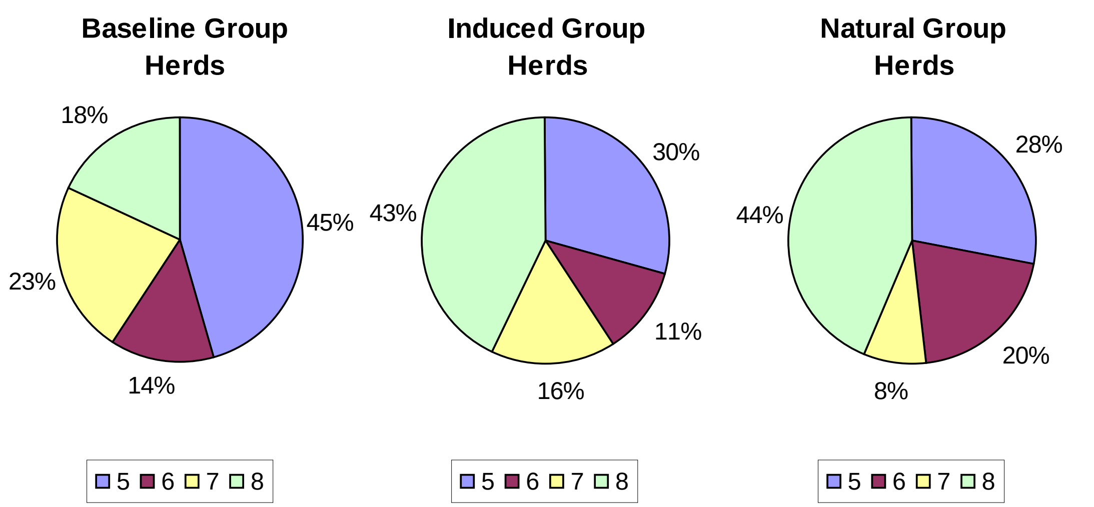


Table 2 shows the percentages of herd sizes by all herds and demonstrates similar findings to Table 1. If a herd occurred, Table 2 illustrates the frequency with which it was 5, 6, 7, or 8 test subjects in length. While Table 1 reveals that 5 person herds were most prevalent in Baseline groups, Table 2 shows that nearly half of all observed herds (45%) were a length of 5. Table 2 also illustrates that nearly half of all herds in Induced and Natural groups (43% and 44% respectively) were complete herds.

Most striking about both Tables 1 and 2 is the difference in percentages among complete herds across treatments. Table 1 shows that complete herds were observed in 21 percent of Induced rounds (19 in total), 18 percent of Natural rounds (11 in total), and in less than 7 percent of Baseline rounds (4 in total). Table 2 shows that, unlike in the Induced and Natural treatments, complete herds constituted less than one fifth of all herds in the Baseline treatment. By either indication, the discrepancy in the distribution of complete herds is particularly noticeable. Furthermore, the Wilcoxon-Mann-Whitney test shows that there is a statistically significant difference between the number of complete herds in Induced groups and Baseline groups as the test yields a p-value of .0537.[18] Therefore, at least with complete herds in the Baseline and Induced treatments, it seems that group identity led to an increase in the frequency of herd behavior.

V.II: Individual Decision Making Results

In this section of my primary results, I observe behavior of test subjects at the individual level across treatments. The following results in this section will help explain my aggregate results and also help me address my central hypothesis: group identity affects the weight that individuals place on their private information relative to the weight placed on the choices of others when making a decision. To understand my aggregate results and address my central hypothesis, I compare the results of all treatments to one another: first, I compare Baseline and Induced test subject behavior (result 2); second, I compare Baseline and Natural test subject behavior (result 3); third, I compare Induced and Natural test subject behavior (result 4).

The primary way in which I examine the weight the test subjects place on their private information to the choices of others for all three comparisons is through the threshold values that test subjects entered in the paid decision problem rounds of the herding game.[19] Specifically, I compare the threshold values that subjects entered to the rational threshold. The *rational threshold* is the threshold that a subject should enter to obtain the highest probability of making a profitable decision. Importantly, the rational threshold is rational because it depends on everyone else being rational. To determine the

[18] When performing the Wilicoxon-Mann-Whitney test, sessions were used as observations. In addition the Wilcoxon-Mann-Whitney test did not generate statistically significant results when comparing complete herds between Baseline and Natural, Baseline and Induced+Natural, or Induced and Natural.

[19] Recall that the threshold value is the value between -10 and 10 for which test subjects wished to choose action A. For example, suppose a test subject enters a threshold value of 2.5. If his private value is 5 (or any number greater than the threshold value), the computer records his action as A. On the other hand, if his private value is -1 (or any number less than the threshold value), the computer records his action as B.

rational threshold, I use Celen and Kariv's rational cutoff equation. Their equation to determine rational cutoffs corresponds to the optimal threshold value that participants should enter for choosing action A when taking into consideration all previous actions. Equation 1 describes rational cutoffs by turn. Here, Ω_n represents the threshold value of participant n. x represents the decision of participant n.

EQUATION 1 – RATIONAL CUTOFF[20]

$$\Omega_n = (-10 + \Omega_{n-1})/2 \text{ if } x_{n-1} = A$$
$$\Omega_n = (10 + \Omega_{n-1})/2 \text{ if } x_{n-1} = B$$

Figures 1-3 provide a visual comparison between rational thresholds and threshold values for all treatments. The data points on these scatter plots represent the relationship between the rational threshold for a given decision and the threshold value that a test subject entered for that particular decision. In addition, for each scatter plot there is a line of best fit for the dataset, which include Choosers 1-8 in all 15 paid rounds of the herding game for all sessions of a given treatment.

[20] $\Omega_1 = 0$ because Chooser 1's threshold value should always be 0 since they do not take into account any previous actions when making a decision.

FIGURE 1

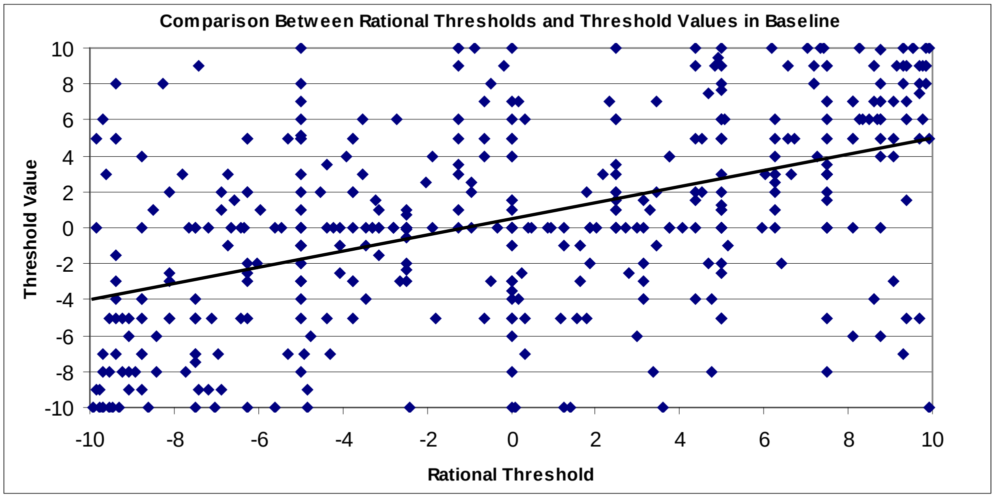


FIGURE 2

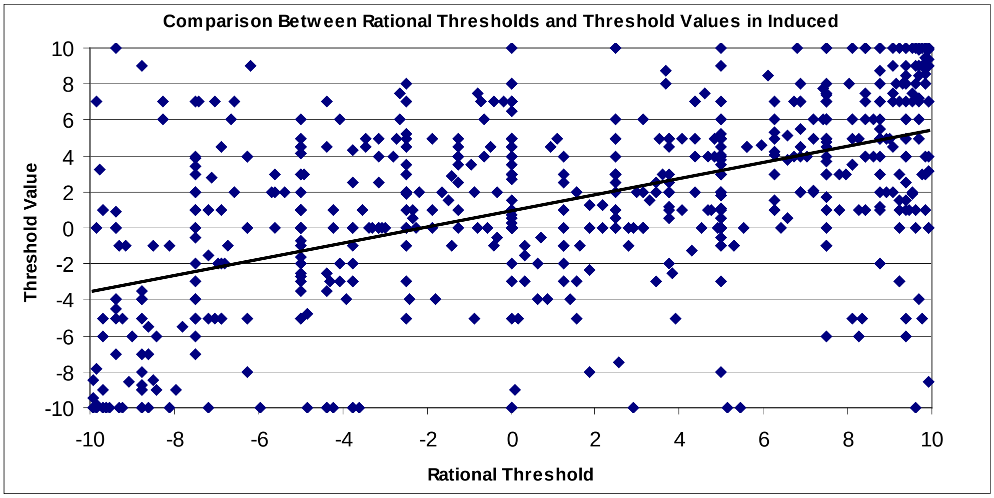
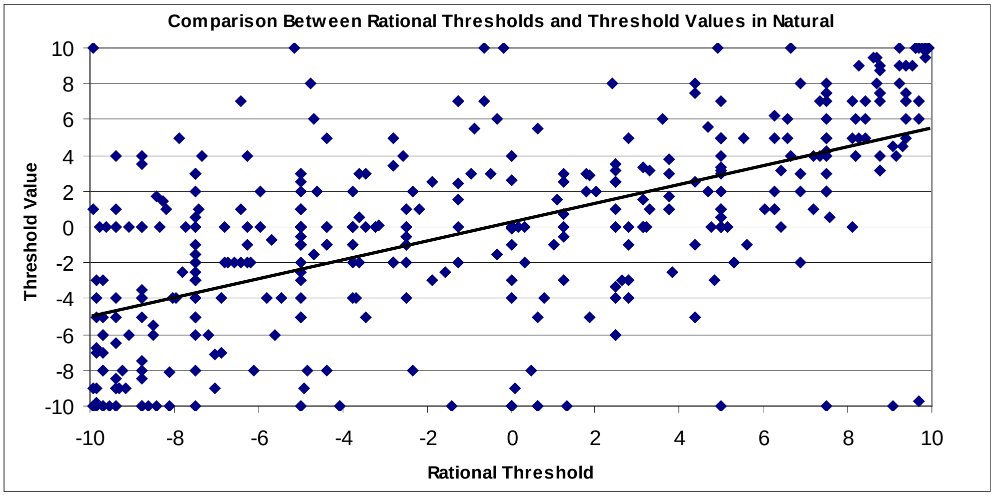


FIGURE 3



To understand how I use the comparison between the two variables when analyzing individual behavior across treatments, let us consider an example. Suppose Chooser 1 enters a threshold value of 0 and his private value is greater than 0, thus the computer records his action as A. According to equation 1, the rational threshold for Chooser 2 = (-10 + 0)/2 = -5. In addition, suppose Chooser 2 decides to enter a threshold value of -8. With a rational threshold of -5 and a threshold value of -8, the data point for Chooser 2 would be (-5,-8) on one of the three scatter plots shown above. If he enters -8, Chooser 2 demonstrates that he is willing to choose action A so long as his private value is greater than -8, which is highly likely given that private values are randomly drawn from [-10,10]. Therefore, Chooser 2 places more weight on Chooser 1's action (and less on his private information) than rational because -8 is less than -5. In fact, since the difference between -8 and -5 is 3, I calculate that Chooser 2 overweighs Chooser 1's action by 3 units.

This example shows that by comparing the threshold value and the rational threshold, I am able to discover two pieces of information about the behavior of test subjects. First, I determine whether test subjects place more (less) weight than rational on the previous actions of group members. Second, I measure the how overweight (underweight) a test subject considers the previous actions of others to be compared to what is perfectly rational. The variable I use to discover these two pieces of information for each decision that a test subject is faced with is called *Error*, which is the main dependent variable I use when observing individual behavior between treatments. Equation 2 describes *Error*. Here, Φ_n represents the *Error* of participant n, z represents the rational threshold of n, and y represents the threshold value of n.

EQUATION 2 – ERROR

$$\Phi_n = (y_n - z_n) \text{ if } z_n > 0$$
$$\Phi_n = (z_n - y_n) \text{ if } z_n < 0$$

Error allows me to accurately compare the weight that each subject places on their private information relative to the public signals of others. If *Error* is positive, it means that a test subject overweighs the previous actions of others relative to what is rational. In general, more extreme threshold values (number close to either -10 or 10) are associated with placing more weight than rational on previous actions. Conversely if *Error* is negative, it means that a test under weighs the previous actions of others relative to what is rational. In general, less extreme threshold values (numbers close to 0) are associated with placing less weight than rational on previous actions. The exact value of a positive (negative) *Error* sign is calculated by the difference between the threshold value and the rational threshold.

Result 2: Comparing Baseline Group Member Behavior with Induced Group Member Behavior

Result 2 – the most important result of this study – compares test subject behavior between my first two treatments. Table 3 illustrates the model I use to compare Baseline and Induced group member behavior. As previously mentioned, my dependent variable in this model is *Error* because it effectively measured how each subject weighed their private information to the decisions of others. However, *Error* in the herding game was influenced by many factors. First, the round of each herding game was positively associated with *Error*. In the early rounds, *Error* was typically low since test subjects were less familiar with the concept of the threshold value and entered values closer to 0; however, as rounds increased, people became more rational and *Error* increased. Therefore, *Round* is included as an independent variable. Second, the decision order of each subject in a given round was also positively associated *Error* because as decision order increased, threshold values were more likely to be farther from the rational threshold. Thus, *DecisionOrder* is also an independent variable in this model.

TABLE 3 – BASELINE AND INDUCED TREATMENT RESULTS

Estimation Technique:	(1) OLS	(2) OLS
	Dependent Variable: Error	
Round	0.0561**	0.0561**
	(0.0244)	(0.0245)
DecisionOrder	-0.0151	0.0639
	(0.0784)	(0.120)
IsInduced	0.00216	0.661
	(0.447)	(0.618)
IsInducedxDecisionOrder		-0.132
		(0.154)
Constant	-3.960***	-4.355***
	(0.527)	(0.621)
Observations	1050	1050
R-squared	0.003	0.004

a. Robust standard errors in parentheses: *** $p<0.01$, ** $p<0.05$, * $p<0.1$
b. Observations include Chooser's 2-8 in all 15 paid rounds for all Baseline and Induced groups (10 in total: 4 Baseline and 6 Induced). Observations are clustered into groups.[21]

Finally, the treatment may also have influenced *Error* because Induced was constructed to have a higher amount of group identity than Baseline. As a result, I included an *IsInduced* dummy variable, which indicates whether a test subject was an Induced group member and determines whether a treatment effect existed. *IsInduced* is the coefficient of interest in this model. The observations in Table 3 include Chooser's 2-8 in all 15 paid rounds for all Baseline and Induced groups (10 in total: 4 Baseline and 6 Induced). Observations of Chooser 1 are excluded from this model because any *Error* is uninformative since Chooser 1 did not take into account any previous decisions when

[21] I do not include Chooser 1 observations because their threshold values should always be 0 since they do not take into account any previous actions when making a decision. Therefore, any error is uninformative.

making a decision. In addition, observations are clustered into groups because group member observations may be correlated.

Regression 1 shows that *IsInduced* has no statistically significant effect on *Error*. That is, holding all else constant, being in an Induced group did not cause test subjects to weigh the decisions of their group members any differently than Baseline test subjects. Regression 2 of Table 3 includes an additional variable: the interaction between *IsInduced* and *DecisionOrder*. I include the interaction term because it is possible that Induced subjects who chose later in a given round might weigh the actions of others differently than Baseline subjects. However, the lack of significance of the *IsInducedxDecisionOrder* interaction does not lend any support to this theory as Induced subjects still did not weigh the decisions of group members any differently than Baseline individuals. Therefore, I am not able to reject H_0 of Hypothesis 1, which states that group identity does not affect how individuals weigh their private information to the decisions of others.

The results of regressions 1 and 2 are puzzling compared to the aggregate results. In particular, the aggregate results show that Induced groups herded more often per round than Baseline groups. In addition, Induced groups engaged in more complete herds than Baseline groups, a result which was statistically significant. However, regressions 1 and 2 indicate that no there was no systematic difference in individual behavior between Induced and Baseline test subjects. This discrepancy suggests that individual behavior might have been different across treatments when subjects were asked to make a decision as herds were forming before them. Moreover, since there was such a difference in the occurrence of complete herds – herds where all group members chose the same action –

between treatment groups, individual behavior may have differed even more when the herds forming before them were simple. That is, behavior may have changed when test subjects were asked to make a decision in which they saw that all previous actions were the same.

TABLE 4 – BASELINE AND INDUCED TREATMENT RESULTS

Estimation Technique:	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS
			Dependent Variable: Error		
Round	0.0561**	0.0561**	0.0868**	0.0872**	0.0889**
	(0.0244)	(0.0245)	(0.0287)	(0.0299)	(0.0275)
DecisionOrder	-0.0151	0.0639	-0.224*	-0.0946	-0.219**
	(0.0784)	(0.120)	(0.102)	(0.172)	(0.0855)
IsInduced	0.00216	0.661	-0.705	1.792*	0.577
	(0.447)	(0.618)	(0.653)	(0.845)	(0.648)
IsInducedxDecisionOrder		-0.132	0.0602	-0.373*	0.0800
		(0.154)	(0.173)	(0.181)	(0.133)
AllSame			-2.236***	-0.741	
			(0.329)	(0.650)	
AllSamexIsInduced			1.360**	-3.033**	
			(0.547)	(1.041)	
AllSamexDecisionOrder				-0.342*	
				(0.180)	
AllSamexIsInducedxDecisionOrder				0.937***	
				(0.259)	
NotAllSame					2.300***
					(0.455)
NotAllSamexIsInduced					-1.166
					(0.949)
NotAllSamexCurrentHerd					-0.0392
					(0.196)
NotAllSamexIsInducedxCurrentHerd					-0.0962
					(0.322)
Constant	-3.960***	-4.355***	-2.392***	-3.141***	-4.665***
	(0.527)	(0.621)	(0.458)	(0.868)	(0.698)
Observations	1050	1050	1050	1050	1050
R-squared	0.003	0.004	0.025	0.035	0.026

a. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1
b. Observations include Chooser's 2-8 in all 15 paid rounds for all Baseline and Induced groups (10 in total: 4 Baseline and 6 Induced). Observations are clustered into groups.[22]

[22] I do not include Chooser 1 observations because their threshold values should always be 0 since they do not take into account any previous actions when making a decision. Therefore, any error is uninformative.

Therefore, I extended the analysis of Table 3 by examining Induced and Baseline individual behavior under simple decisions.[23] Table 4 illustrates this analysis as it includes 3 additional regressions relative to Table 3. Regression 3 of Table 4 is the first regression that investigates individual behavior under simple decisions. Consequently, regression 3 introduces two additional independent variables compared to regression 2. First, *AllSame* is a dummy variable that indicates whether a test subject was presented with a simple decision. Second, *AllSamexIsInduced* is an interaction variable between *AllSame* situations and Induced group members. If an Induced group member was presented with an *AllSame* decision, then *AllSamexIsInduced* = 1, otherwise *AllSamexIsInduced* = 0. The results of this regression show that simple decisions negatively affected *Error*. Specifically, test subjects faced with simple decisions entered less extreme threshold values relative to the rational threshold, which were 2.23 units closer to 0, than test subjects faced with non-simple decisions – decisions in which test subjects did not see that all actions were the same. This implies that test subjects in simple decisions placed less weight than rational on the public signals of others when making a decision. This finding is not surprising, however, because it is almost expected that threshold values would be less extreme than the rational threshold in simple situations because the rational threshold moves rather quickly to -10 and 10, depending on the action that all subjects have taken.

Regression 3 also shows that the *AllSamexIsInduced* interaction variable had a significant and positive effect on *Error* as Induced group members with simple decisions

[23]Simple decisions are decisions in which a test subject sees no previous contrarian signals before making a choice. For example, during a round of the herding game, if Chooser 4 sees all three group members before him choose action A, then his decision is characterized as Simple. However, if Chooser 4 sees the Choosers 1 & 2 choose action A, then sees Chooser 3 select action B, Chooser 4's decision is not simple because all previous signals are not identical.

entered more extreme threshold values relative to the rational threshold (about 1.4 units closer to -10 or 10, respectively). This result suggests that test subjects in the more cohesive Induced groups rationally placed more weight on public signals when all previous decisions of group members coincided, compared to all other decision scenarios. Therefore, when comparing Baseline and Induced test subjects in simple decisions, I can reject H_0 of Hypothesis 1 in favor of H_{A1}, which states that group identity will cause individuals to place more weight on the previous decisions of group members.

Building off of the findings of regression 3, regression 4 seeks to explore whether Induced test subjects in simple decisions continued to act differently as the decision order increased. Therefore, regression 4 includes two additional variables that seek to explain *Error*. The first is *AllSamexDecisionOrder*: simple decisions that are interacted with *DecisionOrder*. The second is *AllSamexIsInducedxDecisionOrder*, which uses *AllSamexDecisionOrder* to interact with *IsInduced*. The results illustrate that as decision order increased in simple decisions, meaning that test subjects saw more and more identical public signals, subjects tended to enter slightly less extreme threshold values than rational compared to all other decision making situations. This result is significant at the 10 percent level. However, when decision order increased under simple decisions, Induced group individuals entered threshold values that were nearly 1 unit more extreme than all other observed thresholds, a result that is significant at the 1 percent level. Thus, Induced test subjects, on average, rationally placed more weight on their group member's previous decisions as they saw more and more of the same decision. In sum, regression 4 provides further reason to conclude in favor of Hypothesis 1's H_{A1} – group identity will cause individuals to place more weight on the previous decisions of group members – when faced with simple decisions.

After examining simple decisions and finding a strong treatment effect, it seemed worthwhile to study non-simple decisions, also known as complex decisions.[24] However, unlike simple decisions, complex decisions can take multiple forms. First, a test subject may be faced with a decision in which a series of people are currently in a herd, but this herd started after a contrarian action was selected. For example, suppose Chooser 1 picked action B, then Chooser's 2-4 picked action A. From the perspective of Chooser 5, a three person herd has started, but the first person that started the herd picked a contrarian signal. Thus, Chooser 5 is faced with a very difficult decision. On the one hand, the 3 consecutive A's before him might persuade him to select a threshold that increases the likelihood of him choosing A. On the other hand, the contrarian signal of Chooser 2 might make him less inclined to follow the 3 consecutive A's before him. Instead, Chooser 5 may place considerable weight on his private information when choosing an action.

Another type of complex decision is when a test subject observes similar actions among earlier Choosers, but then sees that the most recent choice was contrarian. For example, suppose Chooser 1-3 picked action A, then Chooser 4 selected action B. From Chooser 5's viewpoint, a herd had formed, but his immediate predecessor decided to go against the herd. Once again, Chooser 5 is forced to make a hard decision. He may decide to devote less attention to Chooser 4's signal. Conversely, Chooser 5 may feel that

[24] A complex decision is essentially the opposite of a simple decision situation. It is a situation in which a test subject sees at least one contrarian signal before making a decision. For example, during a round of the herding game, if Chooser 4 sees that Chooser 1 chose action A, then sees that Choosers 2 & 3 both picked action B, Chooser 4 is faced with a complex decision. If all three decisions before Chooser 4 were the same, then Chooser 4 would not be faced with a complex decision.

Chooser 4 must have had strong private information to select action B. Either way it is a difficult situation to assess.

Regression 5 of Table 4 examines individual behavior under complex decisions and is constructed similarly to regression 4, but there are two main differences between them. First, *AllSame* variables are replaced with *NotAllSame* variables, marking a change from simple to complex decisions. Second, decision order interaction variables are replaced with a variable called *CurrentHerd*. *CurrentHerd* is the number of group members who chose an identical decision after a contrarian signal was made. Therefore, it demonstrates a situation in which a series of individuals were going against a contrarian signal. For example, if Chooser 4 saw that Choosers 1 and 2 selected action A then saw Chooser 3 selected action B, *CurrentHerd* = 1. However, if Chooser 2 selected B instead of A, meaning that Choosers 2 and 3 picked B while Chooser 1 picked A, *CurrentHerd* = 2. The results show that with the exception of *NotAllSame* – which is significant and shows a positive effect on *Error* for all test subjects – no other variable is significantly correlated with threshold errors. Therefore, I am unable to conclude that group identity caused Induced individuals to put more or less weight on public signals as group members successively overturned a contrarian signal.

Overall, the comparison of Baseline and Induced subject behavior showed that Induced members did not weigh their private information to the choices of others much differently than Baseline members in most situations. However, when faced with a simple decision in which previous actions all coincided, Induced subjects placed more weight on the decisions of group members and followed their peers more often than Baseline subjects. This behavior also helped explain why Induced groups engaged in more complete herds than Baseline groups in the aggregate results.

Result 3: Comparing Baseline Group Member Behavior with Natural Group Member Behavior

Result 3 compares behavior between Baseline group members and Natural group members. Table 5 illustrates the model I use to compare individual behavior of these 2 treatments. What is more, Table 5 is designed in nearly the exact same way as Table 4. I use *Error* as my dependent variable and *Round* and *DecisionOrder* as independent variables. However, instead of using *IsInduced*, I use *IsNatural*, which is also a dummy variable that indicates whether a test subject was a Natural group member. Consequently, *IsNatural* is the variable that will interpret differences in behavior between the two treatments and is my coefficient of interest. It is also worth mentioning that regressions in Table 5 have fewer observations than the regressions of Tables 3 and 4 because the Induced treatment had 1 additional session, thus 2 additional groups, than the Natural treatment.

Regressions 1 and 2 in Table 5 tell a similar story to the first 2 regressions of Table 3. Namely, holding all else constant, natural group members did not behave much differently than Baseline group members when considering all types of decisions. Furthermore, even as test subjects saw more public signals, no treatment effect existed among the Baseline and Natural groups. Unfortunately, these findings do not help explain the difference in observed herds between Baseline and Natural that is highlighted in the aggregate results. Specifically, the aggregate results show that Natural groups engaged in more herds, especially complete herds, than Baseline groups. Therefore, I look at individual behavior between the two treatments when a herd has formed.

TABLE 5 – BASELINE AND NATURAL TREATMENT RESULTS

Estimation Technique:	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS
			Dependent Variable: Error		
Round	0.0304	0.0304	0.0610	0.0662	0.0616
	(0.0296)	(0.0296)	(0.0392)	(0.0387)	(0.0385)
DecisionOrder	0.0719	0.0639	-0.212*	-0.0880	-0.207**
	(0.0657)	(0.122)	(0.103)	(0.174)	(0.0862)
IsNatural	0.190	0.110	-1.838**	0.0263	-0.0198
	(0.480)	(0.603)	(0.549)	(1.044)	(0.664)
IsNaturalxDecisionOrder		0.0159	0.272	-0.0490	0.314*
		(0.131)	(0.154)	(0.233)	(0.161)
AllSame			-2.146***	-0.700	
			(0.356)	(0.658)	
AllSamexIsNatural			1.981**	-1.313	
			(0.725)	(1.423)	
AllSamexDecisionOrder				-0.335	
				(0.185)	
AllSamexIsNaturalxDecisionOrder				0.713*	
				(0.335)	
NotAllSame					2.195***
					(0.488)
NotAllSamexIsNatural					-1.539
					(0.905)
NotAllSamexCurrentHerd					-0.0325
					(0.204)
NotAllSamexIsNaturalxCurrentHerd					-0.300
					(0.477)
Constant	-4.189***	-4.150***	-2.274***	-3.029**	-4.442***
	(0.359)	(0.662)	(0.499)	(0.915)	(0.765)
Observations	840	840	840	840	840
R-squared	0.002	0.002	0.021	0.026	0.023

a. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1
b. Observations include Chooser's 2-8 in all 15 paid rounds for all Baseline and Natural groups (8 in total: 4 Baseline and 4 Natural). Observations are clustered into groups.[25]

I find that there is a statistically significant difference in the manner with which Natural group members acted under simple decisions. As the results of regression 3 illustrate, test subjects entered less extreme threshold values relative to the rational threshold when they saw no previous contrarian signals. Specifically, Baseline and Natural individuals entered threshold values that were 2.146 units closer to 0 than the thresholds they entered in complex decision problems, a result which is statistically

[25] I do not include Chooser 1 observations because their threshold values should always be 0 since they do not take into account any previous actions when making a decision. Therefore, any error is uninformative.

significant at the 1 percent level. Furthermore, regression 3 shows that in situations where individuals saw no contrarian signals, Natural group members entered more extreme threshold values than those entered otherwise, a result which is statistically significant at the 5 percent level. For example, suppose Chooser 5 in both Baseline and Natural groups is faced with the same simple decision: Choosers 1-4 all selected action B. Let us also suppose that Chooser 5 in the Baseline group entered a threshold value of 7, a likely threshold value given that all previous signals tell him to choose B. The results of regression 3 demonstrate that Chooser 5 in the Natural group, on average, entered a threshold value of 9 (slightly less given that the coefficient is 1.981). Therefore, in line with Result 2, Natural subjects placed more weight on the decisions of group members relative to Baseline subjects when confronted with simple decisions.

Regression 4 of Table 5 shows less of a treatment effect between Natural and Baseline group subjects, but a significant one nonetheless. Regression 4 conveys that as decision order increased in simple decision situations, Natural individuals entered slightly more extreme threshold values relative to the rational threshold compared to all other observations. This result is significant at the 10 percent level, and confirms the presumption that group identity leads individuals to place more weight on the previous signals of group members when all signals are identical. Therefore, I can once again reject H_0 of Hypothesis 1 in favor of H_{A1}, under simple decisions.

Next, I compare Baseline and Natural subject behavior when faced with complex decisions. The results of regression 5 in Table 5 show that there is no difference in behavior between individuals in highly cohesive Natural groups and those in Baseline groups when considering complex decisions. Similar to the comparison between Induced and Baseline group subjects, no complex decision variables are significant enough to interpret a treatment effect.

Interestingly, the results of Table 4 are noticeably similar to the results of Table 5. Many of independent variables that compare treatments 2 and 3 to treatment 1 have similar significance levels and coefficients. Moreover, the comparisons of Induced to Baseline and Natural to Baseline both allow me to reject H_0 of hypothesis 1 and conclude in favor of H_{A1}, under simple decisions. Therefore, I can broadly conclude that relatively high amounts group identity causes individuals to weigh the previous decisions of others differently than individuals who hardly identify with group members when all previous signals are the same.

Result 4: Comparing Induced Group Member Behavior with Natural Group Member Behavior

Result 4 – my final primary result – compares individual behavior between Induced and Natural treatments. Table 6 displays the model I use to compare individual behavior of these 2 treatments. Moreover, Table 6 is similar in design and construction to Tables 4 and 5. However, unlike in Table 5 where the *IsNatural* dummy variable indicates whether an observation was from the Natural or Baseline treatment, *IsNatural* now distinguishes Natural members from Induced members. Thus, *IsNatural* =1 if an observation is from a natural group test subject.

TABLE 6 – INDUCED AND NATURAL TREATMENT RESULTS

Estimation Technique:	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS
			Dependent Variable: Error		
Round	0.0365	0.0365	0.0392	0.0401	0.0418
	(0.0295)	(0.0296)	(0.0276)	(0.0267)	(0.0270)
DecisionOrder	-0.00871	-0.0677	-0.159	-0.466***	-0.116
	(0.0657)	(0.0968)	(0.129)	(0.0508)	(0.100)
IsNatural	0.187	-0.551	-1.151	-1.786*	-0.517
	(0.612)	(0.482)	(0.681)	(0.866)	(0.505)
IsNaturalxDecisionOrder		0.148	0.215	0.329*	0.218
		(0.108)	(0.175)	(0.161)	(0.172)
AllSame			-0.840*	-3.759***	
			(0.394)	(0.844)	
AllSamexIsNatural			0.641	1.753	
			(0.736)	(1.503)	
AllSamexDecisionOrder				0.599***	
				(0.178)	
AllSamexIsNaturalxDecisionOrder				-0.231	
				(0.324)	
NotAllSame					1.285*
					(0.688)
NotAllSamexIsNatural					-0.599
					(1.001)
NotAllSamexCurrentHerd					-0.233
					(0.214)
NotAllSamexIsNaturalxCurrentHerd					-0.0985
					(0.475)
Constant	-3.833***	-3.538***	-2.750***	-0.995*	-3.785***
	(0.353)	(0.488)	(0.659)	(0.487)	(0.421)
Observations	1050	1050	1050	1050	1050
R-squared	0.002	0.003	0.008	0.021	0.013

a. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1
b. Observations include Chooser's 2-8 in all 15 paid rounds for all Induced and Natural groups (10 in total: 6 Induced and 4 Natural). Observations are clustered into groups.[26]

As the results of Table 6 show, it is hard to distinguish any statistically significant treatment effect between the threshold values of Induced subjects and those of Natural subjects. Based on the aggregate results between Induced and Natural groups, the lack of a significant treatment effect at the individual level is not unexpected. However, recall that Natural groups were constructed to have higher amounts of group identity than Induced groups. Since increasing group identity from a minimal amount (the Baseline

[26] I do not include Chooser 1 observations because their threshold values should always be 0 since they do not take into account any previous actions when making a decision. Therefore, any error is uninformative.

treatment) to a relatively high amount (Induced or Natural treatments) impacted individual behavior in simple decisions, it would also be reasonable to assume that increasing group identity from a high amount to a relatively higher amount would spur a change in behavior under simple decisions as well. This hypothesis cannot be supported based on the regressions of Table 6. Furthermore, I am unable to reject the H_0 of hypotheses 1 when comparing Induced and Natural subjects.

VI. Supplementary Results

In this section of my research, I determine if any effects unassociated with group identity caused a treatment effect on the threshold values entered by test subjects. These findings will help to strengthen or weaken my claim that the primary difference in any individual behavior across treatments is attributed to peer effects on groups.

Result 5: Effect of Success in Herding Game on Threshold Errors

After each decision problem round in the herding game, test subjects were informed whether their decision was correct. Since I observe the behavior of test subjects in 15 rounds, it is possible that an individual's behavior may have been influenced by success in earlier rounds. For example, if a test subject entered a relatively high threshold value in round 3 and his choice was correct – meaning that he earned money, maybe that same test subject would enter higher threshold values in subsequent rounds. If so, that particular subject may have placed more weight on the decisions of group members because of previous success, not because they felt closely attached to group members. Therefore, it is necessary to examine previous success in earlier rounds of the herding game.

Table 7 shows the model I used determine what effect, if any, previous success had on subject behavior. Once again, my dependent variable is *Error* because it is the most effective way to measure how test subjects weigh their private information to the decisions of others. In addition, I included *Round* and *DecisionOrder* as independent variables to control for the fact that I expect threshold errors to be different as round and decision order increase. I also include three independent variables that indicate a different measure of previous success. The first variable is *PercentCurrentCorrect*.

PercentCurrentCorrect indicates the number of previous paid decision problem rounds each test subject got correct divided by the total number of paid rounds completed. For example, if at the start of round 4, a test subject chose the correct action in 2 of the first 3 paid rounds, then his *PercentCurrentCorrect* would equal 2/3 or .667. Second, I created a dummy variable for choosing the correct decision in the most recent round, which is called *LastRoundCorrect*. If a test subject chose the correct action in the previous round, then *LastRoundCorrect* = 1. Finally, I created a dummy variable that indicates whether the last herd a subject participated in was correct, which is called *LastHerdCorrect*. For this variable, a subject participates in a herd if he is presented with a situation in which at least 3 identical decisions have been made before him and he chooses that same decision. For example, if in round 3 a test subject sees that the previous decisions before him were all action A and he decided to join the herd, *LastHerdCorrect* =1 if this herd turned out to be correct. Moreover, *LastHerdCorrect* would remain 1 until the same subject decided to join another herd, at which time *LastHerdCorrect* would change depending on whether the action of the herd was correct.

Another independent variable I include in this model is *IsInducedorNatural.* This variable indicates whether an observation was from a group with a high amount of group identity (treatments 2 or 3) or a group with a low amount of group identity (treatment 1). I include this variable because it is possible that the effect of previous success on *Error* varied depended on the level of group identity. Since Induced and Natural individuals demonstrated strikingly similar behavior in the primary results section of this paper, I felt it was suitable to group them together for this model. Furthermore, I also interact *IsInducedorNatural* with the three success variables

TABLE 7 – EFFECT OF PREVIOUS SUCCESS ON THRESHOLD ERRORS

Estimation Technique:	(1) OLS	(2) OLS	(3) OLS	(4) OLS
		Dependent Variable: Error		
Round	0.0455**	0.0454**	0.0455*	0.0445*
	(0.0210)	(0.0209)	(0.0211)	(0.0222)
DecisionOrder	0.00968	0.00890	0.00949	0.00860
	(0.0584)	(0.0555)	(0.0590)	(0.0585)
PercentCurrentCorrect	2.507**	2.258	2.512**	2.499**
	(0.858)	(1.934)	(0.852)	(0.872)
LastRoundCorrect	0.0456	0.0465	-0.197	0.0612
	(0.277)	(0.278)	(0.271)	(0.275)
LastHerdCorrect	-0.247	-0.246	-0.254	0.109
	(0.258)	(0.261)	(0.258)	(0.421)
IsInducedorNatural	0.0909	-0.149	-0.146	0.436
	(0.310)	(1.546)	(0.435)	(0.324)
IsInducedorNaturalxPercentCurrentCorrect		0.350		
		(2.073)		
IsInducedorNaturalxLastRoundCorrect			0.346	
			(0.519)	
IsInducedorNaturalxLastHerdCorrect				-0.529
				(0.483)
Constant	-5.589***	-5.416***	-5.423***	-5.800***
	(0.748)	(1.257)	(0.706)	(0.650)
Observations	1372	1372	1372	1372
R-squared	0.019	0.019	0.019	0.019

a. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1
b. Observations include Chooser's 2-8 in paid rounds 2-15 for all groups (14 in total: 4 Baseline, 6 Induced, and 4 Natural). Observations are clustered into groups.[27]

The results Table 7 show that *PercentCurrentCorrect* corresponds to a more extreme threshold value relative the rational threshold. That is, previous success in the herding game increases the likelihood that any test subject will enter a higher threshold, placing more weight on the previous decisions of group members. However, when *PercentCurrentCorrect* is interacted with *IsInducedorNatural*, there is no significant effect, suggesting that previous success did not cause individuals in groups with high amounts of group identity to enter more or less extreme thresholds. What is more, when *LastRoundCorrect* and *LastHerdCorrect* are interacted with *IsInducedorNatural*, there is

[27] I do not include Chooser 1 observations because their threshold values should always be 0 since they do not take into account any previous actions when making a decision. Therefore, any error is uninformative. In addition, I do not include the first paid round because it is highly unlikely that subjects changed their behavior due to success in practice round 5 – an unpaid round.

still no existence of a treatment effect. Therefore, previous success in the herding game did not lead to a notable difference in threshold entries across treatments.

Result 6: Effect of Trivial Pursuit Success on Threshold Errors

Before the herding game began, highly induced and natural group members were able to chat with own-group members while answering Trivial Pursuit questions. Motivated by Chen and Li's (2009) research, the chatting sessions were used primarily as a means to strengthen group identity and group attachment. However, chatting sessions also increased the likelihood of obtaining correct answers to trivia questions. It is also feasible that if test subjects who used chatting sessions were successful in the Trivial Pursuit task, they may have carried over this success to the weight they placed on group member's actions during the herding game. For example, if a test subject chatted with group members and answered all trivia questions successfully, it is possible that he placed more weight on group members actions because he had more trust in them. Conversely, if chatting led to little success in the Trivial Pursuit game, a test subject may have placed less weight on his group member's decisions. If either scenario was in fact true, then subject behavior not only changed due to group identity, but also because of Trivial Pursuit success.

The testing of trivia game success, resulting from chatting, on threshold errors is modeled by Table 8. My dependent variable is *Error* and *Round* and *DecisionOrder* are included as independent variables. In addition, I include three other variables that express Trivial Pursuit success. First, I create a variable called *TrivProfits*, which calculates the total amount each subject earned from the trivia questions. Second, *TotalCorrect*, which provides the total number of trivia questions each subject correctly answered. Finally, I include *ChatHelpful*, which measures how helpful each Induced and Natural group test subject felt the chatting sessions were. This measurement was determined by the post-experimental survey as test subjects were asked to rate, on a scale from 1 to 10, how helpful the chatting sessions were during the Trivial Pursuit task.

TABLE 8 – EFFECT OF TRIVIA PURSUIT SUCCESS ON THRESHOLD ERRORS

Estimation Technique:	(1)	(2)	(3)
	OLS	OLS	OLS
	Dependent Variable: Error		
Round	0.0359	0.0543	0.00540
	(0.0298)	(0.0373)	(0.0498)
DecisionOrder	-0.0109	-0.0655	0.0750
	(0.0610)	(0.0827)	(0.0538)
TrivProfits	-0.571	-0.593	-0.830
	(0.539)	(0.762)	(0.945)
TotalCorrect	0.0827	0.682*	-0.200
	(0.295)	(0.275)	(0.407)
ChatHelpful	0.0618	0.187	-0.0369
	(0.0875)	(0.142)	(0.106)
Constant	-4.094**	-7.451**	-2.097
	(1.454)	(1.929)	(0.970)
Observations	1050	630	420
R-squared	0.004	0.037	0.018

a. Robust standard errors in parentheses: *** $p<0.01$, ** $p<0.05$, * $p<0.1$
b. Observations for regression 1 include Chooser's 2-8 in all 15 paid rounds for all Induced and Natural groups (10 in total: 6 Induced and 4 Natural). Observations are clustered into groups.[28]
c. Observations for regression 2 include Chooser's 2-8 in all 15 paid rounds for all Induced groups. Observations are clustered into groups.
d. Observations for regression 3 include Chooser's 2-8 in all 15 paid rounds for all Natural groups. Observations are clustered into groups.

A regression with all 5 of these independent variables was run multiple times: the first – regression 1 – included both Induced and Natural group members, the second – regression 2 – included only Induced group members, and the third – regression 3 – I included only Natural group members. The results show that no independent variables were significantly correlated with *Error*. Therefore, I am not able to conclude that Trivial Pursuit success increased the weight that test subjects in Induced and Natural groups placed on the decisions of others. This suggests that group functionality had an

[28] I do not include Chooser 1 observations because their threshold values should always be 0 since they do not take into account any previous actions when making a decision. Therefore, any error is uninformative.

insignificant role in determining how test subjects balanced their private information with public signals when making a decision.

Result 7: Relationship between Demographics and Treatments

In total, 112 test subjects were used for the experiment. While all test subjects were students at Williams College, Table 9 shows that different genders, ethnicities, and ages were represented. Therefore, it is possible that the distribution of demographics across treatments may have contributed to the treatment effects that were observed in the primary results section. Specifically, it is possible that Induced and Natural groups consisted of certain demographic factors which contributed to the difference is subject behavior compared to the Baseline.

TABLE 9 – DEMOGRAPHICS

	Treatments (# of Subjects)				*Significance*
	Baseline	Induced	Natural	Totals	P. Value
Gender					0.061
Male	21	20	20	61	
Female	11	28	12	51	
Race					0.436
White	16	24	25	65	
Asian	7	11	4	22	
Black	3	5	1	9	
Hispanic	4	4	1	9	
Other	2	4	1	7	
Age					0.763
18	8	4	5	17	
19	8	18	9	35	
20	7	9	9	25	
21	5	10	6	21	
22	3	5	3	11	
23	1	0	0	1	
30	0	1	0	1	
31	0	1	0	1	

To determine if there is a statistically significant relationship between demographics and my three treatments, I use chi-square and fisher's exact tests, depending on the demographic category. A chi-square test demonstrated that the relationship between gender and treatments was statistically significant at the 10 percent level. As shown by Table 9, a large number of females participated in the highly induced treatment, which likely led to the correlation between gender and treatments. Thus, females may have contributed to the difference in entered threshold values across treatments.

TABLE 10 – BASELINE VS INDUCED WITH GENDER DUMMY

Estimation Technique:	(1) OLS	(2) OLS	(3) OLS	(4) OLS
	Dependent Variable: Error			
Round	0.0556*	0.0567*	0.0808**	0.0847**
	(0.0250)	(0.0254)	(0.0302)	(0.0317)
DecisionOrder	-0.00609	0.0693	-0.174*	-0.0213
	(0.0769)	(0.117)	(0.0810)	(0.144)
IsInduced	0.199	0.346	-0.846*	0.169
	(0.453)	(0.522)	(0.387)	(0.703)
IsMale	0.803***	0.252	1.171***	1.112**
	(0.207)	(0.267)	(0.352)	(0.348)
IsInducedxDecisionOrder		-0.132	0.0929	-0.102
		(0.149)	(0.135)	(0.178)
IsMalexIsInduced		0.902**	0.202	0.284
		(0.317)	(0.418)	(0.415)
AllSamexIsMale			-2.873***	0.152
			(0.355)	(0.788)
AllSamexIsMalexIsInduced			2.350***	-1.637
			(0.569)	(0.930)
AllSamexIsMalexDecisionOrder				-0.783***
				(0.159)
AllSamexIsMalexIsInducedxDecisionOrder				1.001***
				(0.182)
Constant	-4.535***	-4.554***	-3.462***	-4.297***
	(0.544)	(0.580)	(0.405)	(0.784)
Observations	1050	1050	1050	1050
R-squared	0.011	0.015	0.036	0.044

a. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1
b. Observations include Chooser's 2-8 in all 15 paid rounds for all Baseline and Induced groups (10 in total: 4 Baseline and 6 Induced). Observations are clustered into groups.[29]

To determine whether gender distribution differences across treatments were, in fact, correlated with threshold values, I created a gender dummy variable and included it

[29] I do not include Chooser 1 observations because their threshold values should always be 0 since they do not take into account any previous actions when making a decision. Therefore, any error is uninformative.

in the regressions that were presented as part of my primary results.[30] For example, Table 10 displays the first four regressions I constructed to compare Baseline subjects with Induced subjects, and also includes an *IsMale* dummy variable. The results of the first regression show that males elected to enter more extreme threshold values relative to the rational threshold by .8 units, when all else is held constant. Furthermore, regression 2 of Table 10 shows that men in Induced groups entered thresholds that were nearly 1 unit more extreme relative to the rational threshold. Regression 3 shows that Induced males in simple decisions, situations in which a treatment effect occurred, entered thresholds that were nearly 2.5 units more extreme than what was rational. Finally, regression 4 demonstrates that when decision order increased, Induced males faced with simple decisions selected threshold values that were approximately 1 unit more extreme than all other threshold values. In general, the results of Table 10 demonstrate that female members in Induced groups did not place more weight on the public signals of group members. Rather, males place more value on the previous decisions of group members when making a decision. Therefore, I maintain that Induced groups behaved differently than Baseline groups because of stronger levels of group identity, not gender differences.

[30] For a comparison of Baseline groups and Natural groups with a gender dummy variable, see Table 11 in the appendix. The results of Table 11 show no significant gender correlation affect across treatments.

VII. Discussion

Primary Results

In the primary results section of this paper, I discover that groups with high amounts of group identity seem to engage in more herd behavior. I find a large discrepancy in the number complete herds that occur in each treatment. Induced groups and Natural groups engage in complete herds 21 and 18 percent of all rounds, respectively, while Baseline groups engage in complete herds less than 7 percent of all rounds. After performing a Wilcoxon-Mann-Whitney test, I conclude that there is a statistically significant difference between the number of complete herds in Induced groups compared to Baseline groups.

When analyzing simple and complex decisions separately, both Induced and Natural group members demonstrate different behavior compared to Baseline group members. In simple decisions, in which all previous actions are the same, Induced and Natural group members enter more extreme threshold values relative to the rational threshold than Baseline group members. This result allows me to reject H_0 of hypothesis 1 in favor of $H_{A1,}$ which claims that group identity will cause individuals to place more weight on public signals relative to private information, under simple decisions. This suggests that, when the public signal to choose a certain action is most obvious, Induced and Natural individuals are willing to follow their group members more often than Baseline group members. As a result, groups in treatments 2 and 3 engage in more complete herds than treatment 1.

Individuals of Induced and Natural groups are more willing to follow group members due to peer effects. In particular, decisive actions by group members convince individuals in treatments 2 and 3 that relying on previous signals is clearly the optimal solution – the signal is too strong to go against it. However, since many rational peer effect explanations are largely controlled for by experimental design, Induced and Natural members place more weight on others for an essentially irrational reason: they believe that following their peers is simply a good rule to abide by, even though there is no apparent benefit to doing so. While previous experience might have taught subjects that following their peers is a good strategy, this experiment does not provide such an indication.

In contrast, under complex decision situations in which a contrarian signal existed, Induced and Natural subjects enter less extreme threshold values relative to the rational threshold than Baseline members. From an Induced or Natural group member's perspective, contrarian signals suggest a less clear course of action relative to a Baseline test subject because of the presence of peer effects. Indecisive signals cause peers to separate from one another because they believed that the signal must have been truly ambiguous. In other words, peer effects cause individuals to weigh contrarian signals more negatively and thus, prefer to make a decision primarily based on private information. As a result, Baseline groups engage in more 5 person herds – herd sizes that often develop after a contrarian signal. In fact, of the 10 5 person herds that are observed in the Baseline treatment, 7 of them started after a contrarian signal is made.

Supplementary Results

Through the supplementary results section of my research, I am able to conclude that herding game success, Trivial Pursuit task success, and demographics characteristics do not weaken my main results. That is, the treatment effects I observe in my main results are not influenced by factors other than group identity. For example, while herding game success does lead to more extreme threshold errors relative to the rational threshold for all test subjects; it does not cause any systematic differences in behavior across treatments. Additionally, even though a large percentage of females participate in the Induced treatment, the threshold errors they enter do not inflate the results. These findings support my claim that group identity and specifically peer effects lead to a change in subject behavior across treatments.

Lessons Learned

I discover that there is no significant treatment effect when comparing Induced and Natural groups. I expected group identity, and consequently peer effects, to be highest in Natural groups because they are determined by preexisting social categories. Moreover, test subjects in Natural groups have previous relationships with fellow group members. However, the results do not confirm that group identity is any higher among Natural groups. It is possible the use of color preferences, an ingroup outgroup dynamic, and chatting sessions in the Induced group treatment are sufficient group building techniques to render the difference in group identity levels insignificant. Alternatively, it is possible that the absence of conformity benefits and monetary group performance incentives put a limit on the impact that peer effects and group identity can have on test subjects. Regardless of why there is not a difference in subject behavior between Induced and Natural treatments, this research can be improved if group identity clearly varies across all three treatments. Therefore, future research on this topic should consider ways to create distinct levels of group identity between Induced and Natural treatments.

Similarly, since many steps are taken to build group identity in treatments 2 and 3, I am not able to determine which exact procedures lead to the biggest changes in behavior across treatments. While the results show that these identity building procedures result in a change in subject behavior, it would be useful to know which procedure most affects group identity. Chen and Li (2009) argue that the existence of an outgroup is what drives group attachment in their experiment. Conversely, Charness, Rigotti, and Rustichini (2007) claim that group saliency has the biggest influence on group identity. Given the debate among the previous literature, future research on this topic should consider creating treatments with more group identity than the Baseline and less than Induced or Natural. Such research would help to determine which group identity building procedures are most effective.

Finally, despite my best efforts to reduce subject confusion, I still feel that it leads to less significant results. For example, the difference in behavior across treatments is less robust under complex decisions, relative to simple decisions. That is, Induced and Natural subjects enter less extreme threshold values relative to the rational threshold when faced with complex decisions and more extreme threshold values when faced with simple decisions. I speculate that part reason for this is subject confusion. During a simple decision situation, the rational threshold continually moves closer to -10 or 10, depending on which action gets repeated. Moreover, the direction of the rational threshold never changes in a simple herding situation: it is either continually increasing or decreasing. However, in a complex herd situation, the rational threshold often changes directions, making it nearly impossible for test subjects to determine the optimal threshold value to enter.

Peer Effects

The most interesting finding of this study is that peer effects influence subjects to change their behavior in the absence of a rational reason. Subject behavior in simple decisions show that they believe it is generally a good rule to follow their peers. In Natural treatment, this rule might make some sense because Natural group members have relationships with one another prior to the experiment. Therefore, previous success with following their peers may cause them to do the same in the herding game. However, in the Induced treatment, the treatment which contains the most observations, peers follow one another without possessing strong previous relationships, which means that following group members because it is a generally good idea has little credibility. This study shows that inducing individuals to consider others as peers in an extremely short timeframe can still lead to peer effects that may not be entirely rational.

To determine which specific peer effect may be attributed to the results of this study, it is useful to consider Zafar's (2009) three reasons why individuals follow their peers: social learning, social comparison, and social influence. Since player performance is kept hidden during my experiment, I'm confident that individuals do not follow their peers when faced with simple decisions in fear of going against the established norm. Therefore, I do not believe social influence impacted subject behavior. In addition, I also do not think social learning changes behavior across treatments because private information and the signals of others is held constant. Furthermore, even if subjects feel that group members provide a stronger indication as to what the correct action is, the herding game is extremely complex, making it hard to decipher the true strength of public signals. However, I think social comparison may provide an answer. While player performance is hidden, group members know the identities of each other, meaning that a test subject can feel confident that he is following his peers if all of them make the same action, which is the case in complete herds. Thus, in simple decisions, when many group members have already selected an action, social comparison is not entirely controlled for by anonymity.

VIII. References

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IX. APPENDICES[31]

TABLE 11 – BASELINE VS NATURAL WITH GENDER DUMMY

Estimation Technique:	(1)	(2)
	OLS	OLS
	Dependent Variable: Error	
Round	0.0302	0.0302
	(0.0296)	(0.0291)
DecisionOrder	0.0753	0.0695
	(0.0654)	(0.119)
IsNatural	0.201	0.135
	(0.493)	(0.812)
IsMale	0.267	0.259
	(0.478)	(0.270)
IsNaturalxDecisionOrder		0.0115
		(0.129)
IsMalexIsNatural		0.0129
		(0.922)
Constant	-4.382***	-4.348***
	(0.408)	(0.617)
Observations	840	840
R-squared	0.003	0.003

a. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1
b. Observations include Chooser's 2-8 in all 15 paid rounds for all Baseline and Natural groups (8 in total: 4 Baseline and 4 Natural). Observations are clustered into groups.[32]

[31] Some sections of the appendices are from Christopher Warren and Cristina Diaz-Dickson's coauthored paper for Economics 465; hence, the frequent usage of the word "we." These sections include *Pilot Study, Results of Pilot Study, and Discussion of Pilot Study.* However, the *Experiment Instructions, Post-Experiment Survey, and Subject Consent Form* in the appendix all pertain to my thesis work.
[32] I do not include Chooser 1 observations because their threshold values should always be 0 since they do not take into account any previous actions when making a decision. Therefore, any error is uninformative.

Trivial Pursuit Questions

1) Geography: What country do Walloons call home?
   Possible Answers: A – Senegal, B – Belgium (correct), C – Nigeria, D – Holland

2) Entertainment: What planet's moon is the destination in *2001: A Space Odyssey*?
   Possible Answers: A – Mars, B – Neptune, C – Jupiter (correct), D – Pluto

3) History: What Spaniard conquered Peru in 1533?
   Possible Answers: A – Francisco Pizarro (correct), B – Hernando Cortez, C – Ferdinand Magellan, D – Christopher Columbus

4) Arts & Leisure: What is the name of the winged horse in Greek mythology?
   Possible Answers: A – Poseiden, B – Chimeara, C – Centaur, D – Pegasus (correct)

5) Science & Nature: What season is hail most prevalent in?
   Possible Answers: A – Spring, B – Summer (correct), C – Fall, D – Winter

6) Sports & Leisure: In horse racing, what unit is used to measure the height of a horse?
   Possible Answers: A – Hands (correct), B – Feet, C – Yards, D – Meters

EXPERIMENT INSTRUCTIONS

Baseline Instructions

Introduction

You are about to participate in a session in which you will make a series of choices. This is part of a study intended to provide insight into certain aspects of how people make decisions. If you follow the instructions carefully and make good decisions you may earn a considerable amount of money. You will be paid privately in cash at the end of the session.

During the experiment, I ask that you please do not talk to each other. If you have a question, please raise your hand and an experimenter will assist you.

Only the seven other people sitting in the room with you are participating in this session.

This session will consist of two parts. In Part 1, you will answer a series of trivia questions. In Part 2, you will choose between 2 actions whose payoffs are determined by chance.

Part 1: Trivia Questions

- In this part of the experiment, you will be asked to answer 6 trivia questions.
- For each question, you will be asked to choose which of the 4 possible answers is correct. Everyone will be asked the same questions and be offered the same possible answers.
- You will submit answers individually. Once everyone has submitted an answer, your monitor will display the next question.
- After all 6 questions have been completed; the computer will display all the correct answers. In addition, the computer will randomly select 4 of the questions to be calculated for payments. You will receive $0.50 for each of the randomly selected questions you correctly answered and $0 for incorrect answers.
- Are there any questions?

Part 2: Decision Problems

- There will be 20 rounds in this part of the session, with one decision problem per round. The first 5 rounds will be unpaid practice rounds; the next 15 rounds will be paid rounds.
- At the beginning of each round, the computer will select for each participant a ***private value*.**
- Your ***private value*** will be drawn from the set of real numbers (including decimals) from -10 to 10. All values are equally likely.
- All ***private value*** draws are independent. This means that your ***private value*** is unrelated to anyone else's ***private value***, and your ***private value*** in any one round is unrelated to your ***private value*** in any other round.
- In each round, you will be asked to choose one of 2 actions: A or B.
- Action A is correct if the sum of the eight ***private values*** of session participants is greater than or equal to 0, whereas Action B is correct if the sum of the eight private values of session participants is less than zero. Therefore, the correct action depends *only* on the ***private values*** of the session participants.
- In the paid rounds, you will be paid $1.50 for each round in which you choose the correct action and nothing when you choose the incorrect action.
- In each round, the computer will randomly choose a decision order for session participants. Chooser 1 goes first, Chooser 2 goes second, etc. The decision order changes each round at random.
- After Chooser 1 has chosen an action, the computer will display this choice to all session participants. Chooser 2 then makes a choice. After Chooser 2 makes a choice, the computer will display this choice as well to all session participants. This process will continue until all 8 participants have made a choice.
- While you see the choices of those participants who have previously chosen in the round, you do not see their ***private values***.
- When all 8 participants have made a choice, your monitor will display the sum of the ***private values***, and inform you whether your choice was correct. The next round will then begin. This process will continue until all 20 rounds have been completed.

Practice Rounds 1 & 2

- When it is your turn to make a decision, the computer will display your ***private value*** as well as the choices of the participants who have previously chosen in that round.
- The procedures will change slightly after the first two practice rounds without affecting the basic procedures of the game. You will receive updated instructions at the appropriate time.
- Are there any questions?

Practice Rounds 3 & 4

- When it is your turn to make a decision, as in the previous rounds, your monitor will display your ***private value*** as well as the choices of the participants who have previously chosen in that round.
- You will be then asked to enter your ***threshold value***, the value between -10 and 10 at which you would have chosen the other action. Thus, if you chose Action A, you will be asked to enter the lowest ***private value*** for which you still would have chosen Action A. If you chose Action B, you will be asked to enter the highest ***private value*** for which you still would have chosen Action B.
- Are there any questions?

Practice Round 5 and the 15 Paid Rounds

- When it is your turn to make a decision, instead of your monitor first displaying your ***private value***, you will only observe the choices of the participants who have chosen before you. You will then be asked to enter your ***threshold value*** for choosing action A.
- The computer will then display your ***private value***. It will also choose between Action A and Action B on your behalf. That is, if your ***private value*** is greater than your ***threshold value***, it will record that you have chosen Action A; however, if your ***private value*** is less than your ***threshold value***, it will record that you have chosen Action B.
- While you see the choices of those who have previously chosen in the round, you do not see their ***private values*** or their ***threshold values***.
- Recall that in the 15 paid rounds, you receive $1.50 for each round in which you choose the correct action.
- At the end of the experiment, you will be paid in cash your earnings from these 15 rounds, your trivia earnings, as well as your participation fee.
- Are there any questions?

Induced & Natural Instructions

Introduction

You are about to participate in a session in which you will make a series of choices. This is part of a study intended to provide insight into certain aspects of how people make decisions. If you follow the instructions carefully and make good decisions you may earn a considerable amount of money. You will be paid privately in cash at the end of the session.

During the experiment, I ask that you please do not talk to each other. If you have a question, please raise your hand and an experimenter will assist you.

You have joined a group of 8 people. The Purple Group is seated in the first two rows of the room, and the Yellow Group is seated in the last two rows. You will remain in your group for the entire session.

This session will consist of two parts. In Part 1, you will answer a series of trivia questions. In Part 2, you will choose between 2 actions whose payoffs are determined by chance.

Part 1: Trivia Questions

- In this part of the experiment, you will be asked to answer 6 trivia questions.
- For each question, you will be asked to choose which of the 4 possible answers is correct. Everyone will be asked the same questions and be offered the same possible answers.
- Throughout this part of the session, you will be able to exchange messages with your group members to help one another obtain correct answers. Separate chat channels will be used so information can only be shared within your group. You are allowed to discuss any information.
- You will submit answers individually. Once everyone has submitted an answer, your monitor will display the next question.
- After all 6 questions have been completed; the computer will display all the correct answers. In addition, the computer will randomly select 2 of the questions to be calculated for payments. You will receive $0.50 for each of the randomly selected questions you correctly answered and $0 for incorrect answers.
- Are there any questions?

Part 2: Decision Problems

- There will be 20 rounds in this part of the session, with one decision problem per round. The first 5 rounds will be unpaid practice rounds; the next 15 rounds will be paid rounds.
- At the beginning of each round, the computer will select for each participant a ***private value*.**
- Your ***private value*** will be drawn from the set of real numbers (including decimals) from -10 to 10. All values are equally likely.
- All ***private value*** draws are independent. This means that your ***private value*** is unrelated to anyone else's ***private value***, and your ***private value*** in any one round is unrelated to your ***private value*** in any other round.
- In each round, you will be asked to choose one of 2 Actions: A or B.
- Action A is correct if the sum of the eight ***private values*** of your group members is greater than or equal to 0, whereas Action B is correct if the sum of the eight ***private values*** of your group members is less than zero. Therefore, the correct action depends *only* on the ***private values*** of the members of your group.
- In the paid rounds, you will be paid $1.50 for each round in which you choose the correct action and nothing when you choose the incorrect action.
- In each round, the computer will randomly choose a decision order for your group. Chooser 1 goes first, Chooser 2 goes second, etc. The decision order changes each round at random.
- After Chooser 1 has chosen an action, the computer will display this choice to all group members. Chooser 2 then makes a choice. After Chooser 2 makes a choice, the computer will display this choice as well to all group members. This process will continue until all 8 group members have made a choice.
- While you see the choices of those in your group who have previously chosen in the round, you do not see their ***private values***.
- When all 8 group members have made a choice, your monitor will display the sum of your group's ***private values***, and inform you whether your choice was correct. The next round will then begin. This process will continue until all 20 rounds have been completed.

Practice Rounds 1 & 2

- When it is your turn to make a decision, the computer will display your ***private value*** as well as the choices of your group members who have previously chosen in that round.
- The procedures will change slightly after the first two practice rounds without affecting the basic procedures of the game. You will receive updated instructions at the appropriate time.
- Are there any questions?

Practice Rounds 3 & 4

- When it is your turn to make a decision, as in the previous rounds, your monitor will display your ***private value*** as well as the choices of your group members who have previously chosen in that round.
- You will be then asked to enter your ***threshold value***, the value between -10 and 10 at which you would have chosen the other action. Thus, if you chose Action A, you will be asked to enter the lowest ***private value*** for which you still would have chosen Action A. If you chose Action B, you will be asked to enter the highest ***private value*** for which you still would have chosen Action B.
- Are there any questions?

Practice Round 5 and the 15 Paid Rounds

- When it is your turn to make a decision, instead of your monitor first displaying your ***private value***, you will only observe the choices of your group members who have chosen before you. You will then be asked to enter your ***threshold value*** for choosing Action A.
- The computer will then display your ***private value***. It will also choose between Action A and Action B on your behalf. That is, if your ***private value*** is greater than your ***threshold value***, it will record that you have chosen Action A; however, if your ***private value*** is less than your ***threshold value***, it will record that you have chosen Action B.
- While you see the choices of those in your group who have previously chosen in the round, you do not see their ***private values*** or their ***threshold values***.
- Recall that in the 15 paid rounds, you receive $1.50 for each round in which you choose the correct action.
- At the end of the experiment, you will be paid in cash your earnings from these 15 rounds, your trivia earnings, as well as your participation fee.
- Are there any questions?

POST-EXPERIMENT SURVEY

1) You were assigned to which group during the experiment?

2) On a scale from 1 to 10, please rate how much you think communicating with your group members helped solve the trivia questions.

3) On a scale from 1 to 10, please rate how closely attached you felt to your own group throughout the experiment.

4) On a scale from 1 to 10, please rate how familiar you were with the trivia questions before this experiment.

5) In what entry (freshman residential system) did you live freshman year?

6) What is your current residence?
a. If you selected "Off-campus" as your current residence, please specify.

7) What floor of your current residence do you live on?

8) Of the other participants in the room, how many do you know the names of? If at least 1, how many of them were in your group and how many were in the other group?

9) Of the other participants in the room, for how many do you have their phone numbers? If at least 1, how many of them were in your group and how many were in the other group?

10) Of the other participants in the room, how many do you text or call on a regular basis (at least once every few days)? If at least 1, how many of them were in your group and how many were in the other group?

11) Of the other participants in the room, how many have you been romantically involved with (e.g. dating, "hooking up," etc.)? If at least 1, how many of them were in your group and how many were in the other group?

12) Of the other participants in the room, how many do you talk to on a daily basis about non-course-work related topics? If at least 1, how many of them were in your group and how many were in the other group?

13) Of the other participants in the room, how many would you consider "friends?" If at least 1, how many of them were in your group and how many were in the other group?

14) Of the "friends" you've identified in the room, how many would you consider to be "close?" If at least 1, how many of them were in your group and how many were in the other group?

SUBJECT CONSENT FORM

RESEARCH PROCEDURES: This research is being conducted to study the economics of decision-making. This experiment will last up to 90 minutes. If you agree to participate you will be asked to make decisions over a series of rounds at a computer terminal. In some rounds, you may be offered the opportunity to work directly with other test subjects to make a decision. In all rounds, you will make your own decision. Your identity will not be known to any other test subjects.

In addition to the payment for showing up on time, you will receive additional payments which depend partly on your decisions and partly on chance. If you follow the instructions and make careful decisions, you may earn a considerable amount of money. At the end of the experiment, your earnings will be tabulated and exchanged for U.S. currency. Your salient earnings can only be paid upon completion of the experiment. If you withdraw early, you will keep the $5 for showing up on time.

We will place your earnings in a sealed envelope and hand this envelope directly to you. Nobody except you, the experimenter, and the faculty supervisor will know how much you earned in the experiment. There are no hidden tricks or motives in this research. You cannot lose money. You are free to ask any questions about how you will be paid.

PARTICIPATION: You must be 18 or over to participate. Your participation is voluntary, and you may withdraw from the study at any time for any reason. There are no costs to you or any other party.

CONFIDENTIALITY: All electronic files will be saved confidentially on a password-protected and access-restricted local area network. No person-identifiable information will be reported in any published or unpublished work. The data is protected in the local area network as secured by the Williams College login procedures. Access is restricted to Professor Robert Gazzale and Christopher Warren.

CONTACT: This study is being conducted by Christopher Warren, under the supervision of Professor Robert Gazzale, PhD at Williams College. Chris may be reached at 617.840.9861 and Professor Gazzale may be reached at 413.597.4375 for questions or complaints. You may also contact Professor Steve Sheppard, Chair of the Economics Department, Williams College, at 413.597.3184. This research has been reviewed and approved by the Internal Review Board and the Economics Departmental Review Board of Williams College. You may request a copy of this consent form for your records.

CONSENT: I have read the above information, and have received answers to any questions I asked. I consent to take part in the study.

Signature:______________________________________ Date:___________________

PILOT STUDY

The pilot study was run at Jesup Hall in Williams College on November 30, 2009. Only 12 participants came to the experiment, meaning that there were not enough people to conduct one treatment of ideal size. Instead, the natural group treatment was conducted with 6 girls and 6 boys. Of the 12 participants, 7 (6 boys and 1 girl) were members of Professor Robert Gazzale's behavioral economics class and the remaining 5 (all females) were not part of the class. Only the 5 participants who were not part of the class were given a $10 participation fee. Due to resource constraints, both groups sat in the same room (each subject had a different computer terminal) although girls were instructed to sit in the two front rows of the room, while boys were asked to sit in the last two rows of the room. However, efforts to increase groupiness were still attempted as "Girls" read the instruction, started the experiment, and exited the test site before "Boys." Both "Girls" and "Boys" were able to participate in 15 decision problems. The experiment lasted for about 45 minutes and was conducted on ztree – an economic software program. Participants were told that one would randomly be chosen to be paid according to their performance. Participants were informed that correct decisions yielded a payment of $3 instead of $2. The average earnings for male participants was $13.03 and $8.73 for female participants.

Results

Result 1: Individuals who belong to a group engage in herd behavior less frequently than individuals who do not belong to a group.

Here we test our *hypothesis 1*, in which we state that individuals who belong to a group engage in herd behavior less often than individuals who do not belong to a group.

Celen and Kariv (2004) find that herd behavior occurs in 27 of their 75 rounds (36 percent). Specifically, they observe 5, 6, 7, and 8 – person herds. Since eight subjects participate in each round, they consider a meaningful herd to be comprised of a number of subjects greater than half of the total number of participants in a given round. Following this logic, we observe 4, 5, and 6 – person herds. We observe herd behavior in 9 out of the 30 rounds (30 percent). Of the nine herds, six occurred in the boys group and only three in the girls. Celen and Kariv further indicate that, of their 27 herds, 13 (48 percent) involved all eight subjects acting alike. Our data indicate the presence of four 4-person herds, one 5-person herd, and four herds with all six subjects acting alike. Therefore, we conclude in favor of our *hypothesis 1*.

Result 2: In our group treatment, the number of herders increases as the number of decision problems in the experiment increases.

In order to test our *hypothesis 2*, which states that the number of herders decreases with the number of decision problems, we regress a herder dummy variable on period. Our dummy variable indicates whether a participant acted in the same way as his or her predecessor. For example, if participant 2 chose A and participant 3 also chose A, then participant 3 is a herder. This is not to be confused with a herd which, as defined above, describes a group of 4 to 6 subjects who consecutively choose the same action. Table 1 illustrates the results of this regression. We find that as subjects complete more decision problems, the number of herders increases by 3 percent. This result is statistically significant at 1 percent. Therefore, we reject our *hypothesis 2*.

TABLE 1 – OLS REGRESSION: EFFECTS OF PERIOD ON HERDING

Dependent variable	OLS coefficient
Period	0.0327* (0.0156)
Random order	0.0012 (0.0394)
Constant	0.8314 (0.1979)
Observations	180
R^2	0.0243

Notes: Standard errors in parentheses. * Significant at 5 percent level.

Result 3: The presence of groups decreases rational behavior in the context of our experiment.

Now we test our *hypothesis 3*: Let P_o denote an individual's rational behavior not in agroup. Let P_i denote rational behavior in an induced group. Let P_n denote rational behavior in a natural group. Then, $P_o < P_i < P_n$. In order to test this hypothesis, we analyze table 2. Celen and Kariv concentrate on the analysis of the herds in which all subjects act alike – their 8-person herds. Similarly, we focus on our 6-person herds. Following Celen and Kariv, we include a final average row in this table in order to take a mirror image transformation and use the average of the transformed cutoff to get an idea of the average trend. They are able to do that because the cutoff strategy is symmetric around zero. Celen and Kariv find a noticeable increase in average cutoffs by turn. Table 2 describes our observed 6-person herds in detail. We indicate the group – M if men and W if women, – the action herded – A if subjects' private values were greater than or equal to their indicated minimum number, and B otherwise – and the observed cutoffs by position along the line of participants. A star beside the action herded indicates that the herd members acted profitably.

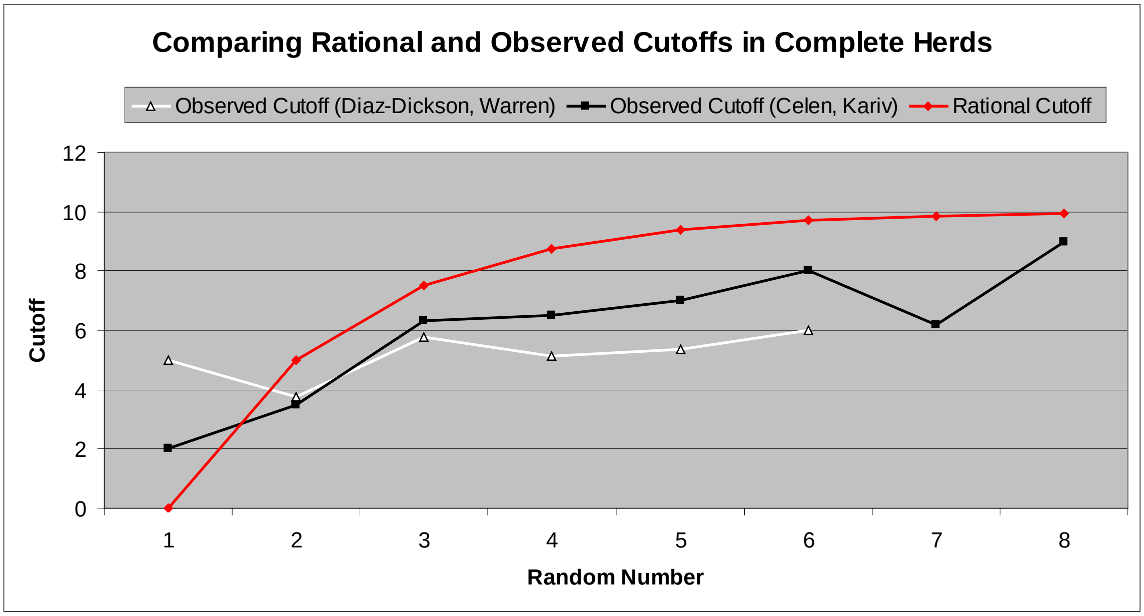
Celen and Kariv find that as subjects' position along the line of participants increases, these averages converge to 10. However, the averages we find in table 2, which describes the differences between observed and rational cutoffs in our 6-person herds, are neither increasing nor converging. Figure 1 provides a comparison between the herds we observe and those observed by Celen and Kariv of the distance of observed cutoffs from the rational cutoffs provided by equation 1. Contrary to our initial *hypothesis 3*, we observe that the presence of groups decreases rational behavior in the context of this experiment. Therefore, we reject of our *hypothesis 3*.

TABLE 2 – OBSERVED CUTOFFS BY TURN IN 6-PERSON HERDS

Group/ Round	Action Herded	Observed Cutoffs by Turn (6-person herds)					
		1	2	3	4	5	6
W/3	B	0	0	10	8	3.5	10
W/13	A*	0	-10	-8	-5	0	-.5
M/5	B*	10	0	5	7.5	10	0
M/8	B*	10	5	0	0	8	9
	Average[33]	5	3.75	5.75	5.12	5.37	6

[33] We are including the average because, following Celen and Kariv, "Since the cutoff strategy is symmetric around zero, we take a mirror image transformation and use the average of the transformed cutoff to get an idea of the average trend" (p.490)

FIGURE I



Result 4: We observe fewer correct herds when we introduce natural groups than in the no-group control treatment.

In tables 2, 3, and 4, we describe the 6, 5, and 4-person herds that we observe in our data. While Celen and Kariv find that all of the herds they observed except one (97 percent) chose correctly, we find that 7 out of 9 (78 percent) of the herds in our data are correct. Therefore, we observe fewer correct herds when we introduce groups than in the no-group control treatment, and we reject *hypothesis 4*, which states that natural group subjects will correctly follow a herd more often than induced group subjects.

TABLE 3 – OBSERVED CUTOFFS BY TURN IN 5-PERSON HERDS

Session/ Round	Action Herded	Observed Cutoffs by Turn (5-person herds)					
		1	2	3	4	5	6
M/4	B*		0	2.5	0	5	10
Average			0	2.5	0	5	10

TABLE 4 – OBSERVED CUTOFFS BY TURN IN 4-PERSON HERDS

Session/ Round	Action Herded	Observed Cutoffs by Turn (4-person herds)					
		1	2	3	4	5	6
W/4	B	10	4	10	2		
M/1	B*	0	5	5	0		
M/7	B*	0	0	5	0		
M/10	A*	10	0	2.5	-9		
Average		5	2.25	5.62	2.75		

Discussion

<u>Results</u>

After analyzing the data collected from our pilot experiment, we find four interesting results. First, we find that, consistent with our *hypothesis 1* individuals who belong to a natural group engage in herd behavior less frequently than individuals who do not belong to a group. Second, contrary to our *hypothesis 2,* we find that, in a group setting, the number of herders increases as the number of decision problems in the experiment increases. We speculate that this might be due to the fact that we did not pay our subjects for their performance on the assigned task. Therefore, as time passed, it is possible that they lost interest in the admittedly slow and repetitive activity, thus decreasing their rational performance and increasing the appeal of herding.

Third, we find that the presence of groups decreases rational behavior in the context of our experiment. This result contradicts our *hypothesis 3*, in which we expected the opposite effect. We believe that the discrepancy between observed and rational cutoffs in our data compared to Celen and Kariv might also be due to the fact that subjects knew that they were not being paid for their performance and thus were not motivated to act rationally on a difficult task. Additionally, we believe that if we had had 8 subjects per group – just as Celen and Kariv – we might have observed a convergence of the average differences between observed and rational cutoffs similarly to Celen and Kariv, or we would have at least been able to make a more accurate comparison to their results. Finally, we suspect that subject confusion may have contributed to the distance of our observed averages from the rational cutoffs, especially when subjects play at the beginning of the line of participants.

Finally, we observe fewer correct herds when we introduce natural groups than in the no-group control treatment. This result contradicts our *hypothesis 4*. However, consistent with our belief that stronger group identity increases the rationality of group members thus increasing the number of correct herds, all of the herds we observed among males were correct, while only one of the female herds was correct. We think that our male participants might be more attached to their groups than our female participants, since all male participants were senior economics majors who are all in our behavioral economics course. In contrast, only one of the girls who participated in our experiment was in our class. The remaining five were in different class years, different majors, and did not share a course. Therefore, we believe that the fact that the males shared more social categories than our females might provide a possible explanation for our first result. Therefore, we speculate that if we had had stronger groupiness among our female subjects, we may have been able to confirm our *hypothesis 4*.

Lessons learned

Our pilot experiment provided us with useful feedback, which we will use to improve our future experiments. First, we believe that paying subjects for performance is necessary for future experiments. In our pilot, subjects were informed that only one participant would be randomly chosen to receive payment based on their performance. We believe that a lack of definite payment may have decreased subjects' performance, which may have affected our results.

Second, we realized the importance of a participation fee. Prior to our experiment, we had expected attendance from the majority of our classmates. However, we did not have the expected attendance. Moreover, only one girl from our class participated in the experiment. Due to this we had to recruit five female participants outside of our class and pay them a participation feel. Therefore, even though we had planned to run our experiment with two groups of 8 subjects, we had to reduce the size of the groups to 6. In the future, in order to ensure that the planned number of participants attends our experiments, we will pay all subjects a participation fee.

Third, we realized that there was much subject confusion. We had expected some level of subject confusion, given the complexity of our experiment. Therefore, in order to reduce potential confusion, we included help boxes in our experimental design, in addition to handing out a thorough instruction sheet, which almost identically follows that of Celen and Kariv. In addition, we provided subjects with ample time to read the instructions and ask questions before the experiment began. However, we believe that this was not sufficient as, in some instances, test subjects demonstrated a fundamental lack of understanding the herding game. Moreover, when looking at Celen and Kariv's data, it was evident that test subjects were also confused about the herding game.

In our future experiments, we will instruct test subjects to partake in practice rounds in order to get accustomed to the herding game, thereby reducing subject confusion and error-proneness. Subjects will participant in five unpaid practice rounds before the actual 15 decision problems. In the first two practice rounds, test subjects will see their private values first then will be asked to make a choice between actions A and B. These rounds will allow subjects to gain a better understanding as to what the relationship is between their private values and actions A and B. In the third and fourth practice rounds, test subjects will see their private values, make a choice between actions A and B, and then be asked to enter a minimum number for which they would choose action A. These rounds will give subjects a better understanding of the relationship between private values and actions A and B, as well as introduce them to the concept of the minimum number (threshold). Finally, in the last practice round, test subjects will make decisions exactly as they would in the 15 decision problem rounds. Thus, they will no longer be given their private values before choosing between actions A and B. Now subjects will choose A or B based on the minimum number they decide to enter.

Fourth, our future experiments can be improved if we alter our ztree program so that all participants see every previous action in real time. In our pilot study, participants only learned about all previous actions once their immediate predecessor made a decision. For example, participant 5 learned of the decisions of participants 1-4 after participant 4 chose either action A or B. This had a potentially negative effect on our experiment for two reasons. First, this design structure reduces the ordering effect of actions A and B. Second, it causes informational overload issues as subjects move farther along the line of participants. By revealing participants' decisions to all subsequent group members in real time, the ordering effect will be enhanced, information overload issues – a cause of subject confusion – will be reduced, and waiting time for each participant will be shortened.

Finally, for future experiments, we want to ensure similar levels of groupiness within treatments. In our pilot study, the male group had a stronger group identity than the female group, which may have been a reason why the two groups performed differently in the experiment. Ideally, we would construct experimental design procedures that maintain a similar level of groupiness for both groups within each treatment so that we can sufficiently compare the results of groups within treatments. Ensuring similar levels of groupiness within treatments is also important because it can strengthen the internal validity of our study.

Internal validity

Because we wanted to examine the effects of groups on herd behavior, we closely followed Celen and Kariv's experiment. By using their experimental design and only modifying it to incorporate groups into our experiment, we are able to conclude that any differences between their experiment and our own are a result of the presence of groups. This strengthens the internal validity of our results. However, one concern that we have is that, since we do not pay our subjects for performance, they may lack the motivation to perform their best. Another concern we have is related to subject confusion. We have a complicated experiment and understand that the results may not be indicative solely of group behavior. Yet the fact that we use Celen and Kariv's experiment allows us to compare our experiments to theirs and assume similar levels of subject confusion.

External validity

We worry that, unlike in our experiment, groups form naturally in the real world. It is unlikely that individuals in the real world would be assigned to predetermined groups to make decisions. Although one of our treatments consists of natural groups with subjects sharing social categories according to their gender, we still attempted to artificially enhance groupiness. However, previous literature finds that induced groups do, in fact affect subjects' behavior. Therefore, we expect the presence of our natural groups to have an effect on herd behavior, even if our subjects do not feel a strong attachment toward their group. One aspect that strengthens the external validity of our results is the fact that we believe that our results are comparable to those observed in the real world in which individuals are aware of the decisions of others. Everyday examples of this include going to the movies, eating at a restaurant and choosing a course. In all of these, the decisions of others provide positive and negative signals, which influence the actions of subsequent individuals.