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Herding Behavior and Cooperation Willingness

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ABSTRACT

How can we turn herding behaviors into measurable human actions? How does cooperation willingness influence herding behavior? Is age an influencing factor to cooperation willingness and herding behavior? This paper answers these questions and proposes a new method to measure herding behavior in a non-financial environment without using empirical data. A single-treatment online survey was used in this study; in the end, 130 participants' answers were taken into account. The findings of this research indicate that cooperation willingness has a significant and positive influence on herding behavior, regardless of age. Also, people aged between 24 and 33 are the most willing to cooperate, and people aged between 44 and 53 are affected by the herding effect the strongest. In further studies, this method of herding measurement could be diversified and improved.

Introduction

It is common for us to run into situations like this today: advertisements suddenly interrupt while you are browsing short videos online, anonymous users give irrational comments on social media, and "experts" claim that only eating vegetables is good for your health. With all these externalities influencing your decisions, it is now difficult for individuals to make rational decisions. Today, it is surprisingly easy to influence others' decisions. Herding effect accounts for this phenomenon. Herding behavior in humans has become increasingly common, and it is necessary to study it in society today.

Previous research has shown what herding behavior is in stock markets. However, no previous research was able to measure herding behavior without empirical data or in a non-financial environment. A non-financial environment refers to society around us as a whole, unlike stock markets or bond markets. This paper makes an effort in establishing a new model for measuring herding behavior. Cooperation willingness and herding behavior are both related to social and psychological factors such as age, gender, social norms, social preferences and mutual expectations of results (Ackermann & Murphy, 2019; *Factors Influencing Herding Behavior Among Indian Stock Investors*, 2017; Kameda & Hastie, 2015; Yuan & Xia, 2014).

This paper answers the following questions: *How can we measure and quantify herding in non-financial environments? How does cooperation willingness influence herding behavior?* Besides these two main questions, several small questions will also be discussed. This study also considers age as a factor influencing cooperation willingness and herding behavior.

This study uses a single-treatment survey that measures every participant's age, cooperation willingness, and herding behavior. Cooperation willingness is measured by the participant's devotion in PGG. This study's model for measuring herding behavior has never been used before. Further details will be discussed in the "Methods" section.

In the end, a total of 130 data were considered valid and used. The data collected for individual age groups are relatively small, with an average of 26 participants per age group. People aged from 34 to 43 took up most of the population, a total of 33 participants. The main finding in this study is that cooperation willingness has a significant, positive influence on herding behavior despite age factors. This study also found that people from ages 24 to 33 are affected by herding behavior the most. They just stepped into society and do not wish to be left behind, thus following others' actions. People from ages 44 to 53 are found to be the most willing

to cooperate. They are more mature and responsible, making them more willing to cooperate with others. The general trend for herding is that as you grow older, you become less easily affected by the herding effect. However, as you grow older, you become more willing to cooperate.

The first section of this paper reviews past papers that discussed herding behavior in humans and cooperation willingness. The second section discusses the method used in this study, which includes a detailed explanation of the new herding measurement method. The third section of this paper presents the raw results gathered in this study. The fourth section provides a discussion of the results. The last section concludes this study.

Related Literature

Herding Behavior

Herding behavior is not a new concept in the field of academics. Raafat et al. (2009) conducted a detailed research on human herding behavior, revealing that herding behavior can be viewed as pattern-based or transmissive. Herding behavior in humans has already been studied thoroughly from a socio-psychological and neuroscience point of view (Baddeley, 2010; Kameda & Hastie, 2015; Raafat et al., 2009; Rook, 2006). Herding behavior derives from the human instinct of being afraid to be alone. From an economic perspective, herding behavior is when people follow others' actions regardless of their prior decisions, even if they can be considered wrong according to their private information (Banerjee, 1992). Herding behavior in humans is related to other factors, for example, gender, age, marital status, social status, mutual expectation of results, and psychological traits (*Factors Influencing Herding Behavior Among Indian Stock Investors*, 2017; Kameda & Hastie, 2015; Marton-Alper et al., 2020).

Herding behavior in humans is mainly observed and studied in stock markets using empirical data (Barde & Économiques, 2016; Chiang & Zheng, 2010; Cipriani & Guarino, 2014). In finance, whether herding behavior is rational or irrational is debated. Spyrou (2013) used previous research conducted by others to conclude that in financial markets, herding behavior can be considered rational if an agent wishes to preserve reputation, has a short horizon, or if the market exists information cascade; herding could be considered irrational if these behaviors arise from psychological reasons, come from rational noise traders, or if agents have incorrectly followed previous investors' decisions.

Raafat et al. (2009) summarized that the two most commonly used methods to measure herding behavior in stock markets are the LSV (Lakonishok et al., 1992) and CH (Christie & Huang, 1995) measures. The LSV measurement defines herding behavior as the action where money managers disproportionately buy or sell individual stocks. It identifies herding as the percentage between buyers who increase their holdings in stock during a given period and the total money managers of that stock minus an externality factor that decreases as the number of active money managers increases. On the other hand, the CH measurement defines herding behavior as investors suppressing their beliefs and following the market consensus during extreme market movements. During these times, individual returns should be only slightly different from the market return, and return dispersions will be low; during other times, return dispersions will be higher. Both measurements do not directly measure herding behavior; they use empirical data to help identify herding behavior as a trend in stock markets.

Though discussed thoroughly in stock markets, herding behavior in real-life situations is studied less. Herding behavior could be barely noticed and realized in daily life. For example, when we are looking at comments for products online, herding effect is already in action and interfering with our decision-making process (Shen et al., 2015). Like in stock markets, herding behavior in a non-financial environment could be considered rational or irrational. Wang et al. (2019) showed that herding behavior in a long-term online learning process could be rational. One difference between financial and non-financial environments is the time pressure decision-makers face. During the online shopping and learning process, customers and learners were given enough

time to consider the rationality of their decisions; however, in stock markets, agents only have little time to think about their decisions. Another difference is the cost of decisions: In stock markets, decisions are closely related to their profit, while in a non-financial environment, decisions are less related to their self-benefit. This study focuses on measuring human herding behavior in non-financial environments.

Cooperation Willingness in PGG

Cooperation willingness is a complex variable; it is influenced by factors such as trust in others, social preferences, and the contribution of others (Ackermann & Murphy, 2019; Yuan & Xia, 2014). Cooperation willingness is affected by social preferences such as social value orientation (the preference for solving a social dilemma) and altruism; prosocials are more willing to cooperate than proselfs (Bogaert et al., 2008).

It is essential to know how to cooperate no matter where you are, whether in school, at workplace, or with family (Ayoko, 2016). Yuan and Xia (2014) showed that cooperators tend to invest more money in groups with a higher cooperation level, showing that higher cooperation levels in a team mean the team is more trustworthy. This proves the importance of cooperation using a social model. The public goods game (PGG) model is excellent for measuring cooperation willingness because different cooperative strategies have been seen in PGG experiments (Salahshour, 2021).

Many researchers have studied possible explanations for the difference in cooperation levels in PGG models (Dong et al., 2016). Jiao et al. (2020) showed that expressing willingness to cooperate affects contribution levels in PGG. They propose that this is because when people express their thoughts, they both sustain their credibility and look for opportunities to cheat; therefore, different "signals" will lead participants to choose their contribution level. It was shown that expressing willingness to cooperate promotes cooperation. Gächter et al. (2004) showed that socio-economic backgrounds do not influence cooperation behaviors in one-shot PGGs. However, they also found that "trust toward strangers and beliefs about the fairness and helpfulness of others" positively influence cooperation. Yang et al. (2018) found that endogenous rewards are a significant factor that promotes cooperation in PGG.

Methods

Survey Design

The survey designed for this paper is separated into three different sections: cooperation willingness measurement, herding behavior measurements, and self-evaluations. The survey contains a total of 14 questions. The first question in the survey asks about the participants' ages. The first section (cooperation willingness measurement) starts with question 2. Question 2 presents a voluntary (no punishment) version of the public goods game where N=5 and the multiplying factor is 2. Each participant will have 100 RMB at the beginning, and the amount of money they choose to invest in the public "pool" is measured as *PGG*.

The second section contains ten questions split into two subsections, each with five questions. All questions are far from basic common knowledge, meaning that only a tiny proportion of the population will know the answer without guessing; for example, how many times did Picasso marry in his entire life? This study designed the questions this way because we hope to let the participants guess out of instinct on the first chance and see whether or not they will change their answer on the second chance after seeing the graph, thus eliminating other factors and only preserving herding behavior. This study introduced time limits to prevent participants from searching for answers online. In section 2, for every question, participants have a second chance to re-select an answer after seeing a made-up graph. In the graph, participants can see which choice was selected by the most people. These graphs can be considered the "herd" in this study (for a basic model, see

Figure 1; for an example, see Figure 2). This section focuses on whether the participants will change their answers after seeing the "herd." The number of times when a participant changed their answer on the second choice is recorded as alpha (α); the number of times when a participant changed their answer on the second choice to the answer the "herd" recommends is recorded as beta (β). We chose to calculate in this manner because it is plausible that herding behavior is not in action in the alpha measurement. Instead, it may be the participant randomly selecting answers. The total number of times each participant chose to use the second chance provided is recorded as gamma (γ).

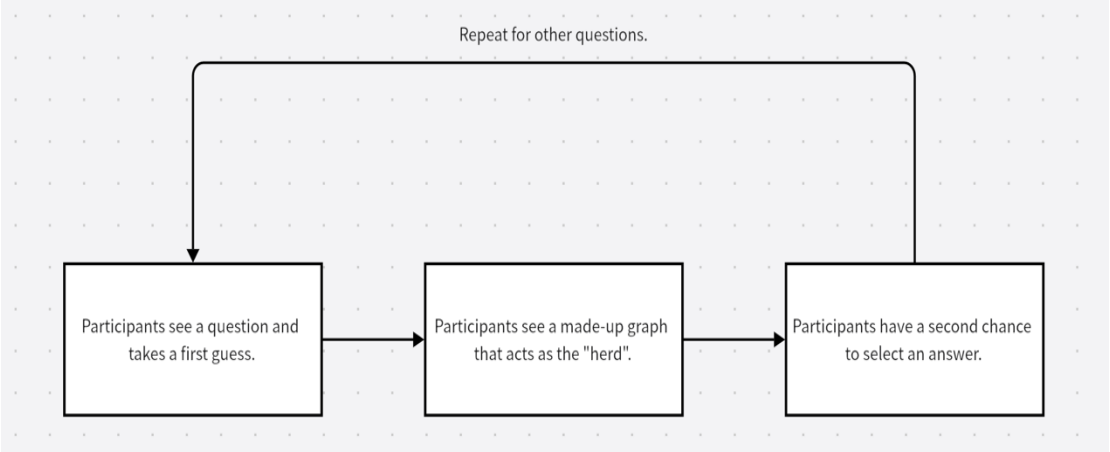

Figure 1. General model of survey design.

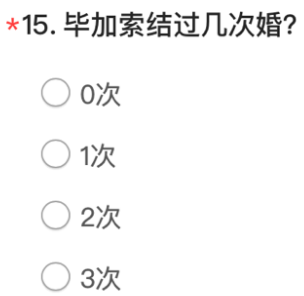

Figure 2. First chance to select an answer. Translation: How many times were Picasson married? (Same question in Figure 3.4)

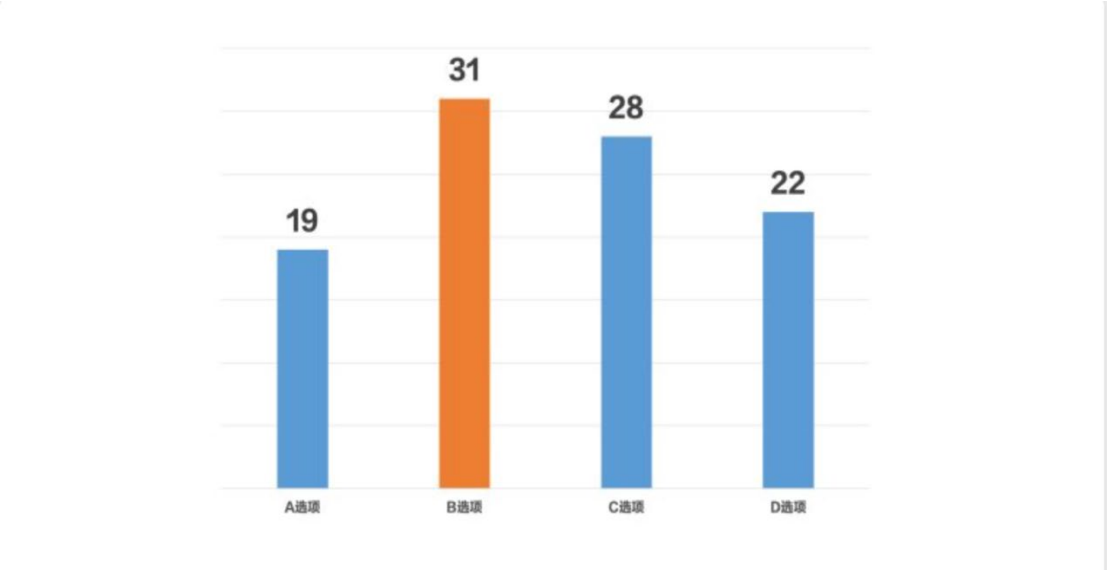

Figure 3. Sees the graph (herd)

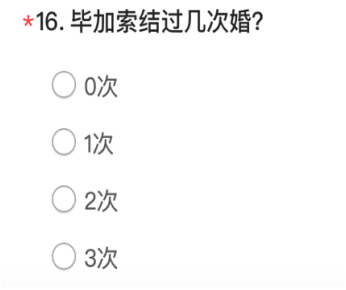

Figure 4. Second chance to select an answer.

The final section is self-evaluation. We directly asked the participants on a scale from highly willing to cooperate to extremely unwilling to cooperate (1~5): How willing would you be if you were asked to cooperate with a stranger? "Highly willing to cooperate" is measured as 5, and "extremely unwilling to cooperate" will be measured as 1. Participants' scores on this scale are measured as *cooperation willingness self-evaluation (CWS)*. It is worth noting that the original survey also contains a similar self-evaluation question but with herding behavior. However, when examining the data, we found that this question did not make sense to most participants, so we eventually took it off the survey.

Cooperation Willingness and Herding Behavior Measurements

The variable *cooperation* is composed of PGG and CWS. The variable *herding* is composed of α, β, and γ. We limit both variables' values from 0 to 1 because it is the easiest to conceptualize.

$\frac{PGG}{100}$ represents how much of the 100 RMB the participant wants to devote to the "public pool" (contribution level). The higher this value is, the higher the participant's willingness to cooperate is. CWS is a value between 1 and 5; to constrain the c-value under 1, we divided it by 5. The c-value, unlike PGG, is both a subjective and objective variable. This paper introduces this value to view cooperation willingness as a complex variable with a subjective component.

$\frac{\alpha}{\gamma}$ and $\frac{\beta}{\gamma}$ reflect the participant's herding behavior. However, there may be a difference between these two values because we cannot separate intended changes from unintended changes; for example, a participant may accidentally select a different answer on the second turn. We calculate the average of these two values to minimize the effect response bias has on this study. Both *c* and *h* values were calculated by square rooting. This study chooses to do so to increase the mean values: without square-rooting, the average value for cooperation and herding will be 0.230 and 0.266, which is below half.

Equation 1: $$c\text{-}value=\sqrt{(\frac{PGG}{100})^2 \times (\frac{CWS}{5})}$$

Equation 2: $$h\text{-}value=\sqrt{\frac{(\frac{\alpha+\beta}{\gamma})}{2}}$$

Results

Reliability and Consistency

As this research mainly focuses on herding behavior from a social point of view, no reliability or consistency tests were taken at the start of the survey, guaranteeing this experiment's broad scope of participants and neglecting all other aspects except age. Intellectual and understanding burdens are not introduced in this experiment to minimize the effect IQ has on this study. Time constraints of 10 and 15 seconds were introduced in this study to prevent participants from searching for answers online.

The results indicate that of all the 152 participants, a wide array of them had a good understanding of the experiment. PGG has a strong positive correlation with CWS, with a p-value smaller than 0.05, thus showing they are two related variables that could be combined later to establish a new variable (c-value). However, though most participants finished in under 500 seconds, six took more than 500 seconds. These six participants' results were deleted in this experiment to ensure this study's accuracy. All 146 participants' results in the cooperation measurement in this study were recorded and valid. 130 participants contributed to this study's "herding" section. The remaining 16 participants either did not choose to answer any of the second chances provided or their time ran out due to time limits that were set.

Descriptive Results

The descriptive statistics of this paper are summarized in Table 1. The biggest population in this study is group 3, comprising 25.4% of the total population. The second age group has the highest herding value (0.471), while the fourth group has the highest cooperation value (0.460). The fourth age group generally contributes the most in the public good game, reaching 56.1. The first age group rated themselves the highest while self-evaluating cooperation willingness (3.52).

In column 1, we can see that group 1 takes up 20.8% of the entire population. It has a relatively high herding value. It has the smallest average cooperation value and PGG but simultaneously the highest CWS of all the five age groups. The average time spent is 153.6 seconds, lower than the average in total. Group 2 takes up 20% of the population and has an average PGG of 49.1, almost the average PGG of the population (column 2). The average time consumed in group 2 is 131.8 seconds, the quickest of all five groups. Column 3 shows us that group 3 takes up 25.4% of the population. The average time used in group 3 is higher than the population's average. In column 4, we can see that group 4 takes up only 15.4% of the population. Still, group 4 has the highest mean cooperation value and a relatively short average time consumed. Group 5 takes up 18.5% of the

population, has the smallest herding value and CWS in all five groups, and participants in group 5 consume the largest amount of time on average.

Considering the whole population in this study (column 6), the mean herding value, cooperation value, and PGG are 0.416, 0.318, and 49.2, all lower than half. However, the average CWS value is 3.05, which is more than half. Looking at standard errors, group 5 always has the largest standard error when compared with the five age groups. The mean time participants spent on this survey was 160.7 seconds. Group 5 used the longest time on average, over 200 seconds, which is probably caused by elderly participants' difficulty in comprehending the questions. Besides group 5, group 3 took the longest time to complete the survey on average. There are no visual relationships between age and time spent, though groups 2 and 4 did spend the fewest time, only around 130 seconds.

Table 1. All data separated by their age. Standard errors in parenthesis. h-value is herding value and c-value is cooperation value.

Age	**14~23 N=27**	**24~33 N=26**	**34~43 N=33**	**44~53 N=20**	**54+ N=24**	**Total N=130**
	(1)	(2)	(3)	(4)	(5)	(6)
Percentage	20.8%	20.0%	25.4%	15.4%	18.5%	
Mean h-value	0.445 (0.061)	0.471 (0.050)	0.435 (0.053)	0.391 (0.070)	0.318 (0.070)	0.416 (0.027)
Mean c-value	0.325 (0.043)	0.372 (0.038)	0.418 (0.055)	0.460 (0.055)	0.349 (0.057)	0.383 (0.023)
Mean PGG	39.3 (5.29)	49.1 (4.13)	52.2 (5.74)	56.1 (5.63)	50.5 (7.00)	49.2 (2.54)
Mean CWS	3.52 (0.180)	2.96 (0.245)	3.15 (0.250)	3.30 (0.252)	2.29 (0.252)	3.05 (0.112)
Mean time(s)	153.6 (12.8)	131.8 (10.8)	171.9 (13.7)	138.6 (16.7)	203.3 (22.8)	160.7 (7.17)

Herding and Cooperation Willingness Analysis Using Linear Regression

The main topic discussed in this paper is how an individual's cooperation willingness affects their herding behavior. The core finding of this study is that cooperation willingness positively influences herding behavior regardless of age (Table 2). Table 2 shows the regression results of this study. The relationship between cooperation willingness and herding behavior is significant and positive (0.227). Figure 5 helps visualize the correlation between cooperation willingness and herding behavior. As mentioned before, cooperation willingness includes a subjective element (CWS). PGG, however, is purely objective. Table 3 shows that PGG also significantly and positively influences herding behavior. This strengthens the conclusion that cooperation willingness positively influences herding behavior. Age also seems to have a negative, slight influence on herding behavior, though not significant.

One possible explanation for cooperation willingness only having a significant influence on herding behavior when we are looking at the whole population is that the sample size for individual age groups is too small. The influence may be significant if we increase the sample size to about 150 for every age group.

Table 2. Regression results of herding value and cooperation value. t-statistics in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

VARIABLES	*Herding*

Cooperation	0.227**
	(2.23)
Age_group	-0.036*
	(-1.89)
Constant	0.434***
	(6.15)
Observations	130
R-squared	0.059

Table 3. Regression results of herding value and PGG. t-statistics in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

VARIABLES	Herding
PGG	0.002**
	(2.27)
Age_group	-0.039**
	(-2.04)
Constant	0.427***
	(5.97)
Observations	130
R-squared	0.060

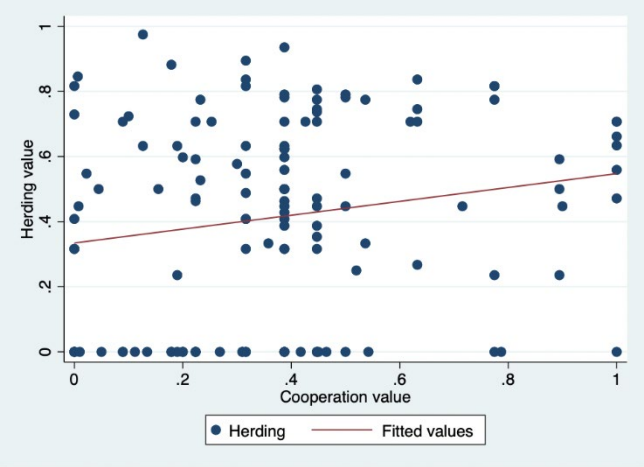

Figure 5. This is a scatterplot with a regression line on cooperation willingness and herding behaviors; it is shown that cooperation willingness correlates positively with herding behavior.

Discussion

The most significant contribution of this study is that it proposed an entirely new method to measure herding behavior without using empirical data. With this method, we can study human herding behavior more thoroughly as a social and psychological phenomenon. Furthermore, herding behavior has now become a variable that could be measured using experiments. This is an up-and-coming method with room for improvement; in further studies, this method could be exploited and extended by much more.

In this study, research showed that cooperation willingness positively influences herding behavior. People who are more willing to cooperate are more altruistic and trusting of others, which are both possible explanations for why they are keener towards herding behavior. Previous studies have not shown direct relationships between these two variables. This study also showed that people aged 24 to 33 are the easiest to be affected by herding effects. People in this age group have just started their journey into adulthood; they are afraid to make mistakes and do not want to fall out of line. The only way to achieve this is by mimicking others' behaviors, which is essentially herding behavior. In addition, people aged 44 to 53 are the most willing to cooperate. People from this age group are more mature; they know what it takes to gain credit, and being selfish will not get them what they want. Although the influence cooperation willingness has on herding behavior in every age group is not significant, it is probably not because there is no relationship between them: the most plausible explanation is that the sample size is too small; for 20 to 30 results, it is almost impossible to see a significant relationship. There is a non-significant, negative influence for and only for people aged 14 to 23 (Table 2). People of this age have unique personalities and wish to be different from others, so even if they are willing to cooperate, they are less affected by herding effects. Once again, this result is insignificant according to the regression results, but according to the basic logic, we can see that it is plausible.

The relationship between herding behavior and other human preferences could be exploited in further studies. Other than cooperation willingness, time and risk preference are possible explanatory variables for herding behavior. When connected with other psychological traits, herding behavior can help better explain human actions and learn about ourselves as human beings.

Conclusion

Social media like Twitter and Instagram have made disseminating information easy and quick. Today, people are affected by information they hear daily without even knowing. When we decide, we now look more toward what others are doing. This process of being affected by others' decisions is called the herding effect. It has become too common in the society around us to be overlooked today. This study looks at herding behavior from a non-financial perspective, the influence of cooperation willingness on herding behavior, and how age affects them. Cooperation willingness is measured by the contribution of participants in PGG. Herding behavior is measured by a new model, which is discussed in detail in previous sections (see "Methods"). In this study, we found that cooperation willingness positively influences herding behavior. As age increases, people tend to be less affected by the herding effect and more willing to cooperate.

As a newly proposed method for measuring herding behavior, there certainly is room for improvement. Herding behavior is complex and influenced by numerous factors. New controlling variables could be added to perfect this method, but generally, this new method is a valid measurement for herding behavior. The other improvement that could be made is to increase the number of samples: the reason the regression results of individual age groups are not significant is the lack of samples.

This research could start a series of thorough studies on herding behavior in non-financial environments. In future researches, the participants could be divided by their gender, IQ levels, and education levels to diversify the population. Also, the society participants live in should be considered an external influence on

their herding behavior. Overall, there is great potential in studying herding behavior as a psychological and social behavior.

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