Maria Andersson, Carmen Lee, Ted Martin Hedestrom & Tommy Gärling

Effects of Financial Incentives on Herding in a Simulated Financial Market

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Andersson, M., Lee, C., Hedeström, T. M., & Gärling, T. Effects of financial incentives on herding in a simulated financial market. *Göteborg Psychological Reports*, 2007, 37, No. 3. In two experimental simulations of a financial market, participants predicted an “upmarket” or “downmarket” conditional on diagnostic information sampled on each trial. Experiment 1 aimed at demonstrating irrational “herding”. Thirty undergraduates in an individual condition received the sampled information, another 30 undergraduates in a group condition received also information about randomly generated predictions ostensibly made by three others. Economic incentives for accurate predictions were based on individual performance. Unexpectedly, performance in the group condition was not worse than in the individual condition. Employing another two groups of 30 undergraduates, Experiment 2 examined the effects of economic incentives for making the same predictions as either the majority or the minority of the others. The results showed that participants followed the majority but not the minority. Responses to a post-experimental questionnaire suggested that those who followed the majority were aware of the others’ influence, falsely believing that they were more accurate than themselves.

Key words: Herding, financial markets, financial incentives, conformity

People are frequently imitating others, for instance, in electing politicians or in purchasing consumer goods. This phenomenon recognized in financial markets is referred to as herding (for a review, see Hirshleifer & Teoh, 2003). If a large number of investors follow each other and make similar decisions, it is a possible cause of market booms and bursts. For this reason, the popular press often holds investors’ tendency to herd as responsible. However, research points in opposing directions; while some studies confirm the existence of herding in financial markets (e.g., Guedj & Bouchaud, 2005), others do not (e.g., Drehmann, Oechssler, & Roider, 2005).

When investors are taking the same action as others it may be because they are directly influenced by them. However, it may also be the result of “clustering of actions” as a consequence of indirect influences (Drehmann et al., 2005; Sias, 2004), including common knowledge (Grinblatt, Titman, & Wermers, 1995), fads (Sias, 2004), or common investment styles (Wermers, 2000). An important challenge to empirical studies is therefore to distinguish herding from clustering of actions. Since in actual markets the bases for investors’ decision making are seldom disclosed, it becomes difficult to identify the true sources of information that influence the decisions. An experimental approach is therefore required.

Carmen Lee, Department of Marketing, Free University of Amsterdam, The Netherlands

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Anderson (2001), Anderson and Holt (1997), and Celen and Kariv (2004) report experiments in which participants made choices sequentially based on private information and information about the choices made by others preceding them. After a number of participants had made their choices, the participants tended to disregard their private information and instead imitated the others. This is also likely to occur among investors in financial markets. When observation of others’ choices provides valid information, it is optimal for individual investors to follow the others without regard to their private information. This form of herding is referred to as information cascades (Bikhchandani, Hirshleifer, & Welch, 1992). Once an information cascade has started, other information made public is likely to be ignored, which may cause inoptimality at the macro level (Drehmann et al., 2005). For a general discussion of herding and information cascades, see Smith and Sørensen (2000).

In social psychological research the issue of whether or not it is beneficial to follow others has been raised. For instance, a tenet in Festinger’s (1954) theory of social comparison processes is that when one disagrees with a number of apparently unrelated sources that are in agreement, and there is no plausible explanation for their agreement, it is sensible to infer that the others are correct. Since people strive to be correct, this will induce a comparison between their own views and the views by other individuals. A number of factors are known to affect the outcome of such comparisons (see Bond & Smith, 1996, for a review). One such factor is task difficulty. In general a more difficult task elicits more conformity. Yet, people may conform even in simple perceptual tasks, such as in the experiments by Asch (1952, 1956). Studies have also shown that the number of individuals is important. Although the results differ regarding the relation between group size and conformity, a general conclusion is that a majority has a stronger influence than a minority (Bond et al., 1996; Brown, 2000; Martin, Gardikiotis, & Hewstone, 2002). Yet, as previous research shows (e.g., Arbuthnot & Wayner, 1982; Clark & Maass, 1990; Hodges & Geyer, 2006; Lascu, Bearden, & Rose, 1995; Mugny & Papastamou, 1980; Nemeth, Wachtler & Endicott, 1977), both the absolute size and the relative size of a majority increase its influence. Similar results were furthermore obtained for minorities in studies that investigated the importance of numerical size for minority influences. It has also been found (e.g., Arbuthnot et al., 1982; Bray, Johnson & Chilstrom, 1982; Nemeth et al., 1977; Wood, Lundgren, Ouellette, Busceme, & Blackstone, 1994) that the degree of consistency in judgments increases the influence of both minorities and majorities.

Two processes have theoretically been posited to mediate influence from others, comparisons with others and validation of these comparisons (Wood et al., 1994). According to Mugny and Perez (1991), comparisons involve identification with the others and result in influence without deliberation, whereas validation assesses the others’ arguments and results in influence after deliberation. In Moscovici’s (1976, 1985) dual-process theory of conformity and conversion, people comply with the majority without thoroughly reflecting on its message because they wish to belong to the majority (conformity). Since people are unwilling to be identified with deviant groups, minorities are in contrast less likely to elicit a comparison process. Instead, primarily depending on its absolute or relative size and degree of consistency, a minority may trigger a validation process leading to that their arguments are considered in detail. This may result in a changed private opinion (conversion) even though the majority’s opinion is still officially proclaimed. Under certain circumstances the change in opinion would also lead to public adoption of the minority’s opinion.

A so-called cognitive response framework has been proposed to understand minority and majority influence by connecting the processes of comparison and validation to heuristic and systematic processing (Maass & Clark 1983, 1984; Martin et al., 2002; Martin & Hewstone, 2003; Martin, Martin, Smith, & Hewstone, 2007; Moskowitz, & Chaiken, 2001).
In heuristic processing influence is triggered by some cue in the environment (signaling, e.g., status or size) or is the result of the use of a consensus heuristic (e.g., “the majority is always right”). In systematic processing, which entails careful evaluation of arguments and interrelated information, influence occurs if the target of influence is persuaded by the source of influence. In the heuristic/systematic model of attitude change (Chen & Chaiken, 1999), a similar distinction is made between two strategies of information processing, also referred to as systematic processing and heuristic processing. In the case of attitude change through systematic processing, attitudes tend to be persistent over time and more resistant to counter-arguments compared to attitude change through heuristic processing.

In the difficult task that financial investments constitute, following a majority is a heuristic that investors to some extent are likely to use. We aim at showing this in simulations of a financial market where the use of this heuristic would lead to worse performance relative to relying on accurate information.

In a review of the effects of financial incentives in experiments, Camerer and Hogarth (1999) concluded that these effects are varied and complex. The presence and level of financial incentives seem to affect performance in judgment tasks, in particular where increased effort would improve performance. In a financial market such as that simulated in the present experiments, it is beneficial to closely examine the outcomes. This represents a task where financial incentives are likely to have a positive effect. Financially rewarding individual performance would therefore possibly counteract reliance on invalid information about other investors’ choices. A parallel can thus be drawn to the validation process or systematic processing of information assumed to counteract conformity (Maass et al., 1984; Martin et al., 2007; Martin et al., 2003). In contrast, financially rewarding group performance may enhance herding because it reinforces the comparison process or non-systematic processing, thus leading to conformity as well as worse performance. Whether this would apply only to a majority and not to a minority is an open question. The answer depends on whether the tendency to compare oneself to a majority is stronger than the effect of financial rewards for following the minority.

Overview of Method

We use a sequential individual decision making task similar to that devised by Massey and Wu (2004, 2005). In this task emulating an essential component of actual financial investments, participants made binary predictions of a future “upmarket” or “downmarket”. A monetary payoff was obtained depending on the number of accurate predictions of the market state. On each trial a “private signal” was presented consisting of a number randomly sampled from either an upmarket or downmarket distribution. Given that participants infer the accurate market state, consistently predicting an upmarket or a downmarket would lead to an average of 80% accurate responses. The expected value of the payoff was the sum across trials of the probability of being accurate on each trial times the payoff obtained for being accurate.

In other conditions information was given about the predictions made by fictitious three other participants (referred to as the group conditions). These predictions were randomly generated resulting in an average of 50% accurate responses. Before making a prediction the participants were first presented the private signal (also ostensibly available to the other participants), then they were presented information about the other participants’ predictions of an upmarket or downmarket. In addition to the individual payoff for making accurate predictions, monetary payoffs were also obtained for either being accurate when the majority (two or three other participants) or the minority (one or no other participant) made accurate
Experiment 1

Experiment 1 investigated the level of herding when only individual performance was rewarded. An individual condition is compared to a group condition. The difference between these conditions was that participants in the individual condition only received the private signal, while participants in the group condition both received the private signal and information about the predictions made by three fictitious participants.

Method

Participants. Sixty undergraduates from Göteborg University (44 women and 16 men) participated in the experiment in return for payments of SEK 50 (1 SEK or Swedish crown was approximately equal to 0.125 US$ at the time of the study). Participants would in addition to this receive a bonus from 0 to 100 SEK depending on performance. The mean age of the participants was 26.0 years (SD =7.1). They were randomly assigned to two equally large groups, the individual condition and the group condition.

Procedure. When arriving to the laboratory participants were seated in separate cubicles facing computers. All instructions and material were presented on the computer screens. The key board and mouse were used to record the responses.

The experiment consisted of 25 trials. Beginning with the first trial the participants’ task was to predict whether on the next trial there would be an “upmarket” or “downmarket”. The task was self-paced. Responses were made by using the mouse to move the cursor to an indicated position. Before each trial the private signal consisting of a number from 5 to16 was presented on the screen. The presented number was on each trial randomly sampled from either the upmarket or downmarket distribution of numbers shown in Figure 1. The mean of the upmarket distribution is 12, and the mean of the downmarket distribution is 9. If the sampled number exceeds 10 the probability is 0.80 that it is sampled from the upmarket and 0.20 that it is sampled from the downmarket; if the number is 10 or less the probability is 0.80 that it is sampled from the downmarket and 0.20 that it is sampled from the upmarket. Five random binary sequences of private signals were used equally often in each condition. Consistent predictions of upmarket or downmarket would lead to 19, 24, 17, 18, or 21 accurate answers for these random sequences.

For two thirds of the participants in each condition the random sequences were reverse-coded from trial 16, implying a market transition. For one third there was a transition from upmarket to downmarket on this trial, and for another one third there was a transition from downmarket to upmarket. For the remaining one third there was no market transition, a consistent upmarket in half of the cases and a consistent downmarket in half of the cases.

The participants were informed that an upmarket was equally likely to occur as a downmarket, that there would be maximally one transition from upmarket to downmarket or the reverse, and that there would be no such transition before the sixth trial. They were further informed that the number representing the private signal was sampled from one of two
overlapping distributions of numbers shown to them (like Figure 1) both as part of the instructions and on each trial.

![Upmarket](upmarket.png)

![Downmarket](downmarket.png)

Figure 1. Upmarket and downmarket distributions of the numbers representing the private signal.

In the individual condition participants made their predictions solely based on the private signal. In the group condition, the participants were told that three other participants were simultaneously taking part in the experiment seated in adjacent rooms. The participants in this condition were further told that after receiving the same sampled number, all four participants had to make their predictions in a randomly pre-determined order, and that they were always the last in this order. Therefore, they would be informed about the three others’ predictions after seeing the private signal, without the others knowing their predictions. After the private signal appeared on the screen each other participant’s prediction of an upmarket or downmarket was in turn shown. When the private signal and the others’ predictions were all displayed, the participants made their predictions. The sequence of the three fictive participants’ predictions was obtained by unrestricted random sampling assuring that they were not correlated. Five such random sequences were used equally often across participants. Consistently following the majority (two in the group) would lead to 13, 11, 13, 12, or 11 accurate answers.

In both the individual condition and the group condition, participants earned 4 SEK for each accurate prediction. After finishing the experiment, the participants were debriefed and paid for their participation in accordance with their performance.
Results

The percentage of accurate prediction and percentage of following the private signal were computed for five blocks each consisting of five trials (see Table 1).

Since the first block represents a learning phase during which participants knew that there would be no market transition, the predictions in the first block were excluded from the following analyses. Parallel 2 (condition: individual vs. group) by 4 (market transition: up-to-down vs. down-to-up vs. always up vs. always down) analyses of variance (ANOVAs) with block as a repeated-measures factor were performed on percentage of accurate prediction and percentage of following the private signal. In both ANOVAs the main effect of condition was significant at the significance level of $\alpha = .05$, $F(1, 52) = 5.65$, $p = .021$, partial $\omega^2 = .07$, and $F(1, 52) = 6.31$, $p = .015$, partial $\omega^2 = .08$. Participants in the group condition made significantly more accurate predictions ($M_{\text{group}} = 68.3\%$ vs. $M_{\text{individual}} = 57.6\%$) and followed the private signal significantly more frequently ($M_{\text{group}} = 78.3\%$ vs. $M_{\text{individual}} = 65.4\%$).

Block had a significant effect on percentage of accurate prediction, $F(3, 156) = 8.81$, $p < .001$, Greenhouse-Geisser $\varepsilon = .72$, partial $\omega^2 = .09$, and was associated with linear, $t(82) = 2.86$, $p = .006$, and cubic trends, $t(82) = 3.91$, $p < .001$. Performance decreased from the second to the third block, then increased.

Table 1. Percentage of accurate prediction and percentage of predictions following private signal related to individual vs. group condition in blocks 1 to 5 (Experiment 1)

<table>
<thead>
<tr>
<th>Block</th>
<th>Accurate prediction</th>
<th>Following private signal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Individual</td>
<td>Group</td>
</tr>
<tr>
<td>1</td>
<td>68.0</td>
<td>81.5</td>
</tr>
<tr>
<td>2</td>
<td>52.5</td>
<td>66.5</td>
</tr>
<tr>
<td>3</td>
<td>53.5</td>
<td>52.5</td>
</tr>
<tr>
<td>4</td>
<td>62.0</td>
<td>81.0</td>
</tr>
<tr>
<td>5</td>
<td>62.5</td>
<td>73.0</td>
</tr>
</tbody>
</table>

Discussion

The results of Experiment 1 were not as expected. If participants in the group condition had followed the majority they should have been less accurate in predicting the accurate market state than participants in the individual condition. On the contrary, they performed significantly better. Furthermore, they also followed the private signal more frequently.

It should first be noted that financially rewarding individual performance counteracted reliance on invalid information about others’ choices. Thus, herding was not observed. As expected, financial incentives may thus play important roles to counteract herding. An explanation of the improved performance in the group condition is also called for. A possibility is that participants in this condition became more competitive, possibly being motivated to outperform the herd. Given that the performance in the individual condition only marginally exceeded the chance level, the financial reward for accurate individual performance might not have been sufficient. Perhaps the additional competitiveness induced by others therefore added to the financial reward.

The results also showed that accuracy of performance increased over blocks of trials except for a decrease in the third block. After a number of trials participants probably started to anticipate a market transition, and for this reason, varied their predictions. After the third
block a transition had taken place for two thirds of the participants. If these participants perceived the transition, they would have no reason to vary their predictions in the last block, which therefore would be very accurate. However, this would not apply to the remaining one third of the participants who did not encounter any transition.

In summary, Experiment 1 did not reveal any effect of herding that impaired performance. On the contrary, the presence of others might have made the participants motivated to outperform them and attend more closely to the private signal, and therefore to perform more accurately. Experiment 2 investigated whether participants will herd if they are financially rewarded for doing so. An effect of economic incentives may in this case reinforce the use of a consensus heuristic, thus leading to worse performance. This effect will probably be different when the group constitutes a majority compared to a minority. A consensus heuristic may only lead to herding when the others constitute a majority. Thus, financial rewards for following a minority would fail to affect performance.

Experiment 2

Experiment 2 examined whether financial incentives for making the same predictions as the majority or the minority would lead to herding. A majority-bonus and a minority-bonus group condition were compared to the group condition in Experiment 1 (referred to as the no-bonus condition). The individual condition was not considered an appropriate control given the observed worse performance in this condition.

Method

Participants. Another 60 undergraduates from Göteborg University (37 women and 23 men) participated in return for payments from 50 to 150 SEK depending on performance. Their mean age was 26.9 years (SD = 9.9). The participants were randomly assigned to two equally large groups, a majority-bonus group condition and a minority-bonus group condition.

Procedure. The procedure was essentially the same as in the group condition of Experiment 1 with the following exceptions. For each accurate prediction participants earned 2 SEK. This reduction was made in order to equate the expected value for following the private signal with the expected value in the no-bonus condition. If an accurate prediction coincided with the predictions made by the majority (two of the others), the participants in the majority-bonus condition received an additional 4 SEK. Participants in the minority condition received an additional 4 SEK if an accurate prediction coincided with the predictions made by the minority (one of the others).

After having completed the experiment participants were asked to answer questions displayed on the computer screen. The results of seven out of 12 posed questions are analyzed below (see Table 4). Answers were reported on 9-point rating scales ranging from never (1) to always (9). Perceived influence was measured by four questions, one asking the participants to rate the degree of perceived influence from the others, one asking about the perceived independence of the participant’s responses of the others’ responses, and two questions tapping the importance of similarity between the participants’ and the others’ responses. Perceived accuracy was captured by three questions, in which participants rated the perceived accuracy of the others’ responses as well as the perceived accuracy of their own responses compared to the others’ responses, respectively. Finally, participants were debriefed and paid.
Results

Performance. Three dependent variables were computed for each individual and block. First, the percentage of accurate predictions was calculated. Second, the percentage of predictions following the private signal was calculated by summarizing the number of times the participants’ predictions followed the signal (>10) subtracted by the number of times their predictions followed the group (the same prediction as two of the other participants) but not the signal, divided by the total number of trials and multiplied by 100. Third, the percentage of predictions following the majority was calculated by summarizing the number of times the participants’ predictions followed the majority subtracted by the number of times their predictions followed the signal but not the majority, divided by the total number of trials and multiplied by 100.

In the following analyses the results for the group condition in Experiment 1, the no-bonus condition, is included. The mean percentages across blocks are given in Table 2.

Table 2. Percentage of accurate prediction, percentage of predictions following private signal, and percentage of predictions following group related to condition in blocks 1 to 5 (Experiment 2)

<table>
<thead>
<tr>
<th>Block</th>
<th>Accurate prediction</th>
<th>Follow Private Signal</th>
<th>Follow Majority</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Individual Majority Minority</td>
<td>Individual Majority Minority</td>
<td>Individual Majority Minority</td>
</tr>
<tr>
<td>1</td>
<td>81.5 68.5 79.0</td>
<td>83.5 53.5 79.5</td>
<td>9.0 25.5 5.5</td>
</tr>
<tr>
<td>2</td>
<td>66.5 59.0 68.5</td>
<td>78.5 54.5 71.0</td>
<td>29.5 24.5 5.0</td>
</tr>
<tr>
<td>3</td>
<td>52.5 55.0 65.0</td>
<td>75.5 45.0 56.0</td>
<td>20.5 29.0 12.0</td>
</tr>
<tr>
<td>4</td>
<td>81.0 63.5 81.0</td>
<td>83.0 46.0 82.0</td>
<td>17.5 32.0 6.0</td>
</tr>
<tr>
<td>5</td>
<td>73.0 59.5 67.5</td>
<td>76.0 56.5 65.5</td>
<td>18.0 20.5 13.5</td>
</tr>
</tbody>
</table>

Parallel 3 (condition: no-bonus vs. majority-bonus vs. minority-bonus) by 4 (market transition: up-to-down vs. down-to-up vs. always up vs. always down) ANOVAs, including blocks 2 to 5 as a repeated-measures factor, were performed on the percentage of accurate prediction, percentage of following the private signal, and percentage of following the majority. In none of these ANOVAs the main effects of condition reached the conventional level of significance ($\alpha=.05$). Still, the participants in the no-bonus and minority-bonus conditions were more frequently accurate than the participants in the majority-bonus condition ($M_{no-bonus}=68.2\%$ vs. $M_{minority-bonus}=70.5\%$ vs. $M_{majority-bonus}=59.3\%$), $F(2, 78) = 2.99$, $p = .056$, partial $\omega^2 = .04$, and followed the private signal more frequently ($M_{no-bonus}=63.9\%$ vs. $M_{minority-bonus}=68.6\%$ vs. $M_{majority-bonus}=50.5\%$), $F(2, 78) = 2.75$, $p = .070$, partial $\omega^2 = .04$. Conversely, the participants in the majority-bonus condition followed the majority more often than the participants in the no-bonus condition, who in turn followed the majority more frequently than did the participants in the minority-bonus condition ($M_{majority-bonus}=26.5\%$ vs. $M_{no-bonus}=21.4\%$ vs. $M_{minority-bonus}=9.1\%$), $F(2, 78) = 2.51$, $p = .088$, partial $\omega^2 = .03$.

The significant effect of block on percentage of accurate predictions, $F(3, 234) = 8.31$, $p < .001$, Greenhouse-Geisser $\epsilon = .72$, partial $\omega^2 = .06$, was associated with a significant cubic trend, $t(78) = 2.51$, $p<.014$, due to a performance decline in the third block.

Post-Experimental Questionnaire Responses. Table 3 displays means and SDs and correlations between questions computed across all participants in the group conditions.
Table 3. Means and SDs and product moment correlations between answers to post-experimental questionnaire

<table>
<thead>
<tr>
<th>Question</th>
<th>M</th>
<th>SD</th>
<th>#3</th>
<th>#4</th>
<th>#5</th>
<th>#6</th>
<th>#9</th>
<th>#10</th>
</tr>
</thead>
<tbody>
<tr>
<td>#2. Were the others’ predictions accurate?</td>
<td>4.3</td>
<td>1.27</td>
<td>.50**</td>
<td>.07</td>
<td>.15</td>
<td>.10</td>
<td>.34**</td>
<td>.11</td>
</tr>
<tr>
<td>#3. Were the others’ predictions more accurate than your predictions?</td>
<td>3.8</td>
<td>1.69</td>
<td>.13</td>
<td>.17</td>
<td>.20</td>
<td>.71**</td>
<td>.35**</td>
<td></td>
</tr>
<tr>
<td>#4. Did you make your predictions independently of the others?</td>
<td>4.2</td>
<td>2.60</td>
<td>.76**</td>
<td>.56**</td>
<td>12</td>
<td>.44**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#5. Were you influenced by the others’ predictions?</td>
<td>4.7</td>
<td>2.54</td>
<td>.70**</td>
<td>.14</td>
<td>.53**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#6. Was it important for you to do the same as the others?</td>
<td>3.0</td>
<td>2.10</td>
<td></td>
<td>.17</td>
<td></td>
<td>.67**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#9. Did the others have a more accurate view of the market state than you?</td>
<td>3.9</td>
<td>1.80</td>
<td></td>
<td></td>
<td>.27*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#10. Was it important that your predictions coincided with the others’ predictions?</td>
<td>3.1</td>
<td>2.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Responses were obtained on nine-point rating scales.
* p<.05
** p<.01

After recoding reversed questions, a principal component analysis (PCA) with varimax rotation was performed (KMO = .704; Bartlett’s test, approximate $\chi^2 = 244.88$, $p<.001$). A 2-factor solution suggested by the Kaiser-criterion explained 69.5% of the variance. All questions had communalities above .50 and a loading of .67 or higher on one factor and no high cross-loadings were found (Table 4). Questions measuring perceived influence loaded on one factor, questions measuring perceived accuracy loaded on the other factor. An additional PCA on the four questions loaded on the perceived influence factor explained 71.3% of the variance. An index formed by averaging across these items had a Cronbach’s $\alpha = .86$. Another PCA performed on the three questions associated with the perceived accuracy factor explained 68.2% of the variance. The index formed by averaging had a Cronbach’s $\alpha = .76$. 
Table 4. Varimax rotated loadings from principal component analysis of answers to post-experimental questions

<table>
<thead>
<tr>
<th>Question</th>
<th>I</th>
<th>II</th>
<th>h²</th>
</tr>
</thead>
<tbody>
<tr>
<td>#2. Do you think the others’ predictions were accurate?</td>
<td>.018</td>
<td>.672</td>
<td>.452</td>
</tr>
<tr>
<td>#3. Were the others’ predictions more accurate than your predictions?</td>
<td>.163</td>
<td>.901</td>
<td>.838</td>
</tr>
<tr>
<td>#4. Did you make your predictions independently of the others?</td>
<td>.825</td>
<td>.001</td>
<td>.680</td>
</tr>
<tr>
<td>#5. Were you influenced by the others’ predictions?</td>
<td>.914</td>
<td>.053</td>
<td>.838</td>
</tr>
<tr>
<td>#6. Was it important for you to do the same as the others?</td>
<td>.868</td>
<td>.097</td>
<td>.762</td>
</tr>
<tr>
<td>#9. Did the others have a more accurate view of the market state than you?</td>
<td>.105</td>
<td>.818</td>
<td>.680</td>
</tr>
<tr>
<td>#10. Was it important that your predictions coincided with the others’ predictions?</td>
<td>.740</td>
<td>.260</td>
<td>.615</td>
</tr>
<tr>
<td>Variance before rotation</td>
<td>44.9</td>
<td>24.6</td>
<td>69.5</td>
</tr>
</tbody>
</table>

A larger perceived influence was observed in the majority-bonus and minority-bonus conditions compared to the no-bonus condition ($M_{majority-bonus} = 4.1$ vs. $M_{minority-bonus} = 4.1$ vs. $M_{no-bonus} = 3.1$), although this difference did not reach significance, $F(2, 87) = 1.70, \ p = .188, \ \omega^2 = .02$. On the index of perceived accuracy, there were non-significant differences between the majority-bonus condition, the minority-bonus condition, and the no-bonus condition ($M_{majority-bonus} = 4.4$ vs. $M_{minority-bonus} = 3.9$ vs. $M_{no-bonus} = 3.7$), $F(2, 87) = 1.88, \ p = .158$, Greenhouse-Geisser $\epsilon = .72$, partial $\omega^2 = .09$.

**Discussion**

The bonus obtained by participants for making the same predictions as the majority led to more herding than in the condition with no bonus, that is a more frequent following of the invalid majority, a less frequent following of the valid private signal, and therefore a lower percentage of accurate predictions. However, no effect of financial incentive was observed in the minority-bonus condition. The questionnaire results furthermore suggested that participants in the majority-bonus condition were aware of the influence of the others, believing that the others were more accurate than themselves. The changes in accuracy of performance across blocks replicated those observed in Experiment 1 and may be accounted for in the same way.

A possible explanation of the asymmetry in the effects of rewarding a majority or minority may be that the tendency to conform overrides validation or systematic processing in majority influence whereas the reverse would be true in minority influence (Moscovici, 1985). Since systematic processing in the minority-bonus condition was likely to reveal that the minority made inaccurate predictions, this would lead to as high reliance on the private signal as in the no-bonus condition in which rewards were obtained only for making accurate predictions.

The fact that participants in the majority-bonus condition seemed to be aware of the influence of the others and believed that they were more accurate suggests that they made a conscious decision to follow the majority. Additional research is still needed to illuminate whether this is a valid conclusion as well as to understand why a consensus heuristic is chosen.
General Discussion

Herding has been referred to as mindless behavior in financial markets (Shiller, 2000). However, this is not supported by the present results. It was shown in the experiments, set up to simulate financial investments, that financial incentives are required for herding to occur. Thus, some reasoned process needs to be posited. An adequate explanation of this process is probably Moscovici’s (1985) dual-process theory of conformity and conversion. Following the herd is a strong motive, possibly sufficiently strong to prevent systematic processing of negative information. However, to follow a minority, or a majority that it is less desirable to belong to (e.g., signaling low status), requires systematic processing leading to critical assessments of the predictions made by the minority or majority. The present experiments designed to show that influence from a majority or a minority leads to worse performance was suitable to show an effect of critical assessments.

An unexpected finding was that when only individual performance was rewarded, herding increased attention to the private signal and resulted in better performance. In showing that herding may lead to both better and worse performance, the present results represent an extension of previous findings (e.g., Drehmann et al., 2005; Guedj & Bouchaud, 2005). Increased motivation caused by induced competition when performance is individually rewarded is a plausible explanation. Competition may be further enhanced if a fixed reward is distributed to the participants proportional to their performance. A necessary condition is, however, that a desire to conform to the majority is not elicited.

Although the present results appear to paint a consistent picture, there are several gaps of knowledge in need of being filled in. First, inferences of mediating processes rely largely on responses to a post-experimental questionnaire and must be tested in additional controlled experiments. In such experiments the difficulty of the investment task may be varied to facilitate or impede critical assessments. Second, other factors moderating conformity should be tested, in particular conformity to a minority. Some factors in the minority’s size and style are presumably important in order to elicit influence. As showed by some studies, the influence of a minority consisting of one person, like in the present experiment, is likely to be marginal (Arbuthnot et al., 1982, & Mugny et al., 1980). Other important factors that should be studied in further experiments are accuracy and consistency of the group’s predictions, and such studies require numerically larger minorities.

A limitation of this research is the possibility to generalize to actual financial markets. To test the invariance of the present findings across different investment tasks in laboratory experiments is one avenue to investigating their generality. Cross-validation research comparing results of experiments to analyses of investments in actual markets is also needed.

References


