

Numerical Information Format and Investment Decisions: Implications for the Disposition Effect and the Status Quo Bias

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Investment decisions are very difficult because they involve money and can impact our quality of life. According to the axioms of rationality, different but equivalent information formats should not affect investment strategies. The authors perform two experiments here, and find evidence of a strong absolute magnitude effect on investment decisions. In Experiment 1, participants (students) chose to sell a losing fund more often when returns were expressed as a percentage of variation between the buying value and the actual value (e.g., 24%) than when they were expressed as a monetary difference between the buying price and the actual price (e.g., \$0.24). In the context of the experiment, the percentage format decreased the disposition effect significantly. Furthermore, describing the stock returns as ratios (e.g., $\frac{1}{4}$) increased the tendency toward the status quo bias. In Experiment 2, the authors showed that the absolute magnitude of the numbers shaped participants' satisfaction with fund returns, and was responsible for the different choices of investment strategies.

An increasing number of people are actively investing in stock markets, and many are basing their investment decisions on descriptive information from sources such as banks, financial advisors, the mass media, or friends. But as the number of people who are investing increases, so inevitably does the number of “naive investors.” According to rational principles of economic theory, the way information is presented should not affect investment decisions. Nevertheless, a well known finding in decision making research shows that logically equivalent information formats can lead to different choices.

The classical framing effect (Tversky and Kahneman [1981]) has a long history in the psychology of decision making. In the study known as the “Asian disease problem,” different framing of logically equivalent information (expressed either as number of lives saved or number of lives lost) is seen to induce different choices. Increasing the difficulty of information processing, such as presenting individuals with fractions that are difficult

to compute (e.g., 856/963), has been found to increase the frequency of preference reversals (Johnson, Payne, and Bettman [1988]).

Other studies have specifically investigated the effect of different numerical information formats. Bayesian reasoning can be improved by representing information in frequency formats rather than in probabilities (Gigerenzer and Hoffrage [1995, 1999]). Stone, Yates, and Parker [1994] found that individuals were willing to pay more for improved tires when they were described in terms of ratios (half the accident rate of standard tires), than when they were described in an incidence rate format (a 0.0000030 probability of serious injury).

Finally, Halpern, Blackman, and Salzman [1989] found that displaying information in a relative format leads to less risky behavior. They studied the perception of risk associated with the use of oral contraceptives. They presented the same probability in six different formats: natural frequencies framed in a positive format (99,991.7 out of 100,000 will not die), percentages (a 0.0083% probability of dying), frequencies (1 in 12,000 die), natural frequencies (8.3 in 100,000 die), ratios (4.15 times greater risk of death), and percentages (415% greater risk of death). The last two formats differ from the previous four in that they do not convey any base rate information. According to Halpern, Blackman, and Salzman [1989], base rate information formats (1 in 12,000 will die) provide an expected value, while relative information formats (e.g., twice as many will die) give no information about the expected frequency (twice as many as what number?). When a base rate was

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provided, these events were perceived as less likely to occur (Halpern, Blackman, and Salzman [1989]).

Halpern, Blackman, and Salzman [1989] also found that respondents ignore the format in which the numerical information is provided and make safety determinations based on the absolute magnitude of the number provided. In their study, respondents ignored the distinction between relative frequencies (4.15 times greater) and relative percentages (415% greater), and focused on the difference between the absolute magnitude of the numbers (4.15 and 415).

The effect of different information formats can be salient in the domain of investment decisions, and these differences may influence investor decisions. In this study, we manipulated the format we used to provide individuals with investment returns. In this way, we were able to assess how different information formats led to different investing decisions. In particular, the experiments presented here focused on two well known dilemmas in investor behavior: the disposition effect and the status quo bias.

The Disposition Effect

The disposition effect refers to investors' tendency to sell winning investments too early, and ride losing investments too long (Shefrin and Statman [1985]). The disposition effect is diffuse among individuals, but professional investors are also affected by it, albeit at a lower rate. Odean [1998] analyzed a database with thousands of investment trades and demonstrated that the disposition effect is present all year, except during December. In December there is a significant increase in the rate of losers traded, probably because investors who end the year with some losses obtain a tax benefit from realizing them.

The disposition effect is coherent with predictions from prospect theory about how people perceive losses. Prospect theory states that individuals are loss- (and risk-) averse when facing positive outcomes (gains), and risk-seeking when facing negative outcomes (losses) (Kahneman and Tversky [1979], Tversky and Kahneman [1981]). Thaler [1999] suggests investors feel selling a losing investment as a pain because it obliges them to face an unrecoverable loss. As a result, investors prefer to hold the loser, just as they prefer to accept a gamble instead of a sure loss, even if the gamble is characterized by the probability of losing more money than the sure loss.

The disposition effect is also coherent with theories about decision regret (Bell [1982]). Winners are sold quickly because investors prefer to avoid the regret due to a market trend change that can reduce their gains. More often, though, investors tend to sell winning stocks while their value is still rising.

The Status Quo Bias

The tendency to avoid losses and uncertainty is also responsible for the status quo bias. Individuals influenced by the status quo bias tend to postpone their decisions or to maintain their current situation unchanged instead of choosing an uncertain outcome (Kahneman, Knetsch, and Thaler [1991]). In the domain of finance, the status quo bias is seen in investors who hold onto a losing portfolio because they fear incurring even greater losses.

Samuelson and Zeckhauser [1988] demonstrated experimentally the existence of the status quo bias in financial decision making. The authors told two groups that they had inherited a large amount of money, and asked how they preferred to invest it. In the first condition, individuals inherited cash and were asked to decide between two investment portfolios. In the second condition, individuals inherited money already invested in one of the two portfolios, and had to decide whether to switch their portfolio or not.

Results demonstrated a strong status quo bias in the second group. In the first condition, there were no differences between how many individuals chose the first or the second portfolio; in the second condition, however, the majority preferred to remain in their original portfolio. The explanation is that individuals in the second condition preferred not to change because of the strong regret they might feel in case of a loss.

Experiment 1

Experiment 1 assessed the impact of different information formats on investment decisions. People often learn about investment trends from newspapers or TV describing the stock's price day by day. For example, I can learn that Microsoft stock is currently at \$27.32.

Stock returns are often described as the difference between the buying price and the selling price. So if the buying price is \$0.98 and the selling price is \$1.22, the stock value is said to have increased \$0.24. But stock returns are also described as percentages. So in this case we could also say the stock return is 24% (the selling stock value is 24% greater than the buying value). Or, we could describe the return as a ratio between the buying price and the selling price. In that case, the stock return would be about $\frac{1}{4}$ (the selling stock value is $\frac{1}{4}$ greater than the buying value).

Even if all these formats are logically equivalent, it is plausible to expect that people will perceive them differently. For example, a \$0.24 increase might be perceived as lower than a 24% increase, because people tend to focus on the absolute magnitude of the numbers more than on their statistical meaning. In our study, the stock returns of two funds were described in

four different formats, as shown in Table 1. One fund was said to be losing, the other to be gaining.

When people are told “the mean stock price of fund A has gained one-quarter of its starting value and the mean stock price of fund B has lost one-fifth of its starting price,” they can easily understand that the amount gained in the first fund is equal to the amount lost in the second fund. If people realize their wealth has not changed, even if it is differently distributed, they are more likely to keep both funds and await future market trends. This conservative behavior is indicative of the status quo bias (Kahneman, Knetsch, and Thaler [1991]). Because ratios can be easily imagined, we could say that meaning is attached to ratios quite easily (unless they are extremely complicated, such as 856/963). For example, 8/10 can easily be imagined as eight pieces over ten.

Our first hypothesis is therefore as follows:

Hypothesis 1: If returns are expressed as ratios, people are more prone to exhibit the status quo bias.

But ratios are not the only way by which information can become meaningful. According to Halpern, Blackman, and Salzman [1989], people tend to focus primarily on the absolute magnitude of numbers. We therefore expect that stating “there was an increase of 24% in the mean price of stock fund A and a decrease of 19% in the mean price of stock fund B” would render these gains and losses more relevant to investors than when they are expressed in other formats. As a consequence, investors might be more willing to realize the loss by selling the losing fund. This behavior is predictable on the basis of the stop-loss effect: When a loss is too high, you sell. And when information is presented as percentages, people should be less prone to the status quo bias and the disposition effect.

Our second hypothesis is therefore as follows:

Hypothesis 2: When stock returns are described as percentages, participants will sell a losing fund more frequently than when they are described in a different format.

Method

The participants in Experiment 1 consisted of 480 undergraduate students: 35% male, 65% female, with a mean age of twenty-two. Participants were assigned randomly to one of four experimental conditions, so each condition contained 120 students.

The material used is shown in the Appendix. Participants were asked to assume that twelve months ago they had invested in two stock funds, “fund A” and “fund B.” They were told that a different amount of money was invested in the two funds (\$1,583 in fund A

Table 1. *Information Formats*

Information Format	Fund A	Fund B
Percentages	Stock fund A experienced a 24% increase in its mean price.	Stock fund B experienced a 19% decrease in its mean price.
Selling Price	The mean stock price of fund A is now \$1.22.	The mean stock price of fund B is now \$0.74.
Difference	The mean stock price of fund A has increased by \$0.24.	The mean stock price of fund B has decreased by \$0.19.
Ratios	The mean stock price of fund A has gained 1/4 of its starting value.	The mean stock price of fund B has lost 1/5 of its starting value.

and \$2,000 in fund B), and that the mean stock price, at the time they decided to invest, was the same for both funds (\$0.98 per stock). Finally, they were told that the two funds were invested in different assets.

The participants were then given the returns of the funds after twelve months and told that one had gained value while the other had lost. The amount of money gained and lost in each fund was the same, but the rate of gain and loss was different because of the different amount of money allocated to each fund. Participants were not told the exact amount of money gained and lost but were given the two stock fund returns.

According to the experimental condition, each participant was presented with the same information about returns in one of four different formats (see Table 1). To avoid possible order effects, half the participants in each condition were told that stock fund A was gaining and stock fund B was losing, while the other half were told the opposite. The participants’ task was to make a choice among four investment strategies: 1) sell the gaining fund and keep the losing fund; 2) sell the losing fund and keep the gaining fund; 3) keep both funds; or 4) sell both funds. Participants were then asked to rate their confidence in the choice and to briefly note the reasons for their choice. We assessed confidence by asking participants to answer the question “how confident are you that the new investment strategy is the best among those presented?” using a seven-point scale, ranging from 1 = not at all confident to 7 = completely confident.

Furthermore, we used confidence as a manipulation check. We reasoned that if the different formats gave the participants the impression that the amount of money lost and gained was different, then they should show more confidence when the perceived amount was greater (as in the percentage condition).

Design and Procedure

The information format was a between-subjects factor with four levels (percentages, selling price, dif-

ference, and ratios). The investment strategy was the dependent variable, and the experiment was administered during class hours. Every participant read the scenario individually and held onto it until the end of the experiment, when they were asked to choose an investment strategy. Participants were then asked the confidence question and the reasons for their choice. The order of presentation of the two fund returns (gaining or losing) was counterbalanced across conditions.

Results

Investment strategy. We performed a 2×4 [(fund returns order) $\times$ (investment strategy)] log-linear analysis to test for an order effect of the two fund returns (gaining or losing). No significant effect was found, $\chi^2(7, N = 480) = 0.000$, n.s., and further analyses considered the combined data set.

Figure 1 shows the mean frequencies for each investment strategy in the four conditions. A 4×4 [(type of information format) $\times$ (investment strategy)] log-linear analysis showed a main effect of the investment strategy, $\chi^2(3, N = 480) = 167.156$; $p = 0.001$, and a significant interaction between the type of information format and the investment strategy, $\chi^2(9, N = 480) = 19.874$; $p = 0.019$. As Figure 1 shows, the two alternatives “sell the gaining fund” and “keep both funds” seemed to be preferred over the others.

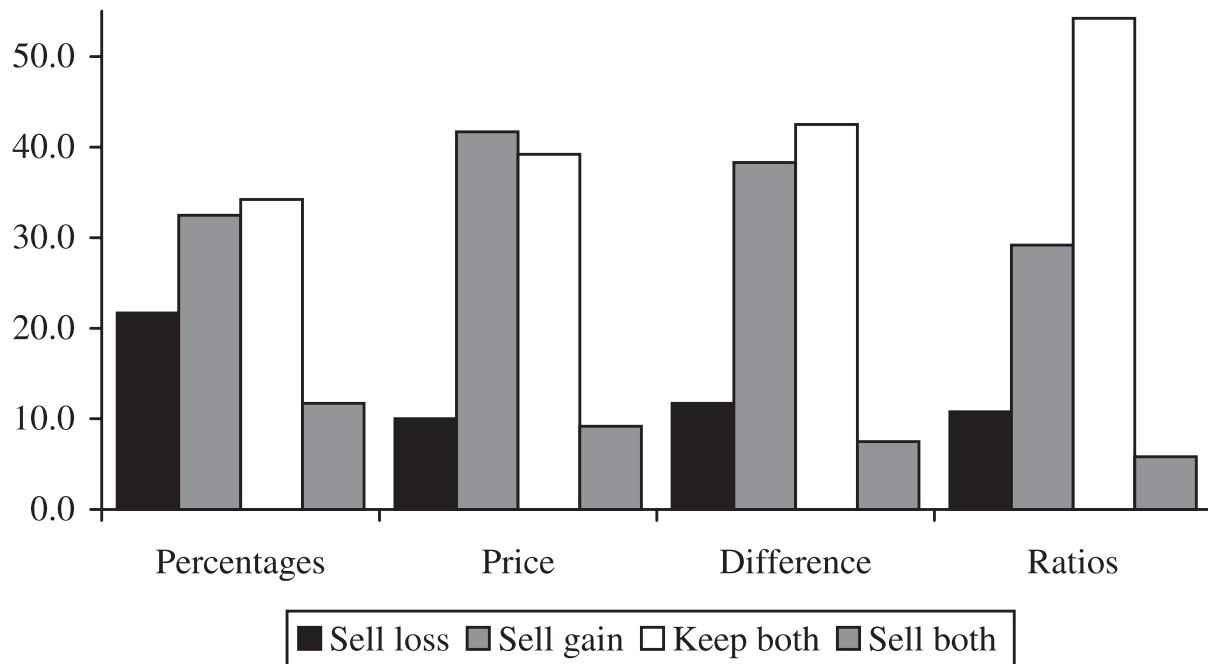
A descriptive analysis of the frequencies reveals the prevalence of the status quo bias, as shown by the high

percentage of people choosing to “keep both funds.” To statistically test whether the preferences for the biased strategy were higher than those for the theoretically best alternative, “sell the losing fund,” we performed a 2×4 [(investment strategy: “keep both funds” versus “sell the losing fund”) $\times$ (type of information format)] log-linear analysis. Participants showed the status quo bias across all conditions: The “keep both funds” alternative was generally preferred over “sell the losing fund” (42% versus 14%), as illustrated by the significant main effect of investment strategy, $\chi^2(1, N = 269) = 75.422$; $p = 0.0001$.

The frequencies also show that the participants were systematically affected by the disposition effect, in that they were less prone to sell the losing fund than to sell the gaining one (35% versus 14%). To statistically test this evidence, we performed a 2×4 [(investment strategy: “sell the gaining fund” versus “sell the losing fund”) $\times$ (type of information format)] log-linear analysis. A significant main effect of investment strategy was found, $\chi^2(1, N = 235) = 48.616$; $p = 0.0001$.

Returning to our first hypothesis, we expected that returns expressed as ratios (rather than another format) would induce more people to exhibit the status quo bias. When the frequency of people choosing to “keep both funds” and to “sell the gaining fund” are compared across conditions, the results show a significant interaction effect of the 2×4 [(investment strategy: “keep both funds” versus “sell the losing fund”) $\times$ (type of information format)] log-linear analysis, χ^2

FIGURE 1
Frequency of Choices for the Four Alternatives in Each Condition of Experiment 1



(3, $N = 269$) = 10.947; $p = 0.012$. In the ratios condition, 54% of the participants chose to “keep both funds,” while 11% chose to “sell the losing fund,” and this difference is the greatest across conditions. At the same time, due to the increase of the status quo bias, the percentage of people showing a disposition effect decreased.

Our second hypothesis predicted that when stock returns are described as percentages (rather than another format), participants will sell the losing fund more frequently. We tested whether the frequency of people choosing to “sell the losing fund” changed across the four conditions. A chi-squared analysis gave a significant interaction effect of $\chi^2(3.65) = 7.923$; $p = 0.048$. Participants preferred to sell the losing fund more often in the percentage condition than in the other conditions (22% versus 10%, 12%, and 11%). Furthermore, the percentage condition is the only one in which the difference between the percentage of participants choosing to sell the gaining fund and sell the losing fund is not statistically significant (21.7% versus 32.5%), $\chi^2(1, 120) = 2.600$; $p = 0.107$. In this condition, the disposition effect seems to be highly reduced.

Confidence. We analyzed participant confidence ratings in an analysis of variance with type of information format as the between-subjects factor. This analysis showed no difference in participant confidence ratings between the four information formats, $F(3.477) = 0.604$, $\eta^2 = 0.004$, n.s. The confidence ratings did not parallel the changes in frequency of people choosing the different alternatives. This result suggests that information format impacts investment strategies, but that individuals do not recognize this influence.

Discussion. The two major findings of Experiment 1 are that:

1. Describing stock returns as ratios increases a tendency toward the status quo bias.
2. Describing stock returns as percentages increases the likelihood that an individual will sell the losing fund (and decreases the influence of the disposition effect).

The first result can be explained by assuming that ratios make the perception of gains and losses more similar, and induces people to think that no relevant change in their global wealth has occurred. This would probably increase the status quo bias.

The second result is attributable to the fact that people tend to focus on the absolute magnitude of a number and not on its statistical value. The absolute magnitude of the number would bring an implicit meaning of “high versus low,” which is processed automatically, independently from the statistical meaning. In the per-

centage condition, the absolute magnitude of the number is the highest, and, as predicted, it is the only condition where the disposition effect is reduced. We designed Experiment 2 to further investigate the absolute magnitude effect.

Experiment 2

Experiment 2 explores the impact of the absolute magnitude effect on investors' perception of fund returns. We replicated two of the conditions previously used in Experiment 1, the “percentages” and the “difference” conditions. In these conditions, the same information is presented in different formats but with equivalent statistical meaning. The different formats imply different absolute magnitudes. For percentages, the absolute magnitude is high (e.g., 24%), while for the difference the absolute magnitude is low (e.g., \$0.24). According to the absolute magnitude effect, the different magnitudes will produce different perceptions of how much each fund has gained and lost.

We posited the following:

Hypothesis: People will be more satisfied with the gaining fund and less satisfied with the losing fund when the absolute magnitude (percentage condition) is high, versus when it is low (difference condition). This occurs because when the absolute magnitude is high, people perceive that the losing fund has lost more and the gaining fund has gained more.

Method

The participants in Experiment 2 consisted of 170 undergraduate students: 36% male, 64% female, with a mean age of twenty-one. Participants were assigned randomly to the “percentage” (eighty-six students) or the “difference” conditions (eighty-four).

Experiment 2 used the same material as Experiment 1, but we administered only the “percentage” and “difference” conditions. The participants' task again was to read the scenario, and choose among four investment strategies: 1) sell the gaining fund and keep the losing fund; 2) sell the losing fund and keep the gaining fund; 3) keep both funds; or 4) sell both funds. The difference here is that participants were asked to answer two questions after making the choice: “How happy are you about the returns from stock fund A?” and “how happy are you about the returns from stock fund B?” The answers were given on an eleven-point scale, from -5 for “not at all happy,” to +5 for “extremely happy.”

Design and Procedure

We manipulated the “type of information format” (percentage versus difference), and recorded the investment choice and each participant’s satisfaction with funds A and B. The experiment was administered during class hours. Every participant read the scenario individually and again held it until the end of the experiment when they were asked to choose an investment strategy. The order of presentation of the two fund returns (the gaining and the losing funds) was counter-balanced across conditions.

Results

Figure 2 shows participants’ choices in the percentage and difference conditions. The choices significantly parallel those of Experiment 1. In particular, more participants decided to sell the losing fund when given the percentage format ($M = 67.5\%$) than when given the difference format ($M = 32.5\%$), $\chi^2 (1.68) = 4.90$; $p = 0.027$.

Consistent with these results, satisfaction with the losing fund was lower in the percentage condition ($M = -2.65$; $SD = 1.87$) than in the difference condition ($M = -2.06$; $SD = 1.75$), $t (170) = -2.13$; $p = 0.035$. Furthermore, satisfaction with the gaining fund was higher in the percentage condition ($M = 2.81$; $SD = 2.18$) than in the difference condition ($M = 2.12$; $SD = 1.80$), $t (170) = 2.25$; $p = 0.026$. As hypothesized, participants were more satisfied with the gaining fund and less satisfied with the losing fund when the absolute magnitude was high (percentage condition), versus when it was low (difference condition). Figure 3 displays participants’ satisfaction with the two funds.

General Discussion

Investors have many choices when deciding how to invest their money in the stock market. But all the choices share a common feature: Daily returns go up or down. To evaluate their decisions, investors routinely assess these returns. From a rational point of view, it should not matter whether they are expressed as a percentage of variation between the buying value and the actual value (e.g., 24%), or as a monetary difference between the buying price and the actual price (e.g., \$0.24). However, studies repeatedly find that people are influenced by information formats.

In this study, we increased and decreased satisfaction with a fund and influenced people’s investing strategies by manipulating only the numerical format of the returns. This effect, called the “absolute magnitude effect,” is the tendency to perceive numerical value according to absolute magnitude instead of statistical meaning.

We showed how the different magnitude of the numerical information can produce different perceptions of how much each fund has gained and lost. As our experiments show, people perceived that the losing fund had lost more and the gaining fund had gained more when the absolute magnitude was high (e.g., 24%) than when it was low (e.g., 0.24). Consistent with these perceptions, when the absolute magnitude was high, people preferred to sell a losing investment. When it was low, they preferred to sell a gaining investment or to maintain the status quo. In the specific context of this experiment, the percentage format decreased the disposition effect significantly, which is the tendency to sell a gaining investment and hold a losing one.

FIGURE 2
Frequency of Choices for the Four Alternatives in Each Condition of Experiment 2

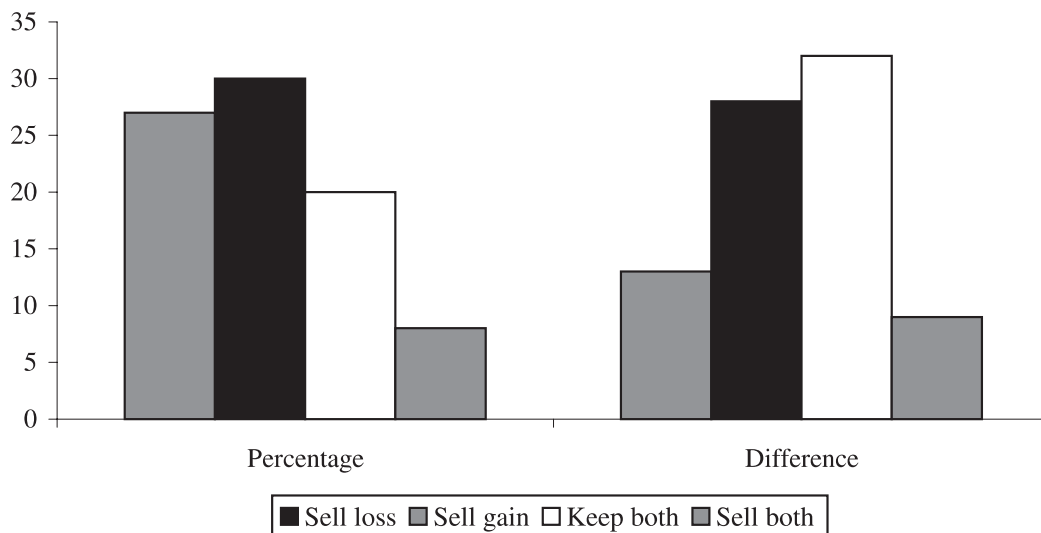
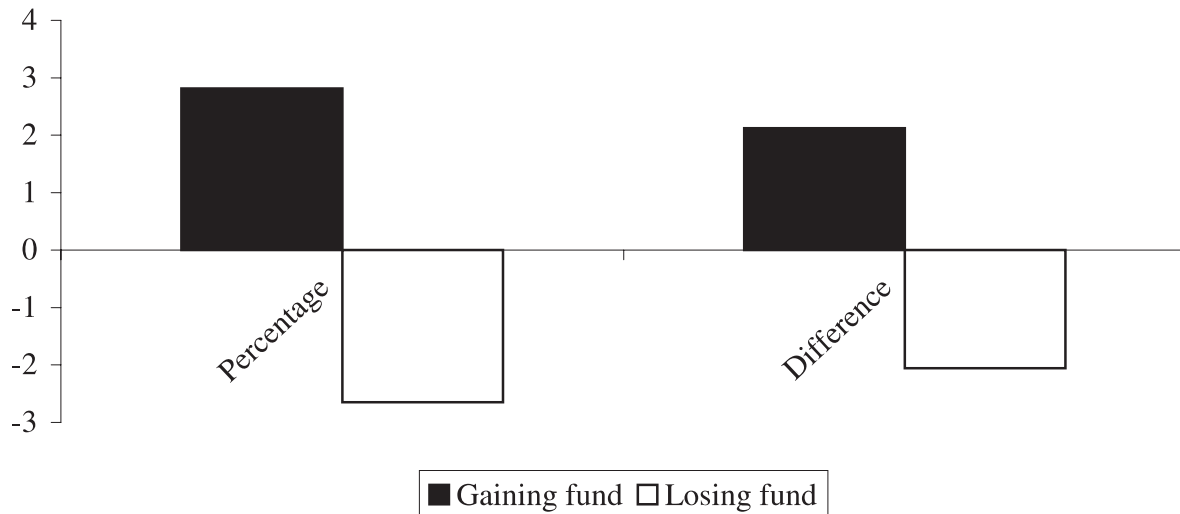


FIGURE 3
Participants' Judgments of Satisfaction With Fund A and Fund B



The absolute magnitude effect has widespread consequences in everyday life because it can impact any decision that entails the presentation of numerical information. For example, when consumers are presented with a special sale offer, merchants could conceivably use percentages to imply that the price cut is greater than it actually is. And being aware of the absolute magnitude effect is important for both advisors and investors. Advisors can decide which way to present information to investors in order to give them the clearest picture of their investments; investors can help prevent investment errors by ensuring they are not misperceiving gains or losses.

This study, however, has two main limitations. First, we used a simplified scenario about investment decisions: Funds were anonymously defined as “A” and “B,” which allowed for no historical or affective meaning to be attached to them. Second, we tested a sample of university students who had no investing expertise. Even if cognitive biases such as the disposition effect or the status quo bias are common among experts, a real investor might overcome the absolute magnitude effect. Future research should be directed at investigating the absolute magnitude effect in real-world contexts with real investors.

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APPENDIX

Materials Used in Experiment 1

Scenario Common to all Conditions

Imagine you have decided to invest a certain amount of money in the stock market. You choose to invest in stock funds A and B, \$1,583 in fund A, and \$2,000 in fund B. At the time you decide to invest, the two stock funds have the same mean stock value (\$0.98

per stock), but they are made up of stocks from different industrial sectors.

Percentage

After twelve months, you check the trend of your investments, and note the following:

- The mean price of fund A has increased by 24%.
- The mean price of fund B has decreased by 19%.

What investment strategy do you deem best for the future among the strategies that your financial advisor has suggested?

Selling Price

After twelve months, you check the trend of your investments, and note the following:

- The mean stock price of fund A is now \$1.22.
- The mean stock price of fund B is now \$0.79.

What investment strategy do you deem best for the future among the strategies that your financial advisor has suggested?

Difference

After twelve months, you check the trend of your investments, and note the following:

- The mean stock price of fund A has increased by \$0.24.
- The mean stock price of fund B has decreased by \$0.19.

What investment strategy do you deem best for the future among the strategies that your financial advisor has suggested?

Ratios

After twelve months, you check the trend of your investments, and note the following:

- The mean stock price of fund A has gained 1/4 of its starting value.
- The mean stock price of fund B has lost 1/5 of its starting value.

What investment strategy do you deem best for the future among the strategies that your financial advisor has suggested?

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