In the Red: How Color Affects Investors and Financial Markets*

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Abstract

Investors frequently view financial information in graphical form, with losses often shown in red. Research in psychology suggests that red color signals danger and motivates avoidance behavior. Yet, it is not known how color influences the way people make financial decisions. In three experiments, we show that using red to communicate financial losses, compared to black or blue color, makes investors (i) more risk averse, (ii) less likely to positively evaluate financial assets, and (iii) more pessimistic about future price changes in the stock market. We find that these results are consistent across two experiments, but that the effects are absent in the third sample of colorblind participants. These findings carry important implications for household finance, financial institutions, and service providers.

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"As to what I have done as a poet,... I take no pride in it... But that in my century I am the only person who knows the truth in the difficult science of colours – of that, I say, I am not a little proud, and here I have a consciousness of a superiority to many."

—Johann Wolfgang von Goethe, 1836

"Color-blind Merrill in a Sea of Red Flags"

—New York Times Headline, 2008

1 Introduction

Scholarly interest in a relation between color and human behavior has a very long history (Sloane 1991), and may be traced back at least to the German poet and scientist Johann Wolfgang von Goethe's book *Theory of Colours* (1810). But it is in the last couple of decades that rigorous scientific research on color has really started to emerge, resulting in publication of such work in the top scientific journals (Hill and Barton 2005; Mehta and Zhu 2009). Eight of the articles that have appeared in the Annual Review of Psychology over the years have been about color, yet the most recent one is the first to specifically examine the influence of perceiving color on human psychological functioning (Elliot and Maier 2014). Moreover, due to the large volume of recent contributions related to *color psychology*, the first edition of the Handbook of Color Psychology is about to be released in 2016 (Elliot, Fairchild, and Franklin 2016). That is, the effect of color on human behavior is a research topic that is currently attracting a lot of interest among social scientists. In this paper, we set out to examine whether color stimuli are also important in explaining behavior in the domain of investments or financial decision making.

A fundamental result in contemporaneous empirical research in color psychology is that different colors carry different communication values. In other words, color is not simply about aesthetics, but different colors have different meanings and associations. Color the-

orists have argued that color associations may partly emerge from evolutionarily ingrained responses to fitness-relevant color stimuli present in an individual's environment. For example, red is the color of objectively dangerous phenomena that humans encountered in early societies, such as blood or fire. Moreover, a red face may be caused by a testosterone surge in an attack-ready opponent (Mazur 2005; Archer 2006). Such biologically-based propensities may also be moderated by societal learning and repeated pairings of a color with an individual's experiences. For example, in many cultures, such conditioning begins in early schooling as students often receive feedback regarding academic errors in red color. In addition, in modern society, red is the prototypic color of sirens and stop signs.

Red is also used as a word in many different languages in a non-literal way, and even in the absence of any color per se, to refer to particularly dangerous situations that humans ought to avoid. Prominent examples from the domain of finance and investments include "in the red" to describe a company reporting financial losses, "red flags" to refer to various warning signs, e.g., in the aftermath of corporate governance failures, or "red herring" to characterize the preliminary prospectus a company uses when issuing securities to the public in the U.S. That is, there are many real-world examples from the finance industry where red is the color used to communicate caution or other danger-relevant concepts.

Modern economies have evolved in a way that requires individuals to make more difficult financial decisions with bigger consequences; simultaneously, improving technology has made financial transactions cheaper and easier (Campbell 2016). Moreover, investment decisions in the modern world are almost always made in environments that involve color stimuli. For instance, financial service providers supply a wealth of information to their users through stock performance graphs, portfolio pie charts, and other visualizations. Yet, it is only very recently that any research on the effect of color on investment behavior has emerged (Gnambs, Appel, and Oeberst 2015). From the perspective of neoclassical theories

in financial economics (Fama and Miller 1971; Fama 1976) this is natural and not surprising. The particular color used to visually represent financial information is a *seemingly irrelevant factor* (Thaler 2015). Investor behavior should not be impacted whether financial losses are represented in the color red, the color green, or any other color. In sharp contrast, empirical evidence in color psychology predicts a systematic relation between color and human behavior. It is, therefore, our task in this paper to estimate the effect of color on investment behavior using predictions based on research from outside the area of financial economics.

Through two experiments, we show that using red, compared to black or blue, to communicate financial losses makes individuals more risk averse, less likely to positively evaluate financial assets, and more pessimistic about future price changes in the stock market. We provide further support for our findings by showing that these effects do not hold for individuals who are colorblind.

Experiment 1 tested whether red color increases people's risk aversion in the domain of financial decision-making. Each participant was randomly assigned to one of three conditions: (i) black, where all the information was displayed in black (ii) red, where potential losses were shown in red while other information was displayed in black, and (iii) blue, where potential losses were shown in blue and other information was displayed in black. Participants subsequently made ten choices between paired lotteries. We find that the perception of the red color reduces the likelihood that an individual makes a risky financial choice by 11.40%.

In Experiment 2, we tested whether red color affects individuals' evaluations of risky financial assets, i.e., stocks of real companies. As in Experiment 1, participants were randomly assigned to one of the three color conditions. Participants were then presented with plots of historical stock prices and asked to report how they perceive each stock.

Specifically, each participant reported his or her (i) attitudes toward each stock (i.e., the extent to which the stock is good/bad and inferior/superior) and (ii) intention to purchase each stock. Additionally, participants were asked to use the charts before them to predict stock prices, six months into the future, for each stock according to three scenarios: (i) most likely price, (ii) best-case highest price, and (iii) worst-case lowest price. We find that red color, compared to black or blue, negatively affects financial judgments. Participants who viewed stock charts in red reported less positive attitudes towards the stock compared to those who saw them in black, as well as lower intentions to purchase the stock. Moreover, participants that viewed stock prices in red predicted lower future prices for all three scenarios. Interestingly, participants who viewed declining stock prices in red forecasted continuing price declines in their predictions of the most likely future prices; conversely, participants who viewed declining stock prices in black predicted price-trend reversals.

To provide further support for the role of color behind these effects, in Experiment 3, we use the same design as in Experiment 2 on a new sample of colorblind participants. Colorblindness, particularly red-green colorblindness, affects a substantial portion of the human population (Wong 2011). We conjecture that if the red color affects financial behavior, then participants who cannot see red should not exhibit the same behavioral effects. Colorblind participants who were shown negative-trending stock charts in red did not report less positive attitudes towards the stocks, nor lower intentions to purchase the stocks, compared to those who saw them in black. Similarly, there were no significant differences in predicted future prices across any of the three scenarios (most-likely stock price, high price, or low price) across any of the color conditions.

This study involves inter-disciplinary work, and contributes to several active research areas. First, a considerable amount of research in financial economics during the past couple of decades has uncovered a large number of different explanations for individuals'

investment behaviors and biases.[1] The evidence presented in this paper contributes to this literature by examining the role of visual features, particularly color, as a new and important explanation for the behavior of investors.

Second, our study shows that empirical predictions based on color psychology may partly explain human behavior in the domain of finance and investment decisions. In particular, our evidence shows that the color red results in avoidance behavior with respect to financial risk-taking, supporting pre-existing work in psychology. As a result, this work also contributes to the emerging research area of the effects of color on psychological functioning.

Third, we find that a distinction between financial data per se and the visual representation of such financial data is relevant when explaining investment behavior. This distinction has previously been ignored in finance research. In contrast with neoclassical models in financial economics (in which visual stimuli such as color are not relevant), we find that the way the very same financial data is visualized and represented to investors has systematic and significant effects on financial decision making. As a result, an important contribution of this study is to introduce frameworks from visual science into research in financial economics.

Finally, our findings hold practical implications. For example, our research suggests that individuals may be less likely to buy stocks when prices are low because this is when red color dominates media and online trading platforms. Yet, given that extreme losers outperform the market over the next several years (De Bondt and Thaler 1985; De Bondt and Thaler 1987), this may be an opportune moment to buy. At the same time, financial service providers could use these findings to better optimize their trading platforms to address these *hard-wired* biases of investors (Kahneman 2011), while federal organizations

[1]For comprehensive reviews of research related to individual investor behavior, we refer to Barberis and Thaler (2003), Campbell (2006), Benartzi and Thaler (2007), and Barber and Odean (2013).

can use our results to *nudge* people toward closer-to-optimal financial behavior (Thaler and Sunstein 2008).

The rest of the paper is organized as follows. Section 2 reviews pre-existing scientific work related to color psychology which is relevant for research on investment decisions. Section 3 reports our experimental design and findings. We conclude in Section 4 with a brief discussion.

2 The Psychology of Color

Every visual stimulus processed by the human perceptual system contains color information.[2] In this section, we review classical and contemporaneous work related to color and human behavior that is relevant for research in financial economics concerning investment decisions.[3] We also review research specifically related to the communication value of the color red. Finally, we develop our empirical predictions related to color in the particular domain of investment decisions.

We restrict our review to pre-existing research in color psychology, but it is important to emphasize that there exist robust and well-developed scientific work focusing on many other aspects of color. For example, color physics is concerned with the ways color, i.e., visible light with specific intensity and wavelength, is defined and modeled.[4] Color physiology studies the means through which the eye and the brain process and evaluate different color stimuli. Color linguistics is concerned with how different colors are described in

[2]Color may be defined in terms of three fundamental properties: hue, lightness, and chroma (Fairchild 2013). Variation in any of these properties may directly, or as a moderator, be expected to influence human affect, cognition, or behavior. Most research on color has so far focused on hue, which is therefore the main focus of our review of previous research and also what we study in this paper.

[3]For more comprehensive reviews of research related to color psychology, we refer to Elliot and Maier (2014), Elliot (2015), and Elliot, Fairchild, and Franklin (2016).

[4]Some research has proposed a relation between color psychology and color physics. For example, longer-wavelength colors (e.g., red) may be experienced as arousing, while shorter-wavelength colors (e.g., green) may be experienced as calming (Goldstein 1942; Stone and English 1998).

different languages. Other researchers study more practical aspects of color, e.g., color vision deficiency, color reproduction, and color appearance phenomena. In sum, research on color is conducted across many scientific fields.

Color research has also been conducted with a focus on business and consumer implications. One field where color has been examined in more detail is marketing; specifically, in research on the behavior of retail consumers (Bellizzi, Crowley, and Hasty 1983; Bellizzi and Hite 1992). With the rapid increase in the number of retail investors due to the emergence of defined contribution pension plans and privatized social security systems (Cronqvist and Thaler 2004; Benartzi and Thaler 2007), examining the effects of color on investment behavior is increasingly important in finance.

2.1 Color and Human Behavior

Different colors have different aesthetic values, i.e., color preferences vary in the cross-section of individuals (Palmer, Schloss, and Sammartino 2013), but recently amounting empirical evidence in color psychology also shows that colors carry different communication values. In other words, color is not simply about aesthetics, but different colors have different meanings and associations.

This raises the question of why different colors carry fundamentally different communication values. Two different channels have been proposed by pre-existing research. First, biologists and color theorists have argued that color associations may emerge from evolutionarily ingrained responses to fitness-relevant color stimuli present in an individual's environment (Mollon 1989). Some of these color cues may have been present in early human societies, thus propagating through evolutionary processes. Research also shows that colors often serve as a signal for non-human animals, thus promoting evolutionarily efficient behavior (Pryke 2009). Second, the meanings of different colors may originate

from repeat conditional pairings of a color with an individual's personal experiences. Such societal learning by repeat color associations may interact with and moderate biologically-based survival proclivities that are present at birth. As a result, individuals may become "prepared" to respond to a particular color in a specific way.

Exposure to color automatically starts evaluation processes in the human perceptual system. In fact, color computations are executed at an early level within the visual system, and these evaluation processes are so fundamental that they are also found in many animals (Schneirla 1959). That is, the process from evaluation of color stimuli to activation, and, in the end, the behavior of individuals, is evoked without complete awareness or conscious intent in an individual.[5] This automatic evaluation process started by color stimuli may result in differential behaviors, depending on the communication value of a particular color. Specifically, color stimuli which carry negative associations and may be perceived as representing danger are predicted to result in avoidance responses (Elliot, Maier, Moller, Friedman, and Meinhardt 2007). By contrast, colors cues that have a positive association are expected to produce affect and approach responses (Lichtenfeld, Elliot, Maier, and Pekrun 2012).

2.2 The Communication Value of Red Color

In many common situations in modern society, red is the color used to communicate caution or other danger-relevant concepts. In particular, red is the prototypic color of alarms, sirens, stop signs, and warning signals that convey danger and the need for attention and vigilance. This red-danger relation is codified in the warning systems of a number of public organizations. For example, red was used to signal "severe risk" in the U.S. Homeland Se-

[5]From a physiological perspective, color affects the release of hormones. Specifically, color perception stimulates the neural portion of the optical pathway to the hypothalamic brain region and into the pineal and pituitary glands, which control the entire endocrine system (Mahnke 1996).

curity's color-coded terrorism threat advisory system (Mayhorn, Wogalter, and Bell 2004), the "Tzeva Adom" (meaning red color in Hebrew) is the early-warning system used in Israel to communicate information about incoming missiles, and the Moscow-Washington hotline was referred to as the "red phone" during the Cold War, though a red phone was actually never used.

There are two theoretical explanations for why red color communicates caution and may increase vigilance. First, an evolutionary biology model may partly explain why red is a sign of danger in many societies. Red is the color of objectively dangerous phenomena that individuals encountered also in early societies, such as blood or fire (Changizi, Zhang, and Shimojo 2006; Changizi 2010). In addition, in many non-human primates, the display of bright red on the body is a signal of the dominance, aggressiveness, or attack-readiness of an opponent (Gerald 2003; Setchell 2005; Pryke 2009). Similarly, in humans, red on the face signals anger and aggressiveness and may serve as a testosterone-based signal of dominance (Mazur 2005; Archer 2006). Exposure to such critical, fitness-relevant color stimuli may create an implicit red-danger association in humans. That is, humans may naturally be endowed with a biological predisposition to associate red with a need for increased attention and vigilance.[6]

Second, social learning and repeat conditional pairings of the color red with an individual's personal experiences may also contribute to the creation of a significant red-danger association. For example, in many cultures, such conditioning starts in early schooling as students receive feedback regarding academic errors in red color (Elliot, Maier, Moller, Friedman, and Meinhardt 2007). That is, the red-danger association may be rooted in so-

[6]Theorists have argued that trichromatic vision evolved to enable primates, such as humans, to sense changes in blood flow beneath the skin that convey critical information about the emotional and physical condition of a conspecific. For example, increased reddish skin color, caused by blood oxygenation, may signal anger or sexual arousal, whereas increased greenish color of the skin may convey illness or a poor physiological state. That is, human color vision may significantly improve various forms of social interactions in a society.

cial learning processes that may, at least in part, moderate evolutionarily engrained human predispositions.

Contemporaneous research in color psychology shows that the effect of color on the behavior of individuals is situation-specific. That is, the physical and psychological context in which color is perceived may influence its meaning and an individual's response to it. For example, in mating situations red may be used by women to signal sexual readiness to men. For example, several studies find that women expecting to converse with an attractive man, relative to an unattractive man, an attractive woman, or an average woman, were more likely to choose to wear red for the conversation (Elliot and Niesta 2008; Elliot, Niesta Kayser, Greitemeyer, Lichtenfeld, Gramzow, Maier, and Liu 2010).[7] Beall and Tracy (2013) report that women at peak fertility are more likely to wear reddish clothing than women not at peak fertility. Guéguen (2012) find that women wear more red cosmetics when near the midpoint of their cycle.

2.3 Empirical Predictions

Research involving humans has shown that encountering a negative object, event, or possibility, automatically evokes a behavior of avoiding the object, event, or possibility (Cacioppo and Gardner 1999). In addition, pre-existing research in color psychology has shown that red color, because of its association with danger and mistakes, activate such avoidance-based processes and behavior, i.e., results in appeasement and behavioral evasion (Elliot, Maier, Moller, Friedman, and Meinhardt 2007).

Based on the aforementioned literature, we conjecture that perception of red color will affect an individual's financial decisions. First, in line with the avoidance-based process,

[7]There is also empirical evidence which shows that men respond differently to red color in mating situations. For example, Guéguen (2012) report that red lipstick increases men's solicitations of women sitting at a bar. Guéguen and Jacob (2013) show that red enhances men's attraction to women's personal ads on the Internet.

we predict that viewing red color in a financial context will increase the individual's risk aversion. Second, we conjecture that perception of red color in financial visualizations will induce less-positive judgements, relative to judgements based on the perception of financial data in other colors, from individuals.

3 Experiments

In the following section, we present the design and findings from three experiments conducted to examine the effects of red color on individuals' financial decisions. In Experiment 1, we examine the effects of red color on risky choice. In Experiment 2, we study the effects of red color on individuals' judgements of financial assets - the stocks of real companies. Finally, in Experiment 3, we recruit a new sample of colorblind participants and re-perform Experiment 2.

3.1 Experiment 1

Design

In Experiment 1, we test whether red color increases individuals' risk aversion in the domain of financial decision-making. To test for potential effects of red color on risky choices, we construct a series of ten paired lotteries in the spirit of Holt and Laury (2002). Participants are then randomly presented with the paired lotteries and asked to select their desired lottery. For example, participants were asked to choose between a lottery with an 80% chance of gaining \$2.00 and a 20% chance of losing \$1.50, and a lottery with an 80% chance of gaining \$4.00 and a 20% chance of losing \$5.00. The lottery design satisfies the two main criteria for risk: utility impactful outcomes and uncertainty over such outcomes (Holton 2004). We present the full series of lotteries in the appendix.

Prior to the lottery task, we randomly assign each participant to one of three conditions:

(1) black, where all the information was displayed in black (RGB: 0, 0, 0), (2) red, where potential losses were shown in red (RGB: 237, 28, 36) while other information was displayed in black, and (3) blue, where potential losses were shown in blue (RGB: 0, 0, 255) and other information was displayed in black. The blue condition served as a control condition to test for a general salience effect of using a color other than black to communicate potentially negative payoffs.

To implement the experiment, we recruit a sample of 150 non-colorblind adults through the Amazon Mechanical Turk website (Buhrmester, Kwang, and Gosling 2011; Paolacci, Chandler, and Ipeirotis 2010).[8] We present brief summary statistics for the study participants in Table 1. Specifically, in column (1), we find that 57 of the participants are female and the mean age is 32 years. The experiment lasted approximately ten minutes and participants were compensated \$0.90, a competitive pay rate given the duration of the task. After the lottery task, two colorblindness checks were performed with no participants indicating colorblindness. Finally, demographic and risk preference information (Weber, Blais, and Betz 2002) were collected.

Findings

We find that participants who were shown potential losses in red exhibited more risk averse behavior. That is, as shown in Figure 1, participants in the red condition chose riskier lotteries less frequently (28.24 $\pm$ 3.56%), than those who viewed them in black (39.40 $\pm$ 4.53%; t-statistic = 1.94). In contrast, there was no difference in the frequency with which participants chose the riskier lotteries when the potential losses were shown in black vs. blue (39.59 $\pm$ 4.60%; t-statistic = 0.03).

To further examine the effect of the red color and control for heterogeneity in demographics, we conduct regression analysis. We present the results in Table 2. We find that

[8]The Institutional Review Board at the university approved the procedures used in Experiment 1.

the effect of the red condition on lottery choices persists when controlling for a set of standard demographic characteristics. Specifically, the estimates in column (2) of panel A suggest that red color reduces the likelihood that an individual makes a risky financial choice by 11.40% (t-statistic = 1.88). Consistent with the univariate analysis, we find no effect of the blue color on lottery choice in column (2) of panel B.

3.2 Experiment 2

Design

In Experiment 2, we test whether red color affects individuals' evaluations of risky financial assets, i.e., stocks of real companies. This study was motivated by the observation that some providers of financial information display negative (positive) stock prices trends in red (green) color, while others use black or blue color, as shown in Figure 2. To examine the effects of red color, we plot historical stock prices of three randomly selected companies: Hyatt Hotels, Netflix, and Yahoo, over two different 52-week periods: one over which the stock experienced a positive annual return and one over which a negative annual return was realized. We thus create a total of six trials. We present brief summary statistic of the stocks used in Experiment 2 in Table 3.

Prior to conducting the stock chart task, we randomly assign each participant to one of the three color conditions: (1) black (RGB: 0, 0, 0), where all line graphs for the stock charts were shown in black, (2) red (RGB: 165, 40, 48) / green (RGB: 0, 105, 62), where stocks with a negative annual return were displayed in red while the alternative positive return period was shown in green, and (3) blue (RGB: 104, 194, 253), where all line graphs for the stock charts were shown in blue. In the interest of ecological validity, the specific RGB codes were chosen to match those used by two prominent sources of financial services: Charles Schwab & Co., a large U.S. brokerage with both a physical and online presence,

and Yahoo Inc., a prominent online financial news provider. Thus, we use the actual colors that investors see in the course of investment decision-making.

We randomly present the stock charts to participants and elicit perceptions of each stock. Specifically, participants we asked to report their (i) attitudes toward each stock (i.e., the extent to which the stock is good/bad and inferior/superior, each on a scale ranging from 1 to 9) and (ii) intentions to purchase each stock (on a scale ranging from 1 to 9). Additionally, participants used the stock charts to predict stock prices, six months into the future, for each stock according to three scenarios: (i) most likely price, (ii) best-case highest price, and (iii) worst-case lowest price.

To implement the experiment, we recruit a new sample of 300 participants through the Amazon Mechanical Turk website.[9] We retain 290 participants after eliminating individuals for incorrect answers on the colorblindness checks and for providing outlying price forecasts, such as negative values or verbal descriptions of future stock price movements as opposed to numeric forecasts. We present brief summary statistics for the study participants in Table 1. Specifically, in column (2), we find that 108 of the participants are female and the mean age is 32 years. The experiment lasted approximately 15 minutes and participants were compensated $1.00, a competitive pay rate given the duration of the task. After the stock chart task, two colorblindness checks were performed. Finally, demographic and risk preference information (Weber, Blais, and Betz 2002) were collected.

Findings

We summarize univariate findings from Experiment 2 in Figure 3. We find that red color, compared to black or blue, negatively affects financial judgments. Specifically, in panel A of Figure 3, we find that participants who viewed negative-trend stock charts in red reported less positive attitudes towards the stock (3.06 ± 0.10) compared to those

[9]The Institutional Review Board at the university approved the procedures used in Experiment 2.

who saw them in black (3.43 ± 0.10; t-statistic = 2.60). Moreover, participants in the red condition reported lower intentions to purchase the stock (2.68 ± 0.16 vs. 3.17 ± 0.17, t-statistic = 2.07). We find no such differences in participants' reported attitudes (3.43 ± 0.17; t-statistic = 0.01) or intentions to purchase (3.15 ± 0.16; t-statistic = 0.06) between the blue and black conditions.

We perform regression analysis over the reported attitudes toward the stocks and intentions to purchase and present the estimates in Table 4. In columns (2) and (4) of panel A, we find that the effects of red color persist for both attitudes toward the stocks and intentions to purchase when controlling for demographic characteristics, respectively. Moreover, the effects of the color red persist for individuals who report investing in the stock market. We do not find significant effects for the color blue relative to black, in panel B, for either attitudes toward the stocks or intentions to purchase.

Panel B of Figure 3 shows that participants who viewed stock prices in red, compared to black, forecasted lower future prices in all three scenarios. Specifically, for the most-likely scenario, the mean normalized price forecast of participants in the red condition was 0.91 while the mean forecast of participants in the black condition was 1.09 (t-statistic = 2.71). Moreover, participants in the red condition also forecasted lower prices in the worst-case price scenario (red: 0.40 ± 0.03; black: 0.53 ± 0.03; t-statistic = 3.47) and in the best-case price (red: 1.70 ± 0.08; black: 1.88 ± 0.07; t-statistic = 1.68). Interestingly, participants who viewed declining stock prices in red predicted continuing price declines in their forecasts of most likely future stock prices, while participants that viewed declining stock prices in black predicted price-trend reversals.

To further examine the effects of red color, we perform regression analysis over participants' price forecasts. We present the estimates in Table 5. In panel A, we find that the effects of red color are significant for all three price forecast scenarios. Moreover, the effects

of the red color persist for individuals who report investing in the stock market. We do not find significant effects for the color blue relative to black, in panel B, for any forecast scenario.

Finally, the use of historical stock prices of actual companies enable us to compare participants' price predictions to the actual stock prices six months later. We compute a participant-level forecast error for each stock-scenario combination as the difference between scenario-specific predicted price and the actual realized price six months later, normalized by the year-end price. Therefore, a negative (positive) forecast error indicates that the forecast price is lower (higher) than the realized price. In panel C of Figure 3, we find that red color increases the discrepancy between the forecasted prices and the actual realized prices. For example, for the most-likely price scenario, participants who viewed stock charts in red predicted prices that were lower than the actual stock price six months later.

Importantly, in the most-likely and worst-case price scenarios, the stock price forecast errors of participants who viewed stock charts in red were larger than those of people who viewed stock charts in black. For instance, for the most-likely price scenario, we find that participants in the red condition display a normalized price forecast error of -0.18 while participants in the black condition display a error of 0.00 (t-statistic = 2.71). For the best-case scenario, participants in all conditions over-estimated future prices. But, those who viewed prices in red made smaller errors (0.62 ± 0.08) compared to those who viewed stock charts in black (0.79 ± 0.07; t-statistic = 1.68). At the same time, no significant differences between the blue and black conditions were found for any of the price prediction scenarios (all $P > 0.10$).

We conduct regression analysis of participants' forecast errors and present the estimates in Table 6. In panel A, we find that the effects of red color are significant across all three

forecast scenarios. In contrast, in panel B, we observe no significant effects for the color blue relative to black.

3.3 Experiment 3

Design

The foregoing studies show that red color affects how people evaluate financial assets and how they make financial decisions. To provide further support for the role of color behind these effects, we use the same design as in Experiment 2 on a new sample of colorblind participants. Colorblindness, particularly red-green colorblindness, affects a substantial portion of the human population (Wong 2011)[10]. We reasoned that if red affects financial behavior, then participants who cannot see red (as shown in a simulation of colorblindness in Figure 4), should not exhibit the same behavioral effects. To test this hypothesis, we recruited 300 colorblind individuals through the Amazon Mechanical Turk website and randomly assigned each participant to one of the three color conditions (black, red / green or blue).[11] We retain 221 participants after excluding individuals who provided outlying price forecasts, did not complete the study, or did not correctly answer the attention check question. Overall, we find that the demographics of the sample of colorblind participants are similar to those of the participants in Experiment 2.

Findings

Colorblind participants who were shown negative-trending stock charts in red did not report less positive attitudes towards the stocks (3.39 ± 0.17) compared to those who saw them in black (3.48 ± 0.13; t-statistic = 0.39), nor lower intentions to purchase the stock (3.26 ± 0.19 vs. 3.42 ± 0.19, t-statistic = 0.57). No differences were found between the

[10]The common form of red-green colorblindness is estimated to affect approximately 8% of men and 0.5% of women with Northern European ancestry (Wong 2011; Albrecht 2010).

[11]The Institutional Review Board at the university approved the procedures used in Experiment 3.

black and blue conditions either (Attitudes: 3.72 ± 0.15; t-statistic = 1.22; Intentions: 3.44 ± 0.19; t-statistic = 0.099). Similarly, there were no significant differences in predicted future prices across any of the three scenarios (most-likely stock price, high price, or low price) across any of the color conditions. Finally, red color did not affect the stock price forecast errors of the colorblind participants for any of the future price prediction scenarios.

We present regression estimates for attitudes towards the stocks and intentions to purchase, price forecasts, and price forecast errors in Tables 7, 8, and 9, respectively. Consistent with the aforementioned univariate analysis, we do not find the red color to have significant effects. Overall, our results suggest that red color does not influence the financial decision making of colorblind individuals.

3.4 Effects of the Green Color

While the focus of the current paper is to examine how use of the red color to communicate financial losses or negative price trends influences financial behavior, for completeness we also collect data on using the green color to communicate financial gains in Experiment 2. We here provide a brief summary of the results.

We do not find using green color, versus black, to communicate gains to have significant effect on financial judgments. For example, the green color does not influence attitudes toward the stock (M_{Black} = 7.05, M_{Green} = 7.22; t-statistic = 1.54) nor intentions to purchase the stock (M_{Black} = 6.57; M_{Green} = 6.65; t-statistic = 0.40). A similar analysis was conducted for normalized price forecasts for positive price-trend stocks across the three scenarios: the most-likely price, highest-price, and lowest-price predictions. Conveying financial information in green does not significantly influence future price forecasts under any scenario. Further, we find no significant differences between price forecasts across color conditions for any of the price forecast scenarios. Finally, forecast errors were calculated

relative to the realized prices for positive price-trend stocks analogously to the negative price-trend stocks. We find no significant effects in any of the forecast scenarios. We summarize the regression estimates of using green color to communicate financial gains in the appendix.

4 Conclusions

Investment decisions in the modern world commonly involve evaluation and processing of visual financial data and information, yet, recent research shows that visual features influence decision making in general (Towal, Mormann, and Koch 2013). Research in financial economics has so far largely ignored the effects of different visual features on investment behavior. Our studies provide consistent evidence that red color affects perceptions of financial information and financial judgments: red color makes people more risk averse and more pessimistic about the quality of financial assets and their future values. Based on the literature from psychology (Elliot, Maier, Moller, Friedman, and Meinhardt 2007), this is likely because red color activates an avoidance mechanism and signals danger to investors.

Our findings extend the prior literature which shows that seemingly irrelevant factors (Kahneman and Tversky 1979; Thaler 2015) affect economic behavior. In addition, recent research has shown that stimuli that are visually salient affect economic choices because they amplify the valuation of the same stimuli (Towal, Mormann, and Koch 2013). Our results contribute to this line of research by showing that other stimulus-based properties, such as the color of stimuli, can negatively affect the value assigned to these stimuli.

Our work also carries noteworthy practical implications. For example, our research suggests that individuals may be less likely to buy stocks when prices are low because this is when red color dominates media and online trading platforms. Yet, this may be the right time to buy, as suggested by the previous literature which argues that extreme losers

outperform the market over the next several years (De Bondt and Thaler 1985; De Bondt and Thaler 1987). At the same time, financial service providers could use these findings to better optimize their trading platforms to address these *hard-wired* biases of investors (Kahneman 2011), while federal organizations can use it to *nudge* people toward closer-to-optimal financial behavior (Thaler and Sunstein 2008). Our findings have a number of public policy implications as well.

This paper is just scratching the surface and opens the door for further detailed examination of the importance of data visualization in investment and other financial decisions (e.g., savings). While this paper is one of the first attempts to introduce frameworks from visual science to enhance our understanding of investment decisions, and while this paper has focused on one specific visual feature, we expect future work to shed new light on other important aspects related to perceptual processes and investment behavior.

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Figure 1: Percent Riskier Lottery Choice

The bars show the mean percent of riskier lottery choice by color condition. Error bars show mean ± standard error.

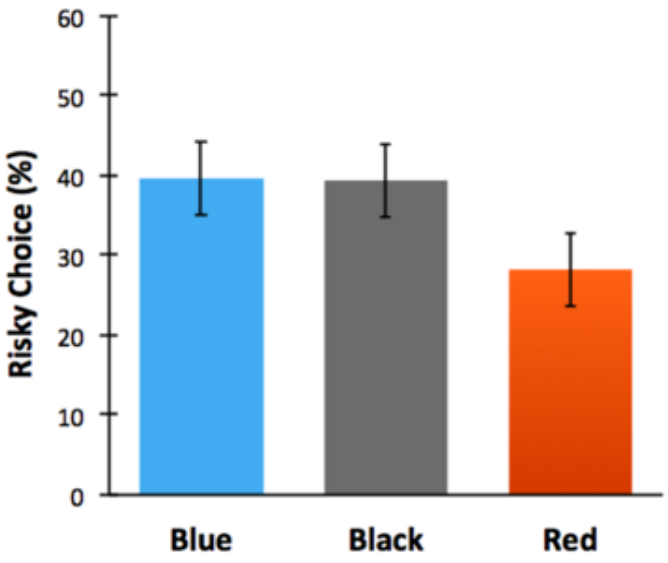
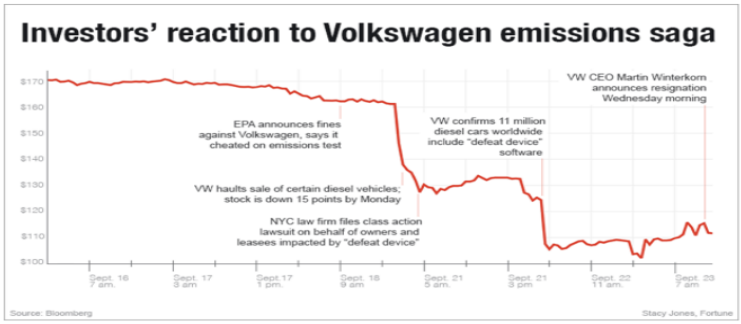


Figure 2: Financial Information Examples

The figures reports three examples of media reports of a decline in the stock price of Volkswagen AG. Panel A: Stock chart from Fortune.com. Panel B: stock chart from Yahoo.com. Panel C: stock chart from Volkswagenag.com.

(A)



Source: fortune.com

(B)

Source: yahoo.com

(C)

Source: volkswagenag.com

Figure 3: Color Affects Financial Judgments

The bars show the mean rating and forecasts by color condition. Panel A: attitudes toward the stock and intentions to purchase. Panel B: future price predictions. Panel C: the difference between predicted and actual stock prices. Error bars show mean ± standard error.

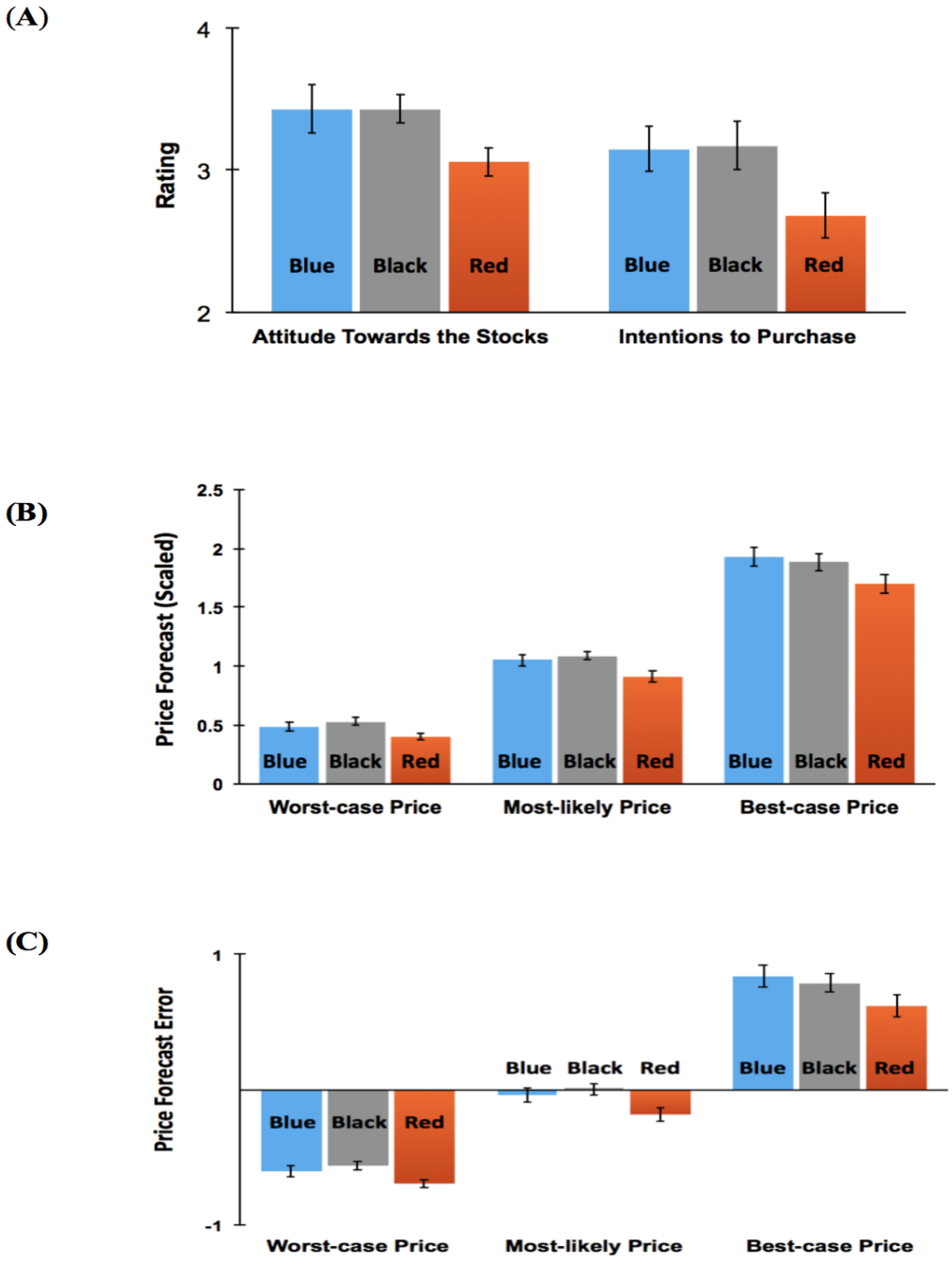


Figure 4: Colorblind Simulation of Stock Charts

The figure presents a simulation of the perception of the stock charts by a colorblind participant. Panel A (B; C) presents a stock chart for the black (red; blue) color condition. Source: www.color-blindness.com/coblis-color-blindness-simulator

Table 1: Participant Summary Statistics

The table presents summary statistics for participants in the experiments. Column 1 reports statistics for participants in Experiment 1. Column 2 reports statistics for participants in Experiment 2. Column 3 reports statistics for participants in Experiment 3. Standard deviations are presented in parentheses. Female reports the number of female participants. Education and Income categories reports the percentage of participants within each respective category.

	(1) Experiment 1	(2) Experiment 2	(3) Experiment 3
Age (years)	32	32	33
	(11.20)	(10.10)	(8.21)
Female	57	108	39
Education (%)			
Some High School	0.67	1.38	0.00
High School	12.67	10.34	14.03
Some College	28.00	30.34	26.70
Undergraduate Degree	42.67	40.34	35.75
Professional Degree	4.00	6.21	9.50
Master's Degree	9.33	10.00	10.41
Doctoral Degree	2.00	1.03	1.36
Not Applicable	0.67	0.34	2.26
Income (%)			
$0 - $25,000	27.33	20.00	15.38
$25,001 - $40,000	19.33	23.79	27.60
$40,001 - $60,000	22.00	23.45	21.27
$60,001 - $80,000	12.00	11.72	15.84
$80,001 - $100,000	7.33	8.28	4.98
$100,001 - $150,000	6.67	8.97	7.69
+$150,000	2.67	1.72	2.71
Not Applicable	2.67	2.07	4.52
No. Participants	150	290	221

Table 2: Percent Riskier Lottery Choice

The table presents OLS regressions of the percentage of riskier lottery choice per color condition. Panel A (B) presents analysis between red (blue) and black conditions wherein the Color Condition equals one if the participant is in the red (blue) condition and zero in the black condition. Invest in Market is an indicator equal to one if the participant invests in the stock market. All regressions include robust standard errors. T-statistics are presented in parentheses while *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Panel A (Red)		Panel B (Blue)	
	(1)	(2)	(1)	(2)
Color Condition	-0.112*	-0.114*	0.002	0.018
	(-1.94)	(-1.88)	(0.03)	(0.25)
Male		0.037		-0.006
		(0.58)		(-0.08)
Age		-0.009		0.018
		(-0.28)		(0.50)
Education		0.008		-0.003
		(0.33)		(-0.09)
Invest in Market		-0.021		-0.116
		(-0.31)		(-1.36)
Income		-0.030*		0.002
		(-1.70)		(0.08)
Risk Tolerance		0.188**		0.091
		(2.57)		(1.23)
Constant	0.394***	0.050	0.394***	0.210
	(8.70)	(0.24)	(8.70)	(0.91)
No. Obs.	101	97	99	96
Adj. R^2	0.027	0.071	-0.010	-0.028

Table 3: Summary of Stocks

The table presents summary statistics of the stocks used to create the charts of historical stock prices in Experiment 2.

Company	Price Trend	Year	Initial Price ($)	Ending Price ($)	Standard Deviation	Capital Gain-Loss (%)	Six-month Realized Price ($)
Hyatt Hotels Corp.	Positive	2014	49.80	60.21	4.24	20.90	56.69
	Negative	2011	47.00	37.63	5.39	-19.92	37.16
Netflix Inc.	Positive	2013	95.98	368.17	75.80	283.59	440.60
	Negative	2011	175.70	68.29	70.79	-61.13	68.49
Yahoo! Inc.	Positive	2013	19.86	40.44	6.01	103.63	35.13
	Negative	2008	23.16	12.20	6.31	-47.32	15.66

Table 4: Attitudes Toward and Intentions to Purchase Negative Price-trend Stocks by Color Condition

The table presents OLS regressions of reported attitude and intentions to purchase the stocks. Panel A (B) presents analysis between red (blue) and black conditions wherein the variable Color Condition equals one if the participant is in the red (blue) condition and zero if in the black condition. Market Familiarity measures the degree to which the participant reported being familiar with the stock market. Invest in Market is an indicator equal to one if the participant invests in the stock market and zero otherwise. All regressions include robust standard errors. T-statistics are presented in parentheses while *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Panel A (Red)				Panel B (Blue)			
	Attitude		Intent to Purchase		Attitude		Intent to Purchase	
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Color Condition	-0.369**	-0.310**	-0.492**	-0.404*	-0.002	-0.008	-0.015	-0.067
	(-2.60)	(-2.14)	(-2.09)	(-1.70)	(-0.01)	(-0.05)	(-0.06)	(-0.30)
Male		-0.203		-0.332		-0.020		0.091
		(-1.20)		(-1.29)		(-0.12)		(0.39)
Age		-0.039		-0.007		0.003		0.045
		(-0.58)		(-0.06)		(0.02)		(0.37)
Education		-0.098		0.012		0.113		0.269***
		(-1.38)		(0.12)		(1.59)		(2.64)
Income		0.084		0.021		-0.024		-0.115*
		(1.64)		(0.25)		(-0.45)		(-1.70)
Market Familiarity		-0.041		0.074		0.071		0.150
		(-0.55)		(0.61)		(0.73)		(1.19)
Invest in Market		0.635***		1.231***		0.339		0.717**
		(3.01)		(3.73)		(1.41)		(2.25)
Risk Tolerance		0.089		0.542*		0.246		0.706**
		(0.52)		(1.84)		(1.04)		(2.21)
Constant	3.433***	3.435***	3.170***	1.811***	3.433***	2.431***	3.170***	0.679
	(34.88)	(8.49)	(18.75)	(2.67)	(34.89)	(4.40)	(18.76)	(0.95)
No. Obs.	191	179	191	179	201	192	201	192
Adj. R^2	0.029	0.107	0.017	0.146	-0.005	0.030	-0.005	0.142

Table 5: Price Forecasts of Negative Price-trend Stocks

The table presents OLS regressions of reported attitudes toward the stocks and intentions to purchase the stocks. Panel A (B) presents analysis between red (blue) and black conditions wherein the variable Color Condition equals one if the participant is in the red (blue) condition and zero if in the black condition. Market Familiarity measures the degree to which the participant reported being familiar with the stock market. Invest in Market is an indicator equal to one if the participant invests in the stock market and zero otherwise. All regressions include robust standard errors. T-statistics are presented in parentheses while *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Panel A (Red)						Panel B (Blue)					
	Worst-case		Most-likely		Best-case		Worst-case		Most-likely		Best-case	
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Color Condition	-0.133***	-0.118***	-0.179***	-0.155**	-0.175*	-0.178*	-0.040	-0.013	-0.040	-0.024	0.050	0.035
	(-3.45)	(-3.03)	(-2.69)	(-2.53)	(-1.66)	(-1.74)	(-0.89)	(-0.24)	(-0.60)	(-0.36)	(0.47)	(0.31)
Male		-0.058		0.012		0.108		-0.050		0.072		0.024
		(-1.42)		(0.17)		(0.98)		(-0.81)		(0.91)		(0.20)
Age		0.025		-0.029		-0.045		0.013		-0.044		-0.082
		(1.11)		(-0.98)		(-0.86)		(0.52)		(-1.59)		(-1.48)
Education		-0.010		-0.017		0.020		0.0004		0.027		0.065
		(-0.62)		(-0.64)		(0.48)		(0.02)		(0.88)		(1.25)
Income		-0.012		0.027		0.034		0.018		0.010		-0.042
		(-1.00)		(1.15)		(0.91)		(0.68)		(0.34)		(-1.04)
Market Familiarity		0.002		-0.026		-0.080		-0.016		-0.032		-0.063
		(0.12)		(-0.76)		(-1.55)		(-0.86)		(-0.93)		(-1.05)
Invest in Market		0.168***		0.246***		0.260*		0.117**		0.155*		0.089
		(3.30)		(2.82)		(1.91)		(2.12)		(1.96)		(0.63)
Risk Tolerance		-0.061*		0.051		0.262**		-0.054*		-0.033		0.026
		(-1.79)		(0.86)		(2.00)		(-1.66)		(-0.50)		(0.22)
Constant	0.530***	0.637***	1.089***	0.974***	1.878***	1.314***	0.530***	0.558***	1.089***	1.045***	1.878***	1.938***
	(20.85)	(6.27)	(25.10)	(6.20)	(28.15)	(4.06)	(20.85)	(5.32)	(25.10)	(6.17)	(28.16)	(5.38)
No. Obs.	191	179	191	179	191	179	201	192	201	192	201	192
Adj. R^2	0.055	0.124	0.032	0.100	0.009	0.066	-0.001	0.014	-0.003	-0.003	-0.004	-0.012

Table 6: Price Forecast Errors for Negative Price-trend Stocks

The table presents OLS regressions of price forecasts errors. Panel A (B) presents analysis between red (blue) and black conditions wherein the variable Color Condition equals one if the participant is in the red (blue) condition and zero if in the black condition. Market Familiarity measures the degree to which the participant reported being familiar with the stock market. Invest in Market is an indicator equal to one if the participant invests in the stock market and zero otherwise. All regressions include robust standard errors. T-statistics are presented in parentheses while *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Panel A (Red)						Panel B (Blue)					
	Worst-case		Most-likely		Best-case		Worst-case		Most-likely		Best-case	
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Color Condition	-0.133***	-0.118***	-0.179***	-0.155**	-0.175*	-0.178*	-0.040	-0.013	-0.040	-0.024	0.050	0.035
	(-3.45)	(-3.03)	(-2.69)	(-2.53)	(-1.66)	(-1.74)	(-0.89)	(-0.24)	(-0.60)	(-0.36)	(0.47)	(0.31)
Male		-0.058		0.012		0.108		-0.050		0.072		0.024
		(-1.42)		(0.17)		(0.98)		(-0.81)		(0.91)		(0.20)
Age		0.025		-0.029		-0.045		0.013		-0.044		-0.082
		(1.11)		(-0.98)		(-0.86)		(0.52)		(-1.59)		(-1.48)
Education		-0.010		-0.017		0.020		0.0004		0.027		0.065
		(-0.62)		(-0.64)		(0.48)		(0.02)		(0.88)		(1.25)
Income		-0.012		0.027		0.034		0.018		0.010		-0.042
		(-1.00)		(1.15)		(0.91)		(0.68)		(0.34)		(-1.04)
Market Familiarity		0.002		-0.026		-0.080		-0.016		-0.032		-0.063
		(0.12)		(-0.76)		(-1.55)		(-0.86)		(-0.93)		(-1.05)
Invest in Market		0.168***		0.246***		0.260*		0.117**		0.155*		0.089
		(3.30)		(2.82)		(1.91)		(2.12)		(1.96)		(0.63)
Risk Tolerance		-0.061*		0.051		0.262**		-0.054*		-0.033		0.026
		(-1.79)		(0.86)		(2.00)		(-1.66)		(-0.50)		(0.22)
Constant	-0.557***	-0.450***	0.002	-0.112	0.792***	0.228	-0.557***	-0.529***	0.002	-0.041	0.792***	0.852**
	(-21.92)	(-4.43)	(0.05)	(-0.71)	(11.87)	(0.70)	(-21.92)	(-5.04)	(0.05)	(-0.24)	(11.87)	(2.36)
No. Obs.	191	179	191	179	191	179	201	192	201	192	201	192
Adj. R^2	0.055	0.124	0.032	0.100	0.009	0.066	-0.001	0.014	-0.003	-0.003	-0.004	-0.012

Table 7: Perceptions of and Intentions to Purchase Negative Price-trend Stocks of Colorblind Participants

The table presents OLS regressions of reported attitudes toward the stocks and intentions to purchase the stocks by colorblind participants. Panel A (B) presents analysis between red (blue) and black conditions wherein the variable Color Condition equals one if the participant is in the red (blue) condition and zero if in the black condition. Market Familiarity measures the degree to which the participant reported being familiar with the stock market. Invest in Market is an indicator equal to one if the participant invests in the stock market and zero otherwise. All regressions include robust standard errors. T-statistics are presented in parentheses while *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Panel A (Red)				Panel B (Blue)			
	Attitude		Intent to Purchase		Attitude		Intent to Purchase	
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Color Condition	-0.041	-0.063	-0.078	-0.084	0.244	0.196	0.026	0.051
	(-0.38)	(-0.55)	(-0.58)	(-0.61)	(1.23)	(0.95)	(0.10)	(0.18)
Male		-0.188		0.235		-0.197		0.033
		(-0.63)		(0.72)		(-0.76)		(0.10)
Age		-0.028		0.007		-0.011		0.057
		(-0.43)		(0.09)		(-0.18)		(0.69)
Education		0.075		0.055		0.055		0.057
		(1.26)		(0.61)		(0.96)		(0.66)
Income		0.016		-0.012		-0.020		0.004
		(0.24)		(-0.13)		(-0.30)		(0.05)
Market Familiarity		0.250***		0.207		0.238***		0.195
		(2.88)		(1.55)		(2.74)		(1.43)
Invest in Market		0.199		0.385		0.164		0.397
		(0.85)		(1.25)		(0.69)		(1.24)
Risk Tolerance		0.730**		0.725**		0.622**		0.627**
		(2.51)		(2.25)		(2.52)		(2.19)
Constant	3.516***	0.606	3.494***	0.106	3.232***	0.846	3.390***	0.103
	(16.84)	(0.71)	(11.73)	(0.10)	(10.90)	(1.01)	(8.06)	(0.10)
No. Obs.	141	130	141	130	155	139	155	139
Adj. R^2	-0.006	0.125	-0.005	0.051	0.003	0.119	-0.006	0.046

Table 8: Price Forecasts of Negative Price-trend Stocks by Colorblind Participants

The table presents OLS regressions of reported price forecasts by colorblind participants. Panel A (B) presents analysis between red (blue) and black conditions wherein the variable Color Condition equals one if the participant is in the red (blue) condition and zero if in the black condition. Market Familiarity measures the degree to which the participant reported being familiar with the stock market. Invest in Market is an indicator equal to one if the participant invests in the stock market and zero otherwise. All regressions include robust standard errors. T-statistics are presented in parentheses while *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Panel A (Red)						Panel B (Blue)					
	Worst-case		Most-likely		Best-case		Worst-case		Most-likely		Best-case	
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Color Condition	-0.026	-0.030	-0.018	-0.039	-0.064	-0.095	0.012	0.016	0.109	0.100	0.105	0.093
	(-1.00)	(-1.08)	(-0.42)	(-0.91)	(-1.14)	(-1.51)	(0.19)	(0.28)	(1.26)	(1.07)	(0.77)	(0.62)
Male		0.042		0.144		0.187		-0.091		-0.242*		-0.181
		(0.57)		(1.55)		(1.07)		(-1.31)		(-1.89)		(-1.12)
Age		0.036**		0.066***		0.003		0.013		0.009		-0.015
		(2.42)		(2.69)		(0.09)		(0.96)		(0.36)		(-0.40)
Education		-0.005		0.002		0.048		0.008		0.024		0.043
		(-0.27)		(0.06)		(1.18)		(0.49)		(0.79)		(0.90)
Income		-0.001		0.013		0.008		-0.017		0.006		0.012
		(-0.09)		(0.52)		(0.22)		(-1.04)		(0.22)		(0.32)
Market Familiarity		0.026		0.006		-0.049		0.033		0.026		-0.014
		(1.11)		(0.15)		(-0.95)		(1.51)		(0.62)		(-0.23)
Invest in Market		0.019		-0.043		-0.035		0.019		0.062		0.123
		(0.35)		(-0.44)		(-0.28)		(0.31)		(0.57)		(0.78)
Risk Tolerance		0.090**		0.230**		-0.044		0.187**		0.222*		0.188
		(2.04)		(2.03)		(-0.40)		(2.40)		(1.78)		(1.03)
Constant	0.589***	0.094	1.114***	0.197	1.983***	1.932***	0.551***	0.017	0.988***	0.360	1.814***	1.265*
	(9.65)	(0.41)	(11.93)	(0.42)	(15.97)	(3.89)	(6.08)	(0.06)	(7.38)	(0.73)	(9.45)	(1.68)
No. Obs.	141	130	141	130	141	130	155	139	155	139	155	139
Adj. R^2	-0.000	0.023	-0.006	0.064	0.002	-0.014	-0.006	0.062	0.004	0.041	-0.003	-0.022

Table 9: Price Forecast Errors for Negative Price-trend Stocks by Colorblind Participants

The table presents OLS regressions of price forecasts errors by colorblind participants. Panel A (B) presents analysis between red (blue) and black conditions wherein the variable Color Condition equals one if the participant is in the red (blue) condition and zero if in the black condition. Market Familiarity measures the degree to which the participant reported being familiar with the stock market. Invest in Market is an indicator equal to one if the participant invests in the stock market and zero otherwise. All regressions include robust standard errors. T-statistics are presented in parentheses while *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Panel A (Red)						Panel B (Blue)					
	Worst-case		Most-likely		Best-case		Worst-case		Most Likely		Best-case	
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Color Condition	-0.026	-0.030	-0.018	-0.039	-0.064	-0.095	0.012	0.016	0.109	0.100	0.105	0.093
	(-1.00)	(-1.08)	(-0.42)	(-0.91)	(-1.14)	(-1.51)	(0.19)	(0.28)	(1.26)	(1.07)	(0.77)	(0.62)
Male		0.042		0.144		0.187		-0.091		-0.242*		-0.181
		(0.57)		(1.55)		(1.07)		(-1.31)		(-1.89)		(-1.12)
Age		0.036**		0.066***		0.003		0.013		0.009		-0.015
		(2.42)		(2.69)		(0.09)		(0.96)		(0.36)		(-0.40)
Education		-0.005		0.002		0.048		0.008		0.024		0.043
		(-0.27)		(0.06)		(1.18)		(0.49)		(0.79)		(0.90)
Income		-0.001		0.013		0.008		-0.017		0.006		0.012
		(-0.09)		(0.52)		(0.22)		(-1.04)		(0.22)		(0.32)
Market Familiarity		0.026		0.006		-0.049		0.033		0.026		-0.014
		(1.11)		(0.15)		(-0.95)		(1.51)		(0.62)		(-0.23)
Invest in Market		0.019		-0.043		-0.035		0.019		0.062		0.123
		(0.35)		(-0.44)		(-0.28)		(0.31)		(0.57)		(0.78)
Risk Tolerance		0.090**		0.230**		-0.044		0.187**		0.222*		0.188
		(2.04)		(2.03)		(-0.40)		(2.40)		(1.78)		(1.03)
Constant	-0.503***	-0.997***	0.023	-0.895*	0.892***	0.841*	-0.541***	-1.074***	-0.104	-0.732	0.723***	0.174
	(-8.24)	(-4.37)	(0.25)	(-1.92)	(7.18)	(1.69)	(-5.97)	(-3.78)	(-0.78)	(-1.49)	(3.76)	(0.23)
No. Obs.	141	130	141	130	141	130	155	139	155	139	155	139
Adj. R^2	-0.000	0.023	-0.006	0.064	0.002	-0.014	-0.006	0.062	0.004	0.041	-0.003	-0.022

A Appendix

Table A1: Lottery Choices

The table presents the paired lottery choices used in Experiment 1. Participants viewed each lottery pair and were asked to select their desired lottery.

Lottery	Choice A	Choice B
1	0% chance of $2.00; 100% chance of -$1.50	0% chance of $4.00; 100% chance of -$5.00
2	10% chance of $2.00; 90% chance of -$1.50	10% chance of $4.00; 90% chance of -$5.00
3	20% chance of $2.00; 80% chance of -$1.50	20% chance of $4.00; 80% chance of -$5.00
4	30% chance of $2.00; 70% chance of -$1.50	30% chance of $4.00; 70% chance of -$5.00
5	40% chance of $2.00; 60% chance of -$1.50	40% chance of $4.00; 60% chance of -$5.00
6	50% chance of $2.00; 50% chance of -$1.50	50% chance of $4.00; 50% chance of -$5.00
7	60% chance of $2.00; 40% chance of -$1.50	60% chance of $4.00; 40% chance of -$5.00
8	70% chance of $2.00; 30% chance of -$1.50	70% chance of $4.00; 30% chance of -$5.00
9	80% chance of $2.00; 20% chance of -$1.50	80% chance of $4.00; 20% chance of -$5.00
10	90% chance of $2.00; 10% chance of -$1.50	90% chance of $4.00; 10% chance of -$5.00

Table A2: Perceptions of and Intentions to Purchase Positive Price-trend Stocks

The table presents OLS regressions of reported attitudes toward the stocks and intentions to purchase the stocks. Panel A (B) presents analysis between green (blue) and black conditions wherein the variable Color Condition equals one if the participant is in the green (blue) condition and zero if in the black condition. Market Familiarity measures the degree to which the participant reported being familiar with the stock market. Invest in Market is an indicator equal to one if the participant invests in the stock market and zero otherwise. All regressions include robust standard errors. T-statistics are presented in parentheses while *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Panel A (Green)				Panel B (Blue)			
	Attitude		Intent to Purchase		Attitude		Intent to Purchase	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Color Condition	0.167	0.122	0.083	-0.042	0.358***	0.357***	0.068	0.070
	(1.55)	(1.06)	(0.40)	(-0.19)	(3.45)	(3.43)	(0.35)	(0.37)
Male		-0.016		-0.038		-0.008		-0.122
		(-0.12)		(-0.18)		(-0.07)		(-0.59)
Age		0.122**		0.154		0.081		0.065
		(2.16)		(1.52)		(1.52)		(0.56)
Education		-0.043		-0.114		-0.079*		-0.177**
		(-0.82)		(-1.21)		(-1.66)		(-2.06)
Income		-0.018		0.110		0.036		0.197***
		(-0.40)		(1.31)		(0.99)		(3.11)
Market Familiarity		-0.015		0.028		0.009		-0.038
		(-0.25)		(0.24)		(0.15)		(-0.35)
Invest in Market		-0.036		-0.707**		-0.006		-0.543*
		(-0.25)		(-2.15)		(-0.04)		(-1.97)
Risk Tolerance		0.098		-0.226		0.061		-0.199
		(0.94)		(-0.93)		(0.53)		(-0.81)
Constant	7.051***	6.940***	6.565***	7.019***	7.051***	6.992***	6.565***	7.203***
	(88.78)	(21.08)	(47.21)	(9.88)	(88.80)	(21.16)	(47.23)	(10.90)
No. Obs.	191	179	191	179	201	192	201	192
Adj. R^2	0.007	-0.001	-0.004	0.027	0.051	0.047	-0.004	0.049

Table A3: Price Forecasts of Positive Price-trend Stocks

The table presents OLS regressions of reported attitudes toward the stocks and intentions to purchase the stocks. Panel A (B) presents analysis between green (blue) and black conditions wherein the variable Color Condition equals one if the participant is in the green (blue) condition and zero if in the black condition. Market Familiarity measures the degree to which the participant reported being familiar with the stock market. Invest in Market is an indicator equal to one if the participant invests in the stock market and zero otherwise. All regressions include robust standard errors. T-statistics are presented in parentheses while *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Panel A (Green)						Panel B (Blue)					
	Worst-case		Most-likely		Best-case		Worst-case		Most-likely		Best-case	
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Color Condition	0.015	0.012	0.020	0.009	0.027	0.010	-0.014	-0.002	0.039	0.023	0.068	0.042
	(0.92)	(0.72)	(1.32)	(0.62)	(1.10)	(0.43)	(-0.43)	(-0.06)	(0.78)	(0.47)	(1.02)	(0.62)
Male		-0.012		0.103***		0.133**		0.036		0.099**		0.132**
		(-0.30)		(2.98)		(2.56)		(0.97)		(2.14)		(2.06)
Age		0.004		-0.007		-0.018		0.002		-0.001		-0.043*
		(0.26)		(-0.55)		(-0.88)		(0.09)		(-0.08)		(-1.73)
Education		0.009		0.024		0.028		0.008		-0.002		-0.018
		(0.62)		(1.62)		(1.11)		(0.49)		(-0.08)		(-0.54)
Income		-0.010		0.010		0.021		0.022*		0.003		-0.006
		(-0.86)		(0.99)		(1.14)		(1.92)		(0.31)		(-0.26)
Market Familiarity		-0.001		-0.016		-0.019		-0.002		0.022		0.008
		(-0.07)		(-1.06)		(-0.67)		(-0.12)		(0.95)		(0.25)
Invest in Market		-0.030		-0.084***		-0.131**		-0.009		-0.112**		-0.096
		(-0.71)		(-2.87)		(-2.53)		(-0.22)		(-2.48)		(-1.41)
Risk Tolerance		-0.093**		-0.026		0.034		-0.036		-0.052		-0.070
		(-2.26)		(-0.77)		(0.60)		(-1.07)		(-1.04)		(-0.88)
Constant	0.742***	0.915***	1.141***	1.090***	1.364***	1.183***	0.771***	0.705***	1.122***	1.175***	1.323***	1.581***
	(22.29)	(8.44)	(38.79)	(14.34)	(27.36)	(7.70)	(16.09)	(7.00)	(19.18)	(11.55)	(15.46)	(6.48)
No. Obs.	191	179	191	179	191	179	201	192	201	192	201	192
Adj. R^2	-0.001	0.025	0.004	0.054	0.001	0.032	-0.004	-0.004	-0.002	-0.002	0.000	0.012

Table A4: Price Forecast Errors for Positive Price-trend Stocks

The table presents OLS regressions of price forecasts errors. Panel A (B) presents analysis between green (blue) and black conditions wherein the variable Color Condition equals one if the participant is in the green (blue) condition and zero if in the black condition. Market Familiarity measures the degree to which the participant reported being familiar with the stock market. Invest in Market is an indicator equal to one if the participant invests in the stock market and zero otherwise. All regressions include robust standard errors. T-statistics are presented in parentheses while *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Panel A (Green)						Panel B (Blue)					
	Worst-case		Most-likely		Best-case		Worst-case		Most-likely		Best-case	
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Color Condition	0.015	0.012	0.020	0.009	0.027	0.010	-0.014	-0.002	0.039	0.022	0.068	0.042
	(0.92)	(0.72)	(1.32)	(0.62)	(1.10)	(0.43)	(-0.43)	(-0.06)	(0.77)	(0.46)	(1.02)	(0.62)
Male		-0.012		0.103***		0.133**		0.036		0.098**		0.132**
		(-0.30)		(2.98)		(2.56)		(0.97)		(2.12)		(2.06)
Age		0.004		-0.007		-0.018		0.002		-0.001		-0.0425*
		(0.26)		(-0.55)		(-0.88)		(0.09)		(-0.08)		(-1.73)
Education		0.009		0.024		0.028		0.008		-0.002		-0.018
		(0.62)		(1.62)		(1.11)		(0.48)		(-0.09)		(-0.54)
Income		-0.010		0.010		0.021		0.022*		0.003		-0.006
		(-0.86)		(0.99)		(1.14)		(1.92)		(0.31)		(-0.26)
Market Familiarity		-0.001		-0.016		-0.019		-0.002		0.022		0.008
		(-0.07)		(-1.06)		(-0.67)		(-0.12)		(0.96)		(0.25)
Invest in Market		-0.030		-0.084***		-0.131**		-0.009		-0.112**		-0.096
		(-0.71)		(-2.87)		(-2.53)		(-0.22)		(-2.49)		(-1.41)
Risk Tolerance		-0.093**		-0.026		0.034		-0.036		-0.053		-0.070
		(-2.26)		(-0.77)		(0.60)		(-1.07)		(-1.05)		(-0.88)
Constant	-0.260***	-0.087	0.138***	0.088	0.362***	0.181	-0.231***	-0.297***	0.120**	0.173*	0.321***	0.579**
	(-7.82)	(-0.80)	(4.71)	(1.15)	(7.26)	(1.18)	(-4.83)	(-2.95)	(2.04)	(1.70)	(3.75)	(2.37)
No. Obs.	191	179	191	179	191	179	201	192	200	191	201	192
Adj. R^2	-0.001	0.025	0.004	0.054	0.001	0.032	-0.004	-0.004	-0.002	-0.002	0.000	0.012