Journal of Forecasting

WILEY

RESEARCH ARTICLE OPEN ACCESS

Information Illusion: Different Amounts of Information and Stock Price Estimates

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Received: 26 August 2022 | **Revised:** 3 April 2023 | **Accepted:** 16 February 2025

Funding: This research was funded by Deutsche Bundesbank.

Keywords: experiments | financial decision making | forecasting | information illusion | information overload | placebic information

ABSTRACT

We initiate a questionnaire-based stock price forecast competition to analyze participants' perception of different amounts of information and the impact on stock price estimates. The results show that providing more information increases the perceived amount of relevant information but does not alter participants' stock price estimates and their accuracy. Individual participants' characteristics, such as gender, financial knowledge, or overconfidence, do not affect these findings. This means that the added information acts as placebic information and leads to information illusion. However, the added information has an impact on individual expectations about the stock price forecast competition itself and leads less overconfident investors to decrease their expectations regarding payoff and chances to win a prize. Our findings provide implications for practitioners and researchers alike. Both regulators and policy makers should consider that placebic information can significantly impact investors' perception, and, therefore, regulation on information that is provided to retail investors should focus on relevant and avoid irrelevant information. Researchers should be aware that placebic information asymmetrically influences expectations of participants in experiments who show different levels of overconfidence.

JEL Classification: C91, D83, D91, G41

1 | Introduction

Information for individual financial decision making has been in the focus of research with regard to both relevance and appropriate amount of information. When it comes to relevance of information in the context of investing in stocks, researchers have come to different conclusions regarding the role of systematic and idiosyncratic information. Studies pointing out the sole relevance of systematic factors argue that considering a stock's beta factor (Barillas and Shanken 2018; Hwang and Rubesam 2018) and, occasionally and depending on the stocks in question and the corresponding time period, a momentum factor and few value and profitability factors (Barillas and Shanken 2018) are sufficient to forecast stock prices. The information to compute the systematic factors is included in past stock prices and the companies' financial statements. According to this line of argument, idiosyncratic company data, such as the number of employees or international diversification, are considered irrelevant for stock returns and prices. In contrast, studies focusing on idiosyncratic risk provide results that indicate an influence of such idiosyncratic factors, for example, when exogenous shocks occur (see Oehler et al. 2017), and a general negative relation between idiosyncratic risk and stock returns (see Ang et al. 2006, 2009; Stambaugh et al. 2015), which would make idiosyncratic factors relevant for forecasting stock prices.

When it comes to the appropriate amount of information, limited cognitive capacity for information perception and

processing (e.g., Kahneman and Tversky 1979; Selten 1990) needs to be considered. Even if individuals wish to fully and correctly incorporate all available information in decision making, they are not able to do so. If more information is available than individuals can perceive and process, this bounded rationality (Simon 1955, 1956) results in, for example, information overload (Miller 1956; Malhotra 1984; Plous 1993; Baron 2000; Agnew and Szykman 2005).

The purpose of our study is to connect these two lines of research on relevance and appropriate amount of information and to analyze (i) how investors perceive different amounts of information, (ii) how different amounts of information influence investors' stock price estimates, and (iii) how different amounts of information influence the expectations of investors about the accuracy of their own stock price estimates in comparison to estimates of other investors. We focus on retail investors as we assume that they have more difficulties than professional investors to focus on and process relevant information for stock price estimates.[1] Whereas previous studies focus on the effects when more actually relevant information is provided (e.g., Tsai et al. 2008 and the literature cited therein), our study is, to the best of our knowledge, the first study that introduces the concept of possibly irrelevant information, that is, information that may be perceived as relevant but does not enhance the accuracy of estimates, to the context of retail investors' financial decision making.

We initiate a questionnaire-based stock price forecast competition among students in business administration. The participants estimate the return and risk of three stocks in 3 months' time. The three stocks differ with respect to the amount of information that is available to the participants. The base case (low amount of information) includes information that is relevant in the context of the systematic characteristics of the stock. One stock (medium amount of information) is presented with information that would be characterized as being irrelevant according to the most basic (one-factor) stock pricing models, but according to more-factor models, such information can still be characterized as being relevant in the context of the systematic characteristics. And one stock (high amount of information) is additionally presented with information that is to be characterized as idiosyncratic information and, therefore, not per se relevant for stock price forecasts based on standard factor models.

Our approach allows us to control for participant characteristics that have been shown to influence stock price estimates or trading behavior, including financial knowledge (Abreau and Mendes 2012), self-assessed knowledge in statistics (Glaser et al. 2007), risk attitude (Dohmen et al. 2011), cognitive reflection (Primi et al. 2016; Frederick 2005), overconfidence in terms of miscalibration (Deaves et al. 2009; Nosic and Weber 2010), Big Five personality factors (Rammstedt et al. 2012; Oehler et al. 2018b, 2021), locus of control (Kovaleva et al. 2012), positive and negative affect (Krohne et al. 1996), and gender (Oehler et al. 2018, 2018b; Oehler and Horn 2019).

Our contribution to the literature is threefold. First, we show that a higher amount of presented information increases the perceived amount of relevant information. This effect is independent of individual characteristics, such as gender, financial knowledge, or overconfidence. Second, neither adding systematic nor idiosyncratic information does alter participants' stock price estimates and, hence, does not influence their accuracy either. The combination of increase in the perceived amount of relevant information and lack of effect of stock price estimates indicates that a higher amount of presented information leads to information illusion where individuals feel better informed although they factually are not able to derive more accurate stock price estimates. Hence, the additional information acts on the participants like placebic information (see Langer et al. 1978). Third, we demonstrate that a higher amount of presented information has an impact on individual expectations about the stock price forecast competition itself, but the influence of the additional information depends on the participants' level of overconfidence. Whereas the participants have exaggerated expectations regarding the payoff, less overconfident participants adjust their expectations with regard to payoff and chances to win a prize in the competition downwards and, by doing so, get closer to the expected payoff and chances that are rationally justifiable when considering the competition as a fair game.[2] More overconfident participants do not adjust their expectations downwards. Other individual characteristics do not have a significant impact.

Our findings provide implications for researchers and practitioners alike. Researchers should be aware that placebic information influences participants' expectations in experiments and potentially also in other methodological setups and their perception of how well they are informed. Additionally, as our participants serve as proxy for retail investors, both regulators and policy makers should consider that placebic information can significantly impact investors' perception, and, therefore, regulation on information documents that retail investors receive should focus on relevant information and avoid irrelevant information. This is of particular importance as there are considerable doubts about the relevance of at least part of the information that investors receive from, for example, financial advisors or key investor information documents (Oehler et al. 2014; Oehler and Wendt 2017; Oehler 2018).

2 | Design and Methodology

2.1 | Experimental Design

We initiate a questionnaire-based stock price forecast competition among 196 undergraduate students in business administration (see Appendix C for the questionnaire).[3] Although these students are not a representative cross section of the population, they represent a subgroup that is valid as a prototype of economically well-educated people that take an interest in stock markets (e.g., Oehler et al. 2018c). We, therefore, assume that the participants of our experiment show levels of financial literacy and interest in stock markets that are at least similar to average levels of retail stock market investors. As the level of economic education should be correlated with individuals' ability to focus on and process relevant information for stock price estimates,[4] our results most likely underestimate the impact on retail investors in general and those who are less financially literate in particular. We acknowledge though that some retail investors are more financially literate than the undergraduate business students in our sample. The effects that we analyze in this study

might be less pronounced among more financially literate retail investors.

In the forecast competition, the participants are asked to provide their estimate of the stock price for each of three stocks[5] in 3 months' time and an upper and lower bound of the stock price that will not be exceeded or undercut with more than 5% probability, respectively, within the next 3 months. Following Glaser et al. (2007), this approach allows us to compute participants' expectation of each stock's return and standard deviation of returns that is underlying their stock price estimate. We choose a 3-month forecast period because information such as book value, earnings, and total assets will be outdated after at most 3 months when new quarterly results are published. Asking participants to forecast for a longer period then 3 months would automatically introduce a new source of uncertainty, that is, uncertainty about the to-be-expected quarterly results. This additional uncertainty could skew the results, and they would get noisier for longer time periods.

The three stocks differ with respect to the amount of information that is available to the participants and the previous price trend. The stocks with corresponding information are presented successively to the participants.

The first stock represents the base case (low amount of information). Participants solely receive a stock price chart and past stock and market returns, which means that they solely receive information that is relevant in the context of the systematic characteristics of the stock. This stock has a sideways price history; despite some variation in the stock price over time, there is no upward or downward overall price trend.

For the other two stocks, participants receive different amounts of information. Please note that Stocks 2 and 3 are presented in random order in the questionnaire. One stock is presented with the base case information categories, that is, stock price chart and past stock and market returns, plus selected balance sheet and cash flow statement information including book value, total assets, and operational profit (medium amount of information). According to the most basic (one-factor) stock pricing models, this additional information would be characterized as being irrelevant, but according to more-factor models, such information can still be characterized as being relevant in the context of the systematic characteristics of the stock.

The other stock is presented with the base case information categories, selected balance sheet and cash flow statement information similar to the previously mentioned stock, plus additional information, such as number of employees, location of headquarter, and branches abroad, as well as some information typically provided in key investor information documents, such as "stock prices can depend on the demand on the stock market or changes in the company's profitability" (high amount of information including idiosyncratic information).[6] The additional information that is only included for this stock is to be characterized as idiosyncratic information and, therefore, not per se relevant for stock price forecasts based on standard factor models.

The second and third stock also differ in their price history; one of them is presented with an upward price trend, whereas the other one is presented with a downward price trend (see Oehler and Wedlich 2018 for a similar approach). Although the first stock is the same for all participants (base case), we form four groups to cover all combinations of amount of information (medium and high) and price trend (upwards and downwards) as second and third stocks in the questionnaire. With this approach, we can control for the influence of stock characteristics such as price variance or price trend in order to purely identify the influence of the amount of information. In each of the four groups, the three participants with the most accurate estimate per stock receive a prize money when the actual stock prices are realized after 3 months. The prize money is €20, €15, and €10 for the first, second, and third prize, respectively.[7]

We do not provide information on risk-free rates. At the time of our stock price forecast competition, risk-free rates for German retail investors had been zero for several years. We do not provide factor data with the stocks for two reasons. First, we are not aware that factor data are provided by financial advisors that cater retail investors and retail investors usually do not gather factor data. Second, there are no obvious correct factor data to be used, for example, it is unclear whether factor data for the German, European, or worldwide stock market is more appropriate.

For each stock, participants are additionally asked to assess on an 11-point Likert-scale (from 0 to 10) whether they received all relevant information necessary to accurately forecast the stock price. Moreover, participants are asked to state the probabilities for receiving the first, second, third, or no prize in the competition and the participation fee they would be willing to pay. As participation was free of charge and participants received a compensation for their participation of €5 (plus potentially a prize money), the question about their willingness to pay is a hypothetical question to assess the risk the participants would be willing to take in the competition.

In addition, the questionnaire includes items to capture further participant characteristics that have been shown to influence stock price forecasts or trading behavior, including participants' financial knowledge (Abreau and Mendes 2012), self-assessed knowledge in statistics (Glaser et al. 2007), risk attitude (Dohmen et al. 2011), cognitive reflection (Primi et al. 2016; Frederick 2005), overconfidence in terms of miscalibration (Deaves et al. 2009; Nosic and Weber 2010), Big Five personality factors (Rammstedt et al. 2012; Oehler et al. 2018b, 2021), locus of control (Kovaleva et al. 2012), positive and negative affect (Krohne et al. 1996), and gender (Oehler et al. 2018, 2018b; Oehler and Horn 2019) (see Oehler et al. 2018b for a similar approach).

An overview of the variables used in the empirical analysis and how they are measured is presented in Table 1. Table 2 displays descriptive statistics.

2.2 | Empirical Analysis

For the three different amounts of information, this means low vs. medium vs. high amount of information, we perform a series of tests of equality (*t*-tests) to analyze differences in the

TABLE 1 | Overview and descriptions of variables used in the empirical analyses.

Vector/variable	Description
Panel A: Participants' characteristics	
$GENDER_i$	Dummy variable that takes a value of 1 when participant *i* is female and 0 otherwise
$OVERCONFIDENCE_i$	Overconfidence based on ten interval estimates based on Deaves et al. (2009). Values can range between 0 and 1. A value of 0 indicates underconfidence; a value of 0.1 indicates neither under- nor overconfidence; a value of 0.2 indicates moderate overconfidence; a value of 1 indicates extreme overconfidence
$RISK\_ATTITUDE_i$	Self-assessment of risk attitude in the financial domain on an eleven-point Likert scale (from 0 to 10) based on Dohmen et al. (2011)
AFFECT	
$NEGAFFECT_i$	Negative affect; determined as median value of three items based on a scale from 1 to 5 on the German version of the PANAS by Krohne et al. (1996)
$POSAFFECT_i$	Positive affect; determined as median value of three items on a scale from 1 to 5 based on the German version of the PANAS by Krohne et al. (1996)
CRT	
$CRT\_FREDERICK_i$	Cognitive reflection measured by the sum of correct answers to three questions based on Frederick (2005)
CRT_PRIMI_i	Cognitive reflection measured by the sum of correct answers to three questions based on Primi et al. (2016)
KNOWLEDGE	
$KNOWLEDGE\_STATISTICS_i$	Self-assessment about the knowledge in statistics on a 6-point Likert scale (from 1 = *very good* to 6 = *very poor*, based on the German school grading scale) based on Glaser et al. (2007). For the empirical analysis, inverted values are used so that 1 indicates very poor statistical knowledge and 6 very good statistical knowledge
$SCORE\_FIN\_KNOW_i$	Financial knowledge determined as sum of two items based on Abreau and Mendes (2012). One item asks participant to name five stocks listed in the German blue-chip index DAX; the other item asks about the authority responsible for complaints about miscounseling in financial advice in Germany. Participants can get five points for each item: one point for every correct stock in the DAX and five points for the correct authority. Hence, the value of $SCORE\_FIN\_KNOW_i$ can range between 0 and 10. A value of 0 means that the participant provided no correct answer. A value of 10 means that the participant answered all questions correctly
LOCUS_OF_CONTROL	
$EXTLOCUS_i$	External locus of control; determined as median value of two items on a scale from 1 to 5 based on Kovaleva et al. (2012)
$INTLOCUS_i$	Internal locus of control; determined as median value of two items on a scale from 1 to 5 based on Kovaleva et al. (2012)
PERSONALITY	
$AGREEABLENESS_i$	Agreeableness; determined as median value of two items on a scale from 1 to 5 based on the BFI-10 of Rammstedt et al. (2012)
$CONSCIENTIOUSNESS_i$	Conscientiousness; determined as median value of two items on a scale from 1 to 5 based on the BFI-10 of Rammstedt et al. (2012)

(Continues)

TABLE 1 | (Continued)

Vector/variable	Description
Panel A: Participants' characteristics	
$EXTRAVERT_i$	Extraversion; determined as median value of two items on a scale from 1 to 5 based on the BFI-10 of Rammstedt et al. (2012)
$NEUROTICISM_i$	Neuroticism; determined as median value of two items on a scale from 1 to 5 based on the BFI-10 of Rammstedt et al. (2012)
$OPENNESS_i$	Openness; determined as median value of two items on a scale from 1 to 5 based on the BFI-10 of Rammstedt et al. (2012)
Panel B: Perceived amount of relevant information in dependence of amount of information	
$PERC\_INFO\_LOW_i$ $PERC\_INFO\_MEDIUM_i$ $PERC\_INFO\_HIGH_i$	Perceived amount of relevant information on an 11-point Likert scale (from 0 = *no relevant information* to 10 = *all relevant information*) in settings with high, low, and medium amount of information
Panel C: Expected stock development in dependence of amount of information	
$S\_RATIO\_LOW_i$ $S\_RATIO\_MEDIUM_i$ $S\_RATIO\_HIGH_i$	Expected Sharpe ratio based on stock price estimates for the stock in settings with high, low, and medium amount of information
$SRETURN\_LOW_i$ $SRETURN\_MEDIUM_i$ $SRETURN\_HIGH_i$	Expected stock return based on stock price estimates in settings with high, low, and medium amount of information
$SRISK\_LOW_i$ $SRISK\_MEDIUM_i$ $SRISK\_HIGH_i$	Expected stock risk based on stock price estimates in settings with high, low, and medium amount of information
Panel D: Behavior in stock forecast competition in dependence of amount of information	
$GROSS\_PAYOFF\_LOW_i$ $GROSS\_PAYOFF\_MEDIUM_i$ $GROSS\_PAYOFF\_HIGH_i$	Expected gross payoff from stock forecast competition based on the stated probabilities to win the first, second, or third prize in settings with high, low, and medium amount of information and the corresponding prize money
$NET\_PAYOFF\_LOW_i$ $NET\_PAYOFF\_MEDIUM_i$ $NET\_PAYOFF\_HIGH_i$	Expected net payoff from stock forecast competition based on the stated probabilities to win the first, second, or third prize and corresponding prize money, minus the maximum fee participant i is willing to pay for participation in settings with high, low, and medium amount of information
$PAY\_FEE\_LOW_i$ $PAY\_FEE\_MEDIUM_i$ $PAY\_FEE\_HIGH_i$	The maximum fee participant i is willing to pay for participation in the stock forecast competition in settings with high, low, and medium amount of information
$PROB\_1ST\_PRIZE\_LOW_i$ $PROB\_1^{ST}\_PRIZE\_MEDIUM_i$ $PROB\_1ST\_PRIZE\_HIGH_i$	Expected probability to win the first prize in the stock forecast competition in settings with high, low, and medium amount of information

(Continues)

TABLE 1 | (Continued)

Panel D: Behavior in stock forecast competition in dependence of amount of information	
PROB_NO_PRIZE_LOW$_i$ *PROB_NO_PRIZE_MEDIUM*$_i$ *PROB_NO_PRIZE_HIGH*$_i$	Expected probability to win no prize in the stock forecast competition in settings with high, low, and medium amount of information
Panel E: Control variables in regressions	
ORDER_AMOUNT$_i$	Dummy variable that is equal to 1 if—after the base case—the stock with medium amount of information is presented as second stock and the stock with high amount of information as third stock, that is, an order of low–medium–high, and 0 if the order is low–high–medium
STOCK_PRICE_TREND$_i^P$	Dummy variable that is equal to 1 when the stock is presented with an upward price trend and 0 in the case of downward price trend

participants' perception of how much relevant information they received, in their stock price estimates, in their expectation with regard to the payoff from the competition, and in the hypothetical participation fee they would be willing to pay. Further, we run a series of multivariate regression models to analyze the determinants of these measures. For the sake of readability we do not include standard errors, *p* values, or *t*-statistics in the tables with the regression results. These statistics are available from the authors upon request.

For the base case with the lowest amount of information, we assume that perception of participant *i* of how much relevant information he or she received, $PERC\_INFO\_LOW_i$, solely depends on the participant's characteristics. To analyze this relationship, we run an ordinary least squares (OLS) regression with the following model (see Table 1 for a detailed description of the variables; vectors are in bold print):

$$PERC\_INFO\_LOW_i = \beta_0 + \beta_1 GENDER_i + \beta_2 OVERCONFIDENCE_i + \beta_3 RISK\_ATTITUDE_i + \gamma_1 \boldsymbol{AFFECT}_i + \gamma_2 \boldsymbol{CRT}_i + \gamma_3 \boldsymbol{KNOWLEDGE}_i + \gamma_4 \boldsymbol{LOCUS\_OF\_CONTROL}_i + \gamma_5 \boldsymbol{PERSONALITY}_i + \varepsilon_{1,i}. \quad (1)$$

As participants' perceived amount of relevant information in the settings with a medium and high amount of information might be influenced by the order of presentation or the price trend of the corresponding stock, we extend Equation (1) when assessing the determinants of perceived information in these settings by the following factors: $ORDER\_AMOUNT_i$ is a dummy variable that is equal to 1 if—after the base case—the stock with medium amount of information is presented as second stock and the stock with high amount of information as third stock, that is, an order of low–medium–high, and 0 if the order is low–high–medium. $STOCK\_PRICE\_TREND_i$ is a dummy variable that is equal to 1 when the stock is presented with an upward price trend and 0 in the case of downward price trend.

To be able to analyze whether participants perceive further information on systematic and idiosyncratic factors as being actually relevant information, we need to account for the perceived amount of relevant information in the base case as anchor value. If, for example, participants state that they have all relevant information already available in the base case, they could not state a higher amount of relevant information in the settings with medium or high amount of information. We observe three pairs of information settings (low vs. medium, low vs. high, and medium vs. high) to analyze the differences in participants' perceived amount of relevant information. For each of the three pairs, we estimate the following equation as OLS regression:

$$PERC\_INFO_i^{moreP} - PERC\_INFO_i^{lessP} = \beta_0 + \beta_1 PERC\_INFO_i^{lessP} + \beta_2 \left(PERC\_INFO_i^{lessP}\right)2 + \beta_3 ORDER\_AMOUNT_i + \beta_4 STOCK\_PRICE\_TREND_i^{moreP} + \boldsymbol{\gamma_1 X}_i + \varepsilon_i, \quad (2)$$

where *moreP* is the setting with the high amount of information when *lessP* is the setting with medium amount of information and *moreP* is the setting with the medium or high

TABLE 2 | Summary statistics.

	Mean	Median	SD	Min	Max
Panel A: Participants' characteristics					
GENDER	0.52	1.00	0.50	0.00	1.00
OVERCONFIDENCE	0.63	0.60	0.21	0.10	1.00
RISK_ATTITUDE	4.40	4.00	2.10	0.00	9.00
AFFECT					
NEGAFFECT	1.58	1.00	0.76	1.00	5.00
POSAFFECT	3.10	3.00	0.83	1.00	5.00
CRT					
CRT_FREDERICK	1.72	2.00	1.15	0.00	3.00
CRT_PRIMI	2.05	2.00	0.89	0.00	3.00
KNOWLEDGE					
KNOWLEDGE_STATISTICS	4.23	4.00	0.88	1.00	6.00
SCORE_FIN_KNOW	3.59	4.00	1.98	0.00	10.00
LOCUS_OF_CONTROL					
EXTLOCUS	2.10	2.00	0.58	1.00	4.00
INTLOCUS	4.17	4.00	0.52	2.00	5.00
PERSONALITY					
AGREEABLENESS	3.10	3.00	0.78	1.50	5.00
CONSCIENTIOUSNESS	3.56	3.50	0.78	1.50	5.00
EXTRAVERT	3.43	3.50	0.84	1.00	5.00
NEUROTICISM	2.91	3.00	0.92	1.00	5.00
OPENNESS	3.24	3.50	0.95	1.00	5.00
Panel B: Perceived amount of relevant information in dependence of amount of information					
PERC_INFO_LOW	4.04	4.00	2.16	0.00	10.00
PERC_INFO_MEDIUM	5.19	5.00	2.02	0.00	10.00
PERC_INFO_HIGH	5.71	6.00	2.16	0.00	10.00
Panel C: Expected stock development in dependence of amount of information					
S_RATIO_LOW	−0.19	0.06	2.20	−6.83	17.92
S_RATIO_MEDIUM	−0.13	−0.02	2.40	−14.25	9.50
S_RATIO_HIGH	−0.11	−0.09	2.18	−5.93	15.53
SRISK_LOW	7.31%	6.58%	4.73%	0.28%	24.24%
SRISK_MEDIUM	7.11%	5.54%	5.92%	0.39%	51.44%
SRISK_HIGH	7.50%	6.54%	5.99%	0.12%	39.23%
SRETURN_LOW	−0.22%	0.21%	7.22%	−19.45%	26.08%
SRETURN_MEDIUM	−0.66%	−0.07%	10.06%	−66.57%	43.78%
SRETURN_HIGH	−0.39%	−0.53%	10.58%	−26.35%	87.32%
Panel D: Behavior in stock forecast competition in dependence of amount of information					
GROSS_PAYOFF_LOW	3.88	2.25	4.23	0.00	19.60

(Continues)

TABLE 2 | (Continued)

Panel D: Behavior in stock forecast competition in dependence of amount of information					
GROSS_PAYOFF_MEDIUM	3.46	1.85	3.82	0.00	19.25
GROSS_PAYOFF_HIGH	3.42	1.83	3.81	0.00	19.25
PROB_1ST_PRIZE_LOW	6.8%	3.0%	11.0%	0.0%	90.0%
PROB_1ST_PRIZE_MEDIUM	6.4%	2.5%	10.3%	0.0%	90.0%
PROB_1ST_PRIZE_HIGH	6.5%	2.5%	11.0%	0.0%	90.0%
PROB_NO_PRIZE_LOW	73.4%	85.0%	27.1%	0.0%	100.0%
PROB_NO_PRIZE_MEDIUM	75.2%	87.0%	25.8%	0.0%	100.0%
PROB_NO_PRIZE_HIGH	76.3%	86.0%	24.6%	0.0%	100.0%
PAY_FEE_LOW	1.12	0.50	1.78	0.00	11.25
PAY_FEE_MEDIUM	1.24	0.50	1.90	0.00	11.25
PAY_FEE_HIGH	1.21	0.50	2.02	0.00	20.00
NET_PAYOFF_LOW	2.76	1.33	3.98	−6.50	16.60
NET_PAYOFF_MEDIUM	2.23	1.13	3.61	−6.00	14.50
NET_PAYOFF_HIGH	2.21	1.18	3.86	−17.35	17.25

amount of information when *lessP* is the base case setting. $PERC\_INFO_i^{lessP}$ and $PERC\_INFO_i^{moreP}$ in Equation (2) may partially be endogenous if the perceived amount of relevant information in the base case serves as anchor value for the further assessments of perceived relevant information. We address the potential multicollinearity effects by calculating variance inflation factors (VIFs) in every OLS regression and by providing stepwise regression analyses where necessary. Moreover, we perform 2SLS regressions for each pair of information settings as robustness checks (see Appendix B.b for further details).

The perceived completeness of the provided information, the order of the stocks with medium and high amount of information in the questionnaire, and the price trend of the stock might drive (1) the stock price estimates and, hence, expected stock return, risk, and Sharpe ratio of return and risk (Sharpe 1966, 1994), (2) the expectations of success in the forecast competition of participant i in information setting p, and (3) the amount of the hypothetical participation fee. This is why we separately apply the following OLS regression model in each of the three information settings p (i.e., low, medium, or high amount of information):

$$\begin{aligned} Y_i^p &= \beta_0 + \beta_1 PERC\_INFO_i^p \\ &+ \beta_2 \left(PERC\_INFO_i^p\right)2 + \beta_3 ORDER\_AMOUNT_i \\ &+ \beta_4 STOCK\_PRICE\_TREND_i^p + \boldsymbol{\gamma_1 X}_i + \varepsilon_i, \end{aligned} \tag{3}$$

with a separate regression for each Y_i^p standing for *SRETURN*, *SRISK*, *S_RATIO*, *NET_PAYOFF*, *GROSS_PAYOFF*, *PROB_1ST_PRIZE*, *PROB_NO_PRIZE*, and *PAY_FEE*, in dependence of the information setting p, respectively. $PERC\_INFO_i^p$ is participant i's perception of completeness of the information in setting p; to capture potential nonlinear effects, we also include the squared term. The variables $ORDER\_AMOUNT_i$ and $STOCK\_PRICE\_TREND_i^p$ are omitted in the regressions that analyze the base case with a low amount of information and a sideways stock price trend as the base case is equal in every questionnaire and always presented first. $\boldsymbol{X}_i$ is a vector that includes participants' characteristics (see the independent variables in Equation 1).

As $PERC\_INFO_i^p$ itself might be influenced by the variables captured in vector $\boldsymbol{X}_i$, the regression results might suffer from multicollinearity effects. To address these concerns, we determine VIFs in every OLS regression and provide stepwise regression analyses where necessary.

Similar to Equation (2), we estimate differences in participants' stock price estimates and in expectations of success in the forecast competition by estimating the following equation as OLS regression:

$$\begin{aligned} Y_i^{moreP} - Y_i^{lessP} &= \beta_0 + \beta_1 PERC\_INFO_i^{lessP} + \beta_2 \left(PERC\_INFO_i^{lessP}\right)2 \\ &+ \beta_3 \left(PERC\_INFO_i^{moreP} - PERC\_INFO_i^{lessP}\right) \\ &+ \beta_4 \left(PERC\_INFO_i^{moreP} - PERC\_INFO_i^{lessP}\right)2 \\ &+ \beta_5 Y_i^{lessP} + \beta_6 ORDER\_AMOUNT_i \\ &+ \beta_7 STOCK\_PRICE\_TREND_i^{moreP} + \boldsymbol{\gamma_1 X_i} + \varepsilon_i \end{aligned} \tag{4}$$

with a separate regression for each Y_i^P standing for *SRETURN*, *SRISK*, *S_RATIO*, *NET_PAYOFF*, *GROSS_PAYOFF*, *PROB_1ST_PRIZE*, *PROB_NO_PRIZE*, and *PAY_FEE*, respectively. We include Y_i^{lessP} to control for anchor effects in these variables from the settings with less information.

TABLE 5 | Participants' characteristics and the increase in the perceived amount of relevant information when adding information (OLS).

	***PERC_INFO_MEDIUM–PERC_INFO_LOW*(1)**	***PERC_INFO_HIGH–PERC_INFO_LOW*(2)**	***PERC_INFO_HIGH–PERC_INFO_MEDIUM*(3)**
GENDER	−0.313	−0.333	0.011
OVERCONFIDENCE	−0.145	0.424	0.578
RISK_ATTITUDE	0.042	0.018	−0.018
AFFECT	ns	ns	ns
CRT	ns	ns	ns
KNOWLEDGE	ns	ns	ns
LOCUS_OF_CONTROL	ns	ns	ns
PERSONALITY	ns[a]	ns	ns
ORDER_AMOUNT low-medium-high	−0.036	0.335	0.334
STOCK_PRICE_TREND medium	0.122		
STOCK_PRICE_TREND high		0.031	0.131
PERC_INFO_LOW	0.190	0.211	
$PERC\_INFO\_LOW^2$	−0.042**	−0.057*	
PERC_INFO_MEDIUM			0.427*
$PERC\_INFO\_MEDIUM^2$			−0.052***
β_0	0.524	1.028	−0.766
R^2	0.244	0.211	0.140
VIF (highest value among all independent variables excluding $(PERC\_INFO_i^{lessP})^2$)	1.691	1.691	1.683

Note: We provide regression coefficients, R^2, and VIF for the OLS regression analysis using Equation (2) with the differences of participants' perceived amount of relevant information between two information settings as dependent variable. Each stock was accompanied by either a low, medium, or high amount of information. The table includes the results for the full regression model. The symbols ****, ***, **, and * denote significance at the one per mill, five per mill, 1% level, and 5% level, respectively; for vectors, ns denotes not significant, that is, $p >= 0.05$. Example: Regressing the difference *PERC_INFO_MEDIUM–PERC_INFO_LOW* on the full regression model of Equation (2) yields a coefficient of −0.313 with a $p \geq 0.05$ for participants' gender as independent variable.
[a]We only observe a significant negative effect (coefficient = −0.238; $p = 0.022$) for the variable associated with agreeableness.

3 | Results and Discussion

3.1 | Effect on Perceived Amount of Relevant Information

3.1.1 | Tests of Equality

The results in Table 3 show that participants state to have significantly more relevant information available to forecast the future stock price if they received more systematic and idiosyncratic information than in the base case setting. When they receive a low amount of information (base case), the participants state their perceived amount of relevant information on average at 4.04 on an 11-point Likert-scale (from 0 to 10). This value increases to 5.19 when they receive a medium amount of information and to 5.71 with a high amount of information. Paired samples *t*-tests between the three information settings show that the differences are statistically significant at the one per mill level. Hence, participants perceive the additional information as actually being relevant information.

3.1.2 | Linear Regression Analysis

Results of OLS regressions applying Equation (1) in Table 4 show that the perception of the amount of relevant information is hardly influenced by participants' characteristics. There are only two exceptions. First, participants with a higher score in financial knowledge state a lower amount of relevant information in the base case setting and when they receive a medium amount of information. Second, participants with a higher score in neuroticism state higher amounts of relevant information in the base case setting and in the setting with a high amount of information.

We run linear regressions applying Equation (2) to identify whether the differences of participants' perceived amount of relevant information between different information settings are related to participants' characteristics. The results in Table 5 indicate that the extent of the differences of participants' perceived information between different information settings is hardly related to participants' characteristics. Instead, the increase in the perceived amount of relevant

TABLE 3 | Perceived amount of relevant information depending on the amount of provided information.

	Perceived amount of relevant information
Stock with ____ amount of information	
Low	4.04 (2.16)
Medium	5.19 (2.02)
High	5.71 (2.16)
Sig. *t*-test	
Low vs. medium	0.000
Low vs. high	0.000
Medium vs. high	0.000
N	196

Note: We report the mean values (standard deviations in parentheses) of participants' perceived amount of relevant information to forecast future stock prices. Every participant received information on three stocks. Each stock was accompanied by a different amount of information (low, medium, or high amount). We provide tests of equality of mean values of the participants' perceived amount of relevant information regarding stocks with different amounts of information using paired samples *t*-tests. We present the results for the three pairs, that is, low vs. medium; low vs. high; medium vs. high amount of information by providing the *p* values of the corresponding *t*-tests.

information when adding information is smaller when participants already stated to have a higher amount of relevant information in the settings with a low and medium amount of information. This means that the extent of differences in perceived relevant information is subject to the perception on the relevance of the initially provided information, which serves as an anchor value. The low VIFs further indicate that this anchor value is hardly correlated with the other independent variables, that is, the participants' characteristics.

As interim conclusion we can put on record that the additional systematic and idiosyncratic information increases the perceived amount of relevant information. This increase is by and large independent of participant characteristics.

3.2 | Effect on Stock Price Estimates

Table 6 presents the results of the paired samples *t*-tests between the information settings with regard to their impact on participants' expectations of stock return, risk, and Sharpe ratio, which are derived from participants' estimates of stock price and lower and upper bound of stock prices during the three-month forecast horizon. The results show that the amount of information has no significant influence on participants' stock price forecasts.

We also performed OLS regressions applying Equation (3) with the expected stock returns, stock risks, and Sharpe ratios as dependent variables. As the results also do not indicate that the perceived amount of relevant information has a significant influence on stock price estimates, we provide the detailed results only in the appendix (see Tables S12 and S13). In addition, an ex post analysis between the forecasts and the actual stock price development shows no differences in the accuracy of the price estimates between different amounts of information and/or differences in perceived amounts of relevant information for the same stock.[8] Hence, the additional information does neither lead to more reasonable nor to misguided estimates. Even though participants feel better informed with higher amounts of information, this does not have an impact on price estimates and their accuracy. Our interpretation is that the additional information presented in the medium and high amount of information settings is placebic information and that participants are subject to an information illusion. They feel better informed although they are not able to make use of the additional information.[9]

TABLE 4 | The influence of participants' characteristics on the perceived amount of relevant information; separate for the different amounts of information.

	***PERC_INFO_LOW*(1)**	***PERC_INFO_MEDIUM*(2)**	***PERC_INFO_HIGH*(3)**
GENDER	0.058	−0.247	−0.272
OVERCONFIDENCE	0.155	−0.097	0.428
RISK_ATTITUDE	−0.070	−0.022	−0.041
AFFECT	ns	ns	ns
CRT	ns	ns	ns
KNOWLEDGE	ns[a]	ns[b]	ns
LOCUS_OF_CONTROL	ns	ns	ns
PERSONALITY	ns[c]	ns	ns[d]
ORDER_AMOUNT low-medium-high		−0.091	0.313
STOCK_PRICE_TREND medium		0.201	
STOCK_PRICE_TREND high			−0.067
β_0	6.057*	6.313**	6.507*
R^2	0.133	0.078	0.078

Note: We provide regression coefficients and R^2 for the OLS regression analysis using Equation (1) with the participants' perceived amount of relevant information per information setting (i.e., low, medium, or high amount of information) as dependent variable. The table includes the results for the full regression model. The symbols ****, ***, **, and * denote significance at the one per mill, five per mill, 1% level, and 5% level, respectively; for vectors, ns denotes not significant, that is, $p \geq 0.05$. Example: Regressing *PERC_INFO_LOW* on the full regression model of Equation (1) yields a coefficient of 0.058 with a $p \geq 0.05$ for participants' gender as independent variable.

[a]We only observe a significant negative effect (coefficient = −0.258; $p = 0.002$) for the variable associated with financial knowledge.

[b]We only observe a significant negative effect (coefficient = −0.178; $p = 0.028$) for the variable associated with financial knowledge.

[c]We only observe a significant positive effect (coefficient = 0.400; $p = 0.037$) for the variable associated with neuroticism.

[d]We only observe a significant positive effect (coefficient = 0.410; $p = 0.039$) for the variable associated with neuroticism.

Taken together, adding more information does not alter participants' stock price estimates and, hence, does also not influence their accuracy. Consequently, more information does neither increase nor decrease the quality of participants' stock price estimates. This indicates that participants feel better informed although they either do not have more relevant information or

TABLE 6 | Mean value of participants' forecast on stock returns, standard deviation of stock returns, and Sharpe ratio in dependence of the amount of information provided with the stocks.

	Expected return (in percent)	Expected standard deviation of returns (in percent)	Expected Sharpe ratio
Stock with ____ amount of information			
Low	−0.22 (7.2)	7.3 (4.7)	−0.19 (2.20)
Medium	−0.66 (10.1)	7.1 (5.9)	−0.13 (2.40)
High	−0.39 (10.6)	7.5 (6.0)	−0.11 (2.17)
Sig. *t*-test			
Low vs. medium	0.574	0.549	0.786
Low vs. high	0.847	0.561	0.731
Medium vs. high	0.807	0.139	0.934
N	196	196	196

Note: We report the mean values (standard deviations in parentheses) of participants' expectation of stock return, standard deviation of stock returns, and Sharpe ratio for stocks presented with different amounts of information. Every participant received information on three stocks. Each stock was accompanied by either a low, medium, or high amount of information. We provide tests of equality of mean values of the participants' expectations regarding stocks with different amounts of information using parametric paired samples *t*-tests. We present the results for the three pairs, that is, low vs. medium; low vs. high; medium vs. high amount of information by providing the *p* values of the corresponding *t*-tests.

TABLE 7 | Mean value of participants' expected gross payoff, probability to win the first or no prize, (hypothetical) participation fee, and expected net payoff from the stock forecast competition in dependence of the amount of information provided with the stocks.

	Expected net payoff (in euro)	Expected gross payoff (in euro)	Probability first prize in competition (in percent)	Probability no prize in competition (in percent)	Participation fee (in euro)	Expected return from forecast competition in percent
Stock with ____ amount of information						
Low	2.76 (3.98)	3.88 (4.23)	6.85 (11.04)	73.41 (27.06)	1.12 (1.78)	538 (1489)
Medium	2.23 (3.61)	3.46 (3.82)	6.36 (10.33)	75,23 (25.75)	1.24 (1.90)	323 (682)
High	2.21 (3.86)	3.41 (3.81)	6.46 (10.97)	76.32 (24.56)	1.21 (2.02)	435 (1238)
Sig. *t*-test						
No vs. medium	0.000	0.002	0.135	0.028	0.060	0.059
No vs. high	0.003	0.001	0.257	0.000	0.402	0.452
Medium vs. high	0.892	0.649	0.785	0.107	0.754	0.184
N	196	196	196	196	196	121/121/127

Note: We report the mean values (standard deviations in parentheses) of participants' expectation of net payoff and gross payoff from the forecast competition, probability to win the first prize and probability to win no prize in the forecast competition, the highest fee a participant would be willing to pay to participate, and (conditional on being willing to pay a participation fee) the expected return from the forecast competition itself for stocks presented with different amounts of information. Every participant received information on three stocks. Each stock was accompanied by either a low, medium, or high amount of information. We provide tests of equality of mean values of the participants' expectations using paired samples *t*-tests. We present the results for the three pairs, that is, low vs. medium; low vs. high; medium vs. high amount of information by providing the *p* values of the corresponding *t*-tests.

are not able to make use of the information. Given these results, we do not analyze the effect of different amounts of information on stock price estimates any further and instead focus on the effects of different amounts of information on participants' behavior in the forecast competition, that is, their expectations of payoffs from the competition itself and willingness to pay for participation.

3.3 | Effect on Expectations for the Competition

3.3.1 | Tests of Equality

The amount of information indeed influences participants' expectations and behavior in the stock price competition as presented in Table 7. For stocks with medium and high amount of information, participants expect a significantly lower net payoff from the competition—as difference between individually expected gross payoff (individually expected probability to win a prize times prize money) and the hypothetical participation fee—than in the base case. The differences are significant at the one per mill and three per mill level in case of medium and high amount of information, respectively. Further results show that the lower expected net payoff is particularly driven by a significantly lower expected gross payoff, but less so by a slightly, not statistically significant, higher participation fee participants would be willing to pay. Paired samples *t*-tests reveal that the expected gross payoff from the competition with low amount of information is significantly higher than the payoff from the competition with a medium (at the two per mill level) and the payoff from the competition with a high amount of information (at the one per mill level). The expected gross payoffs do not differ between medium and high amount of information at statistically significant levels. In all three settings, the mean expected gross payoff exceeds the gross payoff that participants could expect in a fair game, that is, €0.75,[10]—a finding that supports the notion of a better-than-average effect among the participants (e.g., Kruger and Dunning 1999). A closer look at the individual components of the expected gross payoff reveals that differences in the amount of information on average hardly alter the expectation to win the first prize. Instead, with an increasing amount of information, participants on average expect a higher probability to win no prize at all (meaning neither first nor second nor third prize). We assume that this effect is driven by some participants that ascribed themselves negligible chances to win the competition and a combination of two different aspects associated with information overload. First, participants might feel overstrained with the total amount of information when more information is presented, which makes them feel frustrated and pessimistic even regarding their chances to win the second or third prize in the stock forecast competition. Second, participants might assume that they are unable to derive useful insights from the new information, but they might think that other participants have better approaches to deal with the high amount of information so that the other participants are able to take advantage of the new information.

Adding information has no statistically significant effect on the participation fees the participants would be willing to pay. Only 121 participants would pay a participation fee for the competitions with low and medium amount of information at all. One hundred and twenty-seven participants would be willing to pay a participation fee for the competition with high amount of information.

3.3.2 | Linear Regression Analyses

We analyze the relation between participants' characteristics and their expectations in the forecast competition with OLS regressions applying Equation (3). The regression applying the expected net payoff, gross payoff, probability to win the first prize in the competition, probability to win no prize in the competition, and the participation fee subjects would be willing to pay as dependent variables. However, as the regression analyses hardly reveal strongly significant results, we provide the detailed results in the appendix (see Tables S16–S18). Among the analyzed characteristics, solely participants' overconfidence and risk attitude have a weak significant influence on participants' expectations in the forecast competition.

Although we do not observe that participants with certain characteristics are more subject to information illusion or show strongly significant patterns regarding their expectations in the forecast competition, it seems possible that participants' behavior in the forecast competition as response to information illusion differs between participants with different characteristics. We employ OLS regression analysis applying Equation (4) to analyze the latter relation.

The results in Table 8 (Models 1–3), with the differences in expected net payoffs between the information settings as dependent variable, indicate a positive relationship between participants' overconfidence and their expectation of additional net payoff in settings with more information (Models 2 and 3). In contrast, the better the participants' knowledge in statistics and the higher their scores on the personality trait *openness*, the stronger is the decrease in their expectation about net payoff when information is added. Moreover, the higher the participants' expectation of net payoffs in the low-information setting, the lower are their expectations regarding net payoff when more information is provided. This means that we again observe an anchor effect in the sense of a significant impact of the expectations in the setting with a low amount of information on the expectations in settings with more information. Results for OLS regressions with the changes in participants' expected gross payoffs from the stock forecast competition as dependent variables are presented in Columns 4–6. When putting the results in the context of our finding in the previous section that participants expect a significant lower gross payoff from the competition with a high amount of information than from the competition with a low amount of information, the regression analysis in Column 5 indicates that the latter effect is primarily driven by participants with lower levels of overconfidence. In addition, we observe a similar anchor effect as in the context of the net payoffs. Again, participants that expect higher payoffs in the settings with a low and with a medium amount of information decrease their expectations regarding the payoffs in the settings with more information more strongly than participants who expected lower payoffs in the first place. According to the low VIFs, participant characteristics are not significantly related to the anchor values.

TABLE 8 | Participants' characteristics and changes in expected net payoffs from the stock forecast competition when adding information (OLS).

	Differences in expected net payoffs from competition between different information settings			Differences in expected gross payoffs from competition between different information settings		
	MEDIUM–LOW(1)	*HIGH–LOW*(2)	*HIGH–MEDIUM* (3)	*MEDIUM–LOW* (4)	*HIGH–LOW* (5)	*HIGH–MEDIUM* (6)
GENDER	−0.721*	−0.814	−0.140	−0.568	−0.318	0.259
OVERCONFIDENCE	1.094	2.743***	1.788***	1.145	1.745**	0.639
RISK_ATTITUDE	−0.086	0.001	0.077	−0.008	0.070	0.090
AFFECT	ns	ns	ns	ns	ns	ns[a]
CRT	ns	ns	ns	ns	ns	ns
KNOWLEDGE	ns	ns[b]	ns[c]	ns	ns	ns
LOCUS_OF_CONTROL	ns	ns	ns	ns	ns	ns
PERSONALITY	ns	ns[d]	ns[e]	ns	ns[f]	ns
ORDER_PLACEBIC no-medium-high	0.227	−0.073	−0.283	0.268	−0.213	−0.470*
STOCK_PRICE_TREND medium	0.027			0.158		
STOCK_PRICE_TREND high		−0.204	−0.181		−0.377	−0.230
PERC_INFO_LOW	−0.127	−0.036		0.098	0.283	
$PERC\_INFO\_LOW^2$	0.016	0.002		−0.001	−0.029	
NET_PAYOFF_LOW	−0.206****	−0.213****				
GROSS_PAYOFF_LOW				−0.176****	−0.203****	
PERC_INFO_MEDIUM–PERC_INFO_LOW	0.060			0.345		
$(PERC\_INFO\_MEDIUM–PERC\_INFO\_LOW)^2$	−0.015			−0.093		
PERC_INFO_HIGH–PERC_INFO_LOW		−0.054			0.072	
$(PERC\_INFO\_HIGH–PERC\_INFO\_LOW)^2$		0.008			0.002	
PERC_INFO_MEDIUM			−0.078			0.033
$PERC\_INFO\_MEDIUM^2$			0.004			−0.004
NET_PAYOFF_MEDIUM			−0.033			
GROSS_PAYOFF_MEDIUM						−0.081***
PERC_INFO_HIGH–PERC_INFO_MEDIUM			−0.075			0.001
$(PERC\_INFO\_HIGH–PERC\_INFO\_MEDIUM)^2$			−0.018			−0.013

(Continues)

TABLE 8 | (Continued)

	Differences in expected net payoffs from competition between different information settings			Differences in expected gross payoffs from competition between different information settings		
	MEDIUM–LOW(1)	*HIGH–LOW*(2)	*HIGH–MEDIUM* (3)	*MEDIUM–LOW* (4)	*HIGH–LOW* (5)	*HIGH–MEDIUM* (6)
β_0	2.634	5.658	3.635	2.054	2.498	0.397
R^2	0.252	0.253	0.172	0.296	0.316	0.231
VIF (highest value among all independent variables excluding $(PERC\_INFO_i^{lessP})^2$ and $(PERC\_INFO_i^{moreP} - PERC\_INFO_i^{lessP})^2)$	1.727	1.712	1.699	1.719	1.705	1.702

Note: We provide regression coefficients, R^2, and VIF for the OLS regression analysis using Equation (3) with the differences in expected net payoffs (Models 1–3) and gross payoff (Models 4–6) between two information settings as dependent variable. Each stock was accompanied with either a low, medium, or high amount of information. The table includes the results for the full regression model. The symbols ****, ***, **, and * denote significance at the one per mill, five per mill, 1% level, and 5% level, respectively; for vectors, ns denotes not significant, that is, $p \geq 0.05$. Example: Regressing *NET_PAYOFF_MEDIUM–NET_PAYOFF_LOW* on the full regression model of Equation (3) yields a coefficient of −0.721 with a $p < 0.05$ for participants' gender as independent variable.
[a]We only observe a significant positive effect (coefficient = 0.255; $p = 0.040$) for the variable associated with positive affect.
[b]We only observe a significant negative effect (coefficient = −0.468; $p = 0.029$) for the variable associated with knowledge in statistics.
[c]We only observe a significant negative effect (coefficient = −0.410; $p = 0.006$) for the variable associated with knowledge in statistics.
[d]We only observe a significant negative effect (coefficient = −0.410; $p = 0.029$) for the variable associated with openness.
[e]We only observe a significant negative effect (coefficient = −0.277; $p = 0.033$) for the variable associated with openness.
[f]We only observe a significant negative effect (coefficient = −0.311; $p = 0.022$) for the variable associated with openness.

We observe similar results from the OLS regressions on the influence of participant characteristics on changes in their expectations of the chances to win the first prize in the competition (see Table 9, Models 1–3). Additionally, these results reveal that participants that stated to have received a high amount of relevant information to predict the stock price in the low-information setting show smaller decreases in their expectations of the probability to win the first prize. With more information, participants expect that it is more likely that they do not receive a prize (Models 4–6). This increase in the expected probability to win no prize is less pronounced for more overconfident participants and—with strong statistical significance—for participants that already expected a higher likelihood to win no prize in the settings with a low and with a medium amount of information. The VIFs show that the results are not driven by multicollinearity.

The maximum participation fee that participants would be willing to pay only slightly increases over the three information settings on average. However, regression results in Table 10 for the subsample of participants that is willing to pay a fee reveal two patterns. First, when a high amount of information is added, less overconfident participants are willing to pay more additional fee for participating in the competition than more overconfident investors. Second, participants that were willing to pay relatively high fees in the settings with a low or a medium amount of information show less increase in the amount they are willing to pay when more information is added. Both findings are not induced by multicollinearity effects (see VIFs), and regressions on the full sample of participants lead to very similar results.[11]

In summary, the regression analyses in this section reveal that there are significant differences between participants' behavior in the settings with less and more information. With higher amounts of information, participants expect lower net payoffs from the competition as they perceive lower chances to win a prize and, hence, a lower gross payoff while they are simultaneously nevertheless willing to pay a similar participation fee. Therefore, we conclude that participants adapt their behavior in the forecast competition as a reaction to added information, because they perceive that they (and also the other participants) received more relevant information. As the additional information does not lead to more accurate price estimates, participants are subject to an information illusion. The extent to which participants' behavior in the stock prize forecast competition is influenced by information illusion is primarily driven by two factors: Participants' overconfidence and their assessments and expectations in the baseline setting that serve as anchor value. Regression analyses on the anchor values indicate that they are also determined by participants' overconfidence or risk attitude. Hence, our findings indicate that participants' overconfidence plays a key role when they are confronted with more information.

3.4 | Robustness Checks and Discussion

We check the robustness of our finding that participants perceive a higher amount of information also as a higher amount of relevant information by controlling for the order of the information settings (low–medium–high vs. low–high–medium amount of information) and the perceived amount of relevant

TABLE 9 | Participants' characteristics and changes in expectation to win the first prize in the stock forecast competition when adding information (OLS).

	Differences in expected probability to win the first price **in forecast competition between different information settings**			**Differences in expected probability to win** no price **in forecast competition between different information settings**		
	***MEDIUM–LOW* (1)**	***HIGH–LOW* (2)**	***HIGH–MEDIUM* (3)**	***MEDIUM–LOW* (4)**	***HIGH–LOW* (5)**	***HIGH–MEDIUM* (6)**
GENDER	−0.496	−0.386	0.323	3.427	2.434	−0.736
OVERCONFIDENCE	1.920	4.059*	2.513	−4.229	−9.703*	−5.063
RISK_ATTITUDE	−0.188	0.018	0.293	0.328	0.096	−0.379
AFFECT	ns	ns	ns	ns	ns	ns
CRT	ns	ns	ns	ns	ns	ns
KNOWLEDGE	ns	ns	ns	ns	ns	ns
LOCUS_OF_CONTROL	ns	ns	ns	ns	ns	ns
PERSONALITY	ns	ns	ns	ns	ns	ns[a]
ORDER_AMOUNT low-medium-high	0.300	−0.190	−0.613	0.189	2.382	2.342
STOCK_PRICE_TREND medium	−0.021			−0.777		
STOCK_PRICE_TREND high		−1.122	−1.166		0.648	0.197
PERC_INFO_LOW	1.156*	1.,348*		−0.663	−1.780	
$PERC\_INFO\_LOW^2$	−0.095	−0.133*		0.004	0.176	
PROB_1ST_PRIZE_LOW	−0.134****	−0.106****				
PROB_NO_PRIZE_LOW				−0.125****	−0.176****	
PERC_INFO_MEDIUM–PERC_INFO_LOW	0.906			−1.756		
$(PERC\_INFO\_MEDIUM–PERC\_INFO\_LOW)^2$	−0.257			0.811		
PERC_INFO_HIGH–PERC_INFO_LOW		−0.017			−0.419	
$(PERC\_INFO\_HIGH–PERC\_INFO\_LOW)^2$		0.057			0.037	
PERC_INFO_MEDIUM			−0.043			0.579
$PERC\_INFO\_MEDIUM^2$			0.004			−0.061
PROB_1ST_PRIZE_MEDIUM			−0.076*			
PROB_NO_PRIZE_MEDIUM						−0.125****

(Continues)

TABLE 9 | (Continued)

	Differences in expected probability to **win** the first price **in forecast competition between different information settings**			Differences in expected probability to win no price **in forecast competition between different information settings**		
	MEDIUM–LOW **(1)**	***HIGH–LOW*** **(2)**	***HIGH–MEDIUM*** **(3)**	***MEDIUM–LOW*** **(4)**	***HIGH–LOW*** **(5)**	***HIGH–MEDIUM*** **(6)**
PERC_INFO_HIGH–PERC_INFO_MEDIUM			−0.110			−0.193
(PERC_INFO_HIGH–PERC_INFO_MEDIUM)^2			0.182			0.162
β_0	1.385	3.116	−0.422	1.063	15.899	19.606
R^2	0.246	0.172	0.110	0.199	0.277	0.233
VIF (highest value among all independent variables excluding $\left(PERC\_INFO_i^{lessP}\right)^2$ and $\left(PERC\_INFO_i^{moreP} - PERC\_INFO_i^{lessP}\right)^2$)	1.705	1.693	1.683	1.721	1.706	1.691

Note: We provide regression coefficients, R^2, and VIF for the OLS regression analysis using Equation (4) with the differences in expected chances to win the first prize (Models 1–3) and to win no prize (Models 4–6) in the stock forecast competition between two information settings as dependent variable. Each stock was accompanied by either a low, medium, or high amount of information. The table includes the results for the full regression model. The symbols ****, ***, **, and * denote significance at the one per mill, five per mill, 1% level, and 5 % level, respectively; for vectors, ns denotes not significant, that is, $p \geq 0.05$. Example: Regressing *PROB_1ST_PRIZE_MEDIUM–PROB_1ST_PRIZE_LOW* on the full regression model of Equation (4) yields a coefficient of −0.496 with a $p \geq 0.05$ for participants' gender as independent variable.
[a]We only observe a significant negative effect (coefficient = −2.007; $p = 0.018$) for the variable associated with extraversion.

information in dependence of the stock price trend. Although we find a significant influence of the historic stock price trend on the expected stock return in line with previous findings on trend extrapolation (see De Bondt 1993; Rötheli 2011), we do not find indications that challenge the robustness of our results regarding the influence of different amounts of information. The detailed results are presented in the appendix (Tables S20 and S21).

We also check whether our results are driven by differences between participants who are willing to pay a participation fee, that is, willing to take monetary risk, and those who are not. The detailed results in the appendix (Table S22) show that both samples do not significantly differ from each other regarding their perception about the amount of presented relevant information and the expected net payoff. These results are in line with the assumptions of Shefrin and Statman's (2000) Behavioral Portfolio Theory: The expected net payoff can be seen as the (absolute) return of participating in the forecast competition[12]; hence, the €2–3 that participants expect as net payoff represent the threshold value that they want to earn through participating in the competition. As investors according to the Behavioral Portfolio Theory primarily care to reach the threshold level with a high probability, it makes sense that participants with lower confidence in their forecasting skills are not willing to pay a participation fee.

As further robustness check, we perform 2SLS regressions for each pair of information settings in addition to the OLS regressions to address endogeneity concerns; see the appendix for the detailed description of methodology and the results. Results of the 2SLS regressions confirm that the results of the OLS regressions are not driven by endogeneity effects and do not provide additional explanation beyond the findings from the OLS regressions. Hence, we consider our findings robust to endogeneity effects.

As last robustness check, we only consider the subsample of 39 participants with stock market experience (20% of the total number of participants). Due to this relatively small number, we do not report the results of this robustness check in detail and do not perform regression analyses. In untabulated results, we find that the participants with stock market experience state to have significantly more relevant information available to forecast the future stock price when they received more systematic and idiosyncratic information than in the base case setting. Nevertheless, even in this subsample, the amount of information has no significant influence on the stock price forecasts. Hence, this robustness check supports our initial findings, and both groups, participants with stock market experience and participants without stock market experience, are subject to information illusion.

As participants' overconfidence frequently appeared as strongly significant factor in our analyses, we analyze differences between more and less overconfident participants in more detail. Results of *t*-tests between higher-than-median overconfident and the remaining participants are presented in Table 11. Although participants with higher levels of overconfidence generally expect higher net payoffs, they hardly lower their expectations when information is added. In contrast,

TABLE 10 | Participants' characteristics and changes in willingness to pay a participation fee for the stock forecast competition by adding information (OLS) (conditional on being willing to pay for participation in at least one of the considered competitions).

	Differences in amount participants are willing to pay for participation in forecast competition between different information settings		
	***MEDIUM–LOW* (1)**	***HIGH–LOW* (2)**	***HIGH–MEDIUM* (3)**
GENDER	0.376	0.884*	0.711
OVERCONFIDENCE	0.137	−1.587*	−1.850*
RISK_ATTITUDE	0.100	0.101	0.033
AFFECT	ns	ns	ns
CRT	ns	ns	ns
KNOWLEDGE	ns	ns[a]	ns[b]
LOCUS_OF_CONTROL	ns	ns	ns
PERSONALITY	ns	ns	ns[c]
ORDER_PLACEBIC no-medium-high	0.008	−0.123	−0.170
STOCK_PRICE_TREND medium placebic	0.119		
STOCK_PRICE_TREND high placebic		−0.222	−0.189
PERC_INFO_LOW	0.275	0.687*	
$PERC\_INFO\_LOW^2$	−0.014	−0.068	
PAY_FEE_LOW	−0.142**	−0.309****	
PERC_INFO_MEDIUM–PERC_INFO_LOW	0.549***		
$(PERC\_INFO\_MEDIUM–PERC\_INFO\_LOW)^2$	−0.128*		
PERC_INFO_HIGH–PERC_INFO_LOW		0.271	
$(PERC\_INFO\_HIGH–PERC\_INFO\_LOW)^2$		−0.027	
PERC_INFO_MEDIUM			0.414
$PERC\_INFO\_MEDIUM^2$			−0.036
PAY_FEE_MEDIUM			−0.226***
PERC_INFO_HIGH–PERC_INFO_MEDIUM			0.188
$(PERC\_INFO\_HIGH–PERC\_INFO\_MEDIUM)^2$			−0.044
β_0	−1.654	−6.984*	−5.919*
R^2	0.243	0.301	0.261
VIF (highest value among all independent variables excluding $(PERC\_INFO_i^{lessP})^2$ and $(PERC\_INFO_i^{moreP} - PERC\_INFO_i^{lessP})^2$)	2.035	1.912	1.926

Note: We provide regression coefficients, R^2, and VIF for the OLS regression analysis using Equation (4) with the differences in the highest participation fee participants would be willing to pay for the stock forecast competition between two information settings as dependent variable. The table shows results for the subsample of participants that were willing to pay a fee. Each stock was accompanied by either a low, medium, or high amount of information. The table includes the results for the full regression model. The symbols ****, ***, **, and * denote significance at the one per mill, five per mill, 1% level, and 5% level, respectively; for vectors ns denotes not significant, that is, $p \geq 0.05$. Example: Regressing *PAY_FEE_MEDIUM–PAY_FEE_LOW* on the full regression model of Equation (4) yields a coefficient of 0.376 with a $p \geq 0.05$ for participants' gender as independent variable.

[a]We only observe a significant positive effect (coefficient = 0.473; $p = 0.022$) for the variable associated with knowledge in statistics.

[b]We only observe a significant positive effect (coefficient = 0.429; $p = 0.020$) for the variable associated with knowledge in statistics.

[c]We only observe a significant positive effect (coefficient = 0.393; $p = 0.042$) for the variable associated with extraversion.

participants with lower levels of overconfidence state significantly lower expected net payoffs when information is added. As a consequence, more overconfident participants expect significantly higher net payoffs in the setting with high amount of information. In general, more overconfident participants hardly adopt their expectations regarding the stock forecast competition when information is added, whereas less overconfidence leads to significantly lower expectations of gross payoffs, of probabilities to win the first prize in the competition, and significantly higher expected chances to win no prize. In

TABLE 11 | Expectations in the forecast competition depending on participants' overconfidence.

Panel A: Expected payoffs from forecast competition

	Expected net payoff			Expected gross payoff		
	Overconf. median or below	Overconf. higher than median	Sig. *t*-test	Overconf. median or below	Overconf. higher than median	Sig. *t*-test
Stock with ____ amount of information						
Low	2.53 (3.95)	2.99 (4.01)	0.416	3.59 (4.05)	4.18 (4.41)	0.324
Medium	1.86 (3.44)	2.60 (3.75)	0.151	3.00 (3.46)	3.94 (4.12)	0.083
High	1.61 (3.50)	2.82 (4.13)	0.028	2.77 (2.99)	4.08 (4.41)	0.016
Sig. *t*-test						
Low vs. medium	0.008	0.013		0.008	0.121	
Low vs. high	0.005	0.335		0.001	0.522	
Medium vs. high	0.185	0.154		0.137	0.261	

Panel B: Probabilities to win the first prize and no prize in the forecast competition

	Probability to win the first prize			Probability to win no prize		
	Overconf. median or below	Overconf. higher than median	Sig. *t*-test	Overconf. median or below	Overconf. higher than median	Sig. *t*-test
Stock with ____ amount of information						
Low	5.51 (6.91)	8.22 (13.96)	0.088	75.79 (24.99)	70.89 (28.95)	0.215
Medium	4.96 (7.16)	7.79 (12.67)	0.056	77.83 (24.45)	72.57 (26.88)	0.153
High	4.42 (5.68)	8.55 (14.24)	0.009	80.32 (19.99)	72.24 (14.24)	0.021
Sig. *t*-test						
Low vs. medium	0.162	0.418		0.107	0.138	
Low vs. high	0.006	0.550		0.000	0.211	
Medium vs. high	0.268	0.175		0.026	0.661	

Panel C: Maximum participation fee in the forecast competition

	Overconf. median or below	Overconf. higher than median	Sig. *t*-test
Stock with ____ amount of information			
Low	1.05 (1.88)	1.19 (1.67)	0.599
Medium	1.14 (1.96)	1.34 (1.84)	0.452
High	1.16 (1.26)	1.26 (1.26)	0.714
Sig. *t*-test			
Low vs. medium	0.448	0.015	

(Continues)

TABLE 11 | (Continued)

Panel C: Maximum participation fee in the forecast competition			
	Overconf. median or below	**Overconf. higher than median**	**Sig. *t*-test**
Low vs. high	0.576	0.474	
Medium vs. high	0.885	0.511	
N	99	97	

Note: We report the mean values (standard deviations in parentheses) of participants' expected net payoff and gross payoff from the forecast competition (Panel A), probability to win the first prize and no prize in the forecast competition (Panel B), and the highest participation fee participants would be willing to pay for the stock forecast competition (Panel C) subdivided by participants' score on the overconfidence scale. Every participant received information on three stocks. Each stock was accompanied by either a low, medium, or high amount of information. We provide tests of equality using paired samples *t*-tests. We present the results for the three pairs, that is, low vs. medium; low vs. high; medium vs. high amount of information by providing the *p* values of the corresponding *t*-tests. In addition, we provide *p* values of independent samples *t*-tests that test the equality of the mean values of the group of participants with a median or lower score on the overconfidence scale and the group of participants with a higher than median score on the overconfidence scale.

our opinion, the latter findings provide strong indication that less overconfident participants are more affected by information illusion. However, they are not affected in a negative way; because by adjusting their expectations with regard to payoff and chances to win a prize in the competition downwards, less overconfident participants get closer to the expected payoff and chances that are rationally justifiable when considering the competition as a fair game. The finding that more overconfident participants are willing to pay slightly higher participation fees is consistent. Voluntarily paying a higher fee in this case represents—objectively—a riskier behavior that increases the chance of a financial loss. From the more overconfident participants' subjective point of view, however, the participation fee represents the fair price for an investment with a fair chance to earn a return at least as high as their threshold level. Hence, the observed behavior also matches the definition of overconfidence of Dittrich et al. (2005) that overconfidence is "the persistent overvaluation of the own investment decision."

4 | Conclusions

Our study is, to the best of our knowledge, the first study that introduces to the context of retail investors' financial decision making the idea that information may be perceived as relevant but does not enhance the accuracy of retail investors' stock price estimates. Based on a questionnaire-based stock price forecast competition, we show that further information on systematic and idiosyncratic factors in addition to information to assess a stock's market beta increases the perceived amount of relevant information. Nevertheless, the additional information has no influence on participants' stock price estimates and their accuracy. Hence, we conclude that the additional information acts as placebic information and creates an information illusion. This is in line with the efficient market hypothesis (Fama 1970) and with the observation that most retail investors do not outperform the market (Barber and Odean 2013). However, the additional information has an influence on participants' expectations in the stock forecast competition. As reaction to the illusion, less overconfident investors adjust their expectations with regard to payoff and chances to win a prize in the competition downwards and, by doing so, get closer to the expected payoff and chances that are rationally justifiable when considering the competition as a fair game. More overconfident participants do not adjust their expectations downwards.

Our findings provide implications for practitioners and researchers alike. Both regulators and policy makers should consider that placebic information can significantly impact investors' perception, and, therefore, regulation on information that is provided to retail investors in, for example, key investor information documents should focus on unambiguously relevant information. Adding further information will not necessarily lead to better decisions of the retail investors but influence their confidence regarding the accurateness of the decision. Hence, it is essential to provide retail investors with information that enables them to assess the risk of an investment and to increase financial literacy so that retail investors have a better understanding of what information is relevant for their investment decision. We abstain from demanding retail brokers to ban information that they already provide to their customers as long as the information is not misleading and as long as retail investors receive key investor information documents that include relevant information. Some customers might ask for more information, even if they cannot use this information to outperform the market. Overall, a combination of sufficient financial literacy, information quality—which we address in this paper from the angle of relevance of information—and adequate information quantity is essential.

Researchers should be aware that placebic information asymmetrically influences expectations of participants in experiments who show different levels of overconfidence and their perception of how well they are informed. An interesting question for further research is to identify if retail investors perceive some pieces of placebic information as being more relevant than other pieces of placebic information and how financial literacy and/or stock market experience moderate these effects. Moreover, expanding the research on placebic information to other financial assets, such as bonds, would provide a deeper understanding of the impact of different types of information on retail investors. Beyond this, further research should analyze the impact of the amount of information on financial decision making and interdependencies with individual characteristics in other methodological setups and for further groups of decision makers.

Acknowledgments

We would like to thank Daniel Oppenheimer and Lukas Menkhoff for valuable suggestions. We would also like to thank participants of the Virtual Annual Meeting of the Verein fuer Socialpolitik 2020; the 2019 Society for Judgment and Decision Making Conference, Montreal; the Psychonomic Society 2019 Annual Meeting, Montreal; the 88th International Atlantic Economic Conference, Miami; the 2019 Annual Meeting of the Academy of Financial Services, Minneapolis; the IAREP/SABE 2019 Conference, Dublin; and the 2019 Behavioural Finance Working Group Conference, London, and seminar participants at Bamberg University in Bamberg, Germany, for helpful comments and suggestions. All remaining errors are our own. Open Access funding enabled and organized by Projekt DEAL. [Correction added on 28 April 2025 after first online publication: Projekt DEAL funding statement has been added.]

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Endnotes

[1] See, for example, Barber and Odean (2008) who show that the buying behavior of retail investors in stock markets is stronger influenced by attention-grabbing events than the buying behavior of institutional investors.

[2] The data, however, do not allow drawing conclusions regarding the effect of placebic information when participants' initial expectations with regard to payoff and chances to win a prize in the competition already have been below the expected payoff and chances that are rationally justifiable when considering the competition as a fair game.

[3] Participants received the questionnaire in German language, and the questionnaire in the appendix is an English translation. The questionnaire has been pretested with 17 participants. The feedback of the pretest participants has been used to slightly modify the original questionnaire in order to eliminate unclear wording. Participants of the pretest did not participate in the final forecast competition.

[4] Korniotis and Kumar (2013) show that education is correlated with smartness and that smart people show higher skills in the selection of stocks when information asymmetry is high.

[5] The presented stocks are E.ON (stock in the base case referred to as Stock 1 in the rest of the paper; ISIN: DE000ENAG999), Deutsche Euroshop (downward price trend; referred to as Stock 2 in the rest of the paper; ISIN: DE0007480204), and adidas (upward price trend; referred to as Stock 3 in the rest of the paper; ISIN: DE000A1EWWW0). The names of the stock companies are not provided in the questionnaire. Furthermore, stock prices are adjusted so that the presented stock prices in the questionnaire by and large range between €20 and €25. When participants collected their compensation for participating in the questionnaire (plus prize money if applicable), we asked them whether they recognized the stock companies. None of the asked participants provided a correct guess.

[6] Two key investor information documents posted on the Internet (one provided by a savings bank and one provided by a private commercial bank) served as source for the selected placebic information.

[7] Even though not every participant receives a compensation that exactly reflects the accuracy of the estimate, we consider our compensation scheme an incentive compatible setup. As the participants do not get any information about the other participants' estimates and should not be able to forecast the other participants' estimates due to the large number of participants, participants' best chance to win the competition is to make best effort to provide an accurate stock price estimate and not to try to anticipate the estimates of the other participants. Hence, the prize money should appropriately work as incentive for providing the best possible, that is, most accurate, stock price estimate. In addition, our compensation scheme might be superior to a compensation that exactly reflects the accuracy of the estimate as our compensation scheme also simulates the fact that retail investors face a considerable amount of (perceived) ambiguity regarding other stock market participants' ability to use the available information when making forecasts.

[8] See Table S15. The only exception is a statistically weak influence of the amount of information on the accuracy of the expected standard deviation of stock returns of Stock 3. The results suggest a larger gap between expected and actual stock risk when a high amount of information is presented. However, as this effect is of weak statistical significance and as the effect is not observed for other stocks, we do not assume a systematic impact.

[9] Even though we report an impact of financial knowledge on the perception of the amount of relevant information in Section 3.1, *t*-tests between participants with a high score and participants with a low score in financial knowledge show that both groups are subject to an information illusion in a similar way (see Table S14).

[10] In the questionnaire, we mentioned that 60 participants are in each group. When considering the competition as a fair game, the expected gross payoff per competition is (20EUR + 15EUR + 10EUR)/60 = 0.75 EUR.

[11] See Table S19.

[12] For this reason and because only two-thirds of the participants were willing to pay a hypothetical participation fee, we do not compute the relative return as expected gross return divided through the (hypothetical) participation fee but instead focus on the absolute values of the expected payoffs to better fit the participants' investment framework.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.