Information Processing Differences Between Experts and Novices in Fund Investment Decisions and Intervention

Authors: Xin Ziqiang, Wang Luxiao, Li Yue, Ziqiang Xin

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Abstract

Previous fund research has predominantly constructed complex decision models from a professional perspective, rendering them difficult for ordinary fund investors to directly comprehend and apply. To guide numerous novice fund investors toward proper financial management, we introduce an "expert-novice" comparative paradigm to investigate differences in their information processing during investment decision-making and to explore interventions for enhancing novices' decision quality. Study 1 collected information processing data using Mouselab technology, revealing that during fund information search and processing, experts exhibit a more attribute-based information search pattern than novices, with lower compensatory information processing. While attribute-based information search patterns benefit decision quality, this effect is observed only among novices, possibly because experts' information search patterns are relatively stable, and their variability offers limited explanatory power for decision quality. Since existing financial management client interfaces make it difficult for novice investors to employ attribute-based information search patterns, Study 2 provided participants with worksheets to facilitate structured processing, thereby reducing the difficulty of attribute-based search. Results demonstrated that decision quality in the structured processing group surpassed that of the control group. These findings illuminate the information processing characteristics distinguishing expert and novice fund investment decision-making, offering intervention strategies for improving novice financial decisions.

Full Text

Preamble

Title: Differences in Information Processing Between Experienced and Novice Investors in Fund Investment Decision-Making and Intervention Strategies

Authors: XIN Ziqiang[1], WANG Luxiao[1], LI Yue[2]
[1] Department of Psychology, Renmin University of China, Beijing 100872, China
[2] Department of Psychology, School of Sociology and Psychology, Central University of Finance and Economics, Beijing 100081, China

Abstract: Previous fund research has predominantly constructed complex decision-making models from a professional perspective, making them difficult for ordinary fund investors to understand and apply. To guide the numerous novice fund investors toward sound financial management, we introduced an "experienced-novice" comparative paradigm to explore differences in their information processing during investment decision-making and examined how to intervene with novices to improve their decision quality. Study 1 collected information processing data using Mouselab technology, revealing that experienced investors exhibited a stronger preference for attribute-based information search patterns and lower compensatory information processing compared to novices. Attribute-based search patterns benefited decision quality, but this effect was only observed among novices, possibly because experienced investors' search patterns were more stable, with insufficient variability to explain decision quality. Since existing financial client interfaces make it difficult for novice investors to employ attribute-based search patterns, Study 2 provided participants with structured forms to facilitate structured processing and reduce the difficulty of attribute-based searching. Results showed that the structured processing group achieved higher decision quality than the control group. These findings reflect the information processing characteristics of experienced and novice fund investors and provide intervention ideas for improving novices' financial decision-making.

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Corresponding Author: XIN Ziqiang, E-mail: xinziqiang@sohu.com

Abstract

Many individuals now participate in online fund investment, but novice investors often struggle with complex information due to the lack of professional guidance traditionally available through offline financing channels. Previous decision-making research has primarily focused on outcomes, using statistical methods to construct decision models that fail to provide direct evidence of information processing. To assist novices in developing necessary investment decision-making skills, this study employs process tracking technology in the

field of fund investment for the first time. The aim is to explore differences in information processing between experienced investors and novices, thereby identifying the advantages experienced investors possess in information processing. Additionally, this research investigates the relationship between decision-making processes and outcomes, proposing interventions based on information processing to help novices make accurate investment decisions.

Two studies were conducted to achieve these objectives. Study 1 comprehensively traced the fund investment decision-making process using Mouselab, comparing various information processing indicators between experienced investors and novices, including decision time, search depth, search variability, compensatory index, and SM (strategy measure) values of search patterns. The study also examined the impact of search patterns on decision quality for both groups through grouped logistic regression. Study 2 utilized a single-factor (structured intervention group vs. control group) between-subjects design. Participants in the structured intervention group were provided with a form to guide them in structuring fund information, while control group participants received blank paper. All participants then completed a simulated fund investment task, and their decision quality was recorded.

Study 1 revealed that: (1) Experienced investors, compared to novices, preferred attribute-based search patterns during fund investment decision-making and displayed a more non-compensatory approach to information processing. (2) Only novices' decision quality in fund investment was affected by information search patterns, indicating that their decision quality improved when searching for information based on attributes. In contrast, experienced investors' decision quality was unaffected by search patterns but positively influenced by working memory. Study 2 demonstrated that participants who used the form for intervention had higher decision-making quality than those who used blank paper, indicating the effectiveness of structured intervention.

This study makes theoretical and practical contributions. First, it explores characteristics of the information processing process during fund investment decision-making and its relationship with decision outcomes, filling the research gap regarding the "process" of information processing and deepening understanding of the essence of decision-making ability in fund investment. Second, it extends the "expert-novice" paradigm to fund investment, summarizing differences in search patterns and compensatory behavior between experts and novices, further supporting the heuristic decision model. Third, it proposes effective interventions to assist novice investors in improving online fund investment and inspires interface design for fund applications.

Keywords: fund investment decision, experienced investors, novices, information processing, intervention

Introduction

As China' s per capita disposable income continues to grow, the investment and wealth management market has expanded significantly. By the end of 2021, the number of fund investors in China (also known as "fund holders") had reached 720 million (Securities Association of China, 2022). With a large influx of novice fund holders into the market, guiding them toward sound financial management has become a critical issue, with implications not only for individual wealth growth but also for the stable development of China' s capital market. However, previous research has predominantly analyzed market data to construct complex statistical models for predicting return trends. While professional, these models are difficult for ordinary fund investors to understand and utilize. This study focuses on the psychological processes of ordinary fund investors, employing an "expert-novice" or "experienced-novice" comparative paradigm to reveal differences in fund investment decision outcomes and underlying information processing methods. The primary aim is to provide intervention ideas for improving novices' investment decision-making capabilities, facilitating the application of psychological research in investment practice. Meanwhile, empirical evidence on information processing in fund investment decisions remains scarce in domestic and international decision psychology and economic psychology.

1.1 Information Processing in Fund Investment Decision-Making

Previous fund investment research has predominantly employed an outcome-based paradigm, constructing models to infer processes through data analysis (e.g., Luo & Ren, 2015). However, multiple competing models exist that are difficult to falsify, representing a common limitation of outcome-based decision research (Johnson et al., 2008; Wei & Li, 2015). Directly examining decision information processing processes can help understand how particular outcomes emerge. However, current domestic and international research on fund investment decisions remains limited, with studies on various investment decisions focusing more on investors' irrational psychological anomalies, investment styles, or participation levels (Arora & Kumari, 2015; Talwar et al., 2021; Wang & Yu, 2017) rather than directly exploring underlying information processing. Since fund investment involves decision-making under risk—where investors face potential gains and losses (Deng et al., 2022)—it represents a special type of risky decision and one of the most typical risky decisions in daily life (Weber et al., 2002). General research on risky decision processes can provide valuable insights for fund decision research.

Researchers have focused on information processing strategies to explore risky decision-making, though theoretical perspectives and conclusions differ (Pachur et al., 2013). Some researchers, building on expected value theory, propose integrative models (Birnbaum & LaCroix, 2008), advocating that risky decision-making is a compensatory process maximizing expected value. Compensatory

refers to weighting and summing information across dimensions to evaluate a single "value" dimension (Anderson, 2003). When employing compensatory processing strategies, people consider all available information to calculate optimal options (Zhou et al., 2014), reflecting an option-based information search pattern. In contrast, other researchers, based on "bounded rationality" assumptions, propose heuristic models (Brandstätter et al., 2006), suggesting risky decision-making is a non-compensatory, heuristic process where individuals use partial important attribute information to make decisions (Brams et al., 2019), corresponding to an attribute-based information search pattern.

Fund investment decisions typically involve both option and attribute dimensions. For example, on Alipay Wealth Management, different categories of fund products exist (options), such as healthcare or technology funds, with each fund differing across attributes like performance and net value. Investors must obtain and process diverse fund options and attribute information before making decisions, undoubtedly a challenging task. When facing such complex decision tasks, people prefer attribute-based search patterns, as verified in both low-risk daily consumption decisions and high-risk gambling tasks (Lohse & Johnson, 1996; Weenig & Maarleveld, 2002). The psychological mechanism is that excessive options and attributes make it difficult for individuals to acquire and analyze all information, preventing them from making value-maximizing choices. To reduce cognitive load, individuals prefer attribute-based search patterns and non-compensatory strategies. With over ten thousand fund products in the market creating massive information, investment decisions become complex and risky. In this context, investors may not merge and calculate "value" to select optimal options—that is, they may not employ option-based search but rather attribute-based search. Although direct evidence on fund investment decision processes remains scarce, based on general risky decision research and mechanism analysis, we propose Hypothesis 1: When making fund investment decisions, people tend to use attribute-based information search patterns.

1.2 Information Processing Differences Between Experienced and Novice Investors

In recent years, attracted by fund market performance, many inexperienced novice investors have entered the market. By the first quarter of 2021, 42% of investors had less than one year of investment experience (Invesco Great Wall et al., 2021). These novice fund holders typically struggle more with information processing when selecting funds, making it critical to help them acquire necessary investment decision-making skills for healthy market development. In real life, when learning a skill, people often seek advice from experienced individuals —that is, experienced investors or experts. Previous research indicates that experienced individuals generally possess information processing advantages, verified across domains like chess competition and medical diagnosis (Brams et al., 2019; Ji et al., 2022; Wang et al., 2016). However, direct research evidence on "experienced-novice" information processing differences in fund investment

remains lacking.

Findings from "experienced-novice" comparisons in other decision scenarios or cognitive tasks can provide insights for the fund investment domain. After reviewing the literature, information processing differences between experienced and novice investors may manifest in three aspects. First, experienced investors have clearer understanding of each information search step, greater decision confidence, and search for less but more important information (Brams et al., 2019; Spence & Brucks, 1997). They can identify important features or attributes based on experience and employ heuristic processing (Klein & Peio, 1989). However, one specific study simulating lending decisions found that experienced individuals actually searched for more information when making decisions (Andersson, 2004), contradicting typical findings. Second, related to the first point, experienced investors rely more on intuitive or even unconscious decision-making (Dijksterhuis et al., 2009). Third, according to fuzzy-trace theory, experienced investors use more gist-based processing rather than verbatim, detailed processing (Reyna & Lloyd, 2006). Synthesizing these points, experienced investors may not engage in careful calculation but rather employ experience-based heuristic approaches, selecting key attributes as decision bases —that is, they may adopt more non-compensatory, attribute-based processing strategies. We therefore propose Hypothesis 2: Compared to novices, experienced investors exhibit higher non-compensatory information processing in fund investment decisions, reflected in lower search depth, lower compensatory index, and stronger adherence to attribute-based search patterns.

1.3 Impact of Information Processing Methods on Decision Outcomes

The ultimate purpose of studying information processing is to explain how decision outcomes emerge. Previous research indicates that when performing complex multi-attribute decision tasks, intuitive heuristic strategies outperform careful analytical strategies (Dijksterhuis & Olden, 2006; Krava et al., 2021). Fund investment decisions also constitute multi-attribute decisions, suggesting that attribute-based information search patterns may lead to superior fund investment decisions. However, whether this relationship holds for both experienced and novice investors remains unknown.

When individuals accumulate substantial experience in a domain, they develop cognitive schemas. When facing similar decision contexts, they rely on standardized procedures (Gillespie & Peterson, 2009), resulting in stable behavioral decision patterns and performance (Itzkowitz & Itzkowitz, 2017) that do not easily change with problem difficulty or presentation format (Saravanan & Menold, 2022; Spence & Brucks, 1997). Therefore, experienced investors' performance quality depends not on strategy but on certain abilities (Bai & Han, 2011). Research indicates that expert performance critically depends on working memory (Furley & Wood, 2016). We therefore propose Hypothesis 3: Attribute-based information search patterns yield better decision quality, but this relationship'

s strength is weakened among experienced investors compared to novices.

1.4 Intervention in Information Processing Methods

Based on potential differences in information processing methods between experienced and novice investors during fund selection and their consequences, we can target interventions toward novices' information processing to improve their financial decisions. Previous research neglected process analysis and lacked intervention studies from an information processing perspective, instead emphasizing general financial knowledge education and concept cultivation to improve financial behavior (Wang & Yu, 2017). However, such financial education requires societal coordination, involves substantial effort, and yields slow results. To help people quickly acquire financial management skills autonomously, interventions should target investors themselves.

From the perspective of individual information processing, attribute-based information search patterns appear to yield better decision outcomes. Moreover, in complex decision scenarios, presenting information in a structured "options × attributes" matrix format facilitates information comparison and attribute-based search patterns (Weenig & Maarleveld, 2002; Yu & Wang, 2005). This may occur because when information is organized, individuals can more intuitively access data in the same row or column, making it easier to attend to and identify differences between attributes (Slovic & MacPhillamy, 1974). Many researchers believe matrix presentation reduces information search difficulty (Ding et al., 2004; Yu et al., 2013). This presentation method can inspire improvements in decision strategies and performance. In daily life, attribute information is not structured like in decision tasks but scattered within options. Current financial client software typically displays only one fund (option) per page with several attribute information, forcing users to navigate between pages to view more fund options. In this situation, option information is structurally integrated within the same page, but attribute information is dispersed. This increases cognitive load when comparing different funds and makes it easier for decision-makers to weight attributes within the same fund, leading to option-based search patterns. In other words, current fund presentation methods make it difficult for people to use attribute-based information search patterns. Therefore, this study adopts the nudge concept (Thaler & Sunstein, 2008), referencing Spence and Brucks (1997) by providing participants with form paper to guide structured information integration. This promotes intuitive presentation of attribute information alongside option information, helping people overcome the tendency to use option-based processing merely due to processing convenience, thereby returning to attribute-based information search patterns (Weenig & Maarleveld, 2002). This helps them avoid cognitive deficiencies and improve fund decision accuracy. As mentioned, many novice investors have entered the fund market, and their investment patterns are not as stable as experienced investors' , making interventions on novices' information search patterns potentially more effective. Indeed, Spence and Brucks' (1997) intervention study found that

guiding experienced investors to engage in structured processing did not benefit their decision performance. We therefore propose Hypothesis 4: Guiding novice fund investors to structurally integrate information by attributes can improve fund investment decision quality.

1.5 Purpose and Methods of This Study

This study first employs Mouselab technology to obtain information processing data (Study 1). Mouselab technology presents participants with an "options × attributes" information matrix where all information is initially hidden and revealed when the mouse hovers over a cell, then hidden again when the mouse moves away. Participants can repeatedly view information. By collecting mouse movement data, researchers can obtain information search time and content, calculate compensatory indices and search patterns, and comprehensively reflect participants' information processing (Payne, 1976). Researchers commonly use this method to obtain decision process data (e.g., Zhang et al., 2017) to characterize psychological processes when participants gather and process decision information. While it is difficult to predict future returns based solely on current fund attributes, to address the issue of investors entering the market—that is, people' s reasoning processes and outcomes when initially deciding to invest in funds—we set theoretically optimal options in the experimental task to examine decision quality. In summary, Study 1 analyzes differences in information processing between experienced and novice investors in fund decision-making using Mouselab technology and examines how decision processes affect outcomes, thereby providing ideas for intervention measures.

Building on Study 1' s results and the reality that attribute information is not structurally arranged like in decision tasks, Study 2 conducts an intervention study in a simulated internet fund wealth management context. By guiding participants to structurally integrate information, we investigate improvements in decision quality, aiming to help novice fund investors improve their financial behavior by mastering appropriate information processing methods.

2.1 Pilot Study

Since no clear industry standard defines how many years of fund investment experience qualifies someone as an experienced investor, we conducted a pilot study to survey the distribution of fund investment experience among the general public, thereby establishing grouping criteria for experienced and novice investors. We also identified the five fund attributes people care about most for research material design.

2.1.1 Survey Participants and Instruments

Using Credamo' s participant pool, we collected 94 valid questionnaires online, including 51 males and 43 females, with 13 holding graduate degrees or higher.

We first surveyed participants' fund investment experience with two questions. Question 1 asked, "Have you ever invested in or are you currently investing in funds?" Participants with fund investment experience answered Question 2: "Approximately how long have you had fund investment experience?" Options included "0-1 year," "1-2 years," "2-3 years," "3-4 years," "4-5 years," and "5 years or more."

Next, we surveyed fund attributes participants considered when investing, including 13 attributes: "one-year return rate," "net asset value," "fee rate," "daily change," "risk level," "fund sector," "historical performance," "fund rating," "fund holdings," "fund manager profile," "fund company profile," "fund ranking," and "fund size." These attributes were determined based on common information presented on Alipay Wealth Management and major banks' fund platforms, covering all attributes displayed on various wealth management apps. Participants selected the five attributes they cared about most.

Finally, we collected demographic information including gender, age, and education level.

2.1.2 Pilot Study Results

Regarding fund investment experience, participants with less than three years of experience accounted for 67.0%, while those with three or more years accounted for 33.0%, similar to the distribution of novices (60.3%) and experienced/expert investors (39.7%) reported in Lian et al.' s (2003) natural survey sample. Therefore, this study uses three years of experience as the grouping criterion for novices and experienced investors for subsequent participant recruitment.

Regarding fund attributes, the five most frequently selected attributes were: one-year return rate (86.2%), risk level (69.1%), historical performance (64.9%), fund rating (36.2%), and daily change (35.1%). No other attribute exceeded 30% selection frequency. We ultimately decided to use these five attributes to design research materials.

2.2 Participants

Based on the pilot study criteria, Study 1 recruited 39 novice fund investors with less than three years of experience who were interested in fund investment and possessed basic knowledge, and 35 experienced fund investors with three or more years of experience who were very knowledgeable about fund investment. A total of 74 valid participants were obtained, including 30 males and 44 females, with a mean age of 29.04 years (SD = 11.70). Regarding education, 47 held bachelor' s degrees or below and 27 held graduate degrees or above, with half majoring in finance/economics and half in non-finance fields. Referencing domestic "experienced-novice" decision process research results (Chen & Bai, 2019), we selected a medium-to-large effect size of Cohen' s d = 0.7 to estimate sample size. With power = 0.8 and $\alpha = 0.05$, G*Power calculated a required sample size of 68, making our 74 participants adequate. All participants

had normal or corrected-to-normal vision, no intellectual disabilities, and could operate a mouse correctly.

2.3 Research Design and Procedure

To explore differences in information processing between experienced and novice investors in fund investment decision-making, we employed a single-factor between-subjects design with experience level (experienced vs. novice) as the independent variable and various information processing indicators and decision quality as dependent variables.

Participants first completed a simulated fund investment task where they viewed fund information and made investment judgments. Data on information processing time, search patterns, and final decisions were recorded, all reflecting participants' psychological processes during decision-making. Participants then completed an operation span task to measure working memory level, as previous research indicates working memory is a key factor affecting experienced and novice performance (Miao & Chi, 2023). Working memory level was included as a control variable. Finally, participants completed a questionnaire on demographic information and other control variables.

2.4.1 Simulated Fund Investment Task

The simulated fund investment task adapted Posavac et al.' s (2019) design based on the Mouselab standard program developed by Johnson et al. (1989), presented via Mouselab 1.0 software on computers.

The experimental material consisted of a self-designed 6 (fund options) × 5 (fund attributes) information matrix. Following standard Mouselab technology, each row represented a fund option, including six funds: Fund 102, Fund 316, Fund 443, Fund 987, Fund 536, and Fund 224 (numerical portions represented random three-digit fund codes with no other meaning, simulating real fund presentations as commonly used in previous research, e.g., Chen, 2009; Leng et al., 2017). Each option contained five parallel fund attributes selected from the pilot study: annual return rate, risk level, historical performance, fund rating, and daily change. Referencing Alipay fund presentations, annual return rates (22.36% and 15.08%) and daily changes (1.03% and 0.64%) were presented numerically; risk levels included "medium risk" and "high risk" ; historical performance included "on par with category average" and "above category average" ; fund ratings included "three-star" and "four-star." Among the six options, all except Fund 443 had at least one disadvantageous attribute (e.g., Fund 536 had a "three-star"rating while others had "four-star"). Thus, Fund 443 was the optimal option. Participants who selected this optimal option received a decision quality score of 1; otherwise, they received 0.

[Figure 1: see original paper] Sample page from Study 1 simulated fund investment task

As shown in Figure 1, all information was initially hidden. Before participants could view information with the mouse, instructions informed them they were participating in a simulated fund investment task with 1,000 yuan to invest. All investment earnings would be converted to cash compensation proportionally, and instructions explained the meaning of each attribute level. To balance order effects, the presentation positions of all options and attributes were randomized.

This study adopted commonly used process indicators from previous research, including decision duration, search depth, search variability, compensatory index, and search pattern (e.g., Borozan et al., 2022; Payne, 1976; Reisen et al., 2008; Wang et al., 2018). Decision duration reflects decision difficulty; high search depth, low search variability, and high compensatory index reflect compensatory processing; search pattern reflects whether participants search based on options or attributes. These indicators effectively characterize participants' psychological processes during decision-making. Indicator definitions and calculations are as follows: (1) Decision duration: sum of viewing time for all cells, in seconds; (2) Search depth (DS): number of cells viewed / total number of cells, with higher scores indicating greater search depth and higher compensatory processing; (3) Search variability (VS): standard deviation of the proportion of cells viewed per option, with higher scores indicating greater search variability and lower compensatory processing; (4) Compensatory index (CI; Koele & Westenberg, 1995): directly reflects compensatory strategy, calculated from DS and VS using the formula CI = DS(1 -2VS), ranging from 0 to 1, with higher values indicating greater compensatory processing; (5) Search pattern: measured by strategy measure (SM) to determine whether information search is option-based or attribute-based, an important process-tracing indicator in decision research (Yu et al., 2013). SM reflects the difference between within-option transitions (ra) and within-attribute transitions (rd) (see Formula 1), used in multiple studies (e.g., Schulte-Mecklenbeck et al., 2013; Su et al., 2013). SM > 0 indicates option-based search patterns; SM < 0 indicates attribute-based search patterns. Overall, smaller values indicate more attribute-based search patterns, while larger values indicate more option-based patterns.

Note: A represents number of options, D represents number of attributes, ra represents mouse transitions based on options, rd represents mouse transitions based on attributes, and N represents total number of transitions.

2.4.2 Operation Span Task

We used the operation span task developed by Unsworth et al. (2005) to measure working memory, presented via MATLAB software and the PsychToolbox-3 toolbox. Mei et al. (2021) translated and validated this task in Chinese with good reliability and validity. After three practice tasks (letter memory practice, equation judgment practice, and formal task practice), participants began formal testing. As shown in Figure 2 [Figure 2: see original paper], an equation (e.g., 72/8 + 2 = ?) first appeared on screen. Participants calculated the result and judged whether the number on the next page was the correct

answer, responding as quickly as possible. If judgment timed out, the system automatically advanced to the next page and recorded the response as incorrect (if cumulative accuracy on equation judgments fell below 85%, indicating participants might be neglecting equation judgments to memorize letters, their working memory score was invalidated; Mei et al., 2021). After each equation judgment, a letter appeared on screen for 0.8 seconds, followed by the next equation judgment. Thus, each task group presented an equal number of equations and letters. Participants memorized all letters in sequence and selected them in order on the corresponding page. Formal testing presented 15 task groups with 3 to 7 letters each (same number of equations), containing 75 letters total. The number of correctly recalled letters served as the working memory level indicator.

[Figure 2: see original paper] Flowchart of operation span task

2.4.3 Demographic Information and Other Control Variables

Participants reported gender, age, education level, whether they majored in finance/economics, and risk tolerance. Risk tolerance was measured by the question "When you invest, how much risk are you willing to take?" on a 5-point scale (1 = "unwilling to take any risk," 5 = "high risk, high return"), with higher scores indicating greater risk tolerance.

2.5.1 Overall Information Search Pattern

Following Willemsen and Johnson's (2011) recommended Mouselab data processing standards, we filtered out mouse dwell points below 200ms and calculated SM values for all participants. Results showed participants' mean SM value was -4.11 (SD = 5.22), range [-14.08, 11.55]. Sixteen participants (21.6%) had SM > 0, while 58 participants (78.4%) had SM < 0. Chi-square test indicated a significant difference between groups, $^2 = 23.84$, $p < 0.001$, $\phi = 0.57$, showing most participants preferred attribute-based information search, supporting Hypothesis 1.

2.5.2 Differences in Information Processing and Decision Quality Between Experienced and Novice Investors

To explore differences in compensatory processing and information search patterns between experienced and novice investors (descriptive statistics in Table 1), we conducted independent samples t-tests. No difference emerged between experienced and novice groups in decision duration, t(72) = -0.07, p = 0.942, indicating decision time was unaffected by experience level. On compensatory indicators, the experienced group showed significantly lower search depth than the novice group, t(72) = -2.20, p = 0.031, Cohen' s d = 0.51; search variability was slightly higher in the experienced group, with a marginally significant

difference, t(72) = 1.95, p = 0.056, Cohen' s d = 0.47; the experienced group' s compensatory index was significantly lower than the novice group, t(72) = -2.15, p = 0.035, Cohen' s d = 0.50, representing a medium effect size. Overall, experienced investors showed lower "compensatory" information processing, meaning they did not deeply explore and carefully calculate all information but rather used more heuristic processing strategies. Regarding information search patterns, the experienced group' s SM value was significantly lower than the novice group, t(72) = -2.20, p = 0.031, Cohen' s d = 0.51, representing a medium effect size, indicating experienced investors preferred attribute-based search patterns more than novices, supporting Hypothesis 2.

We also compared decision quality between experienced (accuracy 48.57%) and novice (accuracy 46.15%) investors but found no significant difference, $^{2} = 0.04$, $p > 0.05$.

2.5.3 Impact of Information Search Pattern on Decision Quality

To examine the effect of information search pattern (SM as indicator) on decision quality (a binary variable scored 0 or 1), we conducted logistic regression with search pattern as the independent variable, experience level (experienced vs. novice) as moderator, and controlled for gender, age, education, major, risk tolerance, and working memory. Since decision quality depends on retrieval of effective information, we also included search depth as a control variable. Seven participants with equation accuracy below 85% on the operation span task were excluded from subsequent analysis. Model fit $^{2} = 7.82$, p = 0.451, indicated good model fit. As shown in Table 2 , SM negatively predicted decision quality, B = -0.18, SE = 0.08, Wald $^{2} = 4.72$, OR = 0.84, 95% CI = [0.71, 0.98], p = 0.030, Nagelkerke R^2 change = 0.14, indicating that more attribute-based information search patterns predicted better decision quality, while more option-based patterns predicted worse quality. However, no interaction between experience level and SM emerged (p = 0.267).

To better understand how information search patterns function in experienced and novice investors, we conducted logistic regression by experience level. In the novice group, model fit $^{2} = 4.51$, p = 0.720, indicated good fit. After controlling for gender and other variables, SM significantly negatively predicted decision quality, B = -0.17, SE = 0.08, Wald $^{2} = 4.12$, OR = 0.84, 95% CI = [0.72, 0.99], p = 0.042, Nagelkerke R^2 change = 0.16, indicating that compared to attribute-based search, option-based search reduced novices' accuracy by 16%. In the experienced group, model fit was good, $^{2} = 9.90$, p = 0.272. However, SM did not affect decision quality (p = 0.799, Nagelkerke R^2 change = 0.002), while working memory positively predicted experienced investors' decision quality, B = 0.16, SE = 0.08, Wald $^{2} = 4.15$, OR = 1.18, 95% CI = [1.01, 1.38], p = 0.042, with higher working memory associated with better decision quality. These results indicate that attribute-based information search patterns positively affect novices' decision quality but not experienced investors' , pos-

sibly because experienced investors' search patterns are highly stable with low variability, insufficient for predicting decision quality, supporting Hypothesis 3.

Additionally, decision time, search depth, search variability, and compensatory index did not affect decision quality, ps > 0.05.

2.6 Discussion

Study 1 demonstrated that when simultaneously presenting fund options and attribute information, participants overall preferred attribute-based search patterns. Results also showed that experienced investors were more attribute-based and less compensatory in information processing than novices, consistent with previous research showing that experienced individuals process information more heuristically (Reingold & Charness, 2005). Information search patterns affected decision quality but only among novices: novices achieved higher decision quality with more attribute-based search patterns, while experienced investors were unaffected. This suggests novices' decision quality does suffer from information processing problems and provides some support for heuristic system advantages in complex decision-making (Sun et al., 2007). In summary, to improve novices' decision quality, interventions can target information search patterns, but experienced investors' decision quality is not substantially related to search patterns. Both Study 1 and previous literature (Yu & Wang, 2005) indicate that matrix information presentation leads individuals to adopt attribute-based search patterns.

In real life, information is not structured like in decision research (Weenig & Maarleveld, 2002), making attribute-based search difficult. Current wealth management apps typically present only one fund (option) per page with attribute information embedded within the option, seemingly guiding people toward option-based search patterns, which does not help improve novices' decision quality. Study 1' s results suggest that simply presenting attribute and option information simultaneously in a structured way leads individuals to prefer attribute-based search patterns and achieve better performance. Based on this, Study 2 simulates real wealth management app information presentation and provides form paper to guide participants in structurally integrating attribute information, promoting novices' shift to attribute-based search patterns to improve decision quality.

3.1 Participants

Based on pilot study criteria, Study 2 recruited 73 novice fund investors with less than three years of experience who were interested in fund investment and possessed basic knowledge. Referencing effect sizes for information presentation format on search accuracy ($\phi = 0.52$; Pan et al., 2018), with power $= 0.8$ and $\alpha = 0.05$, G*Power calculated a required sample size of 31, making our sample adequate. The sample included 43 males and 30 females, with a mean age of 34.90 years (SD $= 9.06$). Regarding education, 21 held bachelor' s degrees

or below, 51 held bachelor' s degrees, and 1 held a graduate degree or above. All participants had normal or corrected-to-normal vision and no intellectual disabilities. Participants were randomly assigned to experimental and control groups.

3.2 Research Design

Study 2 employed a single-factor between-subjects design. The independent variable was whether participants received structured integration intervention, divided into structured processing group (n = 36) and control group (n = 37). The dependent variable was decision quality, measured using the same criteria as Study 1.

3.3 Task, Materials, and Procedure

Participants completed a simulated fund investment task on computer and were informed that their investment performance would determine their final experimental compensation. Referencing Spence and Brucks (1997), we provided structured guidance by giving participants form paper to structure fund option and attribute information. When participants sat at the computer, paper and pen were prepared on the desk. The structured processing group received a form paper (with a pre-drawn 6×5 blank matrix) to guide structured integration of fund attribute information, while the control group received blank paper.

The study presented fund information entirely via PowerPoint. The computer screen first displayed the simulated fund investment task main page showing only instructions and six fund buttons. Clicking a fund button via hyperlink jumped to that fund' s subpage (see Figure 3 [Figure 3: see original paper]), where participants could view all information for that fund. Participants could organize information on the form paper (structured group) or blank paper (control group) while viewing. Each subpage had a "return" button to go back to the main page to continue viewing information by clicking fund buttons, ensuring participants could see only one fund' s information per page. Participants could repeatedly view all fund information until they decided to make an investment choice.

Finally, participants reported gender, age, education level, fund knowledge level, and risk tolerance. Fund knowledge was measured by one item: "How would you rate your knowledge of funds?" on a 5-point scale (1 = "very poor," 5 = "very good"), with higher scores indicating greater knowledge. Risk tolerance was measured as in Study 1. After the task, compensation was provided based on investment choices.

[Figure 3: see original paper] Sample subpage from Study 2 simulated fund investment task

The six funds' options and attribute information were identical to Study 1, and instructions retained the task introduction and attribute explanations from

Study 1. The only difference was that information was presented one fund per screen, consistent with real wealth management app presentation.

3.4 Results

We first conducted independent samples t-tests on fund knowledge and risk tolerance between groups. The structured processing group's fund knowledge (M = 2.53, SD = 0.91) did not differ significantly from the control group (M = 2.24, SD = 0.83), t(71) = 1.39, p = 0.17. Risk tolerance also did not differ between structured processing group (M = 2.81, SD = 1.04) and control group (M = 3.03, SD = 1.04), t(71) = -0.91, p = 0.37, indicating groups were homogeneous in fund knowledge and risk tolerance.

To examine whether structured intervention improved novices' decision quality, we conducted chi-square analysis. Results showed the structured processing group' s decision quality (17 correct, 47.22% accuracy) was significantly higher than the control group' s (9 correct, 24.32% accuracy), ^{2} = 4.17, p = 0.041, ϕ = 0.24, representing a medium effect size, supporting Hypothesis 4.

3.5 Discussion

Under the main page plus subpage information presentation format of wealth management apps, simply providing novice fund investors with a sheet of paper with table lines helped them make better fund investment decisions. Tabular recording facilitated structured integration of information, guiding individuals to arrange fund attribute and option information. This arrangement helped individuals break away from the cognition that attributes belong to options, enabling more attribute-based information search patterns (Yu & Wang, 2005), consistent with Study 1' s finding that matrix presentation led to attribute-based search patterns. Moreover, structured information reduced information processing difficulty, allowing faster identification of effective cues and facilitating comprehensive judgment (Chernev, 2003).

Therefore, in real life, when people independently invest in funds on wealth management apps lacking offline financial services and professional analysis, simply using a sheet of paper with a table can help inexperienced fund holders adopt more attribute-based information search patterns and improve decision quality. This is because the table nudges them to integrate information in a structured "options × attributes" matrix format, helping them quickly identify key attributes for decision-making.

4.1 Information Processing Differences Between Experienced and Novice Investors in Fund Investment Decision-Making

Study 1 comprehensively explored differences between experienced and novice investors in fund investment decision-making from process to outcome using

Mouselab technology. Process-wise, Study 1 compared differences in compensatory processing and search patterns; outcome-wise, it established the relationship between process and outcome, attempting to open the decision-making black box from a process perspective.

On one hand, Study 1 supported Hypotheses 1 and 2, showing that when presented with matrix-formatted options and attributes, people prefer attribute-based search patterns. This aligns with theoretical developments in decision research, which have gradually shifted from traditional option-based assumptions to attribute-based assumptions, and from compensatory rules to non-compensatory rules, supporting heuristic models (Gigerenzer et al., 2022; Liu, 2022). In Study 1, options were presented using meaningless codes as in previous research (e.g., Chen, 2009; Leng et al., 2017), but this did not prevent option-based transitions since each row represented an option and each column an attribute. Vertical information viewing contradicts people' s daily horizontal reading habits (Tullis, 1988), and research shows that with low time pressure and limited information, participants may adopt option-based search patterns (Chen, 2009). Therefore, fund investors' preference for attribute-based search patterns cannot be explained by information layout. Additionally, due to experience effects, experienced investors were more attribute-based and less compensatory than novices, showing higher heuristic processing (Dijksterhuis et al., 2009).

On the other hand, Study 1 found that information search patterns affected decision quality overall, but only among novices: novices achieved better decision quality with more attribute-based search patterns, while experienced investors were unaffected, supporting Hypothesis 3. For novices still exploring fund investment, higher decision uncertainty makes heuristic advantages more prominent (Gigerenzer & Gaissmaier, 2011). Experienced investors have mature, stable search patterns and decision styles (Gillespie & Peterson, 2009). Study 1 found experienced investors' SM variability was lower than novices' (see Table 1), with 90% of experienced investors having $SM < 0$, suggesting they more stably rely on attribute-based search patterns. This low variability may prevent search patterns from providing explanatory power for decision quality in statistical results.

This also explains why experienced investors' decision quality did not exceed novices' despite more effective search patterns—they do not rely solely on information retrieval and processing. Experienced investors' decisions depend more on general cognitive abilities like working memory (Ericsson, 2000) and actual cognitive ability (Furley & Wood, 2016). They also depend more on individual styles and habits, with experienced individuals potentially unable to avoid overconfidence interference (Lambert et al., 2012), leading to neglect of important information. Many studies show experience does not improve decision quality (Lambert et al., 2012; Larrick & Feiler, 2016; Posavac et al., 2019), and financial literacy research similarly finds limited effects of objective financial knowledge and skills on financial behavior (Fernandes et al., 2014; Liao et al., 2022).

Additionally, no difference emerged in decision duration between experienced and novice investors. Complex tasks often require longer processing and decision times (Wang et al., 2018). With increasing experience, fund decision tasks become simpler and more familiar for experienced investors, suggesting they should be faster. Indeed, some research shows experienced investors spend less time searching and deciding (Ramachandran et al., 2021), but when interference factors are numerous, experienced investors also spend more time integrating and processing information (Ognjanovic et al., 2019), making time differences between novices and experienced investors unstable. Given these contradictory findings, the nature and causes of these issues require further exploration.

4.2 Intervention Measures for Internet Fund Wealth Management

This study simulated online wealth management to identify effective measures to help novice fund investors avoid financial mistakes without professional guidance. Based on Study 1' s results, Study 2 designed an intervention training novices to structurally integrate information after viewing multiple funds individually, shifting them from option-based search patterns potentially forced by online information presentation to attribute-based decision-making. Results confirmed this measure improved decision quality, supporting Hypothesis 4.

Study 2' s results provide a simple method to improve decisions by changing information presentation. Extensive evidence shows highlighting or removing specific information can achieve intervention effects. For example, placing healthy foods first on menus (Dayan & Bar-Hillel, 2011) or providing vivid descriptions (Wilson et al., 2016) increases healthy product purchases; removing marketing information from cigarette packs helps smokers quit gradually (Pechey et al., 2013). While our intervention does not highlight attribute information or remove option information—which would be difficult to implement in real investment contexts—matrix presentation equalizes the salience of attribute and option information, achieving intervention goals.

Previous intervention research often recommends financial literacy education to improve financial knowledge, ability, and values to enhance decision quality, but such interventions are costly and require accompanying training to be effective (Fernandes et al., 2014). Unlike education, this study demonstrates from an investor perspective that mastering appropriate information processing methods can achieve comparable intervention effects, providing a simple, low-cost approach for fund investment intervention.

This study also offers insights for relevant departments and institutions to improve wealth management outcomes. Specifically, wealth management app information presentation should be redesigned. If apps can guide users toward attribute-based search through interface design, they can create nudges that achieve "big effects with small changes" (He et al., 2018) and improve fund decision accuracy.

In actual fund markets, investors face more complex situations than simulated tasks, requiring information retrieval across more fund options and attributes. Compared to experienced investors with stable decision patterns, novices struggle more to extract effective information (Schubert et al., 2013) and may make irrational or unfounded decisions (Saravanan & Menold, 2022). In other words, attribute-based search strategies become more effective for novices in more complex fund decision contexts, and simple structured integration methods help novices avoid low-level decision errors.

4.3 Research Value

As large numbers of novice fund investors enter the market, fund wealth management has attracted research attention. However, relevant conclusions primarily come from economics research analyzing large market data, divorced from real wealth management contexts (e.g., Bing et al., 2021; Tan et al., 2020), making it difficult to provide guidance for ordinary investors. In response, this study focuses on individual fund investors, exploring psychological processes during decision-making for novices and experienced investors and proposing intervention measures. The goal is not to propose fund function models or improve decision theories but to guide the large population of novice fund investors toward sound financial management.

Specifically, this study' s contributions are threefold. First, it uses Mouselab technology to explore information processing characteristics in fund investment decisions and their relationship with decision quality, deepening understanding of the essence and process mechanisms of fund investment decision-making ability and providing new empirical evidence for "process-oriented" research in this field. Second, it extends the "expert-novice" paradigm to fund investment, flexibly combining it with multi-attribute decision information processing measures to summarize differences in search patterns and compensatory behavior between experts and novices, further supporting heuristic decision models (Gigerenzer & Gaissmaier, 2011). Third, it proposes a simple yet effective intervention—guiding investors to use matrix formats for structured attribute information integration—that can help improve online fund investment and inspire wealth management app interface design.

4.4 Limitations and Future Directions

First, this study' s sample size was not large enough, potentially risking insufficient statistical power. An inadequate sample size may increase the risk of incorrectly accepting null hypotheses and produce false positive results (Asendorpf et al., 2013), limiting statistical validity to some extent. Recruiting specific "experienced-novice" fund investors is challenging, so our sample size was not as large as typical social psychology studies. We hope future researchers will verify our findings with larger samples and recommend using more conservative effect sizes for sample size estimation in similar experiments.

Second, future research can improve research tasks. Study 1' s fund investment task simulated complex real fund investment contexts as much as possible, designing a 6 (options) × 5 (attributes) information board referencing previous research (Weenig & Maarleveld, 2002), but still potentially oversimplified reality. As Study 1 results showed, both experienced and novice investors had relatively high overall search depth, possibly because matrix presentation reduced search difficulty (Ding et al., 2004), which is also the mechanism behind Study 2' s effective intervention. Additionally, this study could only simulate investors' immediate fund selection, not long-term cumulative returns. Future research should consider increasing the number of fund options and attributes and conducting long-term studies of investment decision behavior in real contexts.

Third, future research can improve participant selection procedures. This study found differences in working memory between experienced and novice investors, possibly due to age differences between groups (experienced: $M = 37.60$, $SD = 12.04$; novice: $M = 21.36$, $SD = 2.28$, $t(72) = 8.27$, $p < 0.001$; Salthouse, 1985). Age differences commonly exist in "expert-novice"comparison studies (e.g., Chen & Bai, 2019). Although we statistically controlled for age effects, future research should compare experienced and novice investors with more homogeneous age and working memory levels. Additionally, "experienced" and "novice" represent relative distinctions; future research could follow previous studies (e.g., Lian et al., 2003) by further dividing experienced investors into experts and proficient individuals to examine differences.

Finally, this study only focused on improving novices' initial investment performance, lacking attention to experienced investors. In fact, Study 1 found experienced investors did not outperform novices in fund decisions, and their decision quality was unaffected by search patterns. We speculate that experienced fund investors have formed relatively stable investment styles that are difficult to change through search pattern modifications. How to help experienced fund investors avoid mistakes warrants future research.

Conclusion

This study reached the following conclusions: (1) In fund investment decision-making, experienced investors exhibit lower compensatory information processing and stronger preference for attribute-based search patterns than novices; (2) Novices achieve better decision quality with more attribute-based information search patterns; (3) Structured intervention can improve novice fund investors' decision quality.

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Note: Figure translations are in progress. See original paper for figures.