A Picture Is Worth a Thousand Dollars: Visual Aids Promote Investor Decisions

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ABSTRACT   Policymakers emphasize that fees should be an important consideration in making investment decisions that support savings, retirement and other consequential, long term financial outcomes. Nevertheless, retail investors tend to prioritize recent returns. In nonfinancial domains, visual aids designed with choice architecture principles help convey complex quantitative information and reduce decision biases. The current work explores how a variety of *mutual fund* visual aids affect investment decisions. Across three studies, including two with incentivized national samples ($N = 4{,}588$), we demonstrate that visual aids displaying mutual fund fees lower fees paid by up to 25% compared to legally compliant disclosure documents. We address important public policy implications relevant to investors and regulators.

Americans use the $27 trillion mutual fund industry to finance important life goals, including pursuing higher education, protecting against emergencies, and saving for retirement (ICI 2022). Nonprofessional "retail" investors, who are financial product consumers,[1] must make difficult asset allocation decisions (i.e., dividing portfolios between stocks and bonds), and select specific funds to purchase. Funds vary along multiple dimensions, including their overall strategy, risk, return, and the fees they charge. Fees impede savings by detracting from compound growth. As investors regularly overpay for mutual funds (Elton, Gruber, and Busse 2004), investment selection decisions are among the most financially consequential that consumers will make.

To help consumers choose investments, the principal policy approach is to mandate that companies provide "dis-closures," documents that contain information on product attributes (see Dranove and Jin 2010). In "prospectus" documents, for instance, fund companies are legally required to disclose fees and expenses, risks, performance, and investment objectives (see Form N-1A under 17 CFR § 239.15A; app. A for an example used in our studies; apps. A–H are available online). However, each prospectus can contain hundreds of pages of technical information written by and for finance professionals and attorneys—as such, many scholars question whether disclosures help consumers make decisions. Some scholars even argue that disclosures can harm consumers because firms with misaligned incentives might reduce consumers' comprehension of products (Ben-Shahar and Schneider 2011).

Fortunately for policy design, behavioral research demonstrates that disclosures supplemented with visual aids

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1. In this research, we use investor and consumer interchangeably, as nonprofessional retail investors are financial product consumers. Noninvestors are consumers and potential investors that we herein consider and include under our "investor" concept. Professional, nonretail investors (including fund managers) are referred to as "financial professionals."

can convey complex quantitative information and reduce decision biases (Larrick and Soll 2008; Soll, Keeney, and Larrick 2013; Camilleri and Larrick 2014; Ungemach et al. 2018). Visual aids utilizing choice architecture principles benefit both health and energy decisions (Kaenzig and Wustenhagen 2010; Campos, Doxey, and Hammond 2011). Our article applies literature on visual aids to investment selection. Using an innovative experimental design, we demonstrate that visuals displaying the distribution of expenses for similar mutual funds reduce expenses paid. In our experiments, we can unambiguously demonstrate that visuals lead consumers to better investment selection ex ante (at the point of decision making) and ex post (after investment performance is known).

This research makes three primary contributions. First, we add to financial decision making literature investigating investors' overpayment for mutual funds (Elton et al. 2004) by demonstrating that fee visuals decrease fees paid in investment decisions. Using nationally representative samples, we show that fee visuals benefit consumers from varied financial and demographic backgrounds. Second, we contribute to policy discussions involving financial disclosure (e.g., Johnson and Leary 2017; Chin and Beckett 2021; Weiss-Cohen, Newall, and Ayton 2021; Chin et al. 2022) by demonstrating a concrete intervention that policymakers can use to help consumers reach their financial goals. Finally, our article contributes to research examining the usefulness of visual decision aids. Although we concentrate on investment decisions, visual aids apply broadly to decisions and contexts where there is a generally undervalued decision attribute that could advance an important consumer or social goal.

LITERATURE REVIEW AND MARKET ANALYSIS
Mutual Fund Performance and Fees
Investment decisions are complex, with consumers plausibly considering a fund's overall investment strategy, risk level, recent returns, domestic versus international exposure, and underlying composition (e.g., environmentally friendly companies). After narrowing on these factors, consumers must choose specific funds – a task that can be difficult in a market with thousands of investment options. Empirically, research shows that investors disproportionately select investments by "chasing" returns and deprioritizing fees (Kozup, Howlett, and Pagano 2008; Beshears et al. 2009; Choi and Robertson 2020). Indeed, 95% of investing households report that historical performance is "somewhat" or "very" important when choosing mutual funds (ICI 2021). Similarly, considerable academic literature demonstrates that investors often choose funds based on performance (Egan 2019; Weiss-Cohen et al.

2021) and high recent returns (Ben-David et al. 2022). In contrast, consumers often lack knowledge of fees' existence, extent, and application (Government Accountability Office 2021; Scholl and Fontes 2022), including the relationship between fees and net returns.

Unfortunately, basing investment decisions on historical performance is unlikely to provide superior outcomes, as returns are unpredictable and above average returns are unlikely to persist (Cooper, Gutierrez, and Marcum 2005; Fama and French 2010). In contrast, the fees associated with mutual funds are known in advance and stable. Furthermore, considerable literature suggests that higher fund costs predict lower net performance, including which funds consistently underperform the market (Fama and French 2010; Cooper, Halling, and Yang 2021). As such, disclosures note that "past performance does not guarantee future results" (Weiss-Cohen et al. 2021) and policymakers encourage investors to consider fees when making investment decisions (IAC 2016). Unfortunately, many investors continue to disregard mutual fund fees and the differences between fees on different funds (Badoer, Costello, and James 2020; Ben-David et al. 2022).

Ignoring fees can be detrimental, as lower price alternatives are often available. Illustrating this point, Elton et al. (2004) examined prices on S&P 500 index funds from 1996 to 2001, finding expense ratios ranging from .06% to 1.35% per year—meaning that investors in the most expensive fund paid 22.5 times as much for an otherwise identical product (see also Hortaçsu and Syverson 2004). To provide a more recent picture of such price variation, we analyzed data on real-world funds from Morningstar Direct, an investment product database (www.morningstar.com). We assessed S&P 500 index funds; this provides a clean comparison between funds in that risk and gross performance of the funds are nearly identical (discussed further below). The results show that prices vary significantly and numerous funds charge more than 1% per year (fig. 1). As of December 2021, for instance, expense ratios ranged from .02% to 2.31%. These differences can be costly: for a $100,000 investment over 25 years at an 11% average return, for instance, an investor in the most expensive fund receives approximately $757,000 instead of approximately $1,352,000 with the cheapest available fund—a difference of nearly $600,000 due to fees (https://www.sec.gov/investor/tools/mfcc/mfcc-intsec.htm). Costs add up quickly, as investors directly pay the fees and miss out on the investment returns generated by the additional fee money; the compounding of fees is similar to interest compounding. As such, an investor who ignores fees when
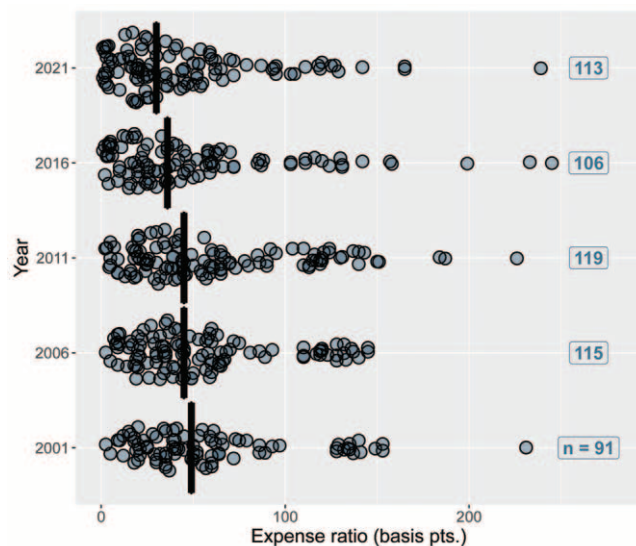
Figure 1. Expenses for S&P 500 index funds have trended downward, but significant price variation remains. Figure displays expense ratios for all S&P 500 index funds in basis points (i.e., 50 is equivalent to an expense ratio of .50%). Index funds seek to, and reliably achieve, index replication rather than index outperformance, and they often operate mechanically, with low costs. The number of funds available in each of the 5 years is shown on the right. The black vertical lines show the median expense ratio in each period. Medians have ranged from 30 to 49 basis points, while minimum values have ranged from 1 to 2.5 basis points; thus, in every period an investor paying the median is overpaying by a factor of at least 18. Expense ratios range from .02% to 2.31% as of December 1, 2022.

selecting investments easily overpays when essentially identical, low-cost alternatives exist.

The investment marketplace is characterized by emphasis on performance and relative neglect of fees, despite the fact that fees vary widely for similar products (i.e. after controlling for risks, returns, and other factors in the consumer's overall decision-making process). Given that choosing a low-cost option from within an asset class can save investors hundreds of thousands of dollars over the long run, we ask: *what can help consumers choose low-cost mutual funds?*

Visual Aids to Improve Decisions

Carefully designed visual labels, metrics, and aids can nudge consumers to process attributes differently and pay attention to critical, yet underweighted, pro-consumer information. A widely cited example demonstrates that consumers are more likely to choose fuel-efficient vehicles, consistent with their preferences, when viewing "gas consumption per 100 miles" versus the standard "miles per gallon" metric and label (Larrick and Soll 2008). Visuals also help consumers understand

energy saving behaviors (Allcott 2011), calorie information (Van Epps et al. 2021) and credit card annual percentage rates (Chin and Bruine de Bruin 2019). Generalizing these findings, Larrick and colleagues (Larrick and Keeney 2015; Yoeli et al. 2017) argue that consumers make better decisions when visual aids link abstract information to objectives people value, use "expanded scales" that convey long-term costs, or provide meaningful comparisons. Here we examine the potential benefits of providing consumers with meaningful comparisons for a neglected decision characteristic when making investment decisions.

Meaningful comparisons can be displayed in multiple ways. One common method is to use specific reference values (Larrick et al. 2015; Van Epps et al. 2021) such as "average value [of calories] for all cereal brands" on nutrition labels (Barone et al. 1996; Newman, Howlett, and Burton 2016). Additionally, aids can include information on a product's position within a distribution using grading such as A, B, C (Heinzle and Wustenhagen 2012), color (Vanclay et al. 2011), or continuous numeric scales (Camilleri et al. 2019; Chin and Bruine de Bruin 2019). Distributions can utilize absolute (e.g., an SUV's emissions among all cars) or relative positions (an SUV's emissions among other SUVs), with research needed to determine which comparisons are meaningful and nondistortionary (see Hille et al. 2018). We use visual aids for a specific mutual fund class (S&P 500 index funds), as that provides a setting where investment objective, risk, and gross returns do not differ between investment products—only fees vary. Given that different visual aids have been explored in the literature, we use designs with a variety of features, including categories, continuous scales, labeling, and reference points, as each feature may help convey the costs of a given fund relative to its competitors. We predict that each visual aid (hereafter, "fee visual") will serve as a choice architecture tool that improves decision quality. In other words, presenting visual aids with fee distributions will decrease fees paid in mutual fund investment decisions relative to traditional disclosures.

EXPERIMENTAL DESIGN AND ANALYTIC OVERVIEW

We explore our prediction using an investment paradigm developed by Scholl (2022), derived from Choi, Laibson, and Madrian (2009). In all studies, participants invest a hypothetical $10,000 among S&P 500 index funds. Index funds are designed to match the performance of the underlying index (i.e., S&P 500 index funds track the S&P 500 index), making these funds essentially identical based on strategy, risk, and,

most critically, gross returns (i.e., performance before fees). As shown above, however, index funds vary widely in costs (see also Hortaçsu and Syverson 2004), which impacts performance net of fees. In short, fees are the only materially differentiating factor between the options. For our principal outcome measure, we calculate the fees that participants would pay on their $10,000 investment over one year assuming no investment returns. These values are proportional to the fees participants would pay, regardless of fund returns, as all S&P 500 index funds will perform identically over a given future period.[2]

To induce an implied trade-off between returns and fees, we also present irrelevant performance information in the form of "returns since inception" (RSI). RSI statistics can create the appearance of high historical performance (Elton et al. 2004; Choi et al. 2009). For instance, a fund established during a market high will have lower RSI than an otherwise identical fund established a few days later, after a market crash, despite having identical returns over comparable prior periods and all future periods. Thus, the disclosure of RSI may lead consumers to perceive funds as better or worse than their counterparts. In our studies, we use a set of real index funds where RSI statistics are positively correlated with fees due to different inception dates. As such, consumers concentrated on prior performance will tend to pay higher fees.

To identify a set of funds, we adapted the process used in Scholl (2022). First, we downloaded data on real-world S&P 500 index funds from Morningstar Direct (www.morningstar.com). Next, we eliminated index funds younger than ten years old to create legally compliant disclosures display-

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2. Minor return deviations known as "tracking error" exist for index funds, but these are small in comparison to fee differences. After accounting for tracking error, the rank ordering of funds we choose would not change. While we examine index funds, considerable literature supports prioritizing low cost funds within any fund category (e.g., "large cap balanced funds" or "small cap growth funds") including low cost, passively managed index funds (Fama and French 2010; Crane and Crotty 2018). Using a menu of index funds offers important methodological advantages over more complex menus that include multiple fund types. Most importantly, these menus allow us to directly and unambiguously measure the consumer welfare benefits of our visual aids. In contrast, measuring the benefits of visual aids under a more complex menu would require precise estimates of participants' expected returns distribution, risk aversion parameters, valuation of nonpecuniary factors (e.g., environmental benefit preferences), and reliance on a structural economic model to ascertain whether the visuals better aligned participant choices with their preferences. Our setup avoids the need for such apparatus because the choice set enables us to directly observe welfare loss as the monetary deviation from the (unambiguous) strictly dominant strategy of putting all money in the lowest fee fund (see Scholl 2022).

ing ten years of actual performance data. We further narrowed this set by identifying five funds that together had a positive correlation between RSI and fees; this structure creates the appearance that returns can increase through higher fees (as in Choi et al. 2009 and Scholl 2022). Finally, funds were anonymized. The studies used funds with the following fee ranges, which we varied to provide additional generalizability: study 1 = [.03%, .50%], studies 2 and 3 = [.09%, .61%] (app. B).

The fee visuals provide substantive information on the mutual fund market. For instance, the visual used in study 3 reflects the asset-weighted composition of mutual fund investments, with the placement of the fees for each fund on the visual bar reflecting the real-world percentile of the distribution at the time the visuals were constructed. Elsewhere, the stimuli vary somewhat to assess sensitivity to specific visual elements (e.g., anchors and labeling).

Before the investment task, each study provided information on mutual funds, the S&P 500 index, and S&P 500 index funds (apps. C–F contain experiment introductions, incentive descriptions, and sample stimuli). In studies 1 and 2, additional instructions noted that a subset of participants would receive bonus payments based on the performance of their investment portfolio, thereby making the task incentive compatible. Operationally, the strict relationship between net returns and fees means that participants were paid in inverse proportion to investment fees on their portfolio.

In each study, participants could access full fund information, including 1, 5, and 10-year returns, RSI, and fees through legally compliant "summary prospectus" documents (app. A). Study 1 tests whether presenting a fee visual decreases participants' investments in more expensive funds. Study 2 employs a larger sample to test for potential heterogeneity in the efficacy of the visual aids for individuals of different subgroups, an issue of importance for policymakers. Additionally, study 2 utilizes new stimuli with a different display and tests robustness to additional visual elements, including various reference points. Study 3 assesses whether experimental effects are primarily driven by the availability of fee information by comparing the visual to an additional experimental condition. In it, we make expenses available and salient by placing expense ratios prominently on the investment selection screen, without a visual aid. Ultimately, our interest is assessing the viability of prototype fee visuals for communicating policymakers' preferred decision attribute – fees. We demonstrate that visuals promote improved consumer decision-making; while we explore potential mechanisms through which visual aids can improve decision

quality, our work prioritizes the advantages of visual aids for policy.

STUDY 1

Study 1 tests the potential effects of a visual aid showing the distribution of fees charged for S&P 500 index funds. In particular, we assess whether a categorical visual reduces fees paid in an investment task.

Method

Sample. Studies 1–2 were approved by the Institutional Review Board at NORC. Participants were sampled from NORC's AmeriSpeak panel (https://www.amerispeak.org/), a probability-based panel designed to be representative of the US household population. During initial AmeriSpeak recruitment, randomly selected households are sampled with a known, nonzero probability of selection from the NORC National Sample Frame and contacted by US mail, email, telephone, and face-to-face field interviews. AmeriSpeak yields coverage of approximately 97% of the U.S. household population (NORC 2022). This study contained a nationally representative sample of 380 English-speaking adults aged 18 and over (52.9% female, 41% owned mutual funds; 20% ages 18–29, 36% ages 30–44, 22.6% ages 45–59, 21.3% ages 60+) who answered on electronic devices (45% desktop).

Experimental Conditions. We randomly assigned participants to a 2 (information condition: fee visual, prospectus only) × 2 (fund order) between-subjects design. After completing other unrelated financial decision-making tasks,[3] participants reviewed information on four real, anonymized S&P 500 index funds and invested $10,000 (in percent) between the funds and a cash (zero return, zero cost) option. We presented the funds in one of two counterbalanced orders to control for order effects.

Participants in the fee visual condition saw a graphic displaying the distribution of fees for S&P 500 index funds, with division into quartiles and an arrow indicating each fund's fees (fig. 2). Participants in the prospectus condition did not see visuals. Participants in both conditions could click on buttons to see summary prospectus documents containing full fund information. Figure 3 depicts sample fee visual images across our studies.

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3. Experimental manipulations for other research questions preceded the investment task but did not substantively affect the results of this study. When controlling for variables from the unrelated manipulations, our effects remain significant.

Figure 2. Study 1 sample stimuli.

Demographics and Device Type. Participants indicated how they were responding (on a desktop, smartphone, or tablet; with the latter two categories collapsed into a mobile device = 1 variable and 0 otherwise). Demographic characteristics such as age, gender, and income came from AmeriSpeak (app. G).

Fees Paid. We calculated the fees that participants would pay over one year based on their initial $10,000 investments, assuming no investment returns. For example, the Lincoln fund's expense ratio was .50%, meaning a $10,000 investment in Lincoln would incur $50 in fees. Possible fees ranged from $3 to $50 for fund investments. There were no expenses associated with the cash option, but also no expected return. We examine cash investments as a robustness check.

Results

ANOVA revealed significant effects of information display on total fees, with those in the fee visual condition achieving a 23.52% fee reduction ($M_{\text{prosp only}}$ = $22.87, $M_{\text{fee vis}}$ = $17.49; table 1). Fund order and the interaction between fund order and information display were not significant (all $p > .2$). The fee visual effect persisted after including covariates and conducting nonparametric tests (table S2; tables S1–S11 are available online).

Discussion

Study 1 supports the proposition that fee visuals can lower fees paid in a mutual fund investment context. In line with our prediction, fee visuals reduced the amount participants
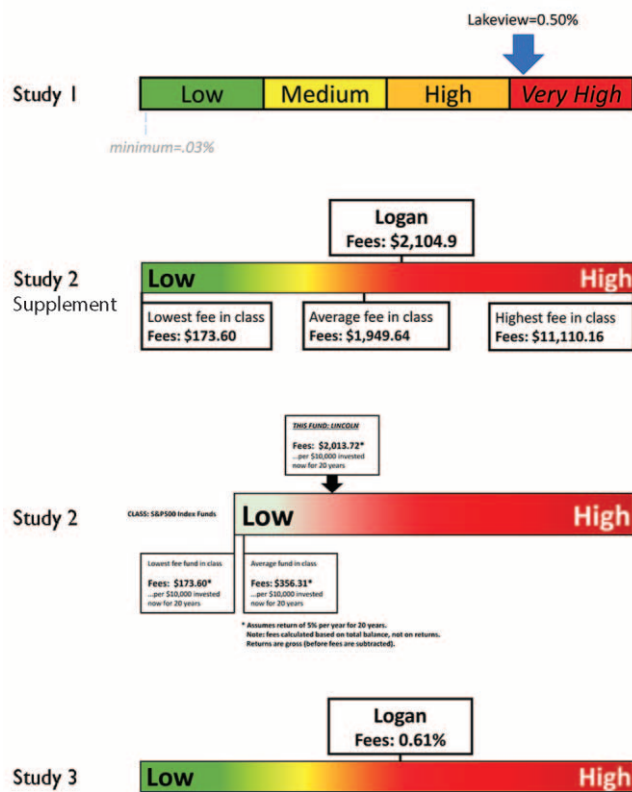
Figure 3. Examples of fee visuals used across studies. For sample visuals and task stimuli for each study, see the accompanying appendix.

invested in more expensive S&P 500 index funds. Fee visuals also did not significantly affect investment nonparticipation (cash was an opt-out). The benefits of fee visuals are robust to excluding participants who allocated 100% to cash and to recalculating fees paid in proportion to mutual fund allocations.

STUDY 2

Building on the fee reduction effects demonstrated in study 1, study 2 tests visual aids featuring reference points, evaluative fee labels, and a continuous fee scale. The visuals also display fees in dollars compounded over 20 years to leverage the principle of "expanded scales," which argues that depicting choice consequences over a longer (vs. shorter) timeframe will have greater influence (Larrick and Keeney 2015). Finally, using a large representative sample, this study tests potential heterogeneous effects of visual aids across subgroups. To simplify analyses, this study eliminates cash as an investment option.

In addition to potential replication of the visual aid effects, we examine whether visual aids affect the importance of fees and returns, making them more or less likely to be used in decision making (Camilleri et al. 2019). Similarly,

Camilleri et al. (2019) displayed greenhouse gas (GHG) emissions for consumer products along a green-to-red (i.e., low to high emissions) scale in combination with GHG converted into a more familiar metric. This combination increased the stated importance of energy consumption among consumers and increased purchases of low-emission options. When potentially negative attributes are "largely invisible," much like costs in the mutual fund industry (Government Accountability Office 2021) and GHG emissions in the food industry, visual aids could increase attribute importance and decrease emphasis on alternative attributes.

Method

Sample. We used a proprietary subset of the AmeriSpeak panel. All panel members were invited to participate, and 3,907 completed the study by answering online (46.1% female; 69% owned mutual funds; 3% ages 18–29, 24.3% ages 30–44, 28.3% ages 45–59, 44.5% ages 60+; 44.2% desktop).

Investment Task. To help eliminate variation due to individual differences, we asked participants to consider a scenario of helping a young family member choose investments in their first job's retirement plan (app. D). Participants invested $10,000 across five anonymized S&P 500 index funds. All participants saw fund RSIs on the investment screen and could click buttons to review summary prospectuses.

Experimental Conditions. First, we included a Prospectus only (i.e., no fee visual) control. Second, we varied reference price information provided on visual aids across five conditions (none, low-only, low-average-high, high-only, and low-high). Finally, we included a low-high visual without evaluative text to test effects of scale labeling. Thus, the study was a seven-cell, between-subjects design (app. D). Our goal was to verify that all variations outperformed the summary prospectus. Exploratory analyses also examined the effects of each fee visual versus the prospectus.

Performance and Fee Importance. After investing, participants assessed fee and performance importance in their investment decision (The fees on each fund [$M = 3.42$, $SD = 1.02$]; RSI [$M = 3.38$, $SD = 1.04$]; $1 = not\ at\ all$, $5 = a\ great\ deal$).

Additional Measures. Participants answered 5-point scale questions ($1 = strongly\ disagree$, $5 = strongly\ agree$) regarding the ease of comparing fund returns and expenses (It was

Table 1. Outcome Variables and Changes in Decision Quality across Studies

Study 1 (N = 380; AmeriSpeak)	Prospectus (n =184)	Fee visual (n =196)	Tests and effect sizes
Total fees (treating cash investments as $0 fees)	$22.87 (13.09)	$17.49 (11.53)[c]	$F(1, 376) = 9.51, p = .002, D = .44$
Fee improvement vs. prospectus		23.52%	
Fee improvement vs. prospectus (reflecting .03% fee minimum)		27.08%	
Total fees (excluding 100% cash participants)	$23.24 (12.86)	$17.67 (11.45)[c]	$F(1, 371) = 10.95, p = .001, D = .46$
Total fees (cash investments spread proportionally over funds)[a]	$26.38 (12.80)	$19.93 (11.75)[c]	$F(1, 371) = 13.53, p < .001, D = .53$
Percent allocated to "cash" fund	13.97 (19.88)	11.9 (17.55)	$F(1, 376) = .33, p = .57$
Number of participants allocating 100% to cash	3	2	$X^2 (1) = .51, p = .48$
Percent naïve investors[b]	7.60	7.69	$X^2 (1) = .03, p = .86$

Study 2 (N = 3,907; Amerispeak)	Prospectus (n = 566)	Fee visual present (n = 3,341)	
Total fees	$39.44 (14.77)	$29.52 (14.49)[c]	$F(1, 3905) = 225.65, p < .001, D = .68$
Fee improvement vs. prospectus		25.15%	
Fee improvement vs. prospectus (reflecting .09% fee minimum)		32.59%	
Percent naïve investors[b]	11.66	9.21	$X^2 (1) = 3.17, p = .07$

Study 3 (N = 301; mTurk)	Prospectus (n = 97)	Expense ratio (n = 103)	Fee visual (n = 101)	
Total fees	$40.56 (10.27)	$37.87 (13.63)[c]	$32.74 (14.34)[c,d]	$F(2, 298) = 9.43, p < .001$
Fee improvement vs. prospectus		6.63%	19.28%	
Fee improvement vs. prospectus (reflecting .09% fee minimum)		8.52%	24.78%	
Percent naïve investors[b]	21.65	15.53	7.92[ce]	$X^2 (2) = 7.38, p = .03$

Note.—Parentheses denote standard deviations. For each study, the first "Improvement" row shows the percent decline in fees paid by participants in the experimental conditions relative to the prospectus condition (e.g., $[M_{fee\ vis} − M_{prosp}] / [M_{prosp}]$). In contrast, the second row accounts for the fact that none of the available mutual funds had a 0% expense ratio; thus, the potential decrease in excess fees is bounded by the minimum fee. The resulting calculation is, for example, $[M_{fee\ vis} − M_{prosp}] /[M_{prosp} −$ minimum fee possible]. The study 2 fee visual condition results are aggregated across multiple fee visual designs (see the appendix for more detail). For follow-up statistical tests between conditions in study 3, see the Results section. Additionally, see the appendix for regression models for each study that include demographic controls and controls interacted with fee visual manipulations.

[a] For this row, we calculated how much participants would have paid in fees if they had invested 100% in the funds using proportional investments. For example, a participant who invested 40% each in funds 1 and 2, and the remaining 20% to cash, would have had fees calculated as if they had invested 50% in each of those funds. Note that denominator degrees of freedom differ because five participants (3 from Prospectus, 2 from fee visual conditions) who invested 100% in cash are excluded. Logistic regression revealed that 100% cash participants did not differ based on condition, order, or their interaction (all $p > .49$), suggesting that fee visuals did not affect willingness to invest (i.e., "investment participation").

[b] For this row, we analyzed whether the fee visual affected "naïve" diversification in each study. We coded respondents' allocations as 0 = not naïve, 1 = naïve, if they invested the same percentage to each of the available options (e.g., 20% to each option; Benartzi and Thaler 2001). In study 3, a logistic regression comparing each of the experimental conditions to the prospectus revealed that the fee visual reduced naïve diversification (log odds = −1.17, SE = .44, $Z = −2.63, p = .008$) versus the prospectus, while the fee expense condition did not. Naïve diversification was also lower for the fee visual versus the fee expense (log odds = −.32, SE = .14, $Z = −2.34, p = .02$).

[c] Estimate is significantly different from the prospectus condition at $p < .01$.

[d] Estimate is significantly different from the expense ratio condition at $p < .01$.

[e] Estimate is significantly different from the expense ratio condition at $p < .05$.

easy to compare options based on fees [M = 3.39, SD = .91]; It was easy to compare options based on returns [M = 3.33, SD = .89]), ease of the task (I saw the information clearly [M = 3.80, SD = 84]; I didn't know what to do [M = 2.80, SD = 1.17], subjective mutual fund knowledge (I am very knowledgeable about mutual funds; [M = 2.68, SD = 1.06]), and device type controls. These items were interwoven with questions on fee and performance importance and allowed us to control for any possible study interface issues. Objective mutual fund knowledge scores (11-item True/False/Don't Know scale; Scholl and Fontes 2022) were merged in from a prior survey ($M_{correct}$ = 5.23, SD = 3.00; app. H). AmeriSpeak provided demographic characteristics.

Results

Total Fees. We calculated the annual fees that participants would incur for their $10,000 investments, as in study 1. ANOVA revealed a significant main effect of information display, with those who saw the fee visuals paying 25.15% less on average than those who did not ($M_{prosp only}$ = $39.44, $M_{fee vis}$ = $29.52; table 1). Table S3 presents analyses with covariates and interactions between the fee visuals and the covariates.

To examine the effects of additional design elements, we ran a regression with every experimental condition contrasted with the summary prospectus (table 2). All visuals significantly reduced fees relative to the control. The estimated magnitude of the differences between the conditions was small relative to the overall effect of having a visual present. Thus, we conclude that all visual aids we examined lowered fees paid.

Exploratory Fee and RSI Importance Analyses. ANOVA revealed significant main effects of information display, with those who saw the fee visuals reporting higher fee importance ($M_{prosp only}$ = 3.11, $M_{fee vis}$ = 3.48; $F(3877)$ = 64.29, $p < .001$, D = .36) and lower RSI importance ($M_{prosp only}$ = 3.51, $M_{fee vis}$ = 3.36; $F(3872)$ = 9.71, p = .002, D = .14) than those who did not (see also table 2). Both effects persisted after controlling for covariates (tables S4 and S5). When comparing the different visual aid conditions, some minor differences emerged on fee importance but not RSI importance. Next, we estimated whether fee and RSI importance mediated the relationship between information display and total fees, using processR version 0.2.6 package for R (model 4; 95% CI, Hayes 2017; 10,000 bootstraps). In a parallel mediation model, both indirect effects were significant (fee importance: B = −2.20, SE = .30, CI [−2.78, −1.62], proportion mediated = 22.17%; RSI importance: B = −.55, SE = .19, CI [−.91, −.18], proportion mediated = 5.56%). A comparison of the mediators revealed that fee importance yielded a stronger indirect effect than RSI importance (B = 1.64, 95% absolute value indirect effect contrast: [0.97, 2.32]). Thus, the decrease in fees paid stemmed more from increased importance on fees than decreased importance on returns.

Table 2. Regression Results for Fee Visual Variations (Study 2)

Predictors	Total fees			Fee importance			RSI importance		
	Estimate	SE	p	Estimate	SE	p	Estimate	SE	p
Prospectus only	Reference			Reference			Reference		
Distribution only	−9.97	.87	<.01	.39	.06	<.01	−.17	.06	.01
Low only	−9.31	.87	<.01	.32	.06	<.01	−.15	.06	.01
Low + high	−10.53	.87	<.01	.47	.06	<.01	−.13	.06	.03
Low + avg + high	−9.92	.86	<.01	.33	.06	<.01	−.20	.06	<.01
High only	−9.57	.87	<.01	.34	.06	<.01	−.13	.06	.04
Low + high (no text)	−10.21	.87	<.01	.36	.06	<.01	−.11	.06	.08
(Intercept)	39.44	.61	<.01	3.11	.04	<.01	3.51	.04	<.01
Observations	3,907			3,879			3,874		
R^2 / R^2 adjusted	.055/.054			.019/.017			.003/.002		

Note.—Table shows regression coefficients with standard errors. Participants that provided responses to all the variables in each model are included in the number of observations. Fee visual conditions are each contrasted with the prospectus only condition. Exploratory post hoc analyses on total fees revealed no differences between the fee visual conditions (all p > .5).

Discussion

Study 2 reinforces the proposition that fee visuals can lower fees paid in mutual fund investment decisions. Critically, aids help consumers from different backgrounds (table S3), including relatively sophisticated consumers and those with no investment experience, as interactions between fee visuals and investor knowledge were not significant. Additionally, the effects of visual aids are robust to a variety of design elements, including labeling and reference points. We conducted a supplementary study (app. E) in which we modified fee visuals to further verify that fee reductions occur when displaying the range of fees with different colors and adding text about product class (S&P 500 index funds) and gross versus net returns (fig. 3). Again, we observed a strong fee visual benefit ($M_{\text{prosp only}}$ = \$36.15, SD = 9.91; $M_{\text{fee vis}}$ = \$32.06, SD = 10.79; $F(1, 450)$ = 17.7, $p < .001$, $D = .40$).

STUDY 3

In studies 1 and 2, we compared fee visuals to legally compliant summary prospectus documents. While this comparison is important from a public policy perspective, prospectuses may be difficult to review—thus, benefits of visuals studied hitherto may arise primarily from information accessibility, not visual elements. To address this concern, we test a new control condition that makes expense ratios available outside of prospectuses. We also measured several potential mediators.[4] This study was preregistered, with data and materials available at https://researchbox.org/1081.

Method

Sample. This study received IRB approval. We analyzed 301 participants with complete response data from Amazon Mechanical Turk (MTurk) (48.8% female; 77.1% owned mutual funds; 14% ages 18–29, 57.8% ages 30–44, 20.9% ages 45–59, 7.3% ages 60+; all with >80% approval rating) who answered online (97% desktop or laptop).

Investment Task. Participants invested \$10,000 in five anonymized S&P 500 mutual funds using the study 2 scenario. All participants saw the fund's RSI accompanying the fund's name and could click buttons to see summary prospectus documents. See appendix F for stimuli.

Experimental Conditions. We utilized three conditions in a between-subjects design. The "prospectus only" condition

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4. We thank the review team for suggestions on these measures.

was identical to study 2. An "expense ratio" condition additionally displayed expense ratios (i.e., fees in percent) for all funds on the investment selection screen, thereby providing accessible, comparable fee information in a nonvisual way. Finally, the fee visual condition modified the "distribution only" visual from study 2 by replacing fees in dollars with the expense ratio.

Additional Measures. As elsewhere, participants answered questions regarding fee and RSI importance, ease of comparing fund returns and expenses, subjective and objective mutual fund knowledge, demographics, and device type. To test alternative mechanisms, we preregistered and included items for investment hesitancy, investment confidence, search intention, and perceived implicit endorsement (Dinner et al. 2011; app. F). Of these variables, only search intention differed between conditions (all other p's > .2), thus we only discuss it further.

Results
Total Fees

We calculated fees associated with investments, as in Studies 1–2. ANOVA revealed a significant effect of information display (table 1). Planned contrasts with Tukey method multiple comparison adjustment revealed that those who saw fee visuals paid 19.28% less on average than those in the prospectus only condition ($M_{\text{prosp only}}$ = \$40.56, $M_{\text{fee vis}}$ = \$32.74, $t(298)$ = 4.26, $p < .001$, $D = .49$), and 13.55% less than those in the expense ratio condition ($M_{\text{exp ratio}}$ = \$37.87, $t(298)$ = 2.84, $p = .013$, $D = .32$). Fee expense and prospectus conditions were not significantly different ($p = .31$, $D = .17$). Table S9 presents analyses including covariates.

Fee Importance. ANOVA revealed a main effect of information display. Planned contrasts with Tukey method multiple comparison adjustment revealed that fee visuals increased fee importance more than the prospectus only condition ($M_{\text{prosp only}}$ = 3.07, $M_{\text{fee vis}}$ = 3.68, $t(298)$ = −3.78, $p < .001$, $D = .45$) but not compared to the expense ratio condition ($M_{\text{exp ratio}}$ = 3.59, $t(298)$ = −.57, $p = .84$). The prospectus only condition was significantly lower than the expense ratio condition ($t(298)$ = −3.23, $p = .004$, $D = .38$).

RSI Importance. ANOVA revealed a nonsignificant effect of information display ($F(2, 298)$ = 2.04, $p = .13$), thus we do not conduct planned contrasts. Appendix F (tables S10

and S11) presents analyses including covariates for each importance measure.

Mediation. Using the processR version 0.2.6 package for R (model 4; 95% CI, Hayes 2017; 10,000 bootstraps), we estimated whether fee and RSI importance mediated the relationship between information display type and total fees. Information display was entered as a macro-specified multi-categorical independent variable, whereas fee and RSI importance were parallel mediators. Both experimental conditions increased fee importance relative to the prospectus condition (B fee visual = .61, SE = .16, t = 3.78, p < .001 and B expense ratio = .52, SE = .16, t = 3.23, p = .001). Neither condition increased RSI importance (p's > 0.05). Including both potential mediators, there were significant indirect effects of both experimental conditions via fee importance (B fee visual = −2.57, SE = .85, CI [−4.41, −1.04]; Proportion indirect effect = 20.75%; B expense ratio = −2.19, SE = .76, CI [−3.80, −.81]; Proportion indirect effect = 17.66%), suggesting that fee importance is an important predictor of total fees. Follow-up regressions including hesitancy, confidence, and implied endorsement as controls and as parallel mediators consistently yielded the conclusion that fee importance was the strongest mediator.

To further explore potential differences between experimental conditions, a nonpreregistered exploratory analysis (model 6) tested search intention. It revealed sequential mediation (CI [−.90, −.04]; Proportion indirect effect = 7.27%), such that the fee visual (vs. expense ratio) increased search intention (B = .27, SE = .13, t = 2.10, p = .04), which increased fee importance (B = .32, SE = .07, t = 4.58, p < .001), subsequently reducing fees paid (B = −4.47, SE = .60, t = −7.40, p < .001). There was no serial indirect effect for expense ratios (vs. prospectus). While additional research would be necessary to substantiate the serial effect, the analysis suggests one benefit of the fee visuals is to induce greater search intention and fee importance.

Discussion

In this final study, we again demonstrate that visual aids reduce fees paid in an investment task. This improvement is significantly stronger than an information display that simply displays fees. The study also reveals mixed evidence for fee and RSI importance as mediators. Here visual aids increased the subjective importance of fees but only compared to the prospectus document. While study 2 suggested that a visual aid could decrease RSI importance, that result was not significant here. Several other potential mediators yielded

nonsignificant results as well, revealing that more work is needed to isolate the mechanisms underlying the effect of fee visuals versus simple expense displays. We discuss several possibilities in the general discussion.

GENERAL DISCUSSION

Decisions about mutual funds are among the most financially consequential consumers face. Across three studies, including two using nationally representative samples, fee visuals consistently reduce fees incurred in mutual fund investment decisions, with savings between 19% and 25% relative to legally compliant disclosures. Savings occur when fee visuals depict annual expense ratios (studies 1 and 3) and dollars over time (study 2), using both incentivized (Studies 1 and 2) and nonincentivized decisions, whether making decisions for oneself (study 1) or another (studies 2–3), and with a variety of design variations. Fee visuals may increase the subjective importance of fees compared to a summary prospectus (studies 2 and 3), though more work is needed to understand the multiple mechanisms through which fee visuals operate. Finally, benefits occur for consumers with different knowledge levels, sophistication, and demographic backgrounds, suggesting broad-based beneficiaries of visual aids. While additional work is needed to refine the mechanism, the immediate policy benefit from fee visuals is clear: failing to utilize visual aids in the $27 trillion mutual fund industry, and realize the nine basis point reduction in fees demonstrated in study 2, means an annual loss for investors of at least $24 billion.

Why Might Fee Visuals Be Effective?

Given that consumers often overprioritize returns (i.e., select funds with seemingly higher past returns) and neglect expenses (Beshears et al. 2009), we provided exploratory tests of whether fee visuals affected return and fee importance. Study 2 provides some preliminary support for these importance measures and study 3 showed that fee importance varied between the visual and prospectus conditions.

At the same time, it is clear that additional mechanisms are at work. In study 2, the proportion of the variance accounted for by the indirect effects was only 27.73%. Behaviorally, the partial role of fee importance is confirmed by average fees, which remain significantly above the minimum prices offered on the menus in all studies. The results of study 3 further reinforce the need for greater understanding, as fee importance did not significantly differ between the fee visual and expense conditions, even though visuals yielded

lower fees paid. Thus, there are questions about the mechanisms underlying differences between these two conditions. While we measured a number of preregistered prospective mechanisms (e.g., perceived evaluability from Hsee and Zhang 2010 and ease of processing the displayed information from Newman et al. 2016), only an ad-hoc search intention measure differed between visual and expense ratio conditions. Future studies could refine the search intention measure and associated constructs, considering measurement procedures to ensure discriminant validity of potentially correlated constructs. At the same time, careful stimulus design will be required to maintain consistency in the amount of information conveyed, communicate necessary financial assumptions, and avoid confusion or disfluency.

The Potential Effectiveness of Fee Visuals in Other Decision Contexts

Our experimental framework employed mutual fund "menus," each consisting of five alternative S&P 500 index funds. The menus omitted high price funds, with no expense ratio above 0.61%, despite market variation in this particular sector of up to 2.31% (fig. 1). As such, this framework likely provides a conservative estimate of the welfare benefits of fee visuals. Fee visuals may provide additional benefits for consumers when extremely expensive funds are offered, as ignoring fees will have greater financial consequences when the stakes are higher.

We also believe that the existence of menus themselves may lead to underestimated effects of fee visuals. Psychological theory on evaluations suggests that visual aids will be particularly effective at changing consumers' opinions in "single evaluation" environments, where there is only a single investment under consideration (e.g., in the common setting in which a financial professional offers a client information on a single fund; Hsee and Zhang 2010). In contrast, visual aids are theoretically less impactful when multiple options are offered. Fee visuals help convey the distribution of fees in the marketplace, but by observing a readily available set of funds with varying prices (such as in our studies), consumers can infer some information about the range of fees, thus reducing the impact of the visuals. This could particularly be the case in study 3, in which some distribution of expense ratios is readily provided by the menu. As such, it would be fruitful to test the impacts of visual aids on single evaluation investment decisions.

The menus may also provide a conservative test when viewed from an economic perspective. Economic analyses have traditionally emphasized search costs as a reason for consumers to purchase higher cost funds, as a costly search process may make it difficult for consumers to identify lower cost options (e.g., Hortaçsu and Syverson 2004). Costly search can be conceptualized in terms of incorrect beliefs regarding prices, including that consumers do not realize there is price variation (e.g., Alexandrov and Koulayev 2018). We believe that visual aids could combat incorrect beliefs by explicitly disclosing variation and the direct potential benefits of search, possibly increasing consumers' motivation to search. In other words, the visual aids are expected to make search easier by giving the consumer a sense that search is valuable and highlighting an important feature to focus on while comparing options.

The Promise and Limits of Fee Visual Aids

As long as investors' primary consideration is maximizing expected returns over the long run, fee visuals, and the associated decrease in investment fees, are likely to be beneficial. Considerable literature supports investing in low-cost funds (Fama and French 2010) because it is difficult to predict future performance. In fact, even sophisticated financial professionals struggle to outperform the market after accounting for fees, making it unlikely that ordinary investors will accomplish this feat. In contrast, picking inexpensive index funds is a straightforward approach (e.g., Cooper et al. 2005; Fama and French 2010). As Eugene Fama recently (and bluntly) stated, "The best predictor of future performance is fees and expenses." Given consumers' and investors' limited knowledge, cognitive resources, and access to sophisticated analytic tools (Cooper et al. 2005; Lusardi 2008; Choi et al. 2009; Scholl and Fontes 2022), financial decision aids that lead investors to choose low-cost options could yield significant improvements to their savings.

That said, a singular focus on fee minimization could harm particular investors in certain situations. If erroneously applied to the investor's portfolio allocation problem without consideration of other issues, it is conceivable that decision aids emphasizing fees could lead to undesirable choices. For example, when deciding between a bond fund with a .05% expense ratio and a stock fund with a .08% expense ratio, fee minimization could lead a young investor to exclusively select the bond fund, which is almost certain to underperform a mix of stock and bond funds over the long run. Similarly, if an investor has religious or ethical concerns regarding the companies underlying a mutual fund, a more expensive actively managed fund that excludes problematic companies may align better with their preferences. Finally, too much fee minimization may discourage investment in

more expensive funds providing foreign market coverage—an important risk diversification consideration.

Other choice architecture work shows unintended effects from visual aids. In particular, aids can affect choices when they display category-level comparisons rather than information on the market as a whole (Hille et al. 2018). They may also increase investment reluctance by lowering subjective investment knowledge (Hadar, Sood, and Fox 2013). Future work should examine if unintended effects occur in domains where optimal decisions may require allocating across multiple categories (e.g., a portfolio mix of stock and bond funds), and when aids include visual indicators whose information spans multiple fund categories. Additionally, while we did not observe decreased "participation" (i.e., allocating to cash instead of a mutual fund) in study 1, future work should provide greater opt-out opportunity to examine whether fee visuals nudge participants away from investing or other optimal choices. Notably, "naïve" allocation was either not impacted (study 1) or decreased in our research (Studies 2 and 3). If naïve allocations represent a low cognitive effort heuristic (Benartzi and Thaler 2001), these results seem to suggest visuals did not make decisions more difficult.

Beyond investments, we believe promising applications of visual aids include any market containing multiple, relatively standardized products sold for different prices. In such markets, visual aids can display a distribution of prices, allowing consumers to effectively leverage the principle of "meaningful comparisons," and appropriately assess underlying products. The necessary criteria are satisfied in the investment marketplace (fig. 1), which contains over 8,000 mutual funds, and for other financial products including mortgages and credit cards.

Conclusion and Policy Implications

Improving policy around investment products often means disclosure change. Indeed, the Securities Act of 1933, oft-known as the "Truth in Securities" law, starts with the purpose "To provide full and fair disclosure of the character of securities sold . . ." Despite this emphasis, our studies suggest that while valuable information is provided, current disclosures are inadequate as decision tools. Across every study, consumers with access to legally compliant disclosures invested in more expensive index funds that provided no benefit over cheaper funds. With fee visuals, consumers paid less in excess fees—fees above the most inexpensive in the choice set—and achieved the same investment goals. While there are numerous ways to improve disclosures, our

work adds to growing research on behavioral interventions suggesting that visuals displaying critical and neglected attribute information may be more effective than text disclosures alone (e.g., Larrick and Soll 2008; Camilleri and Larrick 2014).

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