Using Interactive "Nutrition Labels" for Financial Products to Assist Decision Making Under Uncertainty

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Abstract

Product information labels can help users understand complex information leading them to make better decisions. One area where consumers are particularly prone to make costly decision-making errors is long-term saving, which requires understanding of complex concepts such as uncertainty and trade-offs. While most people are poorly equipped to deal with such concepts, interactive design can potentially help users make better decisions. We developed an interactive information label to assist consumers with retirement saving decision-making. To evaluate it, we exposed 450 users to one of four user interface conditions in a retirement saving simulator where they made 35 yearly decisions under changing circumstances. We found significantly better ability of users to reach their goals with the information label. Furthermore, users who interacted with the label made better decisions than those who were presented with a static information label. Lastly, we found the label particularly effective in helping novice savers.

Keywords: Personal finance; consumer finance; decision making; behavior change; retirement saving; nutrition label; trade-off.
INTRODUCTION

Consumers increasingly make decisions that can have long-term implications for them using online tools. In situations such as choosing a healthcare provider, planning a trip, and saving for retirement, making decisions requires some level of understanding of trade-offs as well as addressing uncertainty. While research shows that most people are poorly equipped to deal with such concepts (Kahneman and Tversky 1979, Thaler and Benartzi 2004), interactive system design can help consumers make more informed decisions. Building on research in information labels and comparison user interfaces, we designed an interactive financial product information label to give users greater transparency about the consequences of their decisions.

A particularly challenging area in which to explore how interactive design can help trade-off decision-making is retirement saving: today’s financial marketplace consists of tens of thousands of investment choices for the average consumer and selecting one investment over another requires assessing trade-offs between potential risk and reward. Retirement savers have to make repeated decisions about asset allocations, taking into account changing circumstances.

The difficulties consumers face when choosing financial products can be explained by four main factors: first, people have difficulty thinking about risk and trade-offs, especially in the context of long-term decision-making (Kahneman and Tversky 1979); second, non-expert consumers cannot easily make comparisons between financial products so it is often necessary for them to rely on third parties for advice (Lisi and Caporin 2012); third, financial firms make it challenging to understand financial products, by inundating consumers with information that is not always in the consumer’s best interest (Mullainathan, Noeth et al. 2012); and finally, most people do not assess risk properly (Merton 2014) and consequently, a common mistake retirement savers make is attempting to maximize returns or minimize volatility rather than reach a pre-determined saving goal (Merton 2014). As a result, it is common for those saving for retirement to have underfunded retirement accounts.

Demographic changes throughout the world coupled with shortfalls in individual saving make retirement planning more important today than in the past. The World Bank has raised concerns about the sustainability of existing public pension systems due to an aging population in OECD countries (Bongaarts 2004). Furthermore, economists investigating the consequences of financial illiteracy have found that households throughout the world
generally are unfamiliar with basic economic concepts needed to make saving and investment decisions (Lusardi and Mitchelli 2007). Countries such as Australia, Chile, Switzerland and the United Kingdom now require some form of minimum compulsory retirement saving, either by employees or their employers (Bateman, Kingston et al. 2001). Examples of this include Australia’s Superannuation Guarantee and Singapore’s Central Provident Fund, both mandatory retirement saving plans put in place to encourage citizens to save appropriately (Bateman, Kingston et al. 2001). Changes in national retirement programs and shifts away from traditional pension plans force individuals to save more own their own as a consequence.

To address these issues, in this study we developed and evaluated an interactive product information label to help users to make long-term financial decisions. We focused on two research questions: (1): can an information label increase users’ long-term saving performance? and (2) can the use of interactive features of the label improve users’ performance beyond improvements achieved through a static label?

BACKGROUND AND RELATED WORK

Prior research has shown that information sources affect financial decision-making directly and indirectly, indicating that information presented as a financial label can potentially influence decision-making. For example, Baldwin and Rice (Baldwin and Rice 1997) showed that institutions have a significant influence on the communication channels and information sources investment analysts use, thereby affecting investment outcomes. How financial information is presented also affects decision-making. Yablowitz and Raban (Gaziel Yablowitz and Raban 2015) demonstrated blogs influence financial decisions differently than traditional financial newspapers. These studies suggest that consumers are not only influenced by a source of information, but also the presentation and format of information, meaning how information is presented on a financial information label can affect decision-making.

Prior work has shown how improvements in the presentation of information and organization of relevant knowledge can lead to better decision-making. Wu et al (Wu, Cirimele et al. 2014), for example, showed how dynamic information aids can be useful to students in training (i.e. novice users) and helped them meet or exceed performance levels of more seasoned hospital residents (expert users). Such research suggests that less financial-
savvy consumers could potentially benefit from a financial information label to bring their decision-making efficacy up to par with consumers who are more experienced.

Prior research has explored how information labels affect user understanding of complex information. Several researchers have applied the notion of online “nutrition labels” to assist lay people with complex concepts. Kelley et al (Kelley, Bresee et al. 2009) applied the notion of nutrition labels to privacy to help consumers understand the complexities of website privacy policies, showing that nutrition labels applied to other domains can be effective. Similar research by Kelley et al (Kelley, Cesca et al. 2010) demonstrated that their privacy nutrition label helped improve user understanding of complex privacy rules. In another example of nutrition labels used successfully to improve consumer knowledge and understanding, Sundaresan et al (Sundaresan, Feamster et al. 2011) used the concept of information labels modeled after nutrition labels to help consumers purchase broadband access from Internet services providers (ISPs). Additionally, adding interactivity to information labels has shown to be useful with studies demonstrating successful use of interactive labels as a mechanism to share user information about physical objects (Ross, Warwick et al. 2012).

The use of nutrition labels has proven to be beneficial to consumers (Byrd-Bredbenner, Alfieri et al. 2001) and adding interactivity to a standard nutrition label has also been shown to improve comprehension (Bedi, Ruvalcaba et al. 2010). While nutrition labels applied in other domains have proven effective in improving consumer comprehension, such summaries are difficult to find in personal finance products.

Research on ratings, feedback and persuasion in user interface design is also relevant to how information labels present data. Lelis and Howes (Lelis and Howes 2011) found that when people try to gather information for the best alternative under consideration they spend more time inspecting reviews of products with lower ratings, meaning adding ratings to an information label could potentially help consumers more easily differentiate between good and bad products. Froehlich et al demonstrated real-time feedback and interactivity applied to informational dashboards improved decisions leading to decreases in energy consumption (Froehlich, Findlater et al. 2012), supporting the notion that providing interactive feedback to users of a financial label would lead to the selection of more appropriate funds. Lee et al (Lee, Kiesler et al. 2011) studied how applying behavioral economic persuasion techniques can influence decision-making thereby motivating users to choose healthier foods, also showing the persuasive power of interactivity and the presentation of information.
Research on recommendation agents for presenting attribute trade-offs (Xu, Benbasat et al. 2014) shows making trade-off decisions more transparent to users increases their perceived decision quality. The implication of such research is that using an information label as a standardized mechanism for comparing funds not only improves decision-making, but increases the perception of making good decisions.

Research in behavioral economics has well documented challenges individuals face when making financial decisions that affect them over the long-term (Kahneman and Tversky 1979, Thaler and Benartzi 2004, Thaler and Benartzi 2007). For example, studies on retirement saving show that the vast majority of people make suboptimal decisions more often than not by taking inappropriate risk, either too little or too much risk at the wrong times, when selecting financial products (Thaler and Benartzi 2007). Tools, such as an interactive financial label, can help consumers understand risk and reward in more intuitive ways rather than as difficult to grasp abstract concepts.

Research has also explored the effect on online interaction on risk decision making and the understanding of long-term financial implications. Zhao et al (Zhao, Fu et al. 2015), for example, showed that displaying social information in a retirement investment user interface influences how much risk older people are willing to take. Other research has explored how financial advisers explain financial concepts with interactive software (Heyman and Artman 2015), and retirement saving behavioral can be influenced by design interventions informed by behavioral economic theory (Gunaratne and Nov 2015), persuasive design (Gunaratne and Nov 2015) and social influence (Gunaratne, Burke et al. 2017). These studies show that user interface design can help facilitate financial decision-making when saving for the long-term to benefit the consumer.

Overall, five key insights from prior research informed our design of the label: (1) information presented to users should be structured well and given in digestible portions to improve comprehension; (2) allowing user interaction with complex information can increase understanding and improve decision-making; (3) summaries of information and providing real-time feedback when input parameters change can improve comprehension; (4) perceived usefulness and actual usefulness of a system increases when users are able to adjust relevant input parameters to change results displayed by the system; (5) individuals have a poor understanding of risk, but when provided with guidance from human experts or expert computers systems, they are shown to make better decisions.
INTERACTIVE PRODUCT INFORMATION LABEL

Providing too much financial information to consumers may inundate them, therefore summarizing variables such as risk, fees, investment timeframes, and fund ratings in a form that consumers can quickly and easily understand helps (Hortacsu and Syverson 2003, Thaler and Benartzi 2004). Such information in the form of a standardized label can help make complex information more comprehensible, and enable consumers to make informed decisions and take action independently. The U.S. government has financial reporting mandates and standards to present information, but consumer comprehension of these documents is poor (Lusardi and Mitchelli 2007) and there are few other sources of standardized financial information for consumers (Lisi and Caporin 2012).

Our objectives in the design of the interactive financial information label (see Figure 1) were to (1) provide consumers key information in a compact, easy to understand format, which could be read quickly, and (2) explore whether the interactive features could lead to reflection and behavior change. To address the latter objective, we drew upon research on persuasive design (Lee, Kiesler et al. 2011, Pandey, Manivannan et al. 2014), and behavior change (Lee, Kiesler et al. 2011, Froehlich, Findlater et al. 2012). To determine what types of information should be presented on a financial label we first referred to guidelines mandated by regulators for consumer funds, and studies of mutual fund information readability. Required information includes fund past performance and information about investment objectives, risk, charges and expenses (Lee, Chung et al. 2011). We also considered the commonly used fund benchmarks and rating systems, including a widely used rating system created by Morningstar.

The information design of the label is informed by prior research specifically about the design of food product labels and research about the layout, print size, organization, justification, typography, information density, and line spacing (Mackey and Metz 2009). We also drew from the design and layout of a label successfully used to convey complex privacy information to users (Kelley, Bresee et al. 2009). The privacy information label clustered related information together based on how privacy information is used. We applied these clustering techniques to our financial label and used a similar format inspired by the privacy label with summary information is listed at the top of the label, secondary recommendation information at the bottom, and financial details in the center.
Building on these sources, we included in the label design a number of proxies to convey information including growth estimates, time frames and risk adjustment tools. Our prototype included: historical returns, growth estimates, fees and costs, ratings and risk, and a recommendation based on a user’s investment time frame. To augment this, we added interactivity: the ability to interact with the label and adjust factors such as growth rates, volatility, fees and time frame to help users understand trade-offs and consequently influence long-term saving decisions.

Returns and Benchmarks

To allow comparisons between products the label included information about typical returns of an investment with one to 20 years of historical returns. It is also common to provide benchmark indexes as points of comparison including the Standard and Poor’s 500 Index (S&P 500), a U.S. stock market index based on 500 large companies. International equivalents include the Financial Times Stock Exchange 100 Index (FTSE 100) in the United...
Kingdom and the Deutsche Boerse AG German Stock Index (DAX). Government bonds, corporate bonds or money market funds are used as points of comparison for lower risk funds. Using benchmarks is widely acknowledged in the finance community as an effective way to provide investors with a means to make comparisons between funds.

**Risk and Volatility**

Some fund prospectuses provide risk information by showing past performance of a fund in best, worst and average cases over time intervals that are typically one, five, ten and twenty years. Risk is typically indicated using measures such as beta and Sharpe ratio, measures of the volatility of a stock or a portfolio in comparison to a market index as a whole. Stating risk allows investors to judge how volatility may affect them over short and long terms. We also wanted to convey to consumers that high volatility does not necessarily mean high risk given a long time horizon.

**Fees**

Fees involved in holding a fund can eat up a great deal of an investor’s capital, and therefore should be disclosed to investors in an easy to understand fashion.

**Rankings and Grades**

One of the few agreed upon consumer ranking indicators is Morningstar’s five-star rating (Lisi and Caporin 2012). Additionally, providing secondary ranking indicators of other factors such as in risk, returns and fees could provide the investor with a better understanding of the underlying attributes of a fund.

**Summary of Use and Fund Composition**

Consumers receive little information about suitable uses of financial products. Some products are better for retirement investing, while others more short-term focused. Usage information should provide an indication of how long to hold the investment.

The educational qualities of nutrition labels suggest that summarized information provides substantial advantages to consumers in areas ranging from food choice (Byrd-Bredbenner, Alfieri et al. 2001) to website privacy policy (Kelley, Cesca et al. 2010).
Dynamic User Interfaces and Interactivity

As Wu et al (Wu, Cirimele et al. 2014) demonstrated, information that updates and changes based on current circumstances improves user decision-making. Applying similar techniques to the display of financial information, Gunaratne and Nov (Gunaratne and Nov 2015) have shown that providing interactive information about long-term fund performance helps improve users’ retirement saving performance. These techniques can be applied to financial information labels by enabling consumers to change saving amounts and adjust fund attributes to make the long-term implications of investing in a fund more clearly visible.

Comparisons

Prior work has demonstrated the benefits of showing users comparisons between choices (Xu, Benbasat et al. 2014) to influence decision-making. We provide users the ability to compare funds to one another through two mechanisms. First, users can select several funds to compare and view them through a tabbed user interface that is designed for easy comparison of the attributes of each respective fund. Second, users can change attributes of funds through an experimentation user interface that enables them to change fund attributes.

Simulator

We tested the interactive financial product information label in a retirement saving simulator we developed for this study (see Figures 2-4). The design of the simulator applied transactional workflows from Vanguard Group’s retirement website. Similar to many retirement saving platforms, our simulator provided the ability to choose from a selection of funds to make yearly saving choices. In experimental conditions users could access the information label by clicking on fund links in the retirement simulator’s fund selection screens.

STUDY

Setting

Retirement saving requires understanding how different asset types can be used in a retirement portfolio over time. Stocks are the riskiest investment type, but provide the greatest return. Bonds are less risky, but provide a lower return. Cash has no risk and provides minimal return (Commission 2014). Therefore, for consumers to achieve their saving goal they need to understand what is the appropriate mix of asset types (and the risk
they carry) at different points in their saving career. Individuals must make repeated choices about these allocations and change the risk they take on over time by changing the funds contained within their retirement portfolio. Retirement saving also requires making comparisons in the selection of funds to build an optimal portfolio. We modeled our study such that participants would need to change fund allocations as time progressed, decreasing the allocation of stock in their portfolio over time to more conservative bond investments.

For the purpose of this study our retirement saving simulator (Figures 2-4) displayed ten artificial funds based on funds commonly offered in the marketplace using fund attribute data from Charles Schwab, J.P. Morgan and Vanguard. We based our funds’ attributes on mutual fund prospectus documents. We provided four groups of funds: stock funds, bond funds, Lifecycle funds and a cash fund. To make the market performance realistic we used price data from the S&P 500 for stock funds and data from the Fidelity Investment Grade Bond Fund (FBNDX) for bond funds. Lifecycle fund price data used a mix of data from the S&P 500 and FBNDX, and dynamically changed allocation over time using a Lifecycle fund allocation model formula (Mitchell and Utkus 2012). Actual market data from 1980 represented the simulated year of 2015, 1981 represented 2016, and so on, ending with the simulated year 2050.

**Procedure and Methods**

Participants in the study first saw an instructional page providing background on the study, next they proceeded to the 35-year retirement simulation, and finally they were presented with a screen displaying the final amount in their simulated retirement portfolio. For each year in the participants could view a screen showing a summary of their savings to date and another screen allowing them to set fund allocations. Before participants could proceed to the next year they were required to make fund allocation choices for the current year (see Figure 2).

The instructional page given prior to beginning the study provided all participants information on retirement investing and described the difference between stock, bond, Lifecycle and cash funds and their respective risk and return rates. Since users were not actually investing with their own money we designed the experiment and worded instructions to encourage users to make realistic choices.

This instructional page provided extensive detail in a table about the different rates of risk and return participants could expect and provided an interactive calculator to all
participants to illustrate compounding interest and risk over time. The calculator displayed a worst case estimate, likely case estimate, and best case estimate to users based on user input, and provided participants with a preview of what to expect in the actual retirement simulator. The instructional page did not provide any instructions or discussion about the interactive financial information label. Users in the study were first exposed fund information after starting the study and clicking on a fund link. When viewing labels informational text was available by hovering over information icons providing tooltips. In conditions where users could interact with the financial label we showed a prominent red button with the text “See how changes affect fund performance.”

Finally, we provided information about the goal of the study being to save $1.5M over the course of 35 years (2015-2050). To emphasize the importance of reaching the goal as closely as possible we instructed, “For the purpose of this study we have given you a goal... You are not rewarded for outperforming your goal. The closer your estimate is to the final amount the greater your Mechanical Turk bonus.” We chose a one-size-fits-all goal to most accurately measure how our financial label would affect saving over time in a controlled setting. This goal was based on expected returns of stock and bonds, as well as common risk and reward attributes for most individuals, akin to a goal a financial advisor would set. Having said that, there are limitations to this approach, in a real world setting a consumer with a financial advisor could determine a different goal based on the consumer’s feelings about risk and reward, as well as varying external economic indicators. Life events and ability to save could change financial circumstances, also affecting the goal. These factors are difficult to capture in a controlled study that attempts to simulate many years in a single session.

Given these limitations, setting a goal and measuring participant saving performance with respect to the goal provided a metric to answer our first research question. Once participants started the retirement simulation, they were randomly assigned to one of four conditions in a between-subjects experimental design. Each year participants invested $10,000 amongst a choice of ten funds. Stock, bond and Lifecycle fund categories had each three individual funds to choose from with differing attributes. The three funds of differing quality in stock, bond and Lifecycle categories consisted of: one fund which clearly had the best attributes of its category—i.e. low fees, and with respect to a saving timeframe, relatively high rates of return and low volatility; a second fund with the worst attributes of its category; and a third fund with attributes between the best and worst funds in its category.
Fees, volatility and growth rates differed from fund to fund within each category. We also provided a money market cash fund that had no fees, zero volatility, no ratings and no historical performance. These ten funds enabled us to provide financial products similar to real world choices.

The retirement simulator consisted of a home screen displaying the current amount of money saved to date and a chart showing accumulation over time (Figure 2). From the home screen users could set this year’s savings mix or optionally rebalance their entire savings. Each of the selection screens consisted of lists of funds from which the participant could set asset allocations. The retirement simulator allowed participants to set asset allocations for the year or to rebalance the entire portfolio of all years of saving (see Figure 3).

**Figure 2.** The retirement simulator home screen consists of dashboard showing previous investment transactions and current funds within an investment portfolio.
Funds’ names did not make it possible for participants to discern differences simply by reading the fund’s name. For example, we used the following names for Lifecycle funds: *Lifecycle Fund 4, Lifecycle Fund 6 and Lifecycle Fund B*. Once users clicked “submit” on their chosen asset allocation, they moved to the next simulation year. Users were then presented with market behavior of the previous year as well as their portfolio’s performance (Figure 2).

![Set this year's savings mix](image)

*Figure 3a. The simulator provided users with ten funds to select from including stock, bond, Lifecycle and cash funds.*
Participants and Reward Mechanism

We recruited participants via Amazon Mechanical Turk and limited participation to U.S. users with a record of at least 100 tasks at an approval rate above 99%. Amazon Mechanical Turk is a crowdsourcing marketplace for online tasks and widely used for experimental research in various fields, including information science (Lin, Trattner et al. 2015) and human-computer interaction (Komarov, Reinecke et al. 2013). We relied in U.S. participants to increase the validity of the study and make it reflective of what participants may encounter throughout their saving careers. U.S. participants who save for retirement use saving platforms similar to the one used in the study. In addition, the saving context—including the autonomy investors have in selecting asset types, and the type of funds
available to them—reflect typical U.S.-based industry standards. To motivate participants to achieve a retirement saving goal rather than maximize returns or evade risks—a common mistake retirement savers make (Merton 2014)—we rewarded goal-driven moderate risk. Consequently, participants’ compensation was $2.00 base pay and a maximum bonus of $4.00 if they met the $1.5M retirement goal. Deviation from the goal either positively or negatively led to a proportionally lower bonus. This 2/1 bonus/base compensation ratio represents substantial incentive to achieve the savings goal rather than trying to maximize returns with riskier behavior.

**Experimental Conditions**

We conducted a between-subjects experiment in which we compared users’ performance when presented with variants of the label against a control condition that presented product information modelled after conventions used by Vanguard Group—the leader in this industry (Stein and Collins 2014).

**Interactive Label – Optional Interaction**

In the *interactive* label condition, users could click on a fund name as they deliberated on the possible choices afforded to them by the simulator. Clicking on the fund name was optional. If users chose to click on a fund name, they were shown an interactive label (Figure 1). Users could interact with the label if they chose to do so, but interaction was not required. Recording whether or not a user interacted with the label in conjunction with performance enabled us to understand the relationship between performance and interaction with the information label. Understanding the specific context under which users interacted with the label helped address our second research question.
Figure 4. The interactive label allows users to experiment with hypothetical saving outcomes by changing fund attributes. In the cases shown above, decreasing the saving timeframe from 20 to 3 years and lowering volatility changed this fund’s recommendation. The saving timeframe column is highlighted to the user.

The label provided historical return information and a benchmark comparison with the S&P 500; future growth estimates in best, average and worst case scenarios; risk and volatility assessments; fees and costs for the fund with a benchmark comparison; ratings of the fund attributes; and an adaptive recommendation on whether or not the user should use the fund, based on an algorithm that took into account the attributes of the fund, the investment timeframe of the participant, and the input provided by the user. The user could change the time period and see the effects of compounding in real-time. Through an interactive fund experimentation feature (Figure 4) we also gave the user the ability to change parameters on the information label such as the number of years in the saving time frame, volatility and annual fees. Changing attributes allowed the user to see how different attributes could affect performance. By default, the performance table shown to the user displayed value columns for 1, 5 and 20 years, identical to the control condition. However, when a user changed the time period, the columns of the performance table changed. For example, setting
the saving timeframe to 12 years resulted in the performance table showing values for 1, 12, and 20 years; changing the saving timeframe to 23 years resulted in 1, 5 and 23 years.

We classified *interactive* label users into two subgroups: those who chose to actively interact with the label by clicking on buttons and changing input (*active*), and those who ignored the optional interactive features of the label (*passive*).

**Interactive Label – Mandatory Interaction**

In the *optional interaction* condition, we did not know if passive users avoided interacting with the label by choice or because they did not understand that the label was interactive. We also did not know if self-selection bias led sophisticated users to use the interactive features more. We therefore included an additional experimental condition, the *mandatory interaction* label, which showed to the participants in this condition the same label, but made the interaction with the label mandatory. In this condition users could not continue to the next year without interacting with the financial label by changing one or more of the input fields. Users in the mandatory interaction condition attempting to continue without interacting with the label were shown a modal dialog box prompting them to interact with the label before continuing. By adding a required interactivity condition, we were able to rule out self-selection and isolate the effect of the interactivity behavior.

**Static Label**

The *static* label condition showed a label identical to the *interactive* label conditions, but excluded interactive experimentation features. The user could not modify input fields on the label. Because our second research question specifically dealt with how interactivity is related to performance, it was important to understand how a user interface that lacked interactivity would affect user performance and if this differed from a user interface with interactivity.

**No Label (Control Condition)**

In the control condition we presented financial information in a format similar to how mutual fund information is presented on Vanguard, the largest U.S. retirement assets manager (Stein and Collins 2014) (see Figure 5). The interface separated information into six sections, accessible through tabs, including: fund summary, price and performance, portfolio and management, fees, distributions, and news and reviews sections. As in other conditions, users could click on funds to view financial information and compare funds.
Figure 5a. The control condition provided extensive information to users in a format similar to popular commercial retirement saving platforms.

Figure 5b: The control condition also included a fund fees tab with information about expense ratios over time and benchmark fund comparisons.

Since the study’s focus was on getting users close to their saving goals (as opposed to saving as much as possible, or exceeding the goal), performance measures used for comparison between the conditions were a function of the distance between savings and goal. To make sure results are consistent across different measures we used both mean gap from the goal, and likelihood of reaching a final saving amount within a 10% range of the goal (10% representing reasonably achievable interval that would be likely to give retirement savers a saving amount not too far from what they were aiming for). The former comparison was made using ANOVA with post-hoc Bonferroni correction, and the latter comparison was made using a Pearson chi-square test.

RESULTS

We included 450 users in a between-subjects experiment, dividing participants between the conditions of interactive label (n=199; of which 43 active, 88 passive, 68 mandatory),
static label (n=134), and control (n=117). Participants’ age was 34.7 (SD=9.8) and 50.7% were female (SD=0.5). Performance varied widely across the experimental conditions (see Table 1). To address the first research question, we examined three key performance measures: the likelihood of reaching within 10% of the study goal, the mean gap from the study goal, and the mean percent in low fee funds.

The likelihood of reaching a final saving amount within a 10% range of the goal differed significantly across the conditions (Pearson chi-square=22.99; df=4; p<0.001) with the likelihood of reaching this range among users in the interactive (active) condition (88.4%) and interactive (mandatory) condition (76.0%), being significantly higher (p<0.001 and p<0.01, respectively, with Bonferroni correction) than the likelihood of the control condition participants (53.0%). Furthermore, compared to users of the static label (where 61.2% reached a final saving amount within a 10% range) this likelihood was significantly higher among the users of interactive (active) condition (p<0.001).

The results of the ANOVA (F_{4,445}= 6.698; p<0.001, see Table 1) revealed that the gap between participants’ goals and their actual saving amounts was smallest, on average, in the interactive (active) condition ($79,385).
<table>
<thead>
<tr>
<th>Condition</th>
<th>Mean gap from goal ($)</th>
<th>Likelihood of reaching goal</th>
<th>Mean % in low fee funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interactive (active)</td>
<td>79,385***†††</td>
<td>0.88***†††</td>
<td>62.0%***†</td>
</tr>
<tr>
<td>Interactive (passive)</td>
<td>129,588</td>
<td>0.68</td>
<td>49.7%**</td>
</tr>
<tr>
<td>Interactive (mandatory)</td>
<td>99,561***</td>
<td>0.76***</td>
<td>54.9%***</td>
</tr>
<tr>
<td>Static</td>
<td>133,594</td>
<td>0.61</td>
<td>52.1%***</td>
</tr>
<tr>
<td>Control</td>
<td>171,272</td>
<td>0.53</td>
<td>41.2%</td>
</tr>
</tbody>
</table>

Table 1. Comparative performance across conditions.

Difference from the control condition: ***significant at p<0.001; **significant at p<0.01; *significant at p<0.05; †significant at p<0.1 (after Bonferroni correction).

Difference from the static condition: †††significant at p<0.001; ††significant at p<0.01; †significant at p<0.05; †significant at p<0.1 (after Bonferroni correction).

The gap between participants’ goal and savings in the interactive (active) condition was significantly smaller than the gap in the control condition (p<0.001) and the static condition (p<0.001). The gap from the goal for users in the interactive (mandatory) was significantly smaller compared to the gap of users in the control condition (p<0.001). The gap from the goal for users in the interactive (passive) and static was weakly significantly smaller compared to the gap of users in the control condition.

To address our second research question, we examined the differences in performance amongst the interactive conditions (active, passive and mandatory) and the static condition. We found that the difference between the mandatory and non-mandatory interaction conditions in terms of the likelihood of reaching within 10% of the goal was not significant, and that the interactive (mandatory) label led to significantly better results than the static label. We also found that the difference between the mandatory and non-mandatory interaction conditions with respect to the gap between saving and the goal was not significantly different, and that the difference between mandatory interaction and a static label condition was marginally significant (at p=0.053). Taken together, these findings suggest that interaction with the label, either mandatory or voluntary, leads to better saving performance.

While participants in the interactive (active), interactive (passive), interactive (mandatory) and static conditions did not spend significantly more time on their task (48.3, 40.2, 41.8 and 40.5 minutes, respectively) than in the control condition (42.7 minutes), they did spend significantly more time viewing the financial label (3.7 minutes, p<0.001; 1.4
minutes, p=0.04; 3.0 minutes, p<0.001; and 1.7 minutes, p<0.001; respectively) than in the control condition (1.0 minutes).

**Level of Investment Experience**

We found the *interactive* label to be particularly effective among novice and intermediate users. Of our study participants, 84 (18.7%) regarded themselves as novices in terms of their experience with investing, 214 (47.6%) regarded themselves as intermediate investors and 144 (32.0%) regarded themselves as expert investors. The remaining eight participants stated they were not sure how to answer. There were no statistical differences between experience levels across the experimental conditions.

When comparing users’ performance across different experience levels (Figure 6), we found that novice users in the *interactive (active)* condition were significantly more likely to reach within 10% of their goal than those in the control condition, and their average gap from the goal was significantly smaller (in both cases p<0.001). Novice users in the *interactive (mandatory)* condition also were significantly more likely (p<0.01) to reach within 10% of their goal than those in the control condition. The gap from the goal was smaller among *static* label users compared to the control condition users (p=0.03). Intermediate users in the *interactive (active)* condition also had a higher likelihood of reaching within 10% of the saving goal (p=0.01) compared to intermediate users without the label in the control condition. Intermediate users in the *interactive (mandatory)* condition performed significantly better (p=0.043) than intermediate users in the control condition. Expert users in the *interactive (active)* condition had a significantly higher likelihood of reaching the saving goal (p=0.035) compared to those in the control condition.

The likelihood of novice users in the *interactive (active)* and *static* label conditions, was not significantly different from the likelihood of intermediate and expert users in these conditions.
Figure 6. Novice and intermediate users interacting with the label in the interactive (active and mandatory) conditions performed better than those without the label in the control condition. Expert users performed better in the interactive (active) condition compared to the control condition, but increases were not as substantial as the novice users.

**Asset allocation choices**

Average stock allocations of participants with access to a label were significantly higher than those in the control condition: interactive (active), 77.8% (p<0.01); interactive (passive), 70.0% (p<0.01); interactive (mandatory), 74.5% (p<0.01); and static, 71.6% (p<0.01); compared to 65.0% in the control condition (see Figure 7).

Furthermore, participants who had access to an information label consistently selected funds with low fees over funds with higher fees, in contrast to participants in the control condition. Interactive (active), interactive (passive), interactive (mandatory) and static condition participants set an average of 62.0%, 49.7%, 54.9% and 52.1% of their portfolio to low fee funds, respectively, higher than the 41.2% set by control condition participants (significant at p<0.001, p<0.01, p<0.001 and p<0.001, respectively).
DISCUSSION

Taken together, the results show that with respect to our first research question, information labels can help users increase long-term saving performance significantly, but that performance improvements vary based on a user’s level of experience with investing. While the high performance of active users of the label could potentially be explained by self-selection of investment-savvy users, such an explanation is unlikely given that we did not find a difference between active and passive users in terms of prior experience. The presence of the interactive label improved the performance of those who used it, but participants who didn’t engage with the interactive label, performed equally well as participants who used the static label. Novice and intermediate users forced to interact with the label in the interactive (mandatory) condition did better than those in the interactive (passive), static and control conditions. Users who interacted with the label did better than those who did not. Novice and intermediate users forced to interact with the label performed better than those who did not interact with the label, however, forced interaction did not bring users up to the level of
proactive users, those in the interactive (active) condition, who interacted with the label. The findings suggest that users better understand the variability of fund performance with respect to risk and return when it is immediately and interactively reflected in the information label. The results also show that the formatting and type of information presented to users affects decision-making. The control condition lacked information such as best, average and worst case growth estimates. The lack of such information could partially explain the poorer performance of users in the control condition compared to the label conditions, and indicates such information should be included to help consumers better assess risk over time—concepts people generally have difficulty understanding (Kahneman and Tversky 1979).

With respect to our second research question, we found interactivity helps users. Performance is better with interactivity compared to performance without interactivity using a static label. However, performance is based on the motivation of the user to interact with the information label, and simply forcing user interaction does not necessarily help a user achieve the same level of performance as a user who chose to interact with the information label. We believe that interaction with the label enables users to learn about the attributes of funds in a similar way to how repeated decision-making over time helps people better understand risk and reward (Thaler and Benartzi 2007).

Our results show that while an interactive label increases the amount of time users spend deliberating over fund choice, it does not increase overall task decision-making time. Providing an information label to users—and in particular an interactive label—leads them to choose low fee funds. While it may seem obvious to select low fee funds over high fee funds, extant research has shown that consumers often do not consider fees when they make fund choices (Hortacsu and Syverson 2003, Mullainathan, Noeth et al. 2012, Fisch and Wilkinson-Ryan 2014).

Similar to Wu et al (Wu, Cirimele et al. 2014), our findings that the label’s impact on participants’ performance changes with expertise level, suggest that such differences in performance between novice and expert users can potentially be eliminated with an information label that increases transparency and enables users to get a sense of the impact of choices on future outcomes. Novice users in the interactive (active), interactive (mandatory) and static label conditions have higher likelihoods of reaching the saving goal than intermediate and expert users, but this was not significant. However, one possible explanation of why novices may have higher likelihoods of reaching the saving goal than intermediate and expert users is that novices are less encumbered by experience that may make them
second-guess saving decisions. This type of behavior is common amongst experienced investors who often have overconfidence that they can beat benchmarks based on their own investment experience rather than following what experts recommend (Barber and Odean 2000). Intermediate and expert participants in our study may well have had some degree of overconfidence that negatively affected them when exposed to a label with expert recommendations, but the adverse effects did not make their performance significantly different from novices.

Studies on financial problem solving comparing novices and experts have shown that trained novices are able to produce solutions to financial problems that are substantially better than those generated by experts (Hershey and Walsh 2000). Experts also tend to rely more on memory for task-specific information and use less information than novices in decision-making (Camerer and Johnson 1997). Bedard et al (Bedard, Mock et al. 1992) found this tendency of experts to use less information than novices holds true when making financial comparisons. In our study, the smaller difference in the gap between novice and expert performance with use of the interactive label can be explained by novices using the label to learn about financial products, resulting in them doing as well as experts or even outperform experts in some instances. Experts may be too reliant on their past experience and do not feel as inclined to put energy into trying to extract more information from the label.

Our findings have also policy implications: Belgium, Denmark and France have taken steps to provide information on financial products to make consumers more aware of risk. The United Kingdom has proposed adding warning labels to high risk financial products aimed at consumers. The U.S. has yet to introduce such information labels for financial products. As demonstrated in our research, interactive financial product information labels can help consumers make better, and more informed decisions. Regulators should therefore consider mandating the use of interactive information labels for financial products, just as simpler labels are used in other contexts such as food and other consumer products.

CONCLUSION

In this study we show how interactive information labels can improve the performance of users trying to reach a retirement saving goal. We found that providing a financial product information label led users to select better financial products for their needs and be able to use the financial product in a way to help them meet a saving goal.
Prior research has examined the benefits of structuring information for novices to help them reach similar performance levels to experts. Additionally, a number of studies have examined the benefits for structuring esoteric information in more usable and accessible formats. This study corroborates such prior work and additionally finds that there are benefits to making information interactive. Interactive information can lead to better performance of users compared to non-interactive information. Moreover, as prior research has shown, active engagement in subject matter helps with learning and retention of information. Structuring information in such a way that promotes interaction encourages active engagement and learning, leading to better user performance.

Little research in design or finance has been done to date on how to use adaptive and interactive design to help consumers with saving and investing. Our interactive financial product information label addresses this growing consumer need and helps users deal with complex information in a way that is easily accessible to non-experts.

In this context, interactive systems design research has an opportunity to influence policy-making and industry conventions. In the future, policy makers and regulators may devise policies about which interactive information elements should be provided to customers to manage their finances online, thereby offering better support for understanding trade-offs and making informed decisions.
REFERENCES


