

Principles for behavioral design: Nudging for better investor outcomes

- People face persistent challenges when making financial decisions, such as inertia and decision overload, that can quietly erode long-term outcomes. At Vanguard, we view these challenges not as investor failings, but as behavioral design opportunities for our digital platforms to help investors achieve better outcomes.
- We believe that the paradigm for digital experience design has shifted and must meet a *dual mandate*: to create digital experiences that are not only easy and intuitive to use, but that also effectively nudge investors toward better financial decisions.
- The “ACE” framework, consisting of three principles, outlines how we deliver the mandate:
 - **Attentiveness:** Establish optimal benchmarks, identify behavioral gaps, and quantify impact.
 - **Commitment:** Design to promote financial success for investors.
 - **Empathy:** Align solutions with real investor behavior, continuously testing and improving to ensure effectiveness.
- ACE forms the cornerstone of our vision for digital client experience design, and we are committed to grounding our greatest client experience opportunities in this framework. By embedding ACE strategically in our behavioral design experiences, we aim to empower more investors to achieve their financial objectives. This underscores Vanguard’s distinctive ownership structure¹ and mission to serve the end investor and exemplifies how behavioral design can effectively serve individual investors.

Authors



Xiao Xu,
Ph.D.



Suzie Mulesky,
Ph.D.



Sachin Padmawar,
CFA



Jaclyn Kalter,
MPP



Jes Koepfler,
Ph.D.

¹ Vanguard is owned by its funds, which are owned by Vanguard's fund shareholder clients.

Challenges in financial decision-making and the need for behavioral design

People often make financial decisions that are not in their best long-term economic interest. For example, on the asset side of the household balance sheet, many people save too little for retirement, cash out retirement savings when they leave a job, or don't adequately diversify their portfolio. On the liability side, common missteps include not shopping for loan rates, neglecting opportunities to refinance debt at lower rates, and accumulating short-term debt without a clear repayment strategy. If unaddressed, these behaviors can result in significant financial consequences for individuals.

The difference in outcomes between a "baseline" strategy—often marked by inconsistent saving, poor diversification, and reactive decision-making—and a more structured, disciplined approach can amount to as much as \$1.6 million in lifetime shortfall (Weber et al., 2022).

Financial institutions commonly offer digital platforms—websites and mobile apps—to enable users to make financial decisions. These platforms present a valuable opportunity to design experiences that help people make better decisions. While some institutions design platforms to benefit clients, other platforms may cause them harm, intentionally or not.

At Vanguard, we advocate and practice a *dual mandate* for client experience: Not only should digital experiences be intuitive and easy to use, but they also should enhance investor outcomes

whenever possible and appropriate through **behavioral design**. We implement behavioral designs to empower investors to make better-informed decisions. For example, offering choices in a particular way in order to make it easier to choose an optimal investment path can improve long-term investor outcomes; it encourages informed decision-making while preserving freedom of choice and investor autonomy.

A **nudge**, as defined by Richard Thaler and Cass Sunstein (2021), is a subtle change in the way choices are presented that predictably influences behavior, without restricting options or significantly altering economic incentives.

Behavioral design, as the term is used in this paper, builds on the foundation of nudging but takes a broader, more integrated approach. It draws on insights from psychology and economics to understand why investors behave the way they do, and to create experiences tailored to their cognitive and behavioral tendencies. Behavioral designs can span a range of interventions. In the digital space, they can include touchpoints such as online alerts and email communications, web flow changes that optimize the design of digital screens, new digital experiences such as retirement planning tools, and defaults in 401(k) accounts.

The ACE framework for behavioral design

What constitutes effective behavioral designs that empower investors? This paper presents a set of principles we follow at Vanguard, which we refer to as ACE—**Attentiveness, Commitment, and Empathy** (see **Figure 1**). We believe these investor-aligned principles are essential for implementing effective behavioral designs that fulfill the dual mandate.

FIGURE 1
The ACE principles



Attentiveness

Establish optimal benchmarks, identify behavioral gaps, and quantify impact.



Commitment

Design to promote financial success for investors.



Empathy

Align solutions with real investor behavior, continuously testing and improving to ensure effectiveness.

Source: Vanguard.

These principles guide our design initiatives and establish boundaries to prevent malicious exploitation of behavioral biases or inadvertently steering investors toward suboptimal financial decisions.

At times, practices in the financial services industry may lead to outcomes that are not fully aligned with consumers' best financial interests. Firms hide extra costs, resulting in billions of dollars in hidden fees (Gabaix and Laibson, 2006; Agarwal et al., 2015; Stango and Zinman, 2014). Trading apps use gamification to encourage excessive trading (Chapkovski, Khapko, and Zoican, 2024). Lenders exploit behavioral biases through default options and payment structures, increasing borrowers' debt (Heidhues and Kőszegi, 2010). Algorithmic underwriting can also widen inequalities (Bartlett et al., 2022; Fuster et al., 2022).²

² Across industries, we often see designs that cause meaningful declines in welfare, intentionally or not. For instance, shoppers frequently underestimate total costs when sales taxes aren't clearly presented; the full cost of a purchase becomes apparent only at checkout (Chetty, Looney, and Kroft, 2009). In digital platforms, design elements optimized for user engagement have been linked to decreased mental well-being, contributing to heightened anxiety and dissatisfaction among users (Allcott et al., 2020).

In contrast, we use the ACE principles to foster empowering designs and avoid malicious or neglectful practices. Behavioral designs have the potential to be either empowering or malicious, depending on how they are applied. When we distinguish between empowering and malicious designs, we are not suggesting that all designs in a particular category are inherently harmful.

Rather, a design becomes malicious when it seeks to drive actions or behaviors that are not in the best interest of the investor.

Figure 2 illustrates the importance of this framework by highlighting three common behavioral tendencies and demonstrating how each can be leveraged, exploited, or ignored, depending on the intent behind the design.

FIGURE 2
Different design approaches for the same behavioral tendencies

Behavioral tendency	Empowering designs	Malicious designs	Neglectful designs
ACE checklist	✔ Attentive ✔ Committed ✔ Empathetic	✖ Attentive ✖ Committed ✖ Empathetic	✖ Attentive ✔ Committed ✖ Empathetic
Inertia*	Autoenrolling workers in retirement plans.	Providing one click to subscribe, a labyrinth to escape.	Allowing IRA contributions to stay in cash investments.
Present bias**	Automatically increasing saving rates a little each year to boost retirement savings.	Gamifying trading to encourage more trades and speculations.	Quantifying the paycheck reduction for a given saving rate without showing the projected retirement income.
Limited attention***	Reminding investors to contribute to their IRA during tax season.	Frequently pushing notifications on asset price movements.	Presenting too many fund options in 401(k) investment menus.

* The tendency to stick with the status quo.

** The tendency to prioritize smaller, immediate rewards over larger future rewards and consequences.

*** The tendency not to consider all available information when making decisions because of cognitive constraints.

Source: Vanguard.

We delve into each principle on the following pages and provide examples that highlight the benefits and opportunities of each. We then provide a detailed case study for the design of a 401(k) autopilot system, which exemplifies how the application of all three principles in combination can yield substantial benefits to investors.



Attentiveness

Establish optimal benchmarks, identify behavioral gaps, and quantify impact.

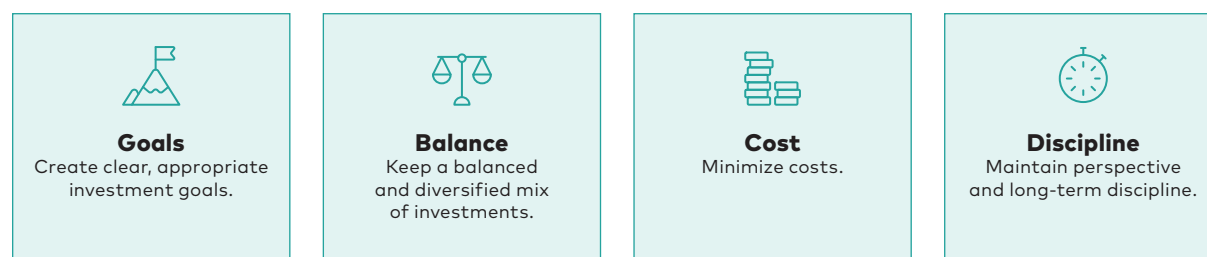
Establish optimal behavioral benchmarks

Our practice of Attentiveness starts by setting clear behavioral benchmarks, defining what sound investor behavior looks like. Vanguard has distilled four actionable investing behaviors for success: Goals, Balance, Cost, and Discipline (Figure 3). For retail investors and retirement plan

participants, these break down into specific, relatable actions such as making regular contributions to investment accounts, diversifying portfolios and rebalancing them periodically to maintain risk-appropriate asset allocation, avoiding panic selling during market volatility, and so on. We believe that paying attention to these investing behaviors can meaningfully boost the chance of financial success.

FIGURE 3

Vanguard's Principles for Investing Success



Source: Vanguard (2023).

Goals, Balance, Cost, and Discipline are grounded in practical insights and scientific foundations. Vanguard has studied established economic models, such as mean-variance portfolio theory (Markowitz, 1952) and life-cycle portfolio choice theory (Merton, 1969; Bodie, Merton, and Samuelson, 1992). From these examinations, Vanguard has developed proprietary versions—the Vanguard V-model family—to optimize asset allocation and financial planning strategies. These models strengthen the rigorous foundation of the principles for investing. Furthermore, they establish optimal behavioral benchmarks and serve as powerful tools to identify and measure behavioral gaps.³

We assess client diversification over time and help clients create portfolios for their goals using the Vanguard Life-Cycle Model (VLCM). The VLCM identifies an optimal glide path tailored to each client's risk tolerance, objectives, and demographic traits by weighing the trade-offs between potential returns and risk. The model compares thousands of glide paths and selects the one with the highest utility score as the recommendation as well as the benchmark for evaluating any behavioral gaps in a client's portfolio choice over the life cycle.

³ Along with the V-models for investment and financial planning decisions, the framework described in *Vanguard's Guide to Financial Wellness* (Costa and Felton, 2024) provides a structured, action-focused approach to boost clients' financial health. Based on three steps—taking control of finances, preparing for the unexpected, and working toward long-term goals—it emphasizes objective behaviors such as budgeting, debt management, emergency savings, insurance, and investing. The framework uses measurable actions rather than subjective feelings, guiding clients with tailored "next best actions" to strengthen financial confidence and independence.

The Vanguard Asset Allocation Model (VAAM) employs a utility optimization framework to effectively balance risk and return across diverse portfolio options, thereby determining optimal asset allocations at a given point. Any departures from the VAAM-identified optimal portfolio, such as significant equity concentrations or geographic bias, can then be examined against this optimal benchmark.

We assess the effectiveness of clients' financial strategies using the Vanguard Financial Advice Model (VFAM), which quantifies the value of personalized advice by comparing an investor's plan with an optimized benchmark tailored to the investor's goals. The VFAM factors in real-world uncertainties such as market volatility, inflation, life expectancy, and taxes to evaluate trade-offs between outcomes and risks. By simulating thousands of scenarios, it identifies optimal financial plans that maximize expected utility and measures the potential value of advice.

Identify behavioral gaps and quantify impact

Being attentive involves continuously scanning for deviations from established behavioral benchmarks by analyzing investor behavior data. Identifying behavioral gaps uncovers significant financial oversights, such as insufficient retirement savings, tax inefficiency, or poor investment decisions, such as overly concentrated stock positions.

Accurate measurement of these gaps is essential for pinpointing areas that need improvement. However, measuring gaps alone does not reveal the severity of the consequences of poor investing decisions or suggest potential improvements that could guide an investor to success.

At this stage in design, we consider how investors' outcomes would improve if their decisions aligned with the benchmark. We leverage the optimal benchmarks in the V-model family to quantify the value of closing behavioral gaps and prioritize interventions based on their potential impact. These calculations, which measure behavioral gaps and potential improvements, provide essential metrics that inform behavioral designs that advocate for investors' interests, as these measures are directly linked to investors' financial success.

By systematically identifying and addressing these behavioral gaps through design, we can develop more meaningful and effective digital client experiences. This proactive approach ensures that interventions are well-informed and targeted, which fosters more rigorous and effective design practices.

Attentiveness isn't just for finance; across industries, it identifies critical gaps between user behavior and optimal outcomes. Amazon, for example, noticed that its Prime members defaulted to fastest shipping, causing unnecessarily frequent deliveries and frustration for eco-conscious customers. In response, Amazon Day was launched; it let users bundle orders for convenience and sustainability while saving costs for both members and Amazon.⁴ Apple tackled another gap: People significantly underestimated their daily screen time (Parry et al., 2021). Apple's Screen Time dashboard quantified the gap between perception and reality and empowered users with controls for healthier habits. These cases show how spotting and addressing behavioral gaps can spark real, lasting benefits for users.

⁴ For further information, see aboutamazon.com/news/operations/what-is-amazon-day-delivery.

Attentiveness in practice

By being attentive to client behaviors and identifying deviations, behavioral research and design teams at Vanguard have uncovered significant opportunities to enhance outcomes for Vanguard investors. The behavioral designs based on these opportunities can help investors improve retirement readiness and achieve other investment goals.

Suboptimal saving patterns. Vanguard’s research shows that while many clients have IRAs, the majority do not contribute regularly and often miss out on the full tax advantages. In addition, only a small fraction of investors set up systematic saving programs for taxable accounts meant for nonretirement goals. Vanguard’s Discipline principle highlights the power of consistent, increasing contributions to achieve long-term objectives, yet clear behavioral gaps remain.

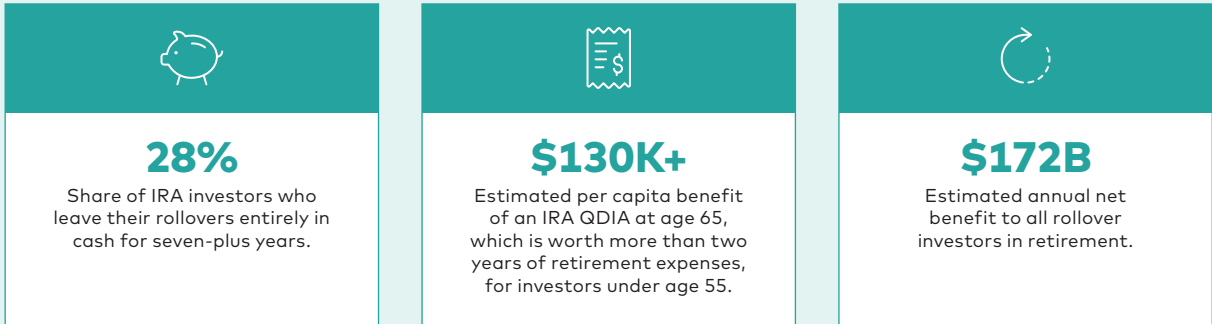
To close these gaps, Vanguard has designed several communication and education nudges to help investors navigate the IRA landscape and encourage clients to increase their IRA contributions either via reminders during tax season or by promoting automated investing in IRAs and taxable accounts. Furthermore, Vanguard reduces barriers to saving behaviors by allowing investors to automate regular investments in low-cost ETFs from their bank accounts.

These nudges have had a real impact: During the 2024 tax season, Vanguard clients contributed \$2.16 billion to IRAs, including \$327 million via automated plans. In the first half of 2025, automated investing in ETFs totaled \$374 million (Vanguard, as of July 2025).

Cash drag in investing. Vanguard research (Reed et al., 2024) found that 28% of rollover IRA assets in 2015 stayed in cash for at least seven years, often because of investors’ limited attention or procrastination. Many investors, new and seasoned alike, let their assets sit in cash in settlement funds instead of investing them in more diversified portfolios. This inertia represents a deviation from the Balance principle, which emphasizes maintaining a balanced, diversified mix of investments.

Vanguard uses behavioral designs that tackle this head-on. The interventions have prompted more than 100,000 investors to move \$6.2 billion out of cash and into more diversified investments in just 18 months, since late 2023 (Vanguard, as of July 2025). Vanguard suggests that policymakers allow qualified default investment alternatives (QDIAs), such as target-date funds, in IRA accounts (**Figure 4**). This shift could yield \$172 billion annually for retirement investors in the long run, according to quantification by V-models (Reed et al. Data as of July 2024). Although policy changes require time to implement, Vanguard remains dedicated to eliminating obstacles that prevent investors from constructing diversified portfolios.

FIGURE 4
Cash drag in IRA



Source: Reed et al., 2024.



Commitment

Design to promote financial success for investors.

Elevating investor experience beyond ease

Foundational experience design objectives aim to make products intuitive, engaging, and easy to use. Emotional design points to the need for experiences not only to be useful and usable, but also to evoke positive feelings (Norman, 2004).

The Commitment principle takes things one step further. In financial decision-making moments, it explicitly incorporates the financial outcomes of investors into the very heart of design, creating a

dual mandate: Not only should the experience feel seamless and rewarding, but it should also nudge users toward decisions that improve their financial outcomes.

Two roles for behavioral design

To illustrate this dual mandate, consider the following 2x2 matrix (**Figure 5**). It maps traditional experience design objectives (ease, effectiveness, emotion⁵) against the Commitment principle's behavioral and financial outcomes (promoting beneficial behaviors).

FIGURE 5
The dual mandate for behavioral designs

	Commitment embraced (promotes positive financial outcomes)	Commitment ignored (ignores positive financial outcomes)
Strong experience design (low friction, clear, intuitive)	 Durable win-win: Intuitive experiences guide investors toward decisions that result in improved financial outcomes.	 Dark patterns: Frictionless, engaging interfaces drive short-term use without regard for investors' longer-term financial outcomes.*
Poor experience design (high friction, confusing, frustrating)	 Paternalistic labyrinth: Overly complex, jargon-laden tools may be intended to help investors, but often frustrate and deter them.	 Sludge: Unnecessary friction, obstacles, or fees make financial processes more difficult or expensive than they need to be.

* Note that not all highly polished, highly engaging designs that skip behavioral safeguards are alike. Some simply don't consider investors' long-run outcomes, while others use slick experience design to push investors into value-destroying choices ("dark patterns"). The latter is exploitative. We highlight the dark patterns here for brevity. However, the former can also lead to harmful outcomes even if it is unintentional.

Source: Vanguard.

When it comes to real-world impact, the four behavioral design categories are distinguished by vivid examples and the lasting effects associated with each category. **Durable win-win** approaches, such as autoenrollment in retirement plans or default diversified portfolios, steer investors toward better financial outcomes and build enduring trust. Similarly, in education, platforms such as Duolingo use behavioral nudges to promote consistent learning without overwhelming users.

In contrast, **dark patterns**, such as gamified trading apps or constant price alerts, may drive up short-term engagement and business revenue but often leave investors with regret and erode trust. Outside finance, e-commerce platforms use urgency tactics such as countdown timers to push purchases, which are effective in the short term but are potentially damaging to brand loyalty.

⁵ See, for example, [Forrester Methodologies: CX Index](#).

Paternalistic labyrinths can take the form of complex interfaces, jargon-heavy advice, or rigid tools that, while preventing some mistakes, can also frustrate users and dampen adoption. This is apparent in public-sector systems such as health care or unemployment assistance portals, where well-meaning protections are often buried under layers of complexity.

Finally, **sludge** is best seen in obstacles such as tricky account cancellation processes or hidden fees, which sap engagement and tarnish a firm’s reputation. Nonfinancial examples include airline booking sites that hide seat selection fees until checkout, creating unnecessary friction and undermining user trust.

This matrix highlights the balance between traditional experience design goals and the Commitment principle. By focusing on both ease of use and improving financial outcomes, we create experiences that benefit investors and foster trust and growth. Neglecting either aspect can lead to suboptimal investor experiences, reputational risk, and potential regulatory or litigation risks.

Committed firms focus on different measures of success

The Commitment principle can also be illustrated by contrasting two scorecard models that measure success (**Figure 6**). Committed firms that follow the Commitment principle gauge success by investors’ progress toward sound investing behaviors such as setting goals, balancing their portfolios, minimizing costs, and investing with discipline. In contrast, uncommitted firms may focus on clicks, trades, and daily engagement, which may not translate to investor success and may even be counterproductive to investor outcomes (e.g., Barber and Odean, 2000).

Commitment incorporates the behavioral benchmark insights gleaned from the Attentiveness principle and enhances the design process, prioritizing investors’ financial success as a stated outcome. This approach ensures that valuable findings regarding behavioral gaps and their potential resolutions are applied effectively to digital experiences, placing benefits for end investors at the center of the design.

FIGURE 6
Committed firms measure their success by evaluating investor outcomes, not just platform engagement

	Committed firms	Uncommitted firms
Success metric	Investor outcomes and progress: Is the investor on track to reach investment goals, stay diversified, have a cost-efficient portfolio, and stay the course? Are investors improving overall financial wellness?	Engagement and activities: How many logins and trades? How much time do investors spend on the app every day, etc.?
Behavioral design incentives	Designs that encourage investor behavior to be closer to the optimal benchmark.	Designs that boost immediate action such as gamifying trading and highlighting popular trades.
Success horizon	Multiyear assessment of value creation for investors.	Short-term assessment of engagement.
Business alignment	Revenue grows with client portfolio growth, long-term loyalty, and trust in the platform.	Revenue is driven by transaction volume, payment for order flow, short-term engagement metrics, etc.

Source: Vanguard.

Commitment in practice

Tax optimization can improve investing outcomes but is often overlooked by investors. Common suboptimal behavior includes neglecting the cost basis method when trading, realizing too much short-term gain, not taking advantage of tax-loss harvesting, and trading right before unrealized gains can be characterized as long-term gains. These tax-inefficient behaviors combined can cost investors billions of dollars.

After studying these behavioral gaps and quantifying their impact on financial outcomes, teams at Vanguard concluded that encouraging investors to adopt a cost basis method called MinTax would benefit investors most. Traditionally, investors have been defaulted into cost basis methods such as FIFO (first in, first out) or Average Cost, depending on the investment type, which can potentially realize larger capital gains if investors are not paying attention. And to achieve tax efficiency, investors had to manually identify the best shares to sell, a task requiring detailed knowledge of each lot's cost basis and holding period. MinTax simplifies this process by

automatically prioritizing the sale of shares to reduce current-year tax impact, first realizing losses to offset gains and favoring long-term gains for lower tax rates.

Embedding the MinTax prompt into the trade execution path demonstrates Vanguard's practice of the Commitment principle. The experience design team for our trading platform provides a cost-aware prompt that nudges investors toward tax-efficient choices without adding complexity. At the same time, the design team also ensures that the trading experience itself remains smooth and key metrics such as trade completion are not negatively affected.

The behavioral designs in the MinTax campaign enhanced investors' financial outcomes by potentially deferring tax liabilities and reducing tax rates. In the first half of 2025, behavioral designs for MinTax resulted in more than 200,000 investors applying the cost basis method in trading of more than \$38 billion, potentially boosting investors' tax efficiency (Vanguard, as of July 2025).



Empathy

Align solutions with real investor behavior, continuously testing and improving to ensure effectiveness.

Designing with empathy means designing for reality

The financial industry often overwhelms investors with complex choices, dense jargon, and unclear trade-offs. The industry assumes investors can easily process large quantities of financial information, understand all their options and the implications, make optimal decisions, and follow through on them.

But in reality, financial decisions are challenging and emotionally charged, even for the most knowledgeable investors. Empathy in behavioral design accounts for investors' natural tendencies, contexts of use, and decision styles—such as limited attention, inertia, and present bias—to help people make and follow through on their best choices. It also uses behavioral science to support, not manipulate, investors, to ensure that designs benefit financial outcomes for investors rather than just short-term business goals for the firm. Empathy ensures that digital experiences are not just elegant and user-friendly, but also effective at serving the needs of the people they're meant to help.

In order to align solutions with real investor behavior, we must first understand investors and diagnose the root causes of their behaviors. Too often, practitioners jump straight into implementing popular behavioral interventions—such as social comparisons in which your outcomes are assessed against “people like you”—without first determining the root causes of suboptimal financial decision-making (Goodyear, Hossain, and Soman, 2022).

This copy-and-paste approach can lead to solutions that miss the mark. A 2020 analysis of behavioral interventions found that many widely used strategies failed to produce meaningful behavioral change (Osman et al., 2020). Without a rigorous diagnosis of what's driving suboptimal behavior, even well-intentioned interventions can fall flat—or worse, backfire.

Understanding investor behaviors, contexts, and motivations calls for careful listening and observation through client research and analytics. Money is a highly emotional topic for many people. Investing behaviors aren't always based on careful logic but sometimes are based on emotional reactions. Consider how investors might behave during an economic downturn versus during times of prosperity. Learn about and listen for clients' emotional triggers during moments such as a job loss, an inheritance following a death, or even the stressful period of transitioning to retirement itself.

The nuance of context and motivation means that there is no one-to-one relationship between behavioral tendencies and design solutions. A single challenge, such as limited attention, can be driven by different emotional or contextual triggers and addressed in multiple ways, and a single behavioral design feature, such as defaults, can potentially solve a range of problems, depending on the context. Empathy in Vanguard's design approach is therefore flexible, evidence-based, and iterative.

We engage in regular investor research interviews, exploratory analytics, and experimentation to get to the “why.” Because it is rare to identify the right solution on the first try, Vanguard’s behavioral design is also a continuing journey to understand the underlying problems and appropriate solutions.

Vanguard’s investor research has found that some behavioral barriers are especially common in financial decision-making. For example, choice complexity and information overload—such as displaying all possible fund choices and fund details—can paralyze investors. That can delay their investment journey or lead to suboptimal decision shortcuts.

Empathy addresses these barriers by simplifying language and aligning it with how investors think. Empathy minimizes jargon, reduces the number of options, breaks decisions down into smaller steps, and pre-selects optimal choices to guide investors without overwhelming them (Schwartz et al., 2002; Chernev, Böckenholt, and Goodman, 2015). One way Vanguard designs processes to overcome these barriers is to display a shortened list of common fund options to create a well-diversified portfolio while offering the ability to search the full set.

Present bias, the tendency to underweight future benefits and consequences, is another common influence on investor behavior. Behavioral designs that highlight future benefits and encourage pre-commitment to a choice that has a benefit later can help mitigate this bias.

Automation and defaults can counter inertia by reducing the effort needed for investors to make and act on appropriate financial decisions. Many of Vanguard’s employer-sponsored retirement plans address inertia and present bias by automatically enrolling workers in plans and offering automatic escalation of saving rates over time. For retail investors, Vanguard’s brokerage accounts, IRAs, and 529 education saving plans offer automated investing options that eliminate the need to manually log in and contribute each time.

A compelling example of empathetic behavioral design comes from health care. When seniors were asked to choose among 40-plus Medicare Part D drug plans—each with a different premium, copay, pharmacy network, and more—many seniors unknowingly selected higher-cost options. Researchers redesigned the communication materials using behavioral insights, including personalized cost comparisons and simplified messaging. As a result, 28% of recipients switched to lower-cost plans compared with 17% in the control group, and they saved a predicted average of \$104 per year (Kling et al., 2009).

Figure 7 summarizes how empathetic design strategies can be tailored to common behavioral tendencies.⁶

⁶ For additional choice architecture tools, see Johnson et al. (2012).

FIGURE 7
Design strategies that address common issues

Tendency	Empathetic behavioral design strategy
 Limited attention, choice complexity	• Simplify information and language. • Use progressive disclosure to limit the amount of information displayed at once. • Reduce the number of choices. • Break choices down into smaller parts. • Make pre-selections or defaults. • Make the decision process easy, quick, and convenient. • Use timely communications or alerts to prevent unintended action.
 Present bias	• Enable early sign-up for automated saving aids. • Highlight or calculate future benefits. • Emphasize losses/costs of making mistakes. • Make the decision process easy, quick, and convenient. • Evoke the investor's future self.
 Status quo bias, inertia, procrastination	• Enable early sign-up. • Set defaults. • Automate manual behaviors. • Prompt an active choice. • Time interventions to moments of higher motivation/fresh starts (e.g., opening a new investment account).
 Low financial literacy, memory issues, unreliable recall	• Provide just-in-time education or guidance. • Simplify information and language. • Reduce the number of choices. • Break down choices into smaller parts. • Enable early sign-up. • Set defaults.
 Financial anxiety and stress, the ostrich effect*	• Time interventions to moments of higher motivation/fresh starts (e.g., opening a new investment account). • Highlight or calculate future benefits. • Encourage a long-term goal mindset.

* The tendency to avoid information that could be negative.

Source: Vanguard.

Evaluating what works, for whom and when.

Part of Empathy also means recognizing that behavioral change is challenging and that not every behavioral design will succeed. As an example outside the financial industry, in a University of Pennsylvania large-scale experiment aimed at increasing physical exercise, most of the 54 behavioral interventions that were tested failed to outperform the control group, and only 8% of the interventions led to lasting behavioral change (Milkman et al., 2021). Even top behavioral experts do not successfully change behavior every time, which underscores just how important testing and iteration are to achieving change.

Rigorous evaluation is key to the Empathy principle—it helps Vanguard identify and mitigate missed opportunities and risks prior to implementing and scaling behavioral interventions. For example, Vanguard researchers who studied how to encourage investing beyond holding a money market settlement fund (see “Empathy in Practice”) found, through a series of in-market experiments, that their solutions were more successful for clients setting up a new account than for those whose portfolios had already been sitting in the settlement fund for a year or more. This evaluation enabled the researchers to refine the behavioral designs for those more tenured clients.

At times, behavioral design interventions can have unintended effects, potentially undermining financial outcomes for certain investors (Szasz et al., 2025; Osman et al., 2020; Madrian and Shea, 2001). Rigorous evaluation can help reveal those moments.

Consider the example of a large employer and its retirement plan administrator: They attempted to boost savings by showing employees who weren't saving enough how their contributions compared with those of their co-workers. The intent was to motivate the employees to save more through peer comparisons. The intervention had some unintended effects: The employees who were ineligible for automated enrollment—those considered most likely to benefit from this

nudge—were less likely to enroll in the plan, by about one-third. Rather than encouraging participation, the comparison with peers who were saving more appeared to discourage it (Beshears et al., 2015).

Monitoring impact over time. Even the most successful interventions may require adaptation to maintain their effectiveness. Positive effects may fade, environments change, and what worked at launch may not work at full scale (Sunstein, 2017; List, 2022).

Take automated enrollment in 401(k) plans: This feature remains a highly effective tool for boosting retirement plan participation (Vanguard, 2025). However, because of frequent job changes, many workers are defaulted into lower saving rates when they switch employers (Choi et al., 2024). Drawing on years of retirement plan research, Vanguard researchers identified opportunities to strengthen the successful automated-enrollment intervention—such as increasing default contribution rates and automatically rolling over prior saving rates between employers—to help workers maintain their saving momentum after a job change (Greig, Hahn, and Tan, 2024).

What falling short looks like. Designs that lack Empathy fail to account for the realities of human behavior. For example, an unempathetic design might assume investors have unlimited attention. Presenting too many fund options simultaneously in a retirement plan menu can overwhelm individuals, and often results in decision fatigue. That can cause them to abandon the process or take naïve decision shortcuts, which can lead to unsuitable asset allocations (Bernartzi and Thaler, 2001; Brown, Liang, and Weisbenner, 2007).

Designs that do not follow the Empathy principle in practice risk disadvantaging investors by assuming perfect decision-making and unlimited attention. This results in experiences that are misaligned with how people actually think and behave, which can lead to worse financial outcomes.

Empathy in practice

When an investor opens an investment account at Vanguard, the funds initially go to a money market settlement fund. It is up to the investor to invest beyond cash in the settlement fund, yet many do not (Reed et al., 2024). Recently, Vanguard's internal research found that more than 235,000 clients had all their assets in the settlement fund, translating to \$11 billion in cash (Vanguard, as of December 2022). These clients missed out on a crucial step toward optimizing their portfolio and financial outcomes.

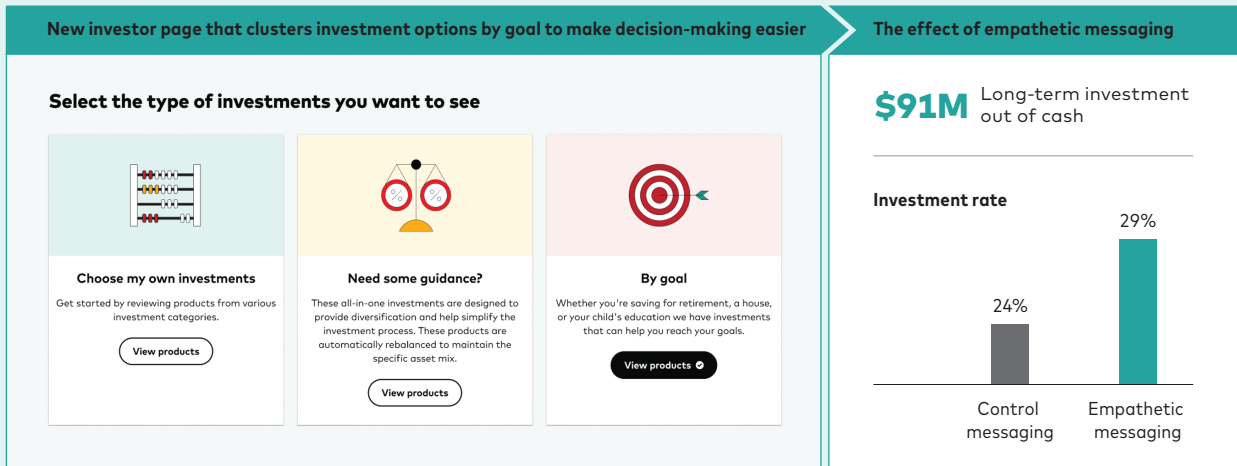
Researchers at Vanguard found evidence that many investors are unaware that their settlement funds are not invested in the market and have misperceptions that the settlement fund invests in the stock or bond market. This is understandable, given factors such as the labels settlement "fund" and "money market." Researchers also found that investors

often struggle to choose an investment when faced with a long list of options, leading them to procrastinate over investing the settlement funds.

The researchers designed an intervention (**Figure 8**) using evidence-based behavioral designs tailored to those identified challenges and tendencies. The teams crafted communications describing the account creation process in three simple steps—"Set up, Add funds, and Invest"—and clearly informed investors that their money was sitting in a conservative, cash-like option.

To reduce choice complexity, the teams also created an investor page that clusters investment options by goal, displays a smaller initial set, and calls out features for easier comparison. Aligning appropriate designs with the root causes (inertia, limited attention, misconception, and choice complexity) resulted in a significant increase in clients investing after funding their accounts—a \$91 million increase in long-term investments after 30 days.

FIGURE 8
Empathetic intervention drives investment out of cash



Source: Vanguard, as of December 2022.

ACE the behavioral designs: The case of autopilot 401(k)

Attentiveness, Commitment, and Empathy in practice are each powerful in their own right—but we have seen the greatest benefits to investors when they are brought together in a systematic approach. Since the early 2000s, behavioral gaps such as 401(k) plan underparticipation, undersaving, and suboptimal portfolio choices have emerged and raised concerns in academia (Madrian and Shea, 2001; Benartzi and Thaler, 2001; Thaler and Benartzi, 2004). Following the ACE principles, Vanguard implemented autopilot 401(k) plan designs to boost plan enrollment, retirement savings, and portfolio diversification (Figure 9).⁷

Attentiveness at Vanguard involves closely monitoring 401(k) saving and investment patterns through research and practice. Observed behaviors are compared with relevant benchmarks of high participation rates, ideal saving rates, and diversified portfolio allocations, thereby guiding behavioral designs.

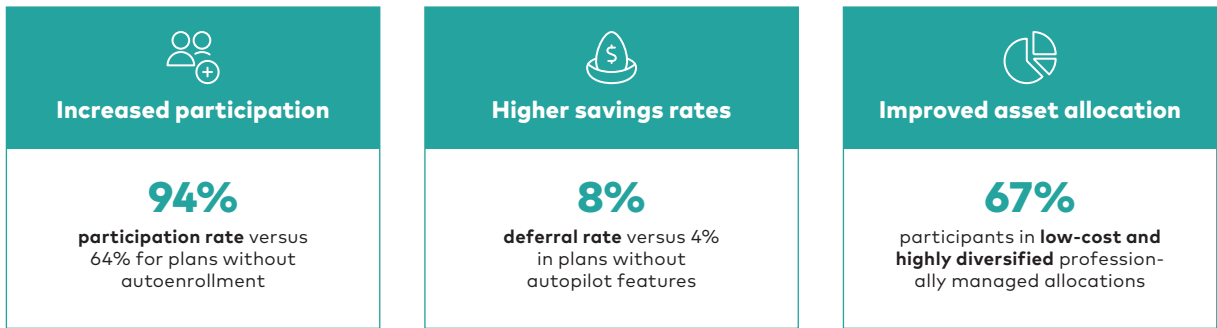
Commitment is demonstrated by Vanguard’s mission of assisting retirement plan participants in enhancing their chances of retirement

readiness. This commitment also aids plan sponsors in fulfilling their fiduciary responsibilities. Simultaneously, Vanguard works to provide a seamless digital experience, ensuring that enrollment, saving, and portfolio selection processes are intuitive and streamlined.

Empathy is integral to Vanguard’s design strategy. Autoenrollment and default saving rates make it effortless for employees to start saving for retirement. Research, such as Vanguard’s How America Saves reports, analyzes participant behavior changes post-implementation. Such continuous monitoring ensures that the design adapts to address behavioral gaps.

Overall, Vanguard incorporates behavioral design elements into traditional retirement plan design systems, encompassing autopilot features, streamlined investment menus, and clear heuristics, thereby prioritizing clarity and simplicity (Pagliaro and Utkus, 2018; Chism, McShane, and Utkus, 2016). These mechanisms can effectively address decision fatigue and guide participants—particularly those uncertain about where to begin—toward prudent, diversified, and cost-effective portfolios.

FIGURE 9
The impact of autopilot 401(k) plan designs on participant outcomes



Sources: Vanguard 2025; Proctor and Young, 2021.

7 The 401(k) autopilot designs include autoenrollment, default deferral rate, auto-escalation of deferral rate, and default investment choice.

Conclusion

In today's financial landscape, investors face significant challenges such as undersaving, inertia, and decision overload. We believe applying the ACE principles for behavioral design is instrumental in driving investor success.

Attentiveness helps us set clear behavioral benchmarks, identify gaps, and focus on what adds the most value to investor outcomes. As Vanguard founder John Bogle said: "Investing is not nearly as difficult as it looks. Successful investing involves doing a few things right and avoiding serious mistakes" (Bogle, 2015). By being attentive, we help investors avoid common pitfalls and stay on track.

Commitment ensures that our solutions are aligned with investors' financial success. Bogle's observation—"My biggest prediction for the future is that people are going to start looking after individual investors" (Forbes, 2008)—is at the heart of our mission. Innovative designs such as 401(k) autopilot and MinTax are designed to help investors achieve a wide range of goals with ease, from saving for retirement to minimizing taxes.

Empathy involves aligning solutions with actual investor behavior, making them intuitive and accessible. As Bogle once said, "When there are multiple solutions to a problem, choose the simplest one" (Bogle, 2017). Financial decisions can be challenging, so our framework uses clear language and transparent communication to build trust. The goal is for every investor to navigate the financial landscape with ease and confidence.

At Vanguard, the ACE framework is not merely a design approach; it represents our commitment to empowering every investor. By adhering to these principles, Vanguard supports well-tested and ethically sound interventions that can enhance investors' financial outcomes. The efficacy of behavioral design strategies for retail investors and retirement plan participants provides substantial evidence that adherence to these principles yields positive results for clients. Our objective is to improve financial outcomes and create a future where financial well-being is accessible to all.

References

- Agarwal, Sumit, Souphala Chomsisengphet, Neale Mahoney, and Johannes Stroebel, 2015. *Regulating Consumer Financial Products: Evidence from Credit Cards*. The Quarterly Journal of Economics 130(1): 111–164.
- Aliaga-Díaz, Roger, Giulio Renzi-Ricci, Ankul Daga, and Harshdeep Ahluwalia, 2019. *Vanguard Asset Allocation Model: An Investment Solution for Active-Passive-Factor Portfolios*. Vanguard.
- Aliaga-Díaz, Roger A., Zachary Rayfield, Ankul Daga, and Marcos Dinerstein, 2025. *Vanguard's Life-Cycle Investing Model (VLCM): A General Portfolio Framework for Goals-Based Investing*. Vanguard.
- Allcott, Hunt, Luca Braghieri, Sarah Eichmeyer, and Matthew Gentzkow, 2020. *The Welfare Effects of Social Media*. The American Economic Review 110(3): 629–676.
- Barber, Brad M., and Terrance Odean, 2000. *Trading Is Hazardous to Your Wealth: The Common Stock Investment Performance of Individual Investors*. The Journal of Finance 55(2): 773–806.
- Bartlett, Robert, Adair Morse, Richard Stanton, and Nancy Wallace, 2022. *Consumer-Lending Discrimination in the FinTech Era*. Journal of Financial Economics 143(1): 30–56.
- Behavioural Insights Team, 2024. *EAST Framework: Four Simple Ways to Apply Behavioural Insights*. Behavioural Insights. www.bi.team/publications/east-four-simple-ways-to-apply-behavioural-insights/.
- Benartzi, Shlomo, and Richard H. Thaler, 2001. *Naïve Diversification Strategies in Defined Contribution Saving Plans*. The American Economic Review 91(1): 79–98.
- Beshears, John, James J. Choi, David Laibson, Brigitte C. Madrian, and Katherine L. Milkman, 2015. *The Effect of Providing Peer Information on Retirement Savings Decisions*. The Journal of Finance 70(3): 1161–1201.
- Bodie, Zvi, Robert C. Merton, and William F. Samuelson, 1992. *Labor Supply Flexibility and Portfolio Choice in a Life Cycle Model*. Journal of Economic Dynamics and Control 16(3–4): 427–449.

- Bogle, John C., 2015. *Bogle on Mutual Funds: New Perspectives for the Intelligent Investor*. John Wiley & Sons.
- Bogle, John C., 2017. *The Little Book of Common Sense Investing: The Only Way to Guarantee Your Fair Share of Stock Market Returns*. John Wiley & Sons.
- Brown, Jeffrey R., Nellie Liang, and Scott Weisbenner, 2007. *Individual Account Investment Options and Portfolio Choice: Behavioral Lessons From 401(k) Plans*. *Journal of Public Economics* 91(10): 1992–2013.
- Chapkovski, Philipp, Mariana Khapko, and Marius Zoican, 2024. *Trading Gamification and Investor Behavior*. *Management Science*.
<https://pubsonline.informs.org/doi/10.1287/mnsc.2022.02650>.
- Chernev, Alexander, Ulf Böckenholt, and Joseph Goodman, 2015. *Choice Overload: A Conceptual Review and Meta-Analysis*. *Journal of Consumer Psychology* 25(2): 333–358.
- Chetty, Raj, Adam Looney, and Kory Kroft, 2009. *Salience and Taxation: Theory and Evidence*. *The American Economic Review* 99(4): 1145–1177.
- Chism, Frank, Kelly N. McShane, and Stephen P. Utkus, 2016. *Constructing a Defined Contribution Investment Lineup: Four Best Practices*. Vanguard.
- Choi, James J., David Laibson, Jordan Cammarota, Richard Lombardo, and John Beshears, 2024. *Smaller Than We Thought? The Effect of Automatic Savings Policies*. National Bureau of Economic Research Working Paper No. w32828. National Bureau of Economic Research.
- Costa, Paulo, and Clifford S. Felton, 2024. *Vanguard's Guide to Financial Wellness*. Vanguard.
- Forbes, 2008. *Intelligent Investing With Steve Forbes*. *Forbes*. https://images.forbes.com/media/pdfs/2009/ii/Outlook2009_Bogle_Briefing_Book_WEB_VERSION.pdf.
- Fuster, Andreas, Paul Goldsmith-Pinkham, Tarun Ramadorai, and Ansgar Walther, 2022. *Predictably Unequal? The Effects of Machine Learning on Credit Markets*. *The Journal of Finance* 77(1): 5–47.
- Gabaix, Xavier, and David Laibson, 2006. *Shrouded Attributes, Consumer Myopia, and Information Suppression in Competitive Markets*. *The Quarterly Journal of Economics* 121(2): 505–540.
- Goodyear, Laura, Tanjim Hossain, and Dilip Soman, 2022. "Prescriptions for Successfully Scaling Behavioral Interventions." From *Behavioral Science in the Wild*. University of Toronto Press: 28–41.
- Greig, Fiona, Kelly Hahn, and Fu Tan, 2024. *Job Transitions Slow Retirement Savings*. Vanguard.
- Heidhues, Paul, and Botond Köszegi, 2010. *Exploiting Naivete About Self-Control in the Credit Market*. *The American Economic Review* 100(5): 2279–2303.
- Johnson, Eric J., Suzanne B. Shu, Benedict G.C. Dellaert, Craig Fox, Daniel G. Goldstein, Gerald Häubl, Richard P. Larrick, John W. Payne, Ellen Peters, David Schkade, Brian Wansink, and Elke U. Weber, 2012. *Beyond Nudges: Tools of a Choice Architecture*. *Marketing Letters* 23(2): 487–504.
- Kling, Jeffrey R., Sendhil Mullainathan, Eldar Shafir, Lee Vermeulen, and Marian V. Wrobel, 2009. *Misperception in Choosing Medicare Drug Plans*. www.povertyactionlab.org/sites/default/files/research-paper/261%20Misperceptions%20in%20Choosing%20Medicare%20Drug%20Plans.pdf.
- Liang, Nellie, and Scott Weisbenner, 2002. *Investor Behavior and the Purchase of Company Stock in 401(k) Plans—the Importance of Plan Design*. National Bureau of Economic Research Working Paper No. 9131. National Bureau of Economic Research.
- List, John A., 2022. *The Voltage Effect: How to Make Good Ideas Great and Great Ideas Scale*. Currency.
- Madrian, Brigitte C., and Dennis F. Shea, 2001. *The Power of Suggestion: Inertia in 401(k) Participation and Savings Behavior*. *The Quarterly Journal of Economics* 116(4): 1149–1187.
- Markowitz, Harry, 1952. *Portfolio Selection*. *Journal of Finance* 7(1): 77–91.
- Merton, Robert C., 1969. *Lifetime Portfolio Selection Under Uncertainty: The Continuous-Time Case*. *The Review of Economics and Statistics* 51(3): 247–257.

- Milkman, Katherine L., Dena Gromet, Hung Ho, Joseph S. Kay, Timothy W. Lee, Pepi Pandiloski, Yeji Park et al., 2021. *Megastudies Improve the Impact of Applied Behavioural Science*. *Nature* 600, No. 7889: 478–483.
- Norman, Don, 2004. *Emotional Design: Why We Love (or Hate) Everyday Things*. Basic Books.
- Osman, Magda, Scott McLachlan, Norman Fenton, Martin Neil, Ragnar Löfstedt, and Björn Meder, 2020. *Learning From Behavioural Changes That Fail*. *Trends in Cognitive Sciences* 24(12): 969–980.
- Padmawar, Sachin, Thomas Paradise, and Boris Wong, 2022. *A Novel Approach to Financial Planning Using Vanguard Financial Advice Model (VFAM)*. Vanguard.
- Pagliaro, Cynthia A., and Stephen P. Utkus, 2018. *Choice Architecture and Member Investment Decisions*. Vanguard.
- Parry, Douglas A., Brittany I. Davidson, Craig J.R. Sewall, Jacob T. Fisher, Hannah Mieczkowski, and Daniel S. Quintana, 2021. *A Systematic Review and Meta-Analysis of Discrepancies Between Logged and Self-Reported Digital Media Use*. *Nature Human Behaviour* 5(11): 1535–1547.
- Proctor, Daniel C., and Jean A. Young, 2021. *Automatic Escalation and DC Saving Rates*. Vanguard.
- Reed, Andy, Aaron Goodman, Fiona Greig, Ariana Abousaedi, and Sachin Padmawar, 2024. *Improving Retirement Outcomes by Default: The Case for an IRA QDIA*. Vanguard.
- Schwartz, Barry, Andrew Ward, John Monterosso, Sonja Lyubomirsky, Katherine White, and Darrin R. Lehman, 2002. *Maximizing Versus Satisficing: Happiness Is a Matter of Choice*. *Journal of Personality and Social Psychology* 83(5): 1178–1197.
- Stango, Victor, and Jonathan Zinman, 2014. *Limited and Varying Consumer Attention: Evidence From Shocks to the Salience of Bank Overdraft Fees*. *The Review of Financial Studies* 27(4): 990–1030.
- Sunstein, Cass R., 2017. *Nudges That Fail*. *Behavioural Public Policy* 1(1): 4–25.
- Szaszi, Barnabas, Daniel G. Goldstein, Dilip Soman, and Susan Michie, 2025. *Generalizability of Choice Architecture Interventions*. *Nature Reviews Psychology* 4(8): 518–529.
- Thaler, Richard H., and Shlomo Benartzi, 2004. *Save More Tomorrow™: Using Behavioral Economics to Increase Employee Saving*. *Journal of Political Economy* 112(S1): S164–S187.
- Thaler, Richard H., and Cass R. Sunstein, 2021. *Nudge: The Final Edition*. Penguin.
- Vanguard, 2023. *Vanguard's Principles for Investing Success*. Vanguard.
- Vanguard, 2025. *How America Saves 2025*. Vanguard.
- Weber, Stephen M., Paulo Costa, Bryan Hassett, Sachin Padmawar, and Georgina Yarwood, 2022. *The Value of Personalized Advice*. Vanguard.

Connect with Vanguard®

vanguard.ca

This document is published by The Vanguard Group, Inc., the indirect parent company of Vanguard Investments Canada Inc. It is not a recommendation, offer or solicitation to buy or sell any security, including any security of any investment fund or any other financial instrument. The information contained in this material is not investment advice and is not tailored to the needs or circumstances of any investor, nor does the information constitute business, financial, tax, legal, regulatory, accounting or any other advice. Research published by The Vanguard Group, Inc., may not be specific to the context of the Canadian market and may contain data and analysis specific to non-Canadian markets and products. The information is for informational purposes only and should not be used as the basis of any investment recommendation. Investors should consult a financial, tax and/or other professional advisor for information applicable to their specific situation.

All investing is subject to risk, including possible loss of principal.

Diversification does not ensure a profit or protect against a loss.

Investments in target-date funds are subject to the risks of their underlying funds. The year in the fund name refers to the approximate year (the target date) when an investor in the fund would retire and leave the workforce. The fund will gradually shift its emphasis from more aggressive investments to more conservative ones based on its target date. An investment in target-date funds is not guaranteed at any time, including on or after the target date.

CFA® is a registered trademark owned by CFA Institute.

The Vanguard logo, featuring the word "Vanguard" in a bold, red, serif font with a registered trademark symbol.

© 2025 Vanguard Investments Canada, Inc.
All rights reserved.

ISGPFBD 092025