OSC Staff Notice 11-796
Digital Engagement Practices in Retail Investing: Gamification and Other Behavioural Techniques

November 17, 2022

Introduction

A priority of the Ontario Securities Commission (the **OSC** or **we**) is improving the investor experience and expanding investor protection through a range of initiatives[1]. Included in this are initiatives to support behavioural insights and policy testing capabilities. Reflecting this commitment, the Investor Office examined gamification and other behavioural techniques that are currently being used or may be used in the future by Order Execution Only or self-directed investment platforms as part of their digital engagement practices (**DEPs**). The report arising from this work (the **Report**) examines how the different gamification and other behavioural techniques may influence retail investors behaviours—both positively and negatively. The Report is appended to this staff notice (this **Notice**).

Purpose

A wave of digital, mobile-friendly investing platforms has created new options for retail investors in Canada and around the world. While these platforms have expanded market participation, there is growing interest in some of the DEPs that they and, to a lesser extent, more traditional retail investment platforms use and how these may raise investor protection concerns. These tactics, sometimes referred to broadly as "gamification," use insights from behavioural science to influence investor behaviour.

Regulators have faced some challenges in understanding and responding to these developments, including: a lack of common terminology and definitions currently in use; an absence of a regulatory inventory of practices currently employed by Canadian (and US) dealers in the marketplace; and, limited direct testing and data as to effects of DEPs on shaping investor behaviour.

To respond to the above, the Investor Office undertook a behavioural science study on gamification and other behavioural techniques under the DEPs umbrella. The Report, which is appended to this Notice, is a result of this work and provides:

(i) a taxonomy of gamification and other behavioural techniques that are currently being used or may be used by online brokerages in the future and their likely impact on retail investor behaviour—both positively and negatively; and

(ii) the results of an online randomized controlled trial **(RCT)** experiment that examines the use of points and top traded lists to determine their impact on trading frequency.

The goal of this work is to assist the OSC, other regulators and stakeholders in understanding these new developments. In responding to the developments, we encourage taking an evidence-informed

[1] Ontario Securities Commission Business Plan for the fiscal years ending 2023-2025, available online at https://www.osc.ca/sites/default/files/2022-04/pub_20220426_osc-2023-2025-business-plan.pdf at p. 23.

approach, using behavioural insights to facilitate the use of DEPs in a manner that supports good investor outcomes.

Research findings

Gamification refers to a variety of behavioural techniques that integrate game-related elements into non-gaming contexts and applications, with the purpose of improving user experience and engagement. We use the term **other behavioural techniques** to refer to DEPs that use insights from behavioural science in ways that can influence investor behaviour but do not meet the definition of gamification. **DEPs** themselves are "the tools including behavioural techniques, differential marketing, gamification, design elements or design features that intentionally or unintentionally engage with retail investors on digital platforms as well as the analytical and technological tools and methods."[2] This definition highlights a range of potential tools, such as behavioural techniques, differential marketing, gamification, design elements, design features, and data analytics, that increase user engagement. There are other DEP tools beyond this definition as well, such as artificial intelligence and dark patterns.

The Report examines five gamification techniques used on self-directed investor platforms:

1. *Gamblification*: Techniques derived from gambling, which most prominently include the use of variable rewards. Variable rewards are economic benefits (e.g., cash payouts) where the size, timing, or likelihood of the benefit is unpredictable to the user. Beyond variable rewards, the gamblification category might also include language and imagery that evokes gambling (e.g., reference to "jackpots" or scratch cards).

2. *Leaderboards*: Public displays of ranked information about application users' performance. Leaderboards enable and encourage social comparison and competition.

3. *Rewards* (negligible or non-economic rewards such as points, badges, scores): Providing rewards for performing tasks or accomplishing goals within an online application. Our definition includes rewards with either no economic value or with nominal economic value that should not materially influence investor behaviour under a purely rational economic decision-making model.

4. *Goal and Progress Framing*: Design elements that i) help users set and visualize their goals, and/or ii) strategically frame users' performance and progress with respect to these goals to stimulate greater levels of engagement.

5. *Feedback*: The provision of information about a user's performance on a task in (near) real-time, including both continuous progress feedback and immediate success feedback.

The Report also examines four other behavioural techniques:

[2] This definition is consistent with that of the U.S. Securities and Exchange Commission (SEC)'s definition found in Release Nos. 34-92766 *Request for Information and Comments on Broker-Dealer and Investment Adviser Digital Engagement Practices, Related Tools and Methods, and Regulatory Considerations and Potential Approaches; Information and Comments on Investment Adviser Use of Technology to Develop and Provide Investment Advice* at page 1, available online at https://www.sec.gov/rules/other/2021/34-92766.pdf.

1. *Salience / Attention-inducing Prompts*: Information is more likely to influence people's behaviour if it attracts their attention.

2. *Simplification and Selective Deployment of Friction Costs*: The design of the user experience that reduces or introduces small barriers across the user journey, influencing the likelihood and manner in which a user completes a specific task. We use "simplification" to refer to reductions in small barriers and "friction costs" to refer to increases in small barriers.

3. *Social Interactions*: Design elements that enable platform users to interact with other users by i) generating, sharing, viewing, and reacting to content, and ii) engaging in direct messaging.

4. *Social Norms*: Design features which signal social norms (i.e., information about how others think and behave).

These techniques could be employed in a manner that has positive influences on retail investors such as:

- encouraging deposits to investment accounts,
- encouraging greater participation and learning of investor education modules on digital platforms,
- improving diversification of the investor's portfolio, and
- setting and monitoring progress towards long-term retirement savings goals.

However, these techniques also could have negative influences on investor behaviour such as:

- increasing risk taking by overweighting small probabilities,
- creating habit forming behaviours,
- invoking a psychological "hot" state that influences a user's subsequent behaviour such as the "hot hand" fallacy, making a person more likely to gamble with a windfall or unexpected bonus,
- increase trading frequency and risk-taking,
- increasing focus on shorter-term outcomes or trading activity that reduces longer term returns and/or undermines investment goals, and
- increasing investor's (over)confidence, negatively impacting investor performance.

We tested some of the techniques identified in the Report in a RCT. We conducted an online RCT with 2,430 Canadians to assess the impact of two techniques of interest on investing behaviours in a simulated trading environment: (1) giving investors "points" with negligible economic value for buying or selling stocks—a form of reward, and (2) showing investors a "top traded list"—a combination of attention-inducing prompts and social norms. The experiment was conducted online in a simulated real-world trading environment with Canadians aged 18-65 engaging through mobile, tablet or desktop devices.

Research participants received $10,000 in simulated "money" to invest in up to six different fictitiously-named stocks. After their initial allocation of funds, they were taken through seven

simulated weeks of stock price movements, with an option to buy and/or sell stocks during each week. At the end of the experiment all participants received a fixed amount of compensation for participating in the experiment. They also earned additional compensation based on their balance at the end of the experiment. Participants were aware that the larger the value of their portfolio at the end of the experiment, the more they would earn. This created an incentive for participants to trade thoughtfully and to try to maximize their returns.

Importantly, participants who were rewarded with points made 39% more trades than participants in the control group (i.e., those who were exposed to the same trading simulation but without any gamification or other behavioural techniques). This statistically significant difference was found despite the fact that the points had negligible value. This is an important finding given that there is a strong negative impact of increased trading volume on investors' returns (on average)[3], and in light of the material benefit that may be gained by digital trading platforms from increased trading volume. Showing research participants a top traded list did not increase their trading frequency.

Furthermore, participants who saw the top traded lists were 14% more likely than participants in the control group to buy and sell those top listed stocks. This finding suggests that showing participants a top traded lists can affect their trading decisions, nudging them towards buying and selling the stocks listed as top traded, which is herding. There were no differences between the points group and the control group in terms of the buying and selling the top traded stocks.

Conclusion

These findings reinforce the importance of using behavioural science as a policy tool by regulators. Given the statistically significant findings derived from the RCT, the Report recommends that regulators consider the implications of the findings, including whether any of the gamification and other behavioural techniques examined have attributes similar to recommendations and/or result in investor behaviour that is (on average) detrimental to investor outcomes, and if so, consider possible responses.

The Report also recommends:

1. collecting more data to see the impact of gamification and other behavioural tactics through leveraging data collected by digital trading platforms, or through other experiments,
2. collecting evidence and data on strategies to mitigate negative impacts of DEPs to determine if mitigation approaches are effective (e.g., adding friction points), and
3. exploring positive impacts of gamification and other behavioural techniques to increase investing knowledge and level of expertise.

We encourage registrants to review the findings of the Report and consider the influence that their DEPs may have on their clients so that negative investor behaviours are not encouraged (whether inadvertently or otherwise), and to focus their use of DEPs in a manner that supports good investor outcomes.

[3] Barber, B. M., & Odean, T. (2000). Trading is hazardous to your wealth: The common stock investment performance of individual investors. *Journal of Finance*, 55(2), 773-806.

We look forward to engaging with investors, registrants, and other stakeholders with respect to the Report's findings and our broader work to improve the investor experience and expand investor protection.

Questions

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Research Report

November 2022

Digital Engagement Practices in Retail Investing:

Gamification & Other Behavioural Techniques

OSC ONTARIO SECURITIES COMMISSION | INVESTOR OFFICE

Ontario

Prepared by the Behavioural Insights Team (BIT) in Collaboration with the Investor Office Research and Behavioural Insights Team (IORBIT) of the Ontario Securities Commission

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Executive Summary

A wave of digital, mobile-friendly investing platforms has created new options for retail investors in Canada and around the world. While these platforms have expanded market participation, there is growing interest in some of the digital engagement practices (DEPs) that they and, to a lesser extent, more traditional retail investment platforms use and how these may raise investor protection concerns. These tactics, sometimes referred to broadly as "gamification," use insights from behavioural science to influence investor behaviour.

Broadly, investing platforms use a wide range of DEPs to increase user engagement. They do this for a variety of business objectives (e.g., customer acquisition and retention, revenue, profitability) and not necessarily to improve long-term outcomes for their retail investors. Various regulators around the world have expressed concerns that some of these tactics may negatively impact investor outcomes. For example, the United States Securities and Exchange Commission (SEC) has flagged concerns that these features may encourage investors to trade more often, invest in different products, or change their investment strategy in inappropriate ways.[1]

The goal of this research report is to support the Ontario Securities Commission (OSC) and other regulators and stakeholders in understanding and responding to these new developments. This report aims to help chart an effective, evidence-informed path forward in the months and years ahead as digital trading platforms continue to evolve and grow.

The Behavioural Insights Team was engaged by the OSC's Investor Office to:

1. Generate a taxonomy of gamification and other behavioural techniques by conducting literature and environmental scans; and,
2. Conduct an experiment that examines the effects of gamification and other related behavioural techniques on retail investor behaviours.

We worked in close partnership with the Investor Office Research and Behavioural Insights Team (IORBIT) to develop the research parameters for the taxonomy, design and conduct an experiment using a randomized controlled trial (RCT), analyze the experimental data, and prepare this report. IORBIT's insights, advice, and feedback were critical to this project's success.

In this report, we examine gamification and other behavioural techniques to see how they affect investor behaviour—both positively and negatively. We outline a taxonomy of gamification and other behavioural techniques currently employed or with high relevance to retail investing, and their potential implications for investor behaviour. The five gamification techniques examined were: (1) gamblification, (2) leaderboards, (3) rewards (negligible or non-economic rewards such as points, badges, scores), (4) goal and progress framing, and (5) feedback. The four other behavioural techniques examined were: (1) salience / attention-inducing prompts, (2) simplification and selective deployment of friction costs, (3) social interactions, and (4) social norms. We also discuss the results of an experiment (an RCT)

[1] U.S. Securities and Exchange Commission (2021, Aug. 27). SEC Requests Information and Comment on Broker-Dealer and Investment Adviser Digital Engagement Practices, Related Tools and Methods, and Regulatory Considerations and Potential Approaches; Information and Comments on Investment Adviser Use of Technology. Retrieved from: https://www.sec.gov/news/press-release/2021-167.

with 2,430 investors that simulated a real-world trading environment, in which we measured the effects of two digital engagement practices, points and top traded lists, on trading behaviour (e.g., trading frequency).

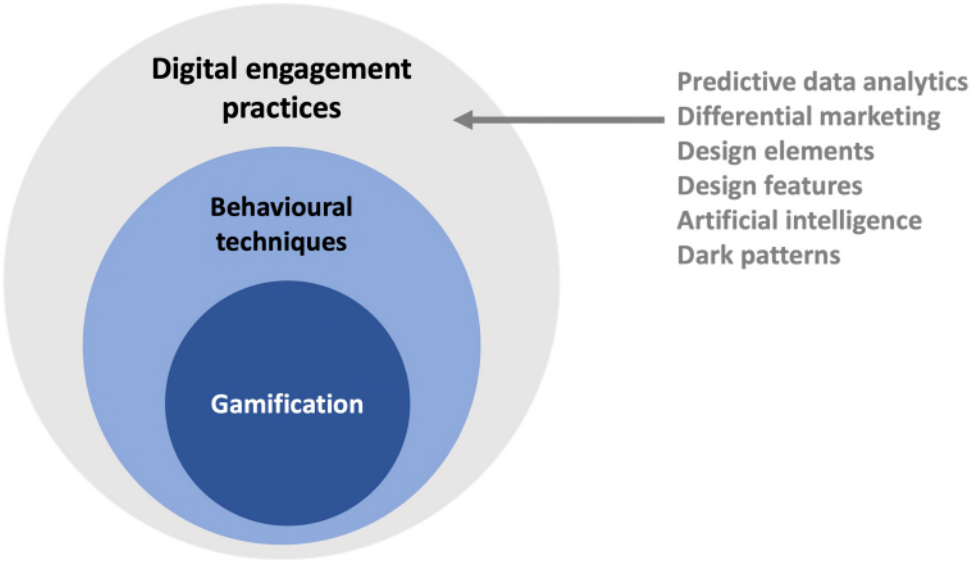
As the use of the terms digital engagement practices, behavioural techniques, and gamification have become increasingly popular, it is imperative for regulators to have a clear and common definition of these terms to allow for rigorous research and potential regulatory action. To navigate the DEP landscape, we have used the SEC's definition of DEPs (see Key Definitions, below) as a foundation. This definition highlights a range of potential tools, such as behavioural techniques, differential marketing, gamification, design elements, design features, and data analytics, that increase user engagement. There are other DEP tools beyond this definition as well, such as artificial intelligence and dark patterns. This report does not examine all such tools; it focuses on gamification and other behavioural techniques used in self-directed digital trading platforms. Figure 1 illustrates the relationship among DEPs, behavioural techniques, and gamification. Gamification techniques are a subset of behavioural techniques, which are in turn a subset of DEPs.

Key Definitions

For the purposes of this report:

- **Digital Engagement Practices** (DEPs) are defined, consistent with the U.S. Securities and Exchange Commission, as "the tools including behavioural techniques, differential marketing, gamification, design elements or design features that intentionally or unintentionally engage with retail investors on digital platforms as well as the analytical and technological tools and methods."
- **Gamification** refers to a variety of behavioural techniques that integrate game-related elements into non-gaming contexts and applications, with the purpose of improving user experience and engagement.
- We use the term **other behavioural techniques** to refer to DEPs that use insights from behavioural science in ways that can influence investor behaviour but do not meet the definition of gamification.
- **Digital trading platforms** are websites, portals, and applications for trading securities that are available to retail investors through their phones, computers, tablets.

Figure 1: The relationship between DEPs, gamification, and other behavioural techniques. This illustration is a simplification as some overlap between these categories is not depicted.



Key Findings

The Experiment

We conducted an online RCT to assess the impact of two gamification techniques of interest on investing behaviours in a simulated trading environment: (1) giving investors "points" with negligible economic value for buying or selling stocks, a form of reward, and (2) showing investors a "top traded list", a combination of attention-inducing prompts and social norms.

Participants who were rewarded with points made almost 40% more trades than participants in the control group (i.e., those who were exposed to the same trading simulation but without any gamification or other behavioural techniques). This is despite the fact that the points had negligible value. This is a striking finding given the strong negative impact of increased trading volume on investors' returns (on average) and the benefit of increased volume that may exist for digital trading platforms.[2] The "top traded list" did not increase trading frequency in our experiment.

In addition, **participants who saw the top traded lists were 14% more likely than participants in the control group to buy and sell those top listed stocks**. This finding suggests that showing participants a top traded lists can affect their trading decisions, nudging them towards buying and selling the stocks listed as top traded. There were no

[2] Barber, B. M., & Odean, T. (2000). Trading is hazardous to your wealth: The common stock investment performance of individual investors. *Journal of Finance*, 55(2), 773-806.

differences between the points group and the control group in terms of the buying and selling the top traded stocks.

Implications

Based on our findings, we recommend that regulators consider the implications for retail investors when digital trading platforms offer points for trading activity, as well as display top traded lists. More broadly, we encourage regulators to consider whether any of the gamification and behavioural techniques examined have attributes similar to recommendations and/or result in investor behaviour that is (on average) detrimental to investor outcomes. If so, then possible responses to these techniques should be considered. Furthermore, we encourage regulators to close the major gaps in empirical evidence by collecting more data. Such data can be generated by conducting more experimental studies using simulated investing platforms, and by reviewing the data from digital trading platforms that have implemented gamification or other behavioural techniques. These actions will enable the OSC and other regulators to set new empirically-driven regulatory strategies and approaches.

Introduction

A wave of digital, mobile-friendly investing platforms has created new options for retail investors in Canada and around the world. While these platforms can increase access and expand market participation, there is growing regulatory interest in some of the digital engagement practices (DEPs) that they and, to a lesser extent, more traditional retail investment platforms use and how these may raise investor protection concerns. These tactics, sometimes referred to broadly as "gamification," use insights from behavioural science to influence user (investor) behaviour. Regulators are concerned that some of these tactics may negatively impact investor outcomes. For example, the United States Securities and Exchange Commission, (the "SEC") has flagged concerns that these features may encourage investors to trade more often, invest in different products, or change their investment strategy.[3]

Broadly, investing platforms use a wide range of Digital Engagement Practices (DEPs) to increase user engagement. They do this for a variety of business objectives (e.g., customer acquisition and retention, revenue, profitability) and not necessarily to improve long-term outcomes for their retail investors. Various regulators around the world have expressed concerns that some of these tactics may negatively impact investor outcomes. For example, the United States Securities and Exchange Commission (SEC) has flagged concerns that these features may encourage investors to trade more often, invest in different products, or change their investment strategy in inappropriate ways.[4]

The goal of this research report is to support the Ontario Securities Commission (OSC) and other regulators and stakeholders in understanding and responding to these new developments. This report aims to help chart an effective, evidence-informed path forward in the months and years ahead as digital trading platforms continue to evolve and grow.

While there is significant interest surrounding the use of gamification and other behavioural techniques, they are recent developments in the investing context, and there is little research into how they are affecting investor behaviour and decision-making. In this context, the Ontario Securities Commission (OSC) engaged the Behavioural Insights Team (BIT) to:

1. Generate a taxonomy of gamification and behavioural techniques by conducting literature and environmental scans of:
    a. Relevant research into how gamification and other behavioural techniques can be used to influence retail investor behaviour, as well as key gaps in that research;
    b. How firms serving retail investors are currently using these techniques in Canada and in select international markets; and
    c. Other ways that firms may use gamification and other behavioural techniques in the future, given the approaches being used in other industries.

[3] U.S. Securities and Exchange Commission (2021, Aug. 27). SEC Requests Information and Comment on Broker-Dealer and Investment Adviser Digital Engagement Practices, Related Tools and Methods, and Regulatory Considerations and Potential Approaches; Information and Comments on Investment Adviser Use of Technology. Retrieved from: https://www.sec.gov/news/press-release/2021-167.

[4] U.S. Securities and Exchange Commission (2021, Aug. 27). SEC Requests Information and Comment on Broker-Dealer and Investment Adviser Digital Engagement Practices, Related Tools and Methods, and Regulatory Considerations and Potential Approaches; Information and Comments on Investment Adviser Use of Technology. Retrieved from: https://www.sec.gov/news/press-release/2021-167.

2. Conduct an experiment that examines the effects of gamification and other related behavioural techniques on retail investor behaviours.

We worked in close partnership with the Investor Office Research and Behavioural Insights Team (IORBIT) to develop the research parameters for the taxonomy, design and conduct an experiment using a randomized controlled trial (RCT), analyse the experimental data, as well as prepare this report. IORBIT's insights, advice, and feedback were critical to this project's success.

In this report, we examine gamification and other behavioural techniques to see how they affect investor behaviour—both positively and negatively. We outline a taxonomy of gamification and other behavioural techniques with high relevance to retail investing, and their potential implications for investor behaviour. We also discuss the results of an experiment (an RCT) with 2,430 investors that simulated a real-world trading environment, in which we measured the effects of two digital engagement practices (i.e., points and top traded lists) on trading behaviour (i.e., trading frequency).

As the use of the terms digital engagement practices, behavioural techniques, and gamification have become increasingly popular, it is imperative for regulators to have a clear and common definition of these terms to allow for rigorous research and potential regulatory action. To navigate the DEP landscape, we use the SEC's definition of DEPs (see Key Definitions, below) as a foundation. This definition highlights a range of potential tools for increasing user engagement. This report does not examine all such tools. For example, we do not examine the use of predictive data analytics, dark patterns, or artificial intelligence. Reflecting our expertise in behavioural science, this research focuses on gamification and other behavioural techniques used in self-directed digital trading platforms. Figure 2 illustrates the relationship between DEPs, behavioural techniques, and gamification. Gamification techniques are a subset of behavioural techniques, which are in turn a subset of DEPs.

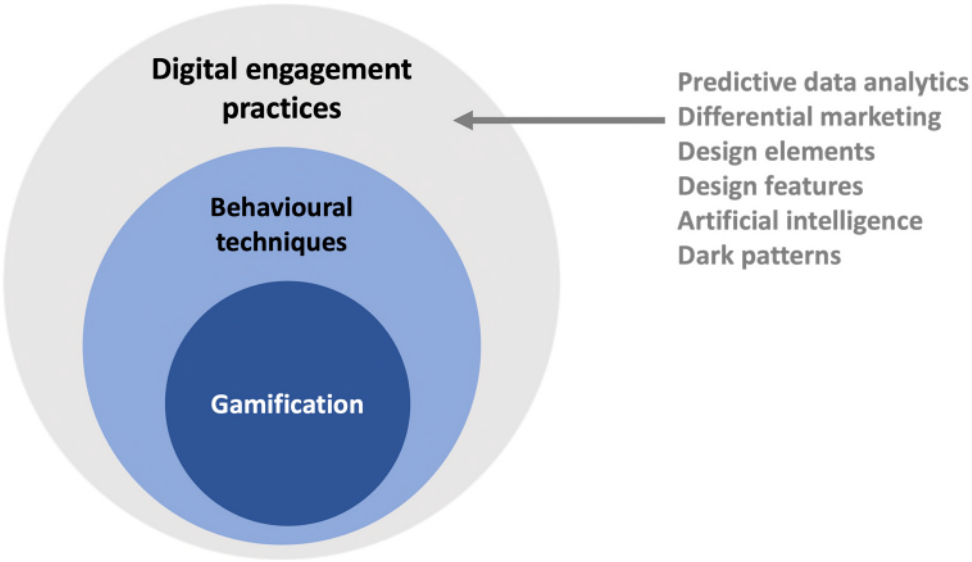
Key Definitions

For the purposes of this report:

- **Digital Engagement Practices** (DEPs) are defined, following the U.S. Securities and Exchange Commission, as "the tools including behavioural techniques, differential marketing, gamification, design elements or design features that intentionally or unintentionally engage with retail investors on digital platforms as well as the analytical and technological tools and methods."
- **Gamification** refers to a variety of behavioural techniques that integrate game-related elements into non-gaming contexts and applications, with the purpose of improving user experience and engagement.
- We use the term **other behavioural techniques** to refer to DEPs that use insights from behavioural science in ways that can influence investor behaviour but do not meet the definition of gamification.
- **Digital trading platforms** are websites, portals, and applications for trading securities that are available to retail investors through their phones, computers, tablets, or other technology.

The image below represents the relationship between DEPs, gamification, and other behavioural techniques, all of which can be implemented in digital platforms.

Figure 2: The relationship between DEPs, gamification, and other behavioural techniques. This illustration is a simplification as some overlap between these categories is not depicted.



Overview of Project Approach

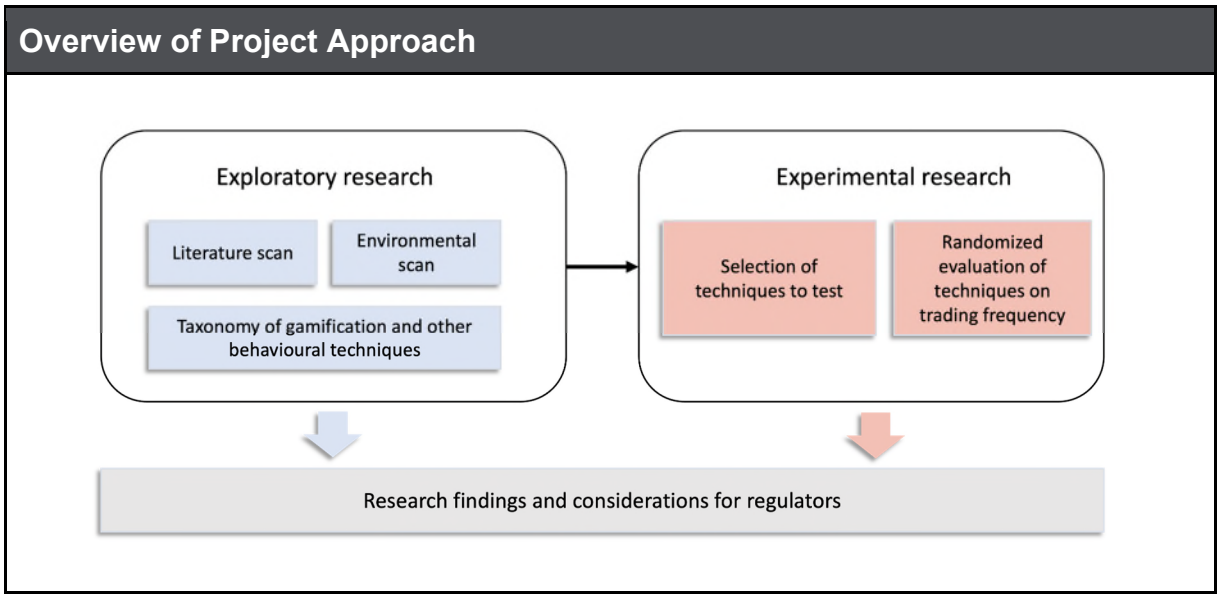
This project was conducted in two main phases: exploratory research and experimental research, as illustrated in the diagram below.

For the exploratory research, we conducted a scan and synthesis of relevant behavioural science to understand how gamification and other behavioural techniques may influence retail investor behaviour, in ways that both support and may negatively impact investor outcomes. We also reviewed select retail investor platforms, news articles, and various regulators' statements and reports to understand how firms in Canada and other select markets are currently using these approaches. Our exploratory research was summarized in a taxonomy that listed each current or potential technique being employed, their known or potential impact on investor behaviour, and their current use on investment platforms we reviewed.

In the second phase, we ran an experiment to empirically test the impact of two selected techniques on key investor behaviours. This experiment was designed to address key gaps in the existing evidence base.

As a final step in our process, we developed a set of considerations for regulators informed by both streams of research.

Figure 3: Overview of the exploratory and experimental research approaches



Key limitations

This section summarizes the most important limitations of this research report. Following sections provide more detailed accounts of limitations related to each research methodology.

1. This report is not exhaustive in identifying how gamification and other behavioural techniques are being used on investment platforms today. The proliferation of platforms, limitations in access to platforms and ability to engage in trading activity, and the bounded timelines for this review prevent an exhaustive report. However, we believe it reflects a reasonable cross-section of the techniques being used by self-directed investing platforms.

2. While we have tried to identify likely uses for gamification and other behavioural techniques beyond what we found in our review, operators of digital trading platforms are likely to identify further applications that this report does not consider.

3. There are a vast number of unanswered empirical questions about how DEPs influence investor behaviour. Our experiment had to select a limited number of techniques to test and behaviours to measure. Further, our experiment was conducted in a controlled environment, an investing simulation. Participants in the experiment did not use real funds and traded in fictitious equities. However, the use of a robust experimental method (i.e., an RCT) provides us with confidence in terms of the validity of our findings and our ability to generalize them to real-world trading. In addition, research participants were compensated based on their returns, and other aspects of the simulation were carefully designed to enhance its generalizability.

Exploratory Research

This section summarizes the methodology and findings from our exploratory research, which included a literature scan and environmental scan.

Exploratory Research Methodology

We applied a mixed-methods approach to address two exploratory research questions:

1. How do gamification and other behavioural techniques influence investor decision-making?
2. How are firms serving retail investors currently using or planning to use these techniques?

Methods included a literature scan and environmental scan. The literature scan provided a theoretical foundation by identifying and summarizing 31 items of relevant behavioural science and economic literature related to gamification, other behavioural techniques, and retail investing. The environmental scan conducted September 7 - October 1, 2021, provided context on the extent to which firms serving self-directed retail investors are applying these techniques. It included a direct observation of 12 self-directed retail investor platforms (which have been anonymized and numbered Platforms 1 to 12 for the purposes of this report), and a further review of 16 news articles and statements. Both methods informed the development of a taxonomy of gamification and other behavioural techniques for retail investing platforms. This taxonomy summarized each current identified technique, their known or potential impact on investor behaviour, and their current use on the investing platforms we reviewed. More information on each part of our exploratory research method is captured in the table below:

Exploratory Research Activities: Overview of Methodology	
Literature Scan	● The literature scan began by conducting research database searches for key terms (e.g., investing, gamification), then used a "snowball method", whereby we reviewed the sources cited by relevant papers. The search was also expanded to identify non-peer reviewed (grey literature), internal BIT resources, and sources recommended by the OSC. ● Key methodological considerations for the literature scan included: ○ Defining gamification: Gamification is an umbrella term used to describe the integration of game-related elements into non-gaming contexts and applications, with the purpose of improving user experience and engagement.[5] Gamification has become an increasingly popular design component of applications that do not constitute games, such as apps aimed at helping users keep track of their

[5] Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011, September). From game design elements to gamefulness: defining" gamification". In Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments (pp. 9-15).

	weight loss goals, learn new languages, or trade securities. It is used broadly to increase engagement with digital applications and to increase the behaviours encouraged by those applications (e.g., studying, exercising). ○ Exploring gamification research: Published academic research on gamification is concentrated in two sectors, education and health. While this may reflect greater use of gamification in these sectors, it may also be that researchers are more likely to conduct experiments and receive data in these domains. While our literature scan prioritized the more limited research related to investor behaviour, we integrated findings from other fields where we believed it would be relevant across user contexts.
Environmental Scan	● To conduct the environmental scan, we collaboratively identified 12 self-directed retail investing platforms of interest (both Canadian and international) with the OSC and went through the process of registering for an account, keeping a record of gamification and other behavioural techniques identified throughout the user experience within each platform. Where it was not possible to register for accounts with platforms based outside of Canada, we reviewed videos on YouTube highlighting the features of each of these apps and how to use them. We did not execute any trades on these platforms. ● We also reviewed a range of other sources, including news articles and statements by regulators for further information on how these platforms may be using (or planning to use) gamification and other behavioural techniques. ● Our scan excluded banking and financial management platforms that do not enable trading in securities. ● See Appendix A for a table summarizing which gamification and other behavioural techniques were observed on each platform reviewed.
Taxonomy of Gamification and Other Behavioural Techniques	● Synthesizing the findings from the literature and environmental scans, we developed a taxonomy of gamification and other behavioural techniques that outlines how each technique has been shown to (or plausibly might) impact specific retail investor behaviours or choices. Investor behaviours of interest included enrolling in the platform, engagement with the platform, deposits, and a wide range of trading-related behaviours like trading frequency and risk-taking. ● As noted above, there is no authoritative list or common understanding of what constitutes a gamification technique in the context of investing platforms. The most widely accepted definition of gamification, “the use of game-design elements in non-gaming contexts”, is broad and does not clearly identify what counts as a

gamification technique. Systematic reviews of gamification techniques employ varying taxonomies. Securities regulators tend to understand gamification very widely, including concepts from behavioural science (e.g., attention-inducing prompts like notifications) that are not generally understood to be part of gamification. To address these challenges, we developed our own taxonomy of gamification and other behavioural techniques that are most relevant to retail investing platforms.

- We developed an initial list (i.e., taxonomy) of gamification techniques based on three widely cited meta-analyses / systematic reviews of gamification.[6,7,8] This initial taxonomy was further refined after conducting our environmental scan; we eliminated certain techniques that did not appear to be relevant to investing platforms (such as chatbots, avatars, or fantasy themes). Our environmental scan also revealed that certain other behavioural techniques that do not meet the traditional definition of gamification are often discussed alongside gamification tactics and used widely on investing platforms. We included those techniques, like attention-inducing prompts, in a separate section of our taxonomy and define them as other behavioural techniques.

- The widespread use of gamification on investing platforms is a new phenomenon that is rapidly escalating and shifting. We believe that new techniques are likely to be deployed by firms operating platforms. Given the overall purpose of this report in supporting regulatory strategy, we did not want to constrain our taxonomy and considerations solely to techniques that have already been implemented. Where we speculate on further potential use cases, we clearly note that such approaches are not yet in effect. We draw conclusions on the potential impact of both current and potential approaches based on our theoretical and empirical findings. Given the importance of specific implementation features and context, we cannot draw definitive conclusions on how gamification techniques are likely to affect investor behaviour across platforms. As supported by the existing research and our own experiment (see section below), we draw inferences on the likely impacts of these techniques on trading frequency, risk appetite, and other aspects of investing behaviour.

[6] Hamari, J., Koivisto, J., & Sarsa, H. (2014, January). Does gamification work?--a literature review of empirical studies on gamification. In *2014 47th Hawaii international conference on system sciences* (pp. 3025-3034).
[7] Looyestyn, J., Kernot, J., Boshoff, K., Ryan, J., Edney, S., & Maher, C. (2017). Does gamification increase engagement with online programs? A systematic review. PloS one, 12(3), e0173403.
[8] Johnson, D., Deterding, S., Kuhn, K. A., Staneva, A., Stoyanov, S., & Hides, L. (2016). Gamification for health and wellbeing: A systematic review of the literature. *Internet Interventions*, 6, 89-106.

Exploratory Research Findings: Taxonomy of Gamification and Other Behavioural Techniques

The following taxonomy includes nine techniques informed by behavioural science that are relevant to investing platforms. For each technique we provide: (1) a definition, (2) a summary of how it is being used across industries and its general impact on user behaviour, and (3) description of how it is being used in investing platforms and its impact on investor behaviour and/or how it *might* be used and affect investor behaviour.

Gamification Techniques

Gamification refers to a variety of behavioural techniques that integrate game-related elements into non-gaming contexts and applications, with the purpose of improving user experience and engagement. Gamification techniques represent a subset of behavioural techniques, which are a subset of (DEPs).

Gamblification

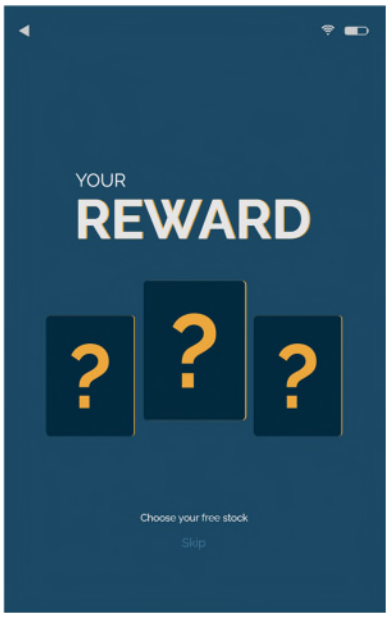


Figure 4: A modified version of Platform 7's rewards, which give "surprise stocks" with variable value to first-time users when they sign up for an account and to users who refer a friend

Definition: Gamblification refers to techniques derived from gambling, which most prominently include the use of variable rewards. Variable rewards are economic benefits (e.g., cash payouts) where the size, timing, or likelihood of the benefit is unpredictable to the user. Beyond variable rewards, the gamblification category might also include language and imagery that evokes gambling (e.g., reference to "jackpots," scratch cards).[9]

General use and impact on behaviour: Gamblification has been used to encourage a broad set of behaviours ranging from user-platform engagement[10] to vaccination[11]. For instance, Google Pay gives users virtual scratch cards worth up to $10 in cash rewards as a variable reward for using this payment option. In Canada, Tim Hortons' "Roll Up the Rim" contest is a famous example of a retailer leveraging variable rewards to motivate purchasing behaviour.

Lotteries and other variable reward interventions can be potent drivers of behaviour for three main reasons:

[9] The overall relationship between trading and gambling is outside the scope of this research. While trading is distinct from gambling insofar as investors pursue long-term strategies (and invest in productive assets), there is a relationship between gambling and investing. Some traders are motivated by the thrill of potential short-term returns and treat trading as gambling. In their paper "Trading as Gambling," Dorn, Dorn and Sengmueller (2015) provide evidence for this, showing that when there are large lotteries, trading activity declines as people substitute lottery entries for trading.
[10] Grieve, R. & Lowe-Calverley, E. (2016, Jul 16). The power of rewards and why we seek them out. The Conversation.
[11] Jacobson, L. & Tamakloe, K. S. (2021, Aug 19). "Have vaccine lotteries worked? Studies so far show mixed results". Politifact.

1. Their combination of high-impact rewards and generally low win probabilities taps into our tendency to disproportionately focus on reward magnitude[12] and overweight small probabilities.[13]

2. The inherent uncertainty of variable rewards is habit-forming. Decades of research have found that animals trained to perform behaviours such as pressing levers[14] or seeking drugs[15] using variable rewards learn these behaviours much more readily than those trained with consistent reward schedules. Such animals are also known to be particularly resistant to so-called behavioural extinction[16,17], meaning that they continue performing their conditioned behaviours long after they are no longer being reinforced. Indeed, variable reward schedules are often used to simulate and study addiction in research settings,[18] and are thought to be responsible for the addictiveness of gambling.[19]

3. Variable rewards and other incentives couched in language reminiscent of gambling can invoke a psychological "hot" state that influences a user's subsequent behaviour. For instance, when an investment is framed as a "jackpot" entry, our decision-making becomes dominated by considerations of reward magnitude and less sensitive to realistic chances.[20] The results of a gamble can further distort our judgements, with one study showing that winning on a gamble makes us 80% likely to continue with the next gamble, compared to 20% after a loss.[21] This behaviour is thought to stem from a flawed assumption that a win signals a streak where future positive outcomes are more likely than before (also known as the hot hand fallacy).[22]

Current use on digital trading platforms and impact on behaviour: Gamblification strategies are present on several digital trading platforms. Platform 7 gives "surprise stocks" with variable value to first-time users when they sign up for an account and to users who refer a friend. Notably, the free stocks are presented in the form of a scratch card, where users are presented with an option of three scratch-off tickets and must choose one to "scratch" their fingers across the phone screen to see what they've won. Platform 10 users have to click on a virtual present to reveal the prize that they have "won" for referring a friend, the value of which also varies. The platform then presents users with a list of three potential stocks for them to invest in with the referral bonus. This list of three stocks makes it more likely the user will choose one of those stocks instead of other securities that could be more

[12]Griffiths, M., & Wood, R. (2001). The psychology of lottery gambling. *International Gambling Studies*, 1(1), 27-45.
[13]Burns, Z., Chiu, A., & Wu, G. (2010). Overweighting of small probabilities. In *Wiley Encyclopedia of Operations Research and Management Science* (pp. 1-8). Hoboken, NJ, USA: John Wiley & Sons.
[14] Skinner, B.F. (1969). *Contingencies of reinforcement: A theoretical analysis.* Meredith Corporation.
[15] Lagorio, C. H., & Winger, G. (2014). Random-ratio schedules produce greater demand for iv drug administration than fixed-ratio schedules in rhesus monkeys. *Psychopharmacology*, *231*(15), 2981-2988.
[16] Miltenberger, R. G. (2008). "Behavioral Modification: Principles and Procedures". Florida, Thomson.
[17] Shull, R. L., & Grimes, J. A. (2006). Resistance to extinction following variable‐interval reinforcement: Reinforcer rate and amount. Journal of the Experimental Analysis of Behavior, 85(1), 23-39.
[18] Egli, M., Schaal, D. W., Thompson, T., & Cleary, J. (1992). Opioid-induced response-rate decrements in pigeons responding under variable-interval schedules: reinforcement mechanisms. Behavioural Pharmacology.
[19] Haw, J. (2008). Random-ratio schedules of reinforcement: The role of early wins and unreinforced trials. Journal of Gambling Issues, (21), 56-67.
[20] Chaudhry, S., & Kulkarni, C. (2021, June). Design Patterns of Investing Apps and Their Effects on Investing Behaviors. In Designing Interactive Systems Conference 2021 (pp. 777-788).
[21]Croson, R., & Sundali, J. (2005). The gambler's fallacy and the hot hand: Empirical data from casinos. *Journal of Risk and Uncertainty*, 30(3), 195-209.
[22]Ayton, P., & Fischer, I. (2004). The hot hand fallacy and the gambler's fallacy: Two faces of subjective randomness?. *Memory & cognition*, 32(8), 1369-1378.

suitable, given the increased salience and reduced friction of purchasing them. Users do not have to invest the referral bonus in these three stocks, but the approach increases the likelihood that they will. Platform 10 also uses variable rewards for new users, offering the cash equivalent of a stock worth up to $4500. The free stock bonus has a value between $5 and $4500 with an average of $15.[23]

Given the evidence on variable rewards more broadly, we expect that these approaches are likely to increase platform sign-ups by offering a large *potential* bonus and increase the frequency of referrals. We also believe that these experiences may increase the likelihood of ongoing use of the application.

Beyond the immediate behaviour being rewarded, there are reasons to believe that gamblification tactics can change *subsequent* financial decisions as well. We are significantly more likely to gamble on money that feels like a windfall or unexpected bonus,[24,25] like a large variable reward. These rewards may increase retail investor risk taking after receiving the bonus, especially where the bonus is unexpectedly large. There are two underlying effects. First, the "house money" effect describes how gamblers are less concerned about losing their winnings than losing their own money, their pre-existing stake.[26] Second, those who receive an unexpectedly large award may be influenced by the "hot hand fallacy",[27] the feeling that one is on a "hot streak" and that things are going to continue going well. This might motivate higher levels of trading activity than users might otherwise engage in.

Potential use on digital trading platforms and impact on behaviour: In the future, digital trading platforms may provide variable rewards for other behaviours, including deposits and trading (e.g., based on the volume or type of trades made). For example, users might be awarded an additional entry into a high-stakes lottery for every trade they carry out. If implemented, the evidence on variable rewards suggests this could have an outsized effect on trading frequency, surpassing the value of a fixed incentive per trade. Trading frequency or volume is a critical behaviour of interest, given the strong negative correlation with investor returns[28] and the incentives platforms can have to see higher trading volume. In terms of deposits, variable rewards would likely result in increased deposit behaviours within a specific account.

Leaderboards

Definition: A public display of ranked information about application users' performance. Leaderboards enable and encourage social comparison and competition.

General use and impact on behaviour: Leaderboards are one of the most common gamification tactics across digital platforms and apps in a variety of industries.[29] By offering

[23] Footnote source deleted re: Platform 10
[24] Kellner, C., Reinstein, D., & Riener, G. (2019). Ex-ante commitments to "give if you win" exceed donations after a win. *Journal of Public Economics*, 169, 109-127.
[25] Adam, M., Roethke, K., & Benlian, A. (2021). Gamblified digital product offerings: an experimental study of loot box menu designs. *Electronic Markets*, 1-16.
[26] Thaler, R. & Johnson, E. (1990), Gambling with the house money and trying to break even: The effects of prior outcomes to risky choice. *Management Science*, 36, (6), 643-660.
[27]Croson, R., & Sundali, J. (2005). The gambler's fallacy and the hot hand: Empirical data from casinos. *Journal of Risk and Uncertainty*, 30(3), 195-209.
[28] Odean, T. (1999). Do investors trade too much? *American economic review, 89*(5), 1279-1298.
[29] Johnson, D., Deterding, S., Kuhn, K. A., Staneva, A., Stoyanov, S., & Hides, L. (2016). Gamification for health and wellbeing: A systematic review of the literature. *Internet Interventions*, 6, 89-106. *Also:* Looyestyn, J., Kernot, J., Boshoff, K., Ryan, J.,

users the opportunity to see and show their peer groups where they stand relative to others, leaderboards tap into our desire for recognition and innate tendency for social comparison and competition.[30,31]

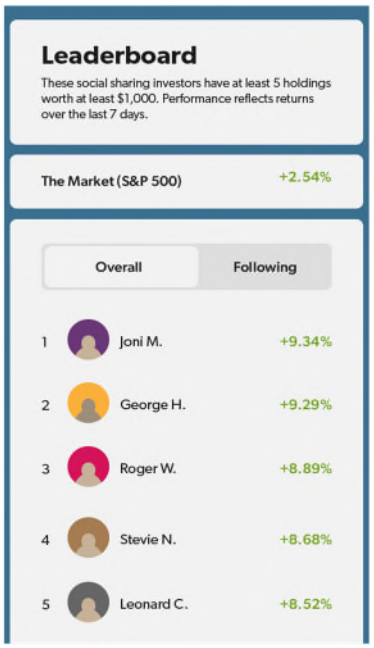


Figure 5: A modified version of Platform 8's social investing features, which rank users on a leaderboard based on weighted returns within a certain time frame.

A 2017 meta-analysis (a statistical analysis that combines the results of multiple scientific studies that address the same question and increases the confidence in the results) indicates that leaderboards are among the most effective gamification tactics, often outperforming other approaches like points and badges and generating small-to-medium-size effects compared to control conditions.[32] In one study focused on educational outcomes, researchers found that gamifying an online learning platform with leaderboards (alongside several other tactics), resulted in a 25% increase in student retention, as well as 23% higher average test scores compared to those produced by control conditions.[33] Another study found that leaderboards alone led to approximately 40% higher levels of user activity in a gamified image annotation task compared to control conditions, which was approximately 4% and 16% more than researchers were able to achieve with levels and points, respectively.[34]

Indeed, commercial platforms frequently use leaderboards to enhance user participation, with particular prevalence within the fitness app industry, where platforms such as Strava and Nike+ track and rank users based on running mileage and other parameters of performance. It is worth noting, however, that inducing a competitive spirit may not have the same effects on everyone and may in fact disadvantage the performance of individuals who are intrinsically less competitive.[35]

Current use on digital trading platforms and impact on behaviour: Leaderboards are a relatively rare feature of digital trading platforms. US-based Platform 8 offers the option to enable social investing, allowing users to compare how they are doing with their peers by featuring on a leaderboard where users are ranked based on returns weighted within a certain time frame. Users must meet certain criteria to feature on the leaderboard, including owning at least a minimum number of holdings worth at least a certain combined valued to

Edney, S., & Maher, C. (2017). Does gamification increase engagement with online programs? A systematic review. *PloS one*, *12*(3), e0173403.

[30] Leibbrandt, A., Gneezy, U., & List, J. A. (2013). Rise and fall of competitiveness in individualistic and collectivistic societies. *Proceedings of the National Academy of Sciences*, *110*(23), 9305-9308.

[31] Looyestyn, J., Kernot, J., Boshoff, K., Ryan, J., Edney, S., & Maher, C. (2017). Does gamification increase engagement with online programs? A systematic review. PloS one, 12(3), e0173403.

[32] Looyestyn, J., Kernot, J., Boshoff, K., Ryan, J., Edney, S., & Maher, C. (2017). Does gamification increase engagement with online programs? A systematic review. *PloS one*, *12*(3), e0173403.

[33] Krause, M. Mogalle, M., Pohl, H. & Williams, J. J. (2015). "A playful game changer: fostering student retention in online education with social gamification". In *Proceedings of the Second ACM Conference on Learning@Scale.*

[34] Mekler, E. D., Brühlmann, F., Opwis, K., & Tuch, A. N. (2013, October). Do points, levels and leaderboards harm intrinsic motivation? An empirical analysis of common gamification elements. In *Proceedings of the First International Conference on gameful design, research, and applications* (pp. 66-73).

[35] Song, H., Kim, J., Tenzek, K. E., & Lee, K. M. (2010, June). The effects of competition on intrinsic motivation in exergames and the conditional indirect effects of presence. In *Annual conference of the International Communication Association, Singapore*.

dissuade members from copying deceptive results from other users (e.g., a massive return solely from one penny stock).

Platform 2 features multiple types of leaderboards. As an example, users have access to an "Editors' choice" leaderboard of investors to follow and copy, as well as a leaderboard of the most copied investors on the platform. Users are also invited to try joining the Platform 2's "Popular Investor Program" which allows successful joiners to generate an income from being copied by other users. As of September 2021, we did not identify any Canadian platforms using leaderboards.

Leaderboards have not been evaluated in a trading context in the academic literature. However, the studies conducted in other contexts, mentioned in the section above, suggest that leaderboards can be expected to increase user engagement with digital trading platforms. This may increase trading frequency and risk-taking, particularly in users who are more motivated by social comparisons[36] and competition than their longer-term financial goals. Leaderboards may also implicitly signal a social norm (see section below) around striving for and celebrating high financial performance. Here, frequently changing leader names may be viewed as the culmination of an ongoing competition, and a sign that this contest is desirable and popular. The impact of this is likely to depend on the salience of the leaderboard, whether economic or non-economic rewards are tied to leaderboard performance, and the type of returns or activity that the leaderboard represents. Leaderboards that focus on shorter-term returns, like Platform 2's 12-month returns, may increase myopic, speculative trading. Traders with a ranking on the leaderboards may also experience increased (over)confidence, which negatively impacts returns from trading.[37]

Potential use on digital trading platforms and impact on behaviour: In the future, digital trading platforms could implement additional leaderboards for other types of investor behaviour, such as trading frequency or even social interactions like "posts" or "likes" (see following section). Displaying a leaderboard that measures activity could clearly increase the frequency of trading. As described further below, even leaderboards for social interactions may be deceptively risky, given how strong an influence on behaviour social feedback and recognition can be. On the other hand, leaderboards for completing investor education modules, where offered by digital platforms, could encourage greater participation and learning.

Rewards (e.g., points, badges, scores)

Definition: Providing rewards for performing tasks or accomplishing goals within an online application. Our definition includes rewards with either no economic value (e.g., badges, scores, animations) or with nominal economic value (e.g., points that can be redeemed for an insignificant financial value) that should not materially influence investor behaviour under a purely rational economic decision-making model. This category excludes larger financial

[36] For further discussion of social comparison, see the section on Social Interactions, below.
[37] Biais, B., Hilton, D., Mazurier, K., & Pouget, S. (2005). Judgemental overconfidence, self-monitoring, and trading performance in an experimental financial market. *The Review of Economic Studies*, 72(2), 287-312.

rewards (e.g., cash bonuses or points that can be redeemed for significant financial value), as they constitute a traditional incentive, not a “behavioural” intervention.

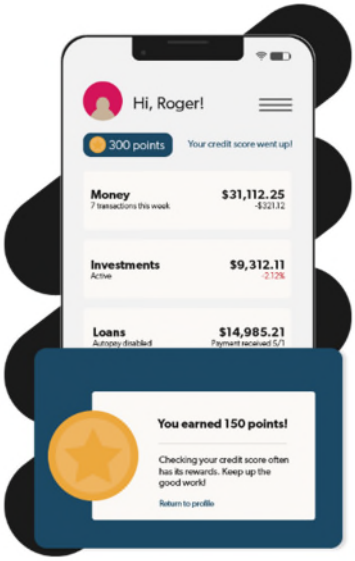


Figure 6: A modified version of Platform 8’s rewards program, which rewards users with points for completing various in-app actions, such as checking your credit score

General use and impact on behaviour: Providing rewards like points, badges and scores are among the most commonly used gamification tactics.[38] While these rewards can have little or no economic value, they can still have a significant effect on consumer / user behaviour, promoting engagement in online programs[39] and influencing consumer behaviour.[40] For example, the Nike+ app awards “NikeFuel points” for completing physical activity tasks. These techniques motivate behaviour through social comparison (see Leaderboards, above) *and* our intrinsic desire to make progress, even if the measure is arbitrary.

Badges, in particular, are popular features of apps and online programs. They act as publicly visible signs of status within the network of application users. Amazon marks individuals as “top reviewers” when enough other users mark their reviews as helpful. A “pre and post” evaluation of the web platform “Sharetribe” found that badges increased user posts, page views, and transactions.[41] In a commercial context, retailers have long offered loyalty points and programs. While these points can generally be redeemed for goods and can be considered a traditional economic reward, their impact on behaviour outstrips their pure economic value as people tend to overvalue points they collect.[42] Not only are they overvalued, the mere decision to redeem a reward significantly increases purchase behaviour before and after the redemption event.[43] However, studies examining the effect of badges exclusively on engagement with online programs have found only small effect sizes.[44]

Current use on digital trading platforms and impact on behaviour: An American financial platform, Platform 8, uses points to reward users. Platform 8 is differentiated from other investing platforms by providing a wide range of financial products and services on one platform, including investing options, credit cards, loans, insurance, bank accounts, credit score information, budgeting tools, etc. While points are not given for investing behaviours, users can earn “Platform 8 points” for actions like spending money with the credit card or

[38] Looyestyn, J., Kernot, J., Boshoff, K., Ryan, J., Edney, S., & Maher, C. (2017). Does gamification increase engagement with online programs? A systematic review. *PloS one*, *12*(3), e0173403.
[39] Looyestyn, J., Kernot, J., Boshoff, K., Ryan, J., Edney, S., & Maher, C. (2017). Does gamification increase engagement with online programs? A systematic review. *PloS one*, *12*(3), e0173403.
[40] Tobon, S., Ruiz-Alba, J. L., & García-Madariaga, J. (2020). Gamification and online consumer decisions: Is the game over?. *Decision Support Systems*, *128*, 113167.
[41] Hamari, J. (2017). Do badges increase user activity? A field experiment on the effects of gamification. *Computers in Human Behavior*, 71, 469-478.
[42] Van Osselaer, S. M., Alba, J. W., & Manchanda, P. (2004). Irrelevant information and mediated intertemporal choice. *Journal of Consumer Psychology, 14*(3), 257-270.
[43] Dorotic, M., Verhoef, P. C., Fok, D., & Bijmolt, T. H. (2014). Reward redemption effects in a loyalty program when customers choose how much and when to redeem. *International Journal of Research in Marketing*, *31*(4), 339-355.
[44] Looyestyn, J., Kernot, J., Boshoff, K., Ryan, J., Edney, S., & Maher, C. (2017). Does gamification increase engagement with online programs? A systematic review. *PloS one*, *12*(3), e0173403.

signing into the app on a daily basis and on consecutive days. The economic value of the Platform 8 points is quite limited. For example, users are rewarded with 1 point for a daily app login, and each Platform 8 point is worth $0.01. The earned points then can be converted into fractional shares of stocks within the investing component of Platform 8's digital platform, converted into cryptocurrency within the digital assets component of the platform, turned into cash, used towards loans, or used as credit towards the Platform 8 credit card. Enabling users to apply their points on traditional securities or crypto investments may be a particularly effective way to get non-investors to use these components of the Platform 8 digital platform.[45] It leverages the concept of 'mental accounting', which describes how people tend to treat money differently based on subjective criteria, such as its source. They may, for example, be more willing to take on risk with "bonus money" than money from other sources (e.g., employment income).

Another US-based personal finance app has taken a slightly different approach. They reward users with a percentage of their debit card purchases back in stock. For example, when a user spends money at Walmart, Amazon, or Starbucks, they earn fractional shares in these companies. When they spend at a smaller business, such as a local restaurant, they earn an investment of their choosing, either a stock or an ETF. The app's company's analysis suggests that one-third of customers using this reward card go on to make a follow up investment in the given stock or fund.[46] While offering users automated investments in the market is not negative for investors, this type of reward system may reduce diversification.

In a much simpler use of rewards, Platform 7 previously showered users' screens with digital animations to celebrate certain actions like placing a first trade or successfully referring friends. A 2021 experiment tested how gamification techniques, including confetti bursts, achievement badges, and messages of encouragement influence users' risk taking when trading. Participants in the experiment were assigned to trade virtual assets on either a simple experimental platform that mimics a retail investing app or a gamified version.[47] In each round, participants were given a virtual asset that they can sell at any time. Every two seconds, the asset price either increased by a random amount or, with a small probability that varied each round, crashed to zero. Users who traded on the gamified version of the platform took on significantly more risk. For example, they waited 14% longer to sell in the gamified version. The impact of gamification was stronger for high-risk environments (i.e., for assets that had a higher probability of crashing). Increasing the probability of a crash from 2% to 5% led to a 246% stronger impact of gamification on risk taking. In addition, the effect was stronger for inexperienced traders with lower financial literacy; a one standard deviation increase in a financial literacy score reduced the impact of gamification by 56%.

Potential use on digital trading platforms and impact on behaviour: Trading platforms could introduce points / scores or badges as a way to potentially motivate a wide range of investor behaviours. For example, badges could be awarded for purchasing different types of securities (e.g., options) or points could be awarded on a per-trade basis. Digital platforms might consider enabling users to "cash in" these points for small rewards (e.g., fractions of stocks, gift certificates, etc.) or keep them purely nominal. Small rewards are likely to have a

[45] Footnote source deleted re: Platform 8
[46] Footnote source deleted re: a US-based platform
[47] Chapkovski, P., Khapko, M., & Zoican, M. (2021). Does gamified trading stimulate risk taking?. SSRN 3971868.

larger impact on investor behaviour, given that they could be overvalued as being economically significant, and would have some financial cost to the digital platforms.

There may also be opportunities for investing platforms to deploy trading-related rewards in ways that are more likely to benefit users. For example, they could award points for improving the diversification of the investor's portfolio (e.g., across asset classes or sectors).

Goal and progress framing

Definition: Design elements that i) help users set and visualize their goals, and/or ii) strategically frame users' performance and progress with respect to these goals to stimulate greater levels of engagement.

General use and impact on behaviour: Diverse goal and progress framing tactics are being used across industries (e.g., air travel, food & drink, health apps) to motivate two primary types of engagement behaviours: i) purchasing and consumption, and ii) work and productivity. For example, flight miles programs motivate consumption by strategically framing their customers' flight histories as progress towards a particular goal. One study has found that reminding customers of how close they are to unlocking rewards associated with hitting an arbitrary points target can make them 55% relatively more willing to agree to receive marketing content in exchange for bonus miles, compared to when they are further from that threshold.[48]

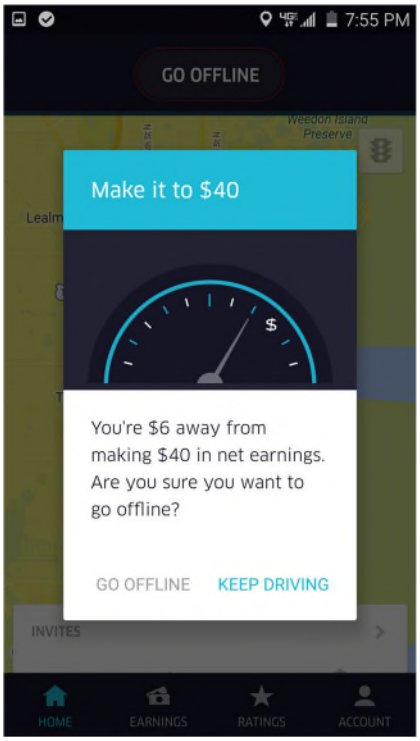


Figure 7: Uber has used progress framing to encourage drivers to continue driving

In a practice that has attracted some controversy, Uber uses goal framing tactics to nudge their workers to keep driving beyond their desired log-off times.[49] When drivers are about to log off for the day, the app alerts them to how close they are to their daily income target (or a target which the company took the liberty to set for them) and encourages them to continue working. Although an absence of publicly available data from these interventions makes it difficult for us to specify the magnitude of the behavioural effect, the aggregate evidence suggests that goals (even arbitrary ones), influence behaviour across a range of activities.

How companies or apps choose to *present* an individual's progress toward a goal is also impactful. First, the closer we think we are to a goal, the more effort we are willing to expend to achieve it, a concept called the goal-gradient hypothesis. Our perceived proximity to a goal can be manipulated through "endowed progress." People getting a "Buy 12 coffees, get 1 free" card, with two of these coffees already pre-stamped

[48]Kivetz, R., Urminsky, O., & Zheng, Y. (2006). The goal-gradient hypothesis resurrected: Purchase acceleration, illusionary goal progress, and customer retention. *Journal of Marketing Research*, 43(1), 39-58.
[49] Scheiber, N. (2017). How Uber uses psychological tricks to push its drivers' buttons. New York Times.

buy more coffee than those getting a “Buy 10 coffees, get 1 free” card even though the actual proximity to the goal, buy 10 more coffees, is the same.[50]

Second, a theory known as the small area hypothesis states that “individuals in pursuit of a goal exhibit stronger motivation when they focus on whichever is smaller in size: the area of their completed actions or their remaining actions needed to reach a goal.”[51] This means that if a user is 10% of the way to a goal, it’s more motivating to focus their attention on the 10% they have accomplished than the 90% they haven’t. Conversely, if they are 90% of the way to a goal, it is more motivating to focus on the 10% remaining than the 90% complete. One study of the behaviours of over 90,000 members of an online Q&A community has found that small-area progress framing accounted for a minimum of 78% increase in user activity and engagement after the platform was restructured.[52]

“Streaks” are another popular tactic used to frame progress. Derived from the concept of “winning streaks” in sports, they are used as a measurement of how consistently a user completes a specific action. For example, Duolingo refers to streaks in their language-learning platform, where users grow their streak for each day in a row they complete a lesson. An analysis of this feature has revealed that the streaks help increase users’ attention to their learning purpose when the challenges increase and improves motivation.[53] Winning streaks were also shown to increase in perceived attractiveness with greater length. The effectiveness of this feature has been noted by other industries: mobility service providers such as Uber and Lyft distribute so-called “streak” or “consecutive ride” bonuses to motivate their driver employees.[54]

Current use on digital trading platforms and impact on behaviour: Our environmental scan did not identify any platforms using goal & progress framing tactics as defined in this report.[55]

Potential use on digital trading platforms and impact on behaviour: Given the clear relevance to financial decision-making, we believe it is likely that digital trading platforms will introduce goal-setting and goal-framing features. While platforms offering effectively self-directed investment services are prohibited from offering recommendations, they could permit investors and financial consumers to set out their financial goals and measure progress.

The way in which companies choose to solicit and define their users’ goals and frame their progress will shape the behaviours that result. Helping users set and monitor progress against retirement savings goals, for example, could help instil a long-term investment outlook. However, such interventions would still need to be paired with clear guidance

[50] Jensen, J. D., King, A. J., & Carcioppolo, N. (2013). Driving toward a goal and the goal-gradient hypothesis: the impact of goal proximity on compliance rate, donation size, and fatigue. Journal of Applied Social Psychology, 43(9), 1881-1895.
[51] Koo, M., & Fishbach, A. (2012). The small-area hypothesis: Effects of progress monitoring on goal adherence. *Journal of Consumer Research*, 39(3), 493–509.
[52] Kundisch, D., & von Rechenberg, T. (2017). Does the framing of progress towards virtual rewards matter? *Business & Information Systems Engineering, 59*(4), 207-222.
[53] Huynh, D., & Iida, H. (2017). An Analysis of Winning Streak's Effects in Language Course of “Duolingo". University Kebangsaan Malaysia Press.
[54] Uber (2022). “How does the Consecutive Trips promotion work?” Retrieved from: https://help.uber.com/driving-and-delivering/article/how-does-the-consecutive-trips-promotion-work?nodeId=de983305-076a-40cf-aaf4-7b23f50a0007. See also: Lyft (2022). "Streak Bonus". Retrieved from: https://help.lyft.com/hc/e/articles/115015748908-Streak-Bonus.
[55] There are financial apps which do not enable users to trade individual securities, offer such features, but are not included in the scope of this research.

regarding the impact of increased trading frequency on long-term outcomes[56] to help mitigate the risk that people think more active trading approaches will support long-term goals. Similarly, goal framing should be attentive to other key aspects of successful personal investing, including diversification, savings rates, risk taking, possible need for funds for short-term emergencies, etc. Beyond encouraging long-term thinking, platforms could help users break down their goals into manageable sub-goals to support goal attainment.[57] On the other hand, setting goals related to shorter-term outcomes or trading activity could be harmful. For example, setting monthly goals for investment returns could lead to more risk-seeking choices.

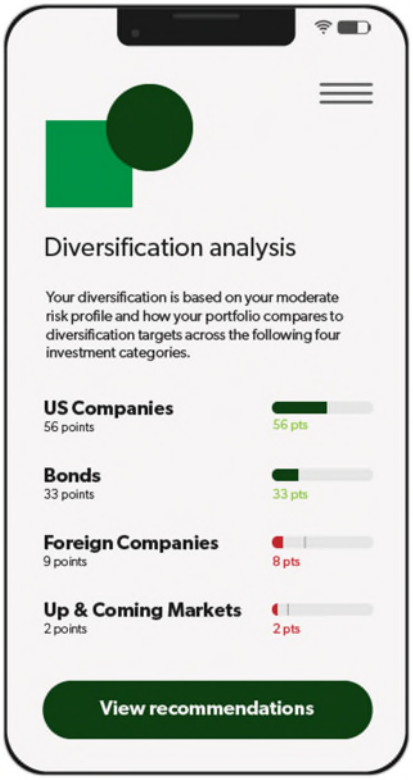


Figure 8: A modified version of a US-based app's tool for diversification analysis gives users a diversification score based on investments held in their portfolio

Feedback

Definition: The provision of information about a user's performance on a task in (near) real-time, including both continuous progress feedback and immediate success feedback.[58] We exclude feedback from other users in this category, as it is covered under Social interactions.

General use and impact on behaviour: Feedback has been most commonly applied in education contexts, where the frequency, intensity, and immediacy of feedback is found to be helpful for learner engagement and learning effectiveness.[59] A recent meta-analysis indicates a medium effect of 0.48 standard mean difference (SMD) of feedback on student learning outcomes.[60] While less common in non-education domains, Uber provides continuous progress feedback to its drivers (e.g., trips taken, money earned, rating) as part of a broader package of gamification techniques.[61] Data on the impact of feedback to Uber drivers is not publicly available.

Feedback has been used to facilitate more responsible gambling on online platforms. Players on the online gambling platform Norsk Tipping were randomly selected to receive personalized feedback, receiving details on their losses over the last month. Compared to a control group, the players who received the feedback reduced their theoretical loss, the amount of money they would be

[56] Odean, T. (1999). Do Investors Trade Too Much? *American Economic Review*, 89 (5): 1279-1298.
[57] Lewis, L. K., Rowlands, A. V., Gardiner, P. A., Standage, M., English, C., & Olds, T. (2016). Small steps: preliminary effectiveness and feasibility of an incremental goal-setting intervention to reduce sitting time in older adults. *Maturitas*, *85*, 64-70.
[58] Johnson, D., Deterding, S., Kuhn, K. A., Staneva, A., Stoyanov, S., & Hides, L. (2016). Gamification for health and wellbeing: A systematic review of the literature. *Internet Interventions*, 6, 89-106.
[59] Nah, F. F. H., Zeng, Q., Telaprolu, V. R., Ayyappa, A. P., & Eschenbrenner, B. (2014, June). Gamification of education: a review of literature. In *International conference on hci in business* (pp. 401-409). Springer, Cham.
[60] Wisniewski, B., Zierer, K., & Hattie, J. (2020). The power of feedback revisited: A meta-analysis of educational feedback research. *Frontiers in Psychology, 10*, 3087.
[61] Scheiber, N. (2017, Apr 2). How Uber Uses Psychological Tricks to Push Its Drivers' Buttons. New York Times. Retrieved from: https://www.nytimes.com/interactive/2017/04/02/technology/uber-drivers-psychological-tricks.html.

expected to lose based on the amount wagered and the house advantage on a given bet type, and amount of money wagered.[62]

The Canadian company Sun Life previously offered Money UP, an online platform that aims to educate consumers on retirement and investing planning by challenging users to pass levels by demonstrating financial knowledge while receiving quick feedback about their answers to questions on quizzes about these topics.

Feedback is effective because it serves as a self-regulation strategy, revealing progress in relation to goals,[63] and because it motivates changes in behaviour by focusing one's attention on the task itself.[64] It can be effective in influencing any behaviour that is the subject of that feedback, although in most cases feedback is used to help people improve at a task.

Current use on digital trading platforms and impact on behaviour: A US-based personal finance app has a tool for diversification analysis that gives users a diversification score based on their investments held in their portfolio, along with recommendations for "handpicked" investments that can help the user diversify. The app's evaluation of this feature found that those who engage with this tool have portfolios that are two times more diversified on average than those who do not.[65]

A Canadian online trading platform has also recently launched a tool that examines investors' portfolio, which measures users' portfolio holdings across four key indicators, including asset allocation, diversification, security ratings, and risk, and provides a report highlighting strengths as well as aspects the user may want to reconsider.

An US-based robo-advisor app uses timely feedback to provide users with the estimated tax impact of a withdrawal (or allocation change) "just in time," before the user commits to the transaction. The company behind the app indicates that the feature is effective in reducing allocation changes—noting that users shown an anticipated tax of $5 or more were 62% less likely to complete an allocation change compared to those who were not.[66] This illustrates the power of timely feedback in influencing investor behaviour.

Researchers have also shown how a feedback intervention can help investors mitigate cognitive bias in trading decisions. In one study, investors played investing "games" in a simulated environment hosted on an external learning platform. They received feedback on their emotional regulation and the cognitive biases they exhibited. This training had a significant, positive impact on reducing the observed disposition effect when these investors later made trades in the real world.[67] The disposition effect refers to the general tendency of investors to sell securities that have increased in value and hold on to securities that have gone down in value. Stakeholders within the field have varying views of simulated trading

[62]Auer, M. M., & Griffiths, M. D. (2016). Personalized behavioral feedback for online gamblers: A real world empirical study. *Frontiers in Psychology*, 1875.
[63] Carver, C. S., & Scheier, M. F. (2012). *Attention and self-regulation: A control-theory approach to human behavior*. Springer Science & Business Media.
[64] Kluger, A. N., & DeNisi, A. (1996). The effects of feedback interventions on performance: A historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin*, *119*(2), 254.
[65] Footnote source deleted re: a US-based platform
[66] Footnote source deleted re: an US-based robo-advisor app
[67] Fenton-O'Creevy, M., Adam, M., Clough, G., Conole, G., Gaved, M., Lins, J. T., et al. (2015). A game based approach to improve traders' decision-making. In: The International Gamification for Business Conference 2015: Strategic Industrial Applications of Games and Gamification.

educational games; some feel they provide a good introduction to trading, while others fear they may increase short-termism.[68]

Potential use on digital trading platforms and impact on behaviour: Trading platforms could use feedback in other ways to support investor education and decision-making. Where platforms help users understand how trades work, how to analyze market data and risk, how to understand their fees and performance, and other investment-related behaviours, feedback is likely to support learning engagement and effectiveness. They could even provide users with a simulated trading environment and provide feedback to help users learn about common trading mistakes (e.g., frequent trading, under-diversification, myopia, disposition effect, etc.)—an approach tested by researchers.[69] As noted above, the value of such approaches is disputed and should be rigorously evaluated before full-scale implementation.

Beyond investor education, platforms could implement feedback on investors' real-world trading behaviour. For example, they could offer continuous progress feedback through more frequent reports on how investors are progressing against their savings goals. However, more frequent feedback might cause investors to focus too strongly on the short-term. A large-scale field experiment has shown that individuals who receive information about their investments' performance too frequently tend to underinvest in riskier assets, losing out on potential gains in the long-term.[70] Similarly, immediate success feedback on trades, like highlighting when investors exit a position at a profit, would likely reinforce investors' disposition effect, reducing future returns. Where the performance / feedback has been positive, it could also increase traders' (over)confidence, which, as noted above, negatively impacts investor performance. Investing is complex, and the impact of different types of feedback will vary depending on the context and the investor.

Overall, we believe there is sufficient evidence to suggest that feedback interventions on, for example, diversification and common investor biases can help investors make better decisions for themselves. However, feedback on short-term performance or individual trades, for example, could encourage investors to take actions that undermine their investment goals.

Other Behavioural Techniques

The following sections describe and assess behavioural techniques that do not meet the definition of gamification. However, these techniques are informed by behavioural science and are being used by digital trading platforms in ways that influence investor behaviour.[71]

[68]FINRA (2021, Jun 30). "FINRA Requests Comment on Effective Methods to Educate Newer Investors". Retrieved from: https://www.finra.org/rules-guidance/notices/special-notice-063021#comments.
[69] Fenton-O'Creevy, M., Adam, M., Clough, G., Conole, G., Gaved, M., Lins, J. T., et al. (2015). A game based approach to improve traders' decision-making. In: The International Gamification for Business Conference 2015: Strategic Industrial Applications of Games and Gamification.
[70] Larson, F., List, J. A., & Metcalfe, R. D. (2016). *Can myopic loss aversion explain the equity premium puzzle? Evidence from a natural field experiment with professional traders* (No. w22605). National Bureau of Economic Research.
[71] U.S. Securities and Exchange Commission (n.d.) "Request for Information and Comments on Broker-Dealer and Investment Adviser Digital Engagement Practices, Related Tools and Methods, and Regulatory Considerations and Potential Approaches...". Retrieved from:https://business.cch.com/srd/34-92766.pdf.

Salience / attention-inducing prompts

Definition: Information is more likely to influence people's behaviour if it attracts their attention. A very wide range of design features are included in this category, including visual cues as well as the specific language used in prompts. Often, the most attention-inducing language leverages other behavioural insights like social norms, loss aversion, and invoking scarcity. In this section, we focus specifically on the way platforms seek to direct user attention to some features and behaviours—and away from others.

General use and impact on behaviour: Strategies to increase the salience of certain information (or decrease the salience of other information) are ubiquitous across industries and used to influence an extraordinarily wide range of behaviours. Retailers, financial services companies, and public sector bodies alike use design choices like colour, images, personalization, the size, and placement of different information, and even humour to attract people's attention to specific information and options. These tactics can have positive effects, such as raising awareness of privacy notices on apps and websites.[72] They can also harm users by distracting them from other information, like additional costs,[73] and the proverbial "fine print." Push notifications are frequently used by app designers to boost engagement with the application, and prompts (e.g., pop-ups) are used to direct user attention to certain activities within the apps.

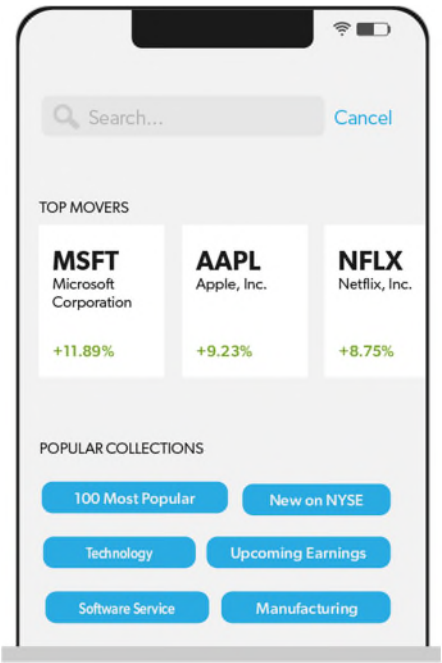


Figure 9: A modified version of Platform 7, which prominently features different lists on their home screen, including "100 Most Popular"

Current use on digital trading platforms and impact on behaviour: All trading apps make deliberate choices about what information is most salient to the user experience from signing up, to logging on, and to executing a trade. The way a choice is presented often influences what choice is made.[74] Given there is no truly "neutral" way to present options, the way information is displayed is necessarily influencing users' attention and action. Some design choices can be helpful, enabling users to find the most relevant features and understand key information more easily. In this section, we focus on more potentially concerning uses of attention-inducing prompts.

Many popular digital trading platforms prominently feature lists of stocks on their home screens, including "Top Movers," and "Most Popular" stocks. The salient placement of these lists has a dramatic impact. New entries into Platform 7's "Most Popular" list are five to seven times more likely to be purchased in the days following their listing.[75] The inclusion of a stock on Platform 7's "Top Mover" list is associated with it being

[72] Ebert, N., Alexander Ackermann, K., & Scheppler, B. (2021, May). Bolder is Better: Raising User Awareness through Salient and Concise Privacy Notices. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems* (pp. 1-12).
[73] Cara, C. (2019). Dark patterns in the media: A systematic review. *Network Intelligence Studies*, 7(14), 105-113.
[74] Johnson, E. J., Shu, S. B., Dellaert, B. G., Fox, C., Goldstein, D. G., Häubl, G., & Weber, E. U. (2012). Beyond nudges: Tools of a choice architecture. *Marketing Letters*, 23(2), 487-504.
[75] Footnote source deleted re: Platform 7

traded 36 times more than the amount that it is traded on average, even when controlling for the overall market activity.[76] These attention-inducing lists are significantly associated with increased "herding"[77], where retail investor choices are positively correlated with each other (they are making the same trades). Herding appears to result in significantly poorer returns for investors, with one study showing average 20-day abnormal returns of -4.7% for top stocks purchased each day.[78] In contrast, research conducted using transaction-level data from two German retail banks indicated that the prominent placement of "top movers" does not appear to affect returns.[79] The contrasting results could be a result of different platform interface designs, but it is also worth noting that the investors in this study were, on average, 45 years old with nine years of investing experience, which may suggest that these types of attention-inducing lists may have a more profound effect on younger, less experienced investors, who are the primary market for certain online trading platforms.

How information is displayed for individual stocks may also influence investor behaviour. Research examining investor-level brokerage data from China has found that increasing the salience of a stock's purchase price while keeping other information unchanged on the online trading screen increased investors' disposition effect[80] by 17%.[81]

Many popular trading apps also use push notifications to send out information to investors. For example, they allow users to create alerts for when stocks they're interested in hit a certain price or percentage increase or decrease of their choice. These types of attentional triggers can be useful for investors who need to monitor price movements as part of their investment strategy. Similar to other salience-inducing prompts like top traded lists, they can also influence investor behaviours in ways that are not aligned to the investor's strategy. The "lottery anomaly" refers to investors' preference for stocks with large potential gains, even when risks are proportionately higher. This anomaly is heightened when such stocks receive more investor attention, which might be the result of more analyst coverage or extremely positive recent returns.[82] Notifications are likely to play a similar role in heightening investor attention.

More broadly, push notifications on stock performance (e.g., "$ACME shares down over -5.2%") sent to investors' cell phones have been found to increase investors' risk-taking. One study showed that this type of attention-induced trade carried, on average, a 19-percentage-point higher leverage than other trades.[83] This impact was stronger for male, younger, and less experienced investors.

Potential use on digital trading platforms and impact on behaviour: Given the current widespread use of attention-inducing prompts on trading apps, it is likely that more platforms

[76] Footnote source deleted re: Platform 7
[77] Footnote source deleted re: Platform 7
[78] Footnote source deleted re: Platform 7
[79] Kalda, A., Loos, B., Previtero, A., & Hackethal, A. (2021). Smart (Phone) Investing? A within Investor-time Analysis of New Technologies and Trading Behavior (No. w28363). National Bureau of Economic Research. **NB:** this study did find that smartphone-trading did have a negative impact overall.
[80] The disposition effect refers to the well-established but "irrational" tendency for investors to sell securities that are worth more than their purchase price and hold on to those that are worth less.
[81] Frydman, C., & Wang, B. (2020). The impact of salience on investor behavior: Evidence from a natural experiment. *Journal of Finance*, 75(1), 229-276.
[82] Bali, T. G., Hirshleifer, D., Peng, L., & Tang, Y. (2021). Attention, social interaction, and investor attraction to lottery stocks (No. w29543). National Bureau of Economic Research.
[83] Arnold, M., Pelster, M., & Subrahmanyam, M. G. (2022). Attention triggers and investors' risk-taking. *Journal of Financial Economics*, 143(2), 846-875.

will continue to employ similar tactics. Prominent lists of trading options, like “Top Mover” and “Most Popular” lists may continue to cause “herding” and may also increase trading frequency. The widespread use of notifications and in-app prompts is also likely to expand, with many such messages leveraging other behavioural science techniques (e.g., invoking scarcity, loss aversion, etc.). Depending on the focus of these messages, they could increase trading frequency or shift traders into higher risk securities (e.g., options).

Attention-inducing prompts could also be deployed to support users in ways that are likely to support their long-term goals. For example, prompts could encourage users to engage in investor education, to increase deposits, or to explore options for diversifying their portfolios.

Simplification and selective deployment of friction costs

Definition: The design of the user experience that reduces or introduces small barriers across the user journey, influencing the likelihood and manner in which a user completes a specific task. We use “simplification” to refer to reductions in small barriers and “friction costs” to refer to increases in small barriers.

General use and impact on behaviour: The small details that make a task appear more challenging or effortful have a large impact on the likelihood of a person completing that task. In fact, the large effect they have on whether someone completes the task is disproportionate to the size of the detail. For example, simplifying the process of applying for college financial support by pre-populating the application with known information resulted in students being more likely to attend university by 8 percentage points.[84] Even something as minor as reducing the number of ‘clicks’ it takes to access a tax form by linking the form directly instead of linking to a website that includes the form has been shown to increase tax collection rates by 4%.[85] Amazon has been a trailblazer in leveraging simplification in online retail, implementing a “1-click” buying option to encourage impulse buying. In terms of mobile apps, the perceived ease of use of an app significantly impacts one’s intention to use the app among young adults.[86] Ease of use may also contribute to the perception of enjoyment of gamified e-banking apps.[87]

However, while simplifying user experiences and reducing points of friction generally have positive effects, it can also make undesirable behaviours *too easy* to follow through on. In these instances, adding friction can help people slow down and think more deeply about their actions rather than relying on their gut instincts. For example, in a large online survey experiment, creating a moment for reflection by asking participants to explain how they knew that a political headline was true or false decreased their intention to share false news headlines.[88]

[84]Bettinger, E. P., Long, B. T., Oreopoulos, P., & Sanbonmatsu, L. (2012). The role of application assistance and information in college decisions: Results from the H&R Block FAFSA experiment. *The Quarterly Journal of Economics*, 127(3), 1205-1242.
[85] The Behavioral Insights Team. (2014). EAST: Four simple ways to apply behavioural insights.https://www.bi.team/wp-content/uploads/2015/07/BIT-Publication-EAST_FA_WEB.pdf.
[86] Mehra, A., Paul, J., & Kaurav, R. P. S. (2021). Determinants of mobile apps adoption among young adults: theoretical extension and analysis. *Journal of Marketing Communications*, *27*(5), 481-509.
[87] Rodrigues, L. F., Oliveira, A., & Costa, C. J. (2016). Does ease-of-use contribute to the perception of enjoyment? A case of gamification in e-banking. *Computers in Human Behavior*, *61*, 114-126.
[88] Fazio, L. (2020). Pausing to consider why a headline is true or false can help reduce the sharing of false news. *Harvard Kennedy School Misinformation Review*, *1*(2).

Current use on digital trading platforms and impact on behaviour: Many trading apps, including Platform 7, 8, 10, and others boast quite seamless user experiences, making it as easy as possible to register for an account and begin placing trades.

1. They make it easy to sign up for a trading account by keeping the sign-up process short and guiding the user through the process. This is likely to increase market participation and save investors time.

2. The platforms also make it easy to deposit and access funds. For example, Platform 10 prompts users to set up automatic deposits into their account when adding funds. They also offer 'premium features' for a small monthly fee ($3), allowing users to "add up to $1,000 in seconds with no holds", enabling more immediate trading. While there are certainly positive elements to this, it *may* also increase "hot state" (non-deliberative) trading by making it easier to make spur of the moment trades.

3. The platforms tend to present users with less data for researching investment options. Besides basic market information, Platform 7 only provides investors with five charting indicators,[89] while another US-based trading platform provides 489.[90] It is unclear what impact, if any, this form of simplification has. On one hand, it may reduce choice overload and increase investor focus on the most relevant information. On the other hand, it may reduce the time investors spend researching and deliberating or make pertinent information harder to find and therefore less likely to be used in trading decisions. Our literature scan did not identify any empirical evidence on the average impact of reducing the number of indicators. From a theoretical perspective, it is important to balance the need for providing investors with the data required to make informed investing decisions (e.g., deciding between similar investment funds, for example) and avoiding information overload.

4. These platforms also appear to require fewer "clicks" to execute trades, although we did not find unequivocal data to confirm this. While a streamlined process can save users time, it may also provide fewer opportunities to rethink their trades and increase speculative trading, leading to lower investment returns.[91] This is particularly relevant when considering the full package of social interactions, attention-inducing prompts, and other behavioural science-informed tactics present on these platforms. For example, a social interaction may trigger an inclination to make a trade that is not aligned with the investor's overall strategy, and then a seamless, quick trading interface would increase their propensity to follow through.

5. Platform 7 has received scrutiny for making it easier to trade more complex, high-risk securities like options by simply checking a box during the account sign-up, without providing explanation of these types of assets or warnings of the increased risk and complexity.[92] While we do not have evidence on the impact of this, it could be problematic in encouraging investors to make trades that do not align with their investment strategy and risk tolerances due to a lack of understanding. Platform 7

[89] Charting Indicators include: Volume, Moving Average (MA), Exponential Moving Average (EMA), Relative Strength Index (RSI), Moving Average Convergence Divergence (MACD).
[90] Footnote source deleted re: Platform 7
[91] Footnote source deleted re: Platform 7
[92] Footnote source deleted re: Platform 7

has now tightened eligibility for users to engage in options trading, requiring users to have a certain level of experience. Our environmental scan did not determine the approach that other platforms are taking to higher risk activities like margin or options trading, as we did not attempt to execute any trades on the accounts we set up.

Potential use on digital trading platforms and impact on behaviour: It is likely that digital trading platforms will continue to search for opportunities to reduce frictions across the user experience. In some areas, it is likely that these platforms have already streamlined the experience as much as possible within the limits set by Canadian regulation that govern Order Execution Only activities.[93]

Members of the U.S. Securities and Exchange Commission (SEC) Investor Advisory Committee have advocated for the inclusion of frictions into the trading process to promote a deliberative mindset.[94] Suggested frictions include building in delays, creating decision points, and using nudges that encourage users to slow down and reflect on the longer-term outcomes of their investment decisions by envisioning the effect of the decision in the future. Balancing the ease of use and friction, as well as selection of where and when friction is required, can help protect investors.

Social interactions

Definition: Design elements that enable platform users to interact with other users by i) generating, sharing, viewing, and reacting to content, and ii) engaging in direct messaging. Note that we exclude referrals from this section as they represent a very low level of social engagement and are not the focus of the social interaction literature. We also exclude social-media style “posts” or “feeds” that come from individuals who self-identify as financial / investing experts.

General use and impact on behaviour: Techniques designed to facilitate social exchange and feedback—such as ‘likes’ on Facebook, Instagram, and Twitter—are central elements of the social media experience. They are also increasingly used by other applications, such as fitness apps, to stimulate greater levels of engagement. For example, Peloton has introduced new social features like hashtags to enable users to connect with peers with similar goals and interests.

Brain scan studies indicate that virtual social feedback might contribute to the addictive nature of social media platforms, as it engages brain regions that are at the core of our ability to process rewards, acquire habits, and become addicted.[95,96] While such an internal reward mechanism plausibly evolved to reinforce (and ensure repeats) of beneficial social interactions, there is a growing recognition that it can generate a problematic level of

[93] Investment Industry Regulatory Organization of Canada – IIROC (2019, Apr 9). "Guidance on Order Execution Only Services and Activities". Retrieved from: https://www.iiroc.ca/news-and-publications/notices-and-guidance/guidance-order-execution-only-services-and-activities.
[94] Powell, L. (2021, September 14). SEC Investor Advisory Committee examines digital engagement practices [Blog post]. Retrieved from https://jimhamiltonblog.blogspot.com/2021/09/sec-investor-advisory-committee_14.html.
[95] Montag, C., Markowetz, A., Blaszkiewicz, K., Andone, I., Lachmann, B., Sariyska, R., ... & Markett, S. (2017). Facebook usage on smartphones and gray matter volume of the nucleus accumbens. *Behavioural brain research, 329*, 221-228.
[96] Sherman, L. E., Hernandez, L. M., Greenfield, P. M., & Dapretto, M. (2018). What the brain ‘Likes’: neural correlates of providing feedback on social media. *Social cognitive and affective neuroscience, 13*(7), 699-707.

attachment to the social media experience. To our knowledge, effect sizes associated with social features have not been reported.[97]

Current use on digital trading platforms and impact on behaviour: Social interactions are present across a range of online digital trading platforms. Users of a US-based trading platform have the option to publicly display their portfolios and share their investment decisions with other users. Platform 11 features a similar mix of social interaction features: users have access to a social news feed consisting of content posted by their peers, the opportunity to chime into conversations highlighted under *'Most popular topics'* hashtags, and the chance to follow and copy others' investment decisions. These functions are also replicated on Platform 2. Platform 8 also had the option to enable 'Social Investing', where users can discover and follow other members' investment holdings, watchlists, and investment activity, and have the ability to comment on and react via emoji to other members' activity. This feature has been disabled, although it is unclear why.[98] At least one platform currently in development will go even further, fully "enabling dialogue and community engagement between users."[99]

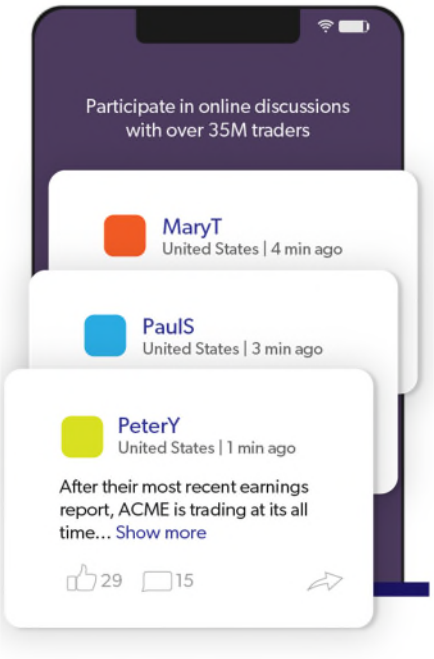


Figure 10: A modified version of Platform 2, which hosts a social news feed consisting of content posted by users

Social interaction features are leveraged by Platform 5, which has integrated a Twitter-like social media platform for the financial community, into their mobile platform, enabling users to follow investing ideas and discussions from other investors.

Social interactivity has a demonstrated impact on engagement with digital applications. This in itself may be problematic, as investors who check the status of their investments more often trade more and have worse performance.[100] Sociality might also contribute to problematic levels of engagement in other ways. If users' trades can be "liked", recommended, or otherwise promoted, their desire for social recognition and status could lead to increased trading frequency in the same way people post more on Facebook to get social affirmation. Social interactions are also likely to increase the disposition effect, with users holding onto losing investments for longer periods of time or not sharing information about losing trades to "save face".[101] The increase in

[97] Hou, Y., Xiong, D., Jiang, T., Song, L., & Wang, Q. (2019). Social media addiction: Its impact, mediation, and intervention. *Cyberpsychology: Journal of psychosocial research on cyberspace*, 13(1).
[98] Footnote source deleted re: Platform 8
[99] Cutts, J. (2021, Sep 14). "Not all brokerages should 'gamify' a la Robinhood - but others can/will go further." Traders Magazine
[100] Barber, B.M. and Odean, T. (2000), Trading Is Hazardous to Your Wealth: The Common Stock Investment Performance of Individual Investors. The Journal of Finance, 55: 773-806.
[101] Chaudhry, S., & Kulkarni, C. (2021, June). Design Patterns of Investing Apps and Their Effects on Investing Behaviors. In *Designing Interactive Systems Conference 2021* (pp. 777-788).

disposition effect is more likely to occur in stock trades than (actively managed) fund trades, as traders can assign blame for poor performance to fund managers in the latter case.[102]

In terms of the quality of investment, the evidence is equivocal about whether making decisions under social influence is inherently bad for financial outcomes. One recent analysis of over 28 million trades on an unspecified online trading platform with social features revealed several insights that are useful for a broad risk assessment. First, investment decisions made as a form of social mirroring represent the majority (67.6%) of decisions compared to those that could be classified as independent. This implies that, when digital trading platforms make social influence features available, users' behaviours are likely significantly affected. Secondly, the study revealed a complex picture when it comes to assessing whether social trades make for poor decisions. Social mirroring, where a user copies the decisions of one or more selected traders, produced more "wins" (a trade with a net positive return) compared to independently chosen trades (84% vs 59%). However, these wins resulting from mirroring had statistically significantly lower ROIs (0.177% vs 0.183%), while ROIs on losses were also significantly more negative (-0.9% vs -0.38%).[103] Thus, while social mirroring may produce more "wins," it may also lead to lower levels of positive ROIs and higher levels of negative ROIs. Despite the evidence that social influence can have benign effects on investor outcomes, it is difficult to ignore prior events which point to a dramatic impact of mass social mirroring phenomena. This is clearly demonstrated in the 2021 "meme stock" phenomenon driven by Reddit's "wallstreetbets" forum.

Social features might interact with other gamification elements in a way that increases user risk. For instance, while it's unclear whether peer-to-peer sharing of investment decisions (which is already available on apps such as Platform 11) produces negative investment outcomes, there would likely be significant cause for concern where sharing functionalities are coupled with leaderboards (see Leaderboards) or badges (see Non-economic rewards). These two techniques have the potential to nudge users towards making decisions in a competitive mode rather than based on their individual investing goals and context, which could be heightened by embedding social interaction features.

Investors already have many options for social interactions related to investing, including prominent message boards like Reddit. However, embedding social interactions within the digital trading platform makes it much easier to act on the basis of that interaction without pause for consideration.

Potential use on digital trading platforms and impact on behaviour: We believe that most potential social interaction features are discussed in the previous sub-section, although we certainly cannot rule out further developments. For example, many digital platforms enable their users to engage in social interactions using avatars–digital personas that serve as idealized visual representations of the users. While avatars are considered a classic gamification technique and are used across a range of contexts (e.g., self-help health

[102] Chang, T. Y., Solomon, D. H., & Westerfield, M. M. (2016). Looking for someone to blame: Delegation, cognitive dissonance, and the disposition effect. *The Journal of Finance*, 71(1), 267-302.
[103] Liu, Y. Y., Nacher, J. C., Ochiai, T., Martino, M., & Altshuler, Y. (2014). Prospect theory for online financial trading. *PloS one, 9*(10), e109458.

apps[104,105], virtual meeting platforms[106]), we did not identify any instances of them being used by investing platforms. Avatars could be used to promote and encourage the forms of social interaction described above. Platforms could also create team-based competitions, as such competitions create more engagement and referrals.[107]

Social norms

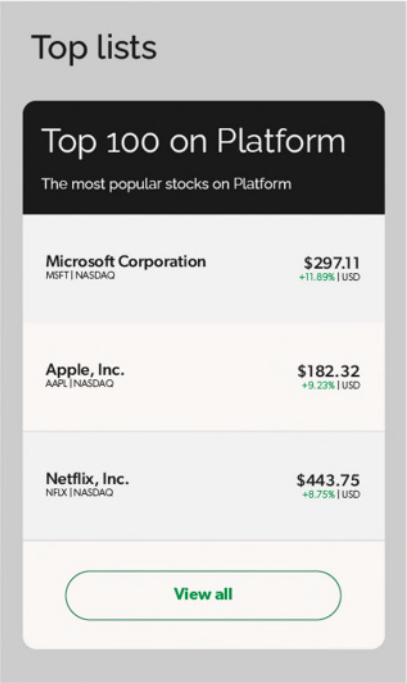


Figure 11: A modified version of Platform 10, which has several lists showing which stocks other users are trading and holding in high volumes

Definition: Design features which signal social norms—i.e., information about how others think and behave. This might involve explicitly informing individuals about statistics pertaining to relevant group behaviours (e.g., *"88% of your fellow users have invested in green energy this year"*) or implicitly signalling "crowd approval" through features such as *"This week's 100 most popular stocks"* and *"Today's trending industries."*

General use and impact on behaviour: As social animals, we are influenced by norms—that is, how we perceive others to think and behave (or how we perceive their expectations of our own thoughts and actions). When a particular norm is not known to us, or when we have little knowledge of the best course of action in a specific situation, being informed of what others are doing either implicitly or explicitly can influence our behaviour. The impact of learning about a norm is higher when that norm is surprising and the group whose behaviour and/or preferences we are being informed of feels relevant to us.

Social norm interventions are a common feature of behaviour change programs in a variety of domains. Communications about descriptive social norms, which inform people about the behaviours of others, have been found to reduce the use of plastic bags[108] and increase energy conservation[109], recycling[110], and timely tax filing[111]. Retailers frequently invoke social norms to increase product sales (e.g., "Over X million satisfied customers!"). While less common, researchers and some organizations are starting to test the impact of dynamic social norms, communicating norms in terms of change rather than absolute levels

[104] Tuah, N. M., Yoag, A., Ahmedy, F., & Baharum, A. (2019). A gamification and avatar self-representation application for diabetes self-management. *Int. J. Adv. Trends Comput. Sci. Eng*, *8*, 401-407.
[105] Hswen, Y., Murti, V., Vormawor, A. A., Bhattacharjee, R., & Naslund, J. A. (2013). Virtual avatars, gaming, and social media: Designing a mobile health app to help children choose healthier food options. *Journal of mobile technology in medicine*, *2*(2), 8.
[106] Kesel, W. (2020, Apr 1). 3 Avatar-Based Virtual Event Platforms for Planners to Consider. BizBash.com.
[107] Morschheuser, B., & Hamari, J. (2019). The gamification of work: Lessons from crowdsourcing. *Journal of Management Inquiry*, 28(2), 145-148.
[108] De Groot, J. I., Abrahamse, W., & Jones, K. (2013). Persuasive normative messages: The influence of injunctive and personal norms on using free plastic bags. *Sustainability*, 5(5), 1829-1844.
[109]Allcott, H., & Rogers, T. (2014). The short-run and long-run effects of behavioral interventions: Experimental evidence from energy conservation. *American Economic Review*, *104*(10), 3003-37.
[110]Ceschi, A., Sartori, R., Dickert, S., Scalco, A., Tur, E. M., Tommasi, F., & Delfini, K. (2021). Testing a norm-based policy for waste management: An agent-based modeling simulation on nudging recycling behavior. *Journal of Environmental Management*, 294, 112938.
[111] Behavioral Insights Team (2014). EAST: Four simple ways to apply behavioural insights. Retrieved from: https://www.bi.team/wp-content/uploads/2015/07/BIT-Publication-EAST_FA_WEB.pdf.

of behaviour (e.g., “78% more Canadians are doing X each year” versus “78% of Canadians are doing X”).[112]

Current use on digital trading platforms and impact on behaviour: Social norms are commonly leveraged on digital trading platforms. Platform 7 displays a daily *‘Top 100 stocks’* list on its homepage, which sends an implicit signal about the stocks that are receiving most attention, and thus represent a “normal” position. Platform 11 presents users with a list of *‘Most popular topics’*, capturing the most-discussed industries and investments of the day. Similar tactics are used by platforms with a presence in the Canadian market. Platform 10 features dynamic social norms through elements such as *‘Top 100 on Platform’* and a *‘Top 100 Canadian/US Stocks’* list based on the most actively traded stocks on the Canadian/US exchanges on any given day. Such lists tend to have a small sub-heading briefly explaining the list to amplify the lists’ appeal (e.g., “The most popular stocks on Platform 10”). These features have concrete implications for how retail investors make decisions. As noted above, Platform 7’s daily *‘Top 100 stocks’* list promotes “herding,” whereby disproportionately large numbers of retail investors buy or sell particular stocks at the same time.[113] In turn, herding appears to decrease investment returns, on average. It is unclear how much of this effect is driven by the salience of the information compared to the fact that it represents a social norm that might be loosely summarized as: *‘if everyone else is doing / saying it, it must be right’*.[114] We imagine that both factors contribute to the effects observed.

Potential use on digital trading platforms and impact on behaviour: We anticipate that the types of lists of commonly traded securities noted above will remain the most common form of social norm intervention deployed on digital trading platforms. More specific and personalized social norm prompts could certainly be pushed to users (e.g., “80% of investors like you are buying ACME”), although such prompts may not be permitted on self-directed digital trading platforms under IIROC rules. Were they implemented, we believe that these explicit prompts would be just as, if not more, impactful than the lists of top traded stocks.

Summary

The preceding taxonomy outlined five gamification techniques and four other behavioural techniques relevant to retail investing on digital trading platforms. For each technique, we provided a definition, outlined how the technique is used in general, how it is used on digital trading platforms today, and how it might be deployed on those platforms in the future. We also explored the positive and negative impacts these techniques may have on various retail investor behaviours. It is challenging to assess the relative impact that each of these techniques may have on investor outcomes given the novelty of these approaches and corresponding gaps in empirical research. However, based on current evidence and theory, we believe that social interactions, rewards, and gamblification techniques are likely to have the largest impact on behaviour.

[112] Sparkman, G., & Walton, G. M. (2017). Dynamic norms promote sustainable behavior, even if it is counternormative. *Psychological science, 28*(11), 1663-1674.
[113] Footnote source deleted re: Platform 7
[114] Sherif, M. (1935). A study of some social factors in perception. *Archives of Psychology, 27*: 187.

Experimental Research

Experimental Research Methodology

We conducted a randomized controlled trial (RCT) to assess the impact of two behavioural techniques on investing behaviours: (1) giving investors points with a very low value for buying or selling stocks (rewards) and (2) showing investors a "top traded list" (social norms and attention-inducing prompts). There were no fees for trading in any of the conditions. Our primary interest was in whether these techniques increased trading frequency relative to a control group not exposed to points nor to a top traded list. We also explored outcomes related to diversification of holdings, disposition effects, and, for the top traded list, stock selection.

RCTs examine the causal relationship between a condition and outcomes by eliminating the effect of potentially correlated external factors. What sets RCTs apart from other methods is that participants are randomly assigned to experiment groups, as defined below. With a sufficiently large sample, random assignment ensures that—on average—individuals across groups only differ in terms of their group assignment. By eliminating differences across groups, we ensure that any difference in outcomes can be attributed to group conditions, as opposed to other confounding factors.

Condition	Description
Control (n=803)	Participants in the Control condition traded six fictitiously-named stocks (based on real stocks) over seven simulated weeks of investing on a platform that did not include any behavioural techniques.
Points (n=811)	Participants in the points condition traded simulated stocks on a platform that included point rewards, which were prominently displayed. Participants received 100 points each time they bought or sold a stock, and every 1,200 points were worth $0.01 in additional compensation. As a result, the maximum value of these points was only about $0.08 if they traded every stock every week, a negligible but non-zero economic value.
Top Traded List (n=816)	Participants in the top traded list condition traded stocks on a platform that included a top traded list showing three stocks labelled as most actively traded on the investing simulation platform each week. The top traded list rotated each week based on the historical data on trading volumes for selected stocks, as described further below.

The experiment was conducted online in a simulated trading environment using Predictiv, BIT's proprietary platform for online experimentation. Our sample included 2,430 Canadian residents from all provinces aged 18-65 years engaging with the experiment on mobile (55%), tablet (4%), or desktop (41%) devices. Over 50% of our sample were investors.[115] Our sample was well balanced on gender (50% female) and age (median age: 35-44).

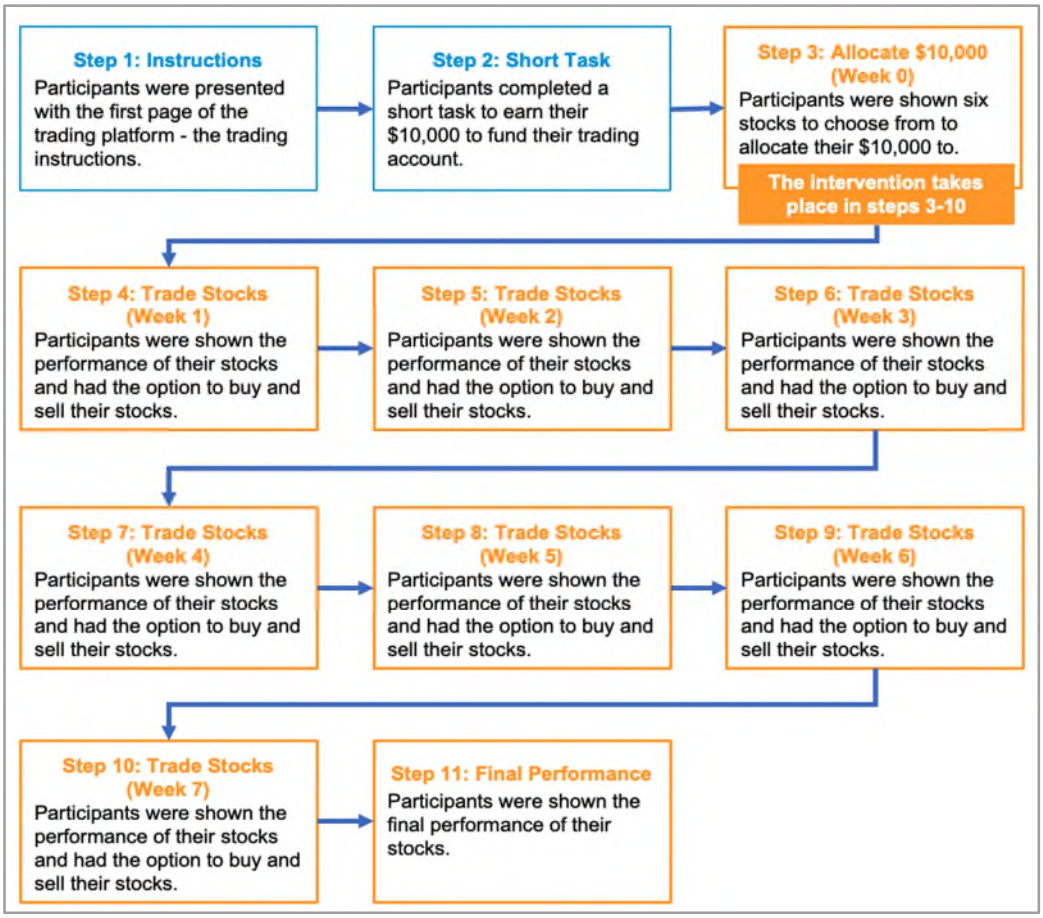
[115] Investors were defined as such by holding at least one of: individually held stocks, ETFs, securities or derivatives, bonds or notes other than Canada Savings Bonds, mutual funds, or private equity investments.

Additional demographic details are available in Appendix B (Detailed Experimental Research Findings).

Research participants received $10,000 in simulated "money" to invest in up to six different fictitiously-named stocks. After their initial allocation of funds, they were taken through seven simulated weeks of stock price movements, with an option to buy and/or sell stocks between each week. At the end of the experiment all participants received a fixed amount of approximately $1.00 for participating in the experiment. They also earned up to $1.70 additional compensation based on their balance at the end of the experiment.[116] Participants were aware that the larger the portfolio at the end of the experiment, the more they would earn. This created an incentive for participants to trade thoughtfully and to try to maximize their returns.

The following graphic provides a more detailed overview of the steps participants went through to buy and sell stocks on the simulated stock market. All participants went through the same steps regardless of which trial condition they were randomly assigned to.

Figure 12: Overview of research experiment



[116] Participants in the points condition also earned compensation based on the number of trades they made, with each trade earning 100 points and 1,200 points being worth $0.01 in additional compensation. As a result, the maximum value of these points was only $0.075, a negligible but non-zero economic value. This reflects how points are likely to be used by trading platforms based on our environmental scan.

Price movements for the fictitiously-named stocks used in our simulation were based on real stocks. To do so, we randomly selected stocks that met the following criteria: (1) listed on the Nasdaq exchange website, (2) within the technology sector, (3) with a micro ($50M-$300M) or nano (<$50M) market capitalization, and (4) an opening price below $4 per share. For the selected stocks, we used historical opening price data for eight consecutive Mondays in 2021 to determine the opening prices for each of the weeks of the experiment. The purpose was to create stocks with a similar risk profile and a medium-high level of volatility. Participants were informed at the onset of the simulation that all stock price movements were based on real, historical data.

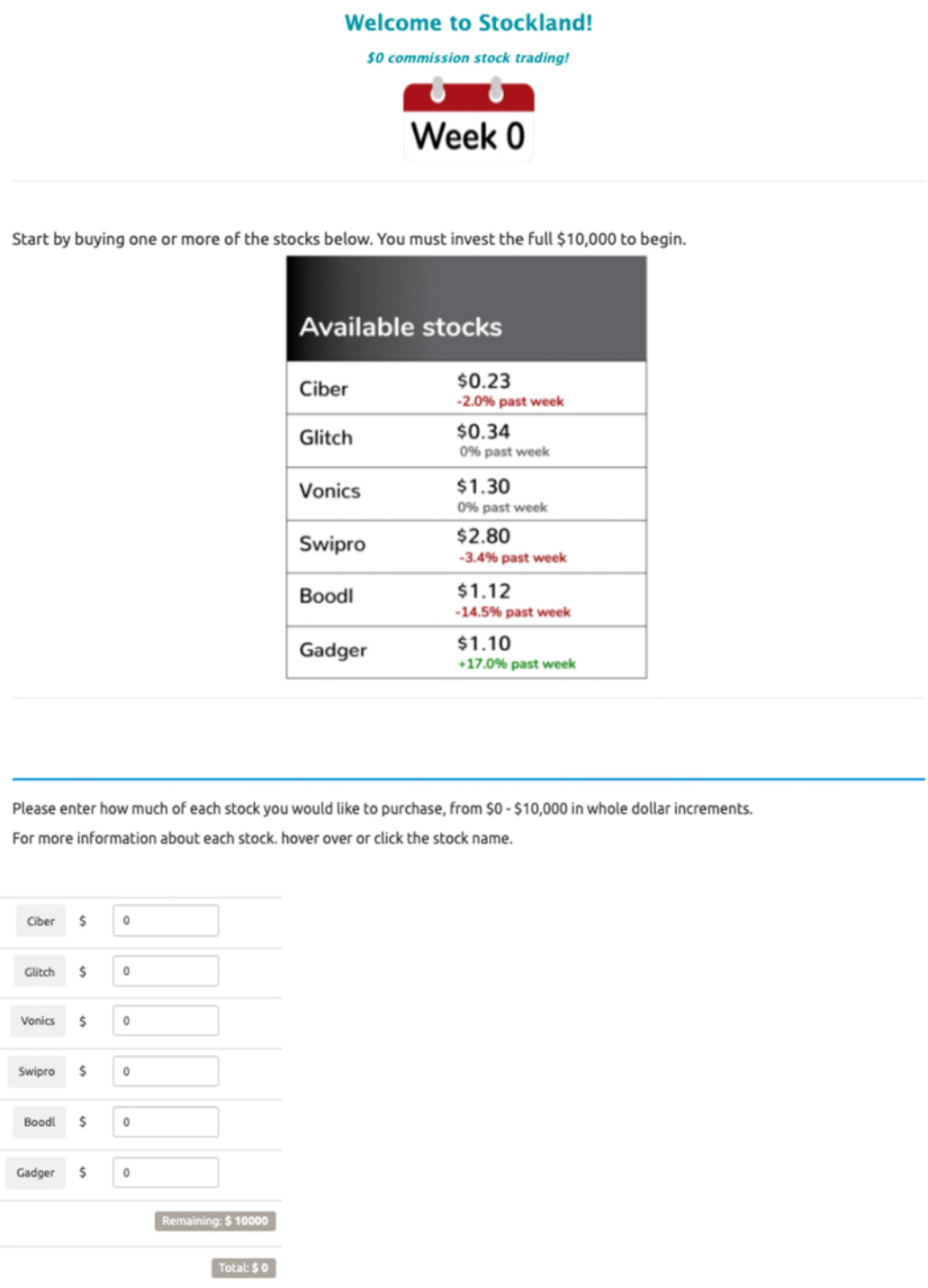
Our experiment was designed to maximize its generalizability to real-world trading. Beyond the use of variable compensation and modelling stocks on randomly selected real equities, our RCT methodology enabled us to isolate the effects of the behavioural techniques we examined, controlling for potentially confounding factors. Overall, the trial implementation was successful:

- Recruitment was effective and the study was well-powered, with more than 800 participants in each condition.
- There were no differences in attrition across groups.
- Participants engaged meaningfully with the trading simulation, with a median completion time above 12 minutes.

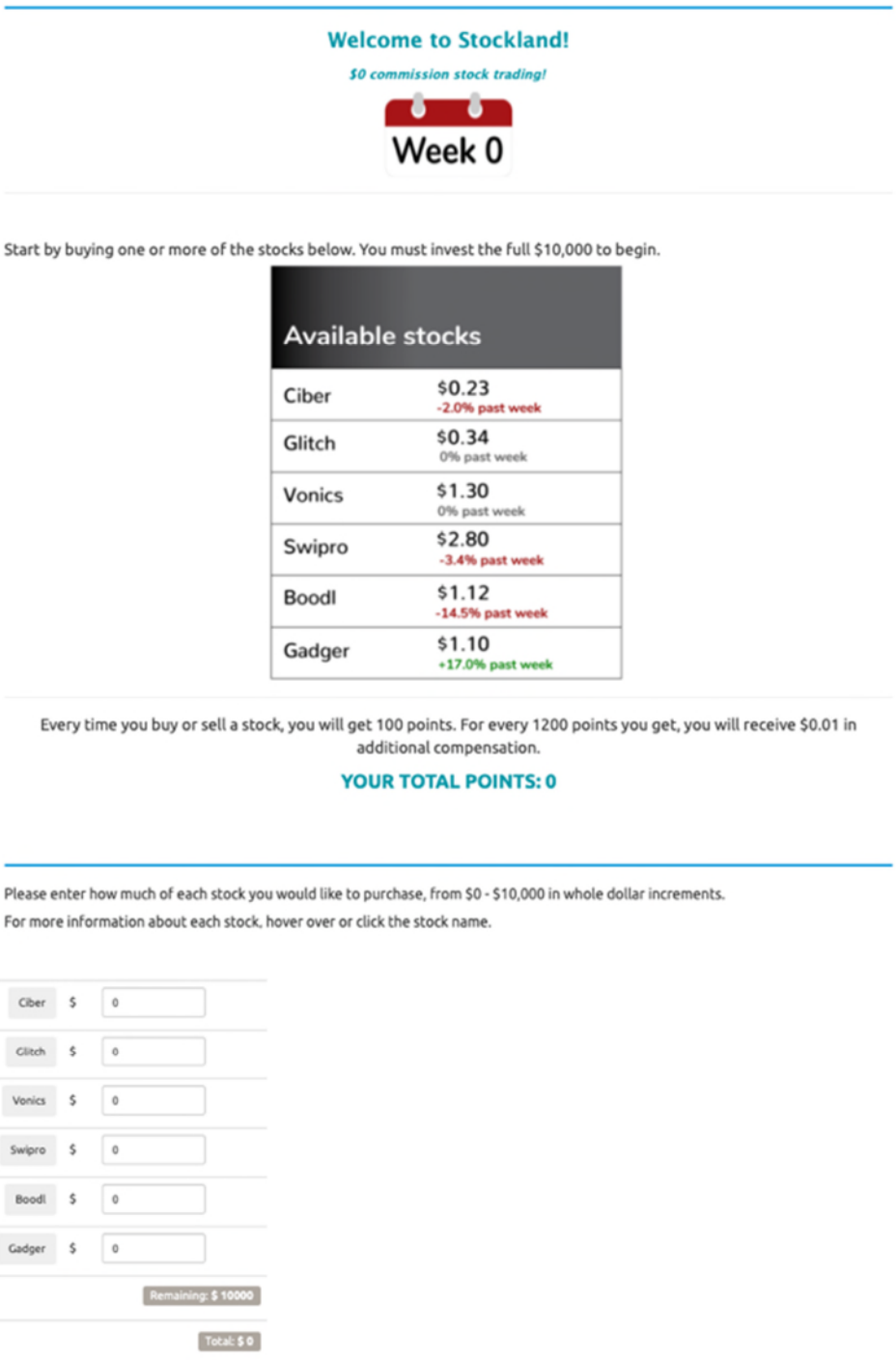
Notwithstanding the quality of the research design and execution, the nature of the study as a trading *simulation* is an important limitation. It is likely that some aspect of participant behaviour would be different in a real-world setting. For example, participants may be less risk averse in a simulated environment than they would be if their own savings were on the line. Further, the compression of trading activity into a single session cannot replicate the effects of time on investor decision-making. Real-world events like the explosion of interest in GameStop in early 2021 could prompt shifts in how behavioural techniques influence trading behaviours.

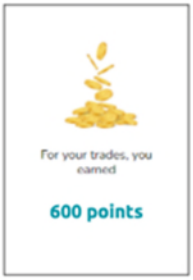
Figure 13: Selected experiment screenshots

Control condition



Points condition





Please click the 'Next' button to move on to the next week of trading.

Next

See how well your stocks performed: Another week has passed and your stocks have gone up or down.

Sell and buy more stocks: You can now sell stocks by entering the amount you want to sell in the 'sell' column. Then you will be able to buy stocks.

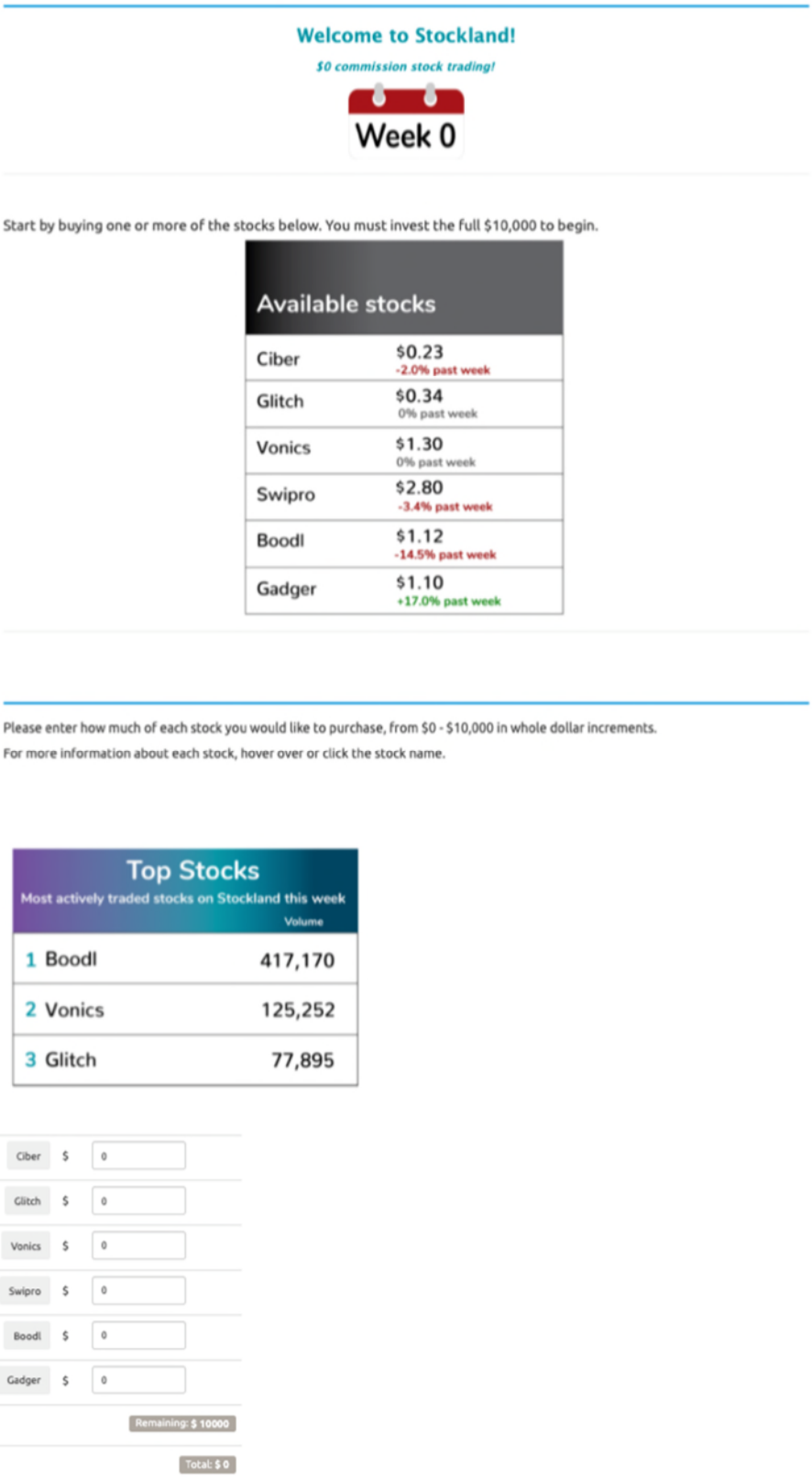
Total portfolio value = $11712 (+27.44%)

YOUR TOTAL POINTS: 1300

Stock (market cap)	Change % (past week)	Market Value	Sell
Ciber $25.22M	+35.3%	$2953 +$770	0
Glitch $3.2M	+45.2%	$2583 +$804	0
Vonics $5.68M	+2.1%	$1511 +$31	0
Swipro $1.29B	-9.1%	$819 -$81	0
Boodl $51.87M	+47.7%	$1258 +$406	0
Gadger $4.96B	+29.8%	$2588 +$594	0

Total: 0

Top Traded List condition



Another week has passed and your stocks have gone up or down. You can now sell stocks by entering the amount you want to sell in the 'sell' column. Then, you will be able to buy more stocks.

Total portfolio value = $11125 (+21.28%)

Top Stocks

Most actively traded stocks on Stockland this week

		Volume
1	Boodl	740,625
2	Vonics	165,988
3	Swipro	68,579

Stock (market cap)	Change % (past week)	Market Value	Sell
Ciber $25.22M	+35.3%	$2043 +$533	0
Glitch $3.2M	+45.2%	$2583 +$804	0
Vonics $5.68M	+2.1%	$2227 +$45	0
Swipro $1.29B	-9.1%	$1639 -$164	0
Boodl $51.87M	+47.7%	$1407 +$454	0
Gadger $4.96B	+29.8%	$1226 +$281	0

Total: 0

Next

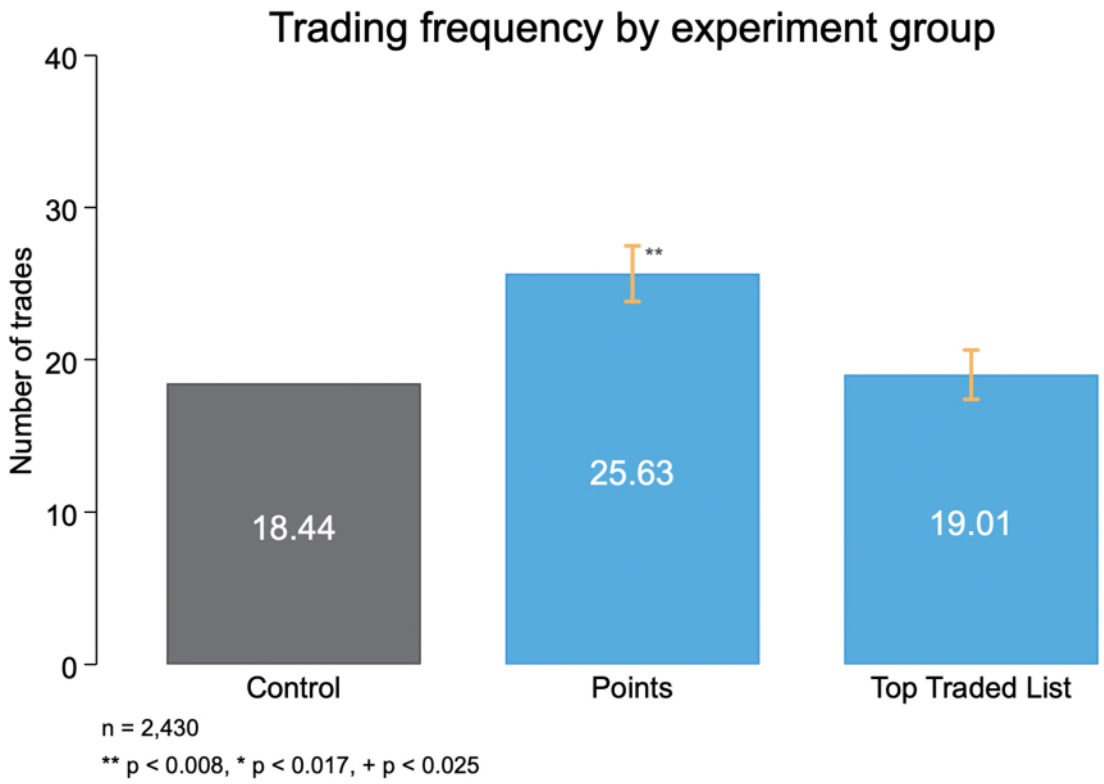
Experimental Research Findings

Primary Results: Trading Frequency

Our primary outcome of interest was trading frequency, given the potential incentive for digital trading platforms to encourage more trading and the negative impact of higher trading frequency on investor returns. We measured trading frequency as the number of times participants either buy or sell a stock over the course of the trading simulation.

As shown on Figure 14 below, **participants in the points group made 39% more trades** than the control group, a statistically significant difference.[117] Showing research participants a top traded list did not increase their trading frequency.

Figure 14: Trading frequency by experiment group



Primary analysis, controlling for age, gender, education, income, objective investing knowledge, and risk preference.[118]

[117] Our threshold for significance ($p < 0.008$) includes a Benjamini-Hochberg correction for multiple comparisons and represents a more conservative approach to statistical significance compared to the usual threshold of 0.05. Any results with p-values above 0.008 should be considered suggestive as they do not meet the pre-specified threshold for statistical significance. Error bars represent a 95% confidence interval.

[118] Note on interpreting bar graphs in this report: The height of the control group's bar represents the average outcome observed for participants in the control condition. The height of the experimental groups' bars represent what we think *would* have happened to control group participants if they had been treated in the way the experimental groups were. In other words, the heights of the Points and Top Traded List groups represent the height of the control group average plus our estimate of the effect of the treatment (based on our analysis, which controls for covariates about participants in all groups).

These findings suggest that reward-based gamification tactics can meaningfully influence investor behaviours by encouraging greater frequency of trading. This can occur even when rewards have a negligible economic value for investing, as in our simulation. This finding is important because more frequent trading has been shown to yield poorer investment outcomes for retail investors, especially among those with less investment knowledge or experience.[119]

Secondary Results: Diversification

Our secondary outcome of interest was participants' diversification, defined as the extent to which investors diversify their money across the six different stocks investors could buy and sell throughout the experiment.[120] Diversification is a critical risk mitigation strategy for investors.

There were **no differences across experiment groups on participants' diversification**. On average, participants' diversification scores across groups ranged from 0.69 to 0.71 on a 0-1 index, where 1 represents an equal allocation of funds across all investment options. These findings suggest that exposure to these two techniques is not associated with significantly less diverse investment portfolios. We had hypothesized that the top traded list may reduce diversification by concentrating trading in the listed stocks. While we did not observe that in our trial, diversification outcomes may be influenced by other factors, such as the limited number of available stocks and their characteristics as well as the limited number of 'weeks' of trading, that we could not fully model in our experiment.

Exploratory Results

The experiment provided rich data on a wide range of other investor behaviours and choices. This section summarizes the additional analysis that we did using this additional data that went beyond what was required to answer our core research questions.

Impact of top traded list on stock selection

Participants in the top traded list group bought and sold more of the stocks on that list than participants in the other groups. As shown in Figure 15 below,[121] 44% of the total value of the stocks bought or sold in a given week in the control group (and points group) were from the top traded list, but that value was 50% in the top traded list group. This is a 14% relative increase. This effect was somewhat stronger for buying stocks than it was for selling stocks, and as a result we see participants holding more of the top traded list stocks in the top traded group than in the control group.[122]

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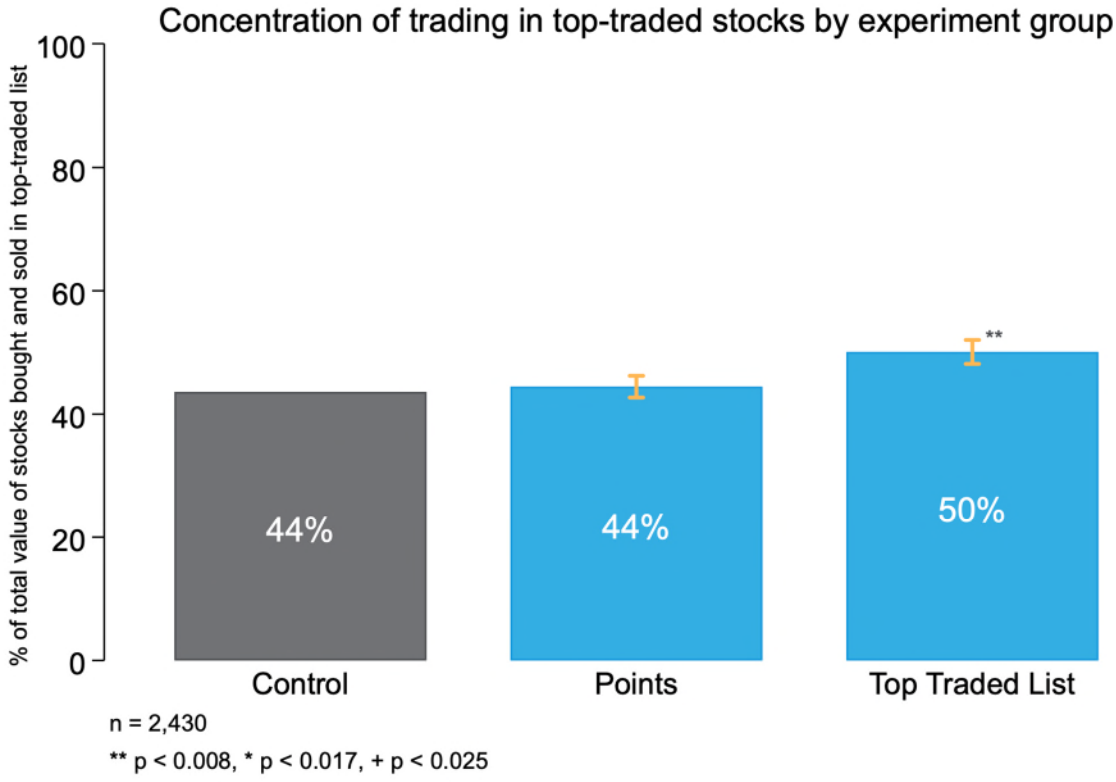
[119] Odean, T. (1999). Do investors trade too much? American economic review, 89(5), 1279-1298.
[120] This was measured using the inverse of an indicator of deviation (in terms of sum of squared errors) from a uniform distribution of resources across all available investments, which we labelled a 'Diversification Index'. A value of 1 would mean a completely equal distribution of funds across the stocks. A value of 0 would mean that only one stock was held. Additional details on this measure are available in Appendix C.
[121] The number of participants analyzed (n) varies for these analyses as they only includes participants who helds stocks across each week in the experiment.
[122] Supplemental analyses focused on stock *selling* and *holding* further elucidate these findings. On average, participants who saw the top traded lists had a 49% likelihood of selling a top traded stock in a given week, an 11% increase relative to participants in the control group (who had a 44% chance of selling a top traded stock). Overall, 51% of the stocks held by the group that saw the top traded list were on that list, a 7% relative increase compared to the control group (48%).

These findings reinforce analysis conducted by Barber et al. (2020) showing that a salient list of stocks frequently traded by other investors shifts trading activity toward those stocks.[123] That study also shows that this negatively influences investor returns.

Figure 15: Amount of top traded stocks bought and sold as a percentage of total amount traded.



Exploratory analysis, controlling for age, gender, education, income, objective investing knowledge, and risk preference.

Final fund values

There is a robust evidence base linking increased trading volume to lower retail investor returns over time.[124] This can be attributed to the timing of retail investor trades relative to other (e.g., institutional) traders, as well as transaction fees and other costs related to trading. In our experiment, there were no transaction fees or other related charges, which would have decreased final fund values for participants with greater trading frequency. Other aspects of our experimental design – including the single-session limit on decision time horizons, number of stocks available, and stock types – are different from real-world trading. Given these factors, we did not hypothesise that either gamification conditions would impact participants' final fund balance at the end of the trading session. Indeed, we find statistically similar balances at the end of the session across all three groups.[125]

[123] Barber, B. M., Huang, X., Odean, T., & Schwarz, C. (2020). Attention induced trading and returns: Evidence from Robinhood users. *Journal of Finance* (Forthcoming).
[124] Barber, B.M. and Odean, T. (2000), Trading Is Hazardous to Your Wealth: The Common Stock Investment Performance of Individual Investors. *The Journal of Finance*, 55: 773-806.
[125] All participants started the simulation with $10,000 and, on average, ended with fund values ranging from $12,395 to $12,516 across groups.

Disposition effect analysis

The disposition effect refers to the tendency of investors to sell assets that have increased in value while keeping assets that have dropped in value. This tendency can negatively impact investor returns, and we wanted to measure whether either of the behavioural techniques had an impact on the disposition effect.

To measure the disposition effect, we created a variable for each stock, at each experiment screen (i.e., week), indicating if price increased or decreased. We then assessed the effect of price increase or decrease on participants' likelihood of purchasing or selling the stock. We found that, on average, there was not a disposition effect observed in any of the groups, and there were no differences in disposition effect across groups.[126] The lack of disposition effect, which is present in most investing contexts, was driven by investors in our experiment holding onto winning investments at a high rate. We hypothesize that this is driven by lower risk aversion by our research participants than real-world investors.

We also assessed the extent to which disposition effects impact trading frequency.[127] We found a statistically significant correlation. This suggests that **people who exhibit a greater disposition effect are also more likely to make more trades**. A 10% increase in participants' disposition effect index was associated with approximately one additional trade being made. The positive correlation between participants' disposition effects and trading frequency suggests that a higher disposition effect may increase trading frequency as individuals make a greater number of buy and sell decisions in response to market price fluctuations. Alternatively or additionally, there may be one or more factors that affect both outcomes. For example, individuals who are more prone to the disposition effect are more likely to be making trades based on intuitive, rather than deliberative, decision-making processes, which in turn may yield greater trading frequency.

[126] For each participant, we calculated a disposition effect index that varied between 0 and 1, where 1 represented a total disposition effect – that is, a hypothetical situation in which a participant always retains losing stocks and always sells winning stocks. A value of 0.5 was indicative of neutral behaviour – i.e., participants being no more likely to lean towards buying or selling as a result of a winning or losing outcome. We do not observe a disposition effect across groups as the average disposition effect index was below 0.5 for all groups. Additional details on our disposition effect calculations are available in Appendix C (Experimental Research Analysis Technical Details).

[127] To do so, we regressed each participants' disposition effect coefficient on their frequency of trading.

Conclusion: Considerations for Regulators

A wave of digital, mobile-friendly self-directed investing platforms has created new options for retail investors in Canada and around the world. While these platforms have expanded market participation, there is growing concern over some of the digital engagement practices used by them and (to a lesser extent) by more traditional retail investment platforms.

The goal of this research is to support the Ontario Securities Commission (OSC) and other regulators and stakeholders in understanding and responding to these new developments: to help chart an effective, evidence-informed path forward as digital trading platforms continue to evolve and grow.

Across the research activities, we found significant gaps in the empirical literature; very few studies have examined the impact of these techniques on various investor behaviours. There are notable exceptions. For example, there is good evidence that top traded lists can induce "herding" behaviour by concentrating investor attention on salient stocks,[128] and that an assortment of gamification tactics used in a simulated trading environment can increase investor risk-taking.[129]

Our research on behalf of the OSC adds another critical finding, that offering rewards (points) with negligible economic value may dramatically increase trading frequency. Based on this finding, **we recommend that regulators consider whether to limit digital trading platforms from offering points or other rewards for trading activity**. We also believe that regulators should consider collecting more data on how top traded lists (whether it be most actively traded, top movers or otherwise) influence retail investor behaviour including investor allocations to those stocks on the "top lists".

While our research program produced insightful findings of the effects of points and top traded lists on trading frequency, we should be cognizant of the effects of other gamification behavioural techniques on investor behaviours. Thus, we further recommend that the OSC and other regulators gather more data, especially for other techniques (e.g., gamblification, feedback, social interactions, etc.). To do so, we recommend more studies be conducted on simulated investing platforms, akin to our work as well as that of Chapkovski et al.[130] Regulators should also seek to leverage data collected by digital trading platforms. This could include data from A/B tests of new digital engagement practices (DEPs). If DEPs have not been A/B tested, historical data on key investor outcomes, including trading frequency, types of transactions (e.g., margin trades, options), and other behaviours before and after new DEPs have been introduced would be almost as valuable. This additional data will enable the OSC and other regulators to set new, empirically-driven strategies based on high-quality evidence.

We particularly recommend further evidence generation on social interactions, rewards, and gamblification. Based on our literature scan, these are the behavioural techniques in our taxonomy that are likely to have the largest impact on behaviour.

[128] Barber, B. M., Huang, X., Odean, T., & Schwarz, C. (2020). Attention induced trading and returns: Evidence from Robinhood users. *Journal of Finance* (Forthcoming).
[129] Chapkovski, P., Khapko, M., & Zoican, M. (2021). Does gamified trading stimulate risk taking?
[130] Chapkovski, P., Khapko, M., & Zoican, M. (2021). Does gamified trading stimulate risk taking?

In addition to collecting data focused on DEPs, we encourage regulators to generate and collect evidence and data on potential strategies to *mitigate* potentially negative impacts of DEPs on investor choices to determine if mitigation approaches are effective. For example, there are theoretical reasons to believe that imposing moments of frictions in executing a trade could, to a certain extent, counterbalance the tendency of some gamification techniques to encourage less deliberative trading decisions.

Last, we encourage more exploration of the *positive impacts* that gamification and other behavioural techniques can have on investor behaviours. For example, simplification of the user experience is likely to increase market participation, reduce confusion, and save investors time. Feedback techniques have proven very effective in educational contexts; digital trading platforms could use these same approaches to enhance their users' investing knowledge and expertise.

Appendix A: Use of Gamification and Other Tactics on Trading Platforms

Table 1. Gamification and behavioural tactics identified on retail investing platforms surveyed in the period of 1–30 September 2021.

			GAMIFICATION & OTHER BEHAVIOURAL TACTICS								
	Location*	How platform was reviewed	Gamblification	Leader-boards	Rewards	Social interactions	Social norms	Salient prompts	Progress framing	Feedback	Simplification
Platform 1	Canada	Android (demo)	No	No	No	Yes	Yes	No	No	No	Yes
Platform 2	USA	Android (demo)	Yes	Yes	No	Yes	Yes	Yes	No	No	No
Platform 3	Canada/ USA	Web (demo)	No	No	No	No	Yes	No	No	No	Yes
Platform 4	Canada	iOS (demo)	No	No	No	No	No	No	No	No	Yes
Platform 5	Canada	iOS (demo)	No	No	No	Yes	No	No	No	No	No
Platform 6	Canada	Android (account)	No	No	No	No	No	No	No	No	No
Platform 7	USA	Web search	Yes	No	No	No	Yes	Yes	No	No	Yes
Platform 8	USA	Web search	Yes	Yes	Yes	Yes	Yes	No	No	No	No

Platform 9	USA	Web search	No	No	No	No	No	No	No	No	No
Platform 10	Canada	iOS (account)	Yes	No	Yes	No	Yes	Yes	No	No	Yes
Platform 11	USA	Android (demo)	No	No	Yes	Yes	Yes	Yes	No	No	No
Platform 12	USA	iOS (demo)	No	No	No	No	Yes	No	No	No	Yes

Legend and Notes

- Platforms were reviewed on Android, iOS or Web.
- Some platforms enabled us to review features without creating an account. These platforms are labelled “(demo)” in the table above.
- Where we needed to create an account to review the features, the platforms are labelled “(account)”.
- If we could not create an account (e.g., for certain US platforms), we conducted a web search (e.g., review of videos, news articles) to try to identify gamification and other behaviourally-informed features. These platforms are labelled “web search.”
- We attempted to review a Canadian bank’s platform, but investigating any features required provision of banking details. We attempted a web search but the information available was quite limited. To the best of our understanding, it does not include any gamification or other behavioural tactics, but because of the limitations we did not want to include it in this table due to the limitations of our review.

**These are the jurisdictions where these platforms are available to retail investors.

Appendix B: Detailed Experimental Research Findings

Results by Experiment Group

Primary analysis: Trading frequency

Total Trades					
Group	**Mean**	**Standard Deviation**	**Minimum value**	**Maximum value**	**Observations**
Control	18.44	16.84	1	90	803
Points	25.51	20.06	1	90	811
Top Traded List	18.90	16.38	1	90	816
					N = 2,430

Regression analysis:

The regression coefficient on the Points condition, 7.19 (CI: 5.4, 9.0), shows that random assignment to the Points group caused participants to, on average, conduct approximately 7 more trades compared to participants in the control group (p=0.00). Therefore, exposure to the Point-based rewards increased trading frequency by 39%. The regression coefficient on the Top Traded condition, 0.57 (CI: -1.0, 2.2), was not statistically significant (p=0.49).

Average Diversification Index					
Group	**Mean**	**Standard Deviation**	**Minimum value**	**Maximum value**	**Observations**
Control	0.70	0.27	0	1	803
Points	0.69	0.27	0	1	811
Top Traded List	0.70	0.27	0	1	816
					N = 2,430

Regression analysis:

Regression coefficients were similar and not statistically significant for the Points condition (-0.01; CI: -0.03, 0.02; p=0.62) and the Top traded condition (0.01; CI: -0.02, 0.03; p=0.54).

Exploratory analyses

Average Ratio of Top Traded Stocks Held

Group	Mean	Standard Deviation	Minimum value	Maximum value	Observations
Control	0.48	0.13	0.08	1	780
Points	0.48	0.12	0.04	1	802
Top Traded List	0.50	0.14	0	1	791
					N = 2,373

Regression analysis:

The OLS regression coefficient, 0.035 (CI: 0.02, 0.05; p=0.00) suggests that exposure to a list labelling a number of stocks as “top traded” was associated with a 7% increase in the ratio of these stock holdings. In contrast, the regression coefficient on the Points condition, 0.01 (CI: -0.01, 0.02), was not statistically significant (p=0.41).

Average Ratio of Top Traded Stocks Sold

Group	Mean	Standard Deviation	Minimum value	Maximum value	Observations
Control	0.44	0.26	0	1	670
Points	0.45	0.22	0	1	725
Top Traded List	0.49	0.26	0	1	696
					N = 2,091

Regression analysis:

The OLS regression coefficient, 0.049 (CI: 0.02, 0.08; p=0.00) suggests that exposure to a list

labelling a number of stocks as “top traded” was associated with an 11% increase in the ratio of these stock sold. In contrast, the regression coefficient on the Points condition, 0.005 (CI: -0.02, 0.03), was not statistically significant (p=0.72).

Average Ratio of Top traded Stocks Bought and Sold

Group	Mean	Standard Deviation	Minimum value	Maximum value	Observations
Control	0.44	0.19	0	1	803
Points	0.45	0.17	0	1	811
Top Traded List	0.50	0.21	0	1	816
					N = 2,430

Regression analysis:

The OLS regression coefficient, 0.065 (CI: 0.05, 0.08; p=0.00) suggests that exposure to a list labelling a number of stocks as “top traded” was associated with a 14% increase in the ratio of these stock sold. In contrast, the regression coefficient on the Points condition, 0.08 (CI: -0.01, 0.03), was not statistically significant (p=0.35).

Final Fund Value

Group	Mean	Standard Deviation	Minimum value	Maximum value	Observations
Control	12,394.63	1952.09	5379	22,448	803
Points	12,420.80	1991.44	5695	22,197	811
Top Traded List	12,515.81	2071.25	6784	22,047	816
					N = 2,430

Regression analysis:

Regression coefficients were not statistically significant for the Points condition (44.5; CI: -149.4, 238.3; p=0.65) and the Top Traded condition (133.4; CI: -64.5, 331.3; p=0.19).

Average Disposition Effect					
Group	**Mean**	**Standard Deviation**	**Minimum value**	**Maximum value**	**Observations**
Control	0.33	0.15	0	0.86	803
Points	0.34	0.17	0	1	811
Top Traded List	0.34	0.15	0	1	816
					N = 2,430

Regression analysis:

Regression coefficients for the Points (0.01; CI: -0.01, 0.02; p=0.36) and Top Traded (0.01; CI: -0.01, 0.02; p=0.45) conditions were not statistically significant.

Background Questions and Demographics

Investor Status	
Reports holding an investment product (i.e., individually held stocks, ETFs, securities or derivatives, bonds or notes other than Canada Savings Bonds, mutual funds, or private equity investments.	55.27%
Does not report holding an investment product	44.73%
	N = 2,430

Gender	
Female	49.26%
Male	50.00%
Other	0.74%
	N = 2,430

Province	
Ontario	46.30%
Alberta	13.17%
British Columbia	12.72%
Quebec	10.53%
Manitoba	4.94%
Nova Scotia	3.79%
Saskatchewan	3.25%
New Brunswick	3.21%
Newfoundland and Labrador	1.40%
Prince Edward Island	0.45%
Northwest Territories	0.12%
Nunavut	0.08%
Yukon	0.04%
	N = 2,430

Age	
18-24	10.62%
25-24	24.90%
35-44	25.80%
45-54	18.89%
55-65	19.79%
	N = 2,430

Ethnicity	
Asian (including Chinese, Japanese, Korean, etc.)	10.25%
Black / African Canadian / Caribbean	5.57%

British / Scottish / Irish / Welsh	16.09%
Canadian only	29.55%
Eastern European, including Russia	2.43%
Hispanic / Latin American	2.26%
Middle Eastern	5.27%
South Asian (including India, Pakistan, Sri Lanka, Bangladesh, Nepal)	2.96%
Southeast Asian (including Burma, Thailand, Vietnam, Laos, Cambodia, Philippines, Singapore, etc.)	12.30%
Western European	3.42%
First Nations / Métis / Inuit	6.38%
Other	3.62%
	N = 2,430

Household Annual Income Before Taxes	
Less than $14,999	8.07%
$15,000 to $19,999	3.74%
$20,000 to $22,499	3.91%
$22,500 to $24,999	1.93%
$25,000 to $27,499	3.09%
$27,500 to $29,999	2.63%
$30,000 to $32,499	3.13%
$32,500 to $34,999	2.63%
$35,000 to $37,499	2.67%
$37,500 to $39,999	2.51%
$40,000 to $42,499	3.00%
$42,500 to $44,999	2.51%
$45,000 to $47,499	2.76%
$47,500 to $49,999	2.96%

$50,000 to $52,499	3.87%
$52,500 to $54,999	1.73%
$55,000 to $59,999	4.40%
$60,000 to $69,999	6.83%
$70,000 to $79,999	7.08%
$80,000 to $89,999	5.06%
$90,000 to $99,999	4.65%
$100,000 to $124,999	8.19%
$125,000 to $149,999	3.83%
$150,000 and above	4.77%
Prefer not to say	4.03%
	N = 2,430

Employment Status	
Employed full-time	48.77%
Employed part-time	11.03%
Self-employed full-time	4.98%
Self-employed part-time	3.46%
Active military	0.25%
Inactive military/Veteran	0.04%
Temporarily unemployed	8.68%
Full-time homemaker	5.60%
Retired	7.13%
Student	5.68%
Disabled	3.58%
Prefer not to answer	0.82%
	N = 2,430

Highest Level of Education Completed	
3rd Grade or less	4.90%
Middle School - Grades 4 - 8	19.05%
Completed some high school	14.65%
High school graduate	26.46%
Other post high school vocational training	4.16%
Completed some college, but no degree	17.49%
College/University Degree	12.31%
Prefer not to say	0.99%
	N = 2,430

Device used to complete activity	
Desktop computer	41.40%
Mobile phone	54.84%
Tablet	3.76%
	N = 2,430

Self-reported overall knowledge of financial matters	
Very low	12.35%
Low	23.09%
Average	48.81%
High	12.30%
Very high	3.46%
	N = 2,430

Objective knowledge score	
0/3 questions correctly	13.46%

answered	
1/3 questions correctly answered	26.05%
2/3 questions correctly answered	43.50%
3/3 questions correctly answered	17.00%
	N = 2,430

Years of experience holding an investment account	
0	46.30%
Between 0 and 5	28.31%
Between 5 and 10	9.59%
Between 10 and 15	3.99%
Between 15 and 20	4.98%
Between 20 and 25	2.30%
Between 25 and 30	2.31%
More than 30	2.22%
	N = 2,430

Type of management of primary investment account	
I work with, or have, an **advisor** or portfolio manager or exempt market dealer	22.14%
I use an **online investment adviser/robo-adviser** that selects investments on my behalf (e.g., Wealth Simple, Questrade, Nest Wealth)	10.16%
I am a **self-directed** investor, I do not work with an advisor and I manage my own investments through a discount brokerage (order execution only account), mostly through an online platform **on my computer**	12.47%
I am a **self-directed** investor, I do not work with an advisor and I manage my own investments through a discount brokerage (order execution only account), mostly	8.31%

through an app **on my phone or tablet**	
I only have investments through my employer's **pension plan**	2.18%
N/A	44.73%
	N = 2,430

Attitude towards risk when making investing decisions	
I am **very conservative** and try to minimize risk and avoid the possibility of any loss	26.21%
I am I am **conservative** but willing to accept a small amount of risk and possibility of loss	39.67%
I am willing to accept a **moderate** level of risk and tolerate moderate losses to achieve potentially higher returns	28.68%
I am **aggressive** and typically take on significant risk. I can tolerate large losses for the potential of achieving higher returns	5.43%
	N = 2,430

Appendix C: Experimental Research Analysis Technical Details

Trading Frequency

To assess differences in the number of trade decisions made between the control condition (Group 1) and each of the two experimental conditions (Groups 2 and 3), we examined the treatment effect of condition using an OLS regression model:

$$\mathbf{Freq = \alpha + \beta T_i + e}$$

Where:

i represents the individual, with Var_i representing the value of hypothetical variable Var for the i^{th} participant

Freq is our outcome variable, which represents trade number counts and takes on values ranging from 1 to 90 (the number of trading instances in the experiment and thus the maximum possible trade count a participant can have).

T is a categorical indicator for the treatment groups, which is to be used as a predictor of the outcome variable and can take on the value of 0, 1, or 2

β is the coefficient of interest – a scalar which represents the impact that being assigned to each of the three groups has on the number of trades a participant makes

α is the regression constant

e is the error term

Diversification Index

Our diversification index (DI) involves summing the squares of deviation from uniform allocation for each given stock, and then dividing the sum by the score participants would get if they concentrated all their funds into a single stock. Doing this yields a value that varies continuously between 0 and 1, where 1 = anti-diversification. Subtracting this amount from 1 then allows us to flip this value into a 0 to 1 scale where 0 represents anti-diversification and 1 represents maximal diversification (as defined by equal allocation of funds across all investment options).[131]

As defined for a single simulated week, the DI was estimated as follows:

$$\mathbf{DI = 1 - (sum\ [(M/6 - (X\_n)]\^2) / H}$$

Where:

[131] Note: While diversification would usually also take into account some measure of riskiness (e.g. having a good balance of riskiness of stocks), as well as the overall quantity of investments, ours purely takes into account the "spread" of money across different stock options. This is because: (1) stocks included in this experiment have been designed to have very similar risk profiles, and (2) the experiment specifies a low ceiling for quantity of investments and thus requires a metric of diversification that is 'blind' to the total number of possible investments.

M equals the total amount of money held by each investor at each experiment screen.

M/6 represents the amount that would be invested in that stock if the investor engaged in uniform distribution of funds across all the available stocks (e.g., at experiment onset, $10,000/6=$1666.67).

n represents each stock, 1-6

X_n is the amount invested in stock option n

H represents the sum of squared errors that a participant would receive if they allocated all their funds into a single stock to the detriment of all other options. This differs across simulated weeks due to the variation in available funds.

To assess differences in the Diversification Index (DI) between the control condition (Group 1) and each of the two experimental conditions (Groups 2 and 3), we examined the treatment effect of condition using an OLS regression model:

$$DI_i = \alpha + \beta T_i + e$$

Where:

i represents the individual, with Var_i representing the value of hypothetical variable Var for the i^{th} participant

DI is our outcome variable, which varies continuously between 0 and 1

T is a categorical indicator for the treatment groups, which is to be used as a predictor of the outcome variable and can take on the value of 0, 1, or 2

β is the coefficient of interest – a scalar which represents the impact that being assigned to each of the three groups has on a participant's diversification index

α is the regression constant

e is the error term

Disposition Effects

For each participant, we calculated a disposition effect coefficient as follows:

$$\left(\frac{\#\text{ losing stocks that are retained}}{\text{total \# losing stocks}} \times \frac{\text{total \# losing stocks}}{\text{total \# of all stocks}}\right) + \left(\frac{\#\text{ winning stocks that are sold}}{\text{total \# winning stocks}} \times \frac{\text{total \# winning stocks}}{\text{total \# of all stocks}}\right)$$

Here, fractions marked in blue served the purpose of differentially weighting decisions made in the loss and gain domains based on the relative frequencies of gains and losses in the total pool of investment outcomes.

The resulting index varies between 0 and 1, where 1 represents complete disposition – that is, a hypothetical situation in which a participant *always* retains losing stocks and *always* sells winning stocks. A value of 0.5 should be indicative of neutral behaviour – i.e., participants being no more likely to lean towards buying or selling as a result of a winning or losing outcome. Each participants' disposition effect coefficient was calculated for each week of trading and averaged to yield a single measure.

To assess for potential differences in the disposition effect (DE) between the control condition (Group 1) and each of the two experimental conditions (Groups 2 and 3), we

examined the treatment effect of condition using an OLS regression model:

$$\mathbf{DE = \alpha + \beta T_i + e}$$

Where:

i represents the individual, with Var_i representing the value of hypothetical variable Var for the i^{th} participant

T is a categorical indicator for our treatment groups, which is to be used as a predictor of the outcome variable and can take on the value of 0, 1, or 2

β is the coefficient of interest – a scalar which represents the impact that being assigned to each of the three groups has on a participant's disposition effect

α is the regression constant

ϵ is the error term

Further, to assess for a potential impact of disposition effect on overall trading frequency, we used an OLS regression mode as follows:

$$\mathbf{Freq = \alpha + \beta DE_i + e}$$

Where:

i represents the individual, with Var_i representing the value of hypothetical variable Var for the i^{th} participant

Freq is our outcome variable, which represents trade number counts and takes on values ranging from 0 to 90 (the number of trading opportunities in the experiment and thus the maximum possible trade count a participant can have).

DE is a continuous measure of the disposition effect, which takes on values between 0 and 1 and serves as our independent variable

β is the coefficient of interest – a scalar which represents the impact that each additional unit on the disposition effect scale has on a participant's frequency of trading

α is the regression constant

e is the error term

Exposure to Top Traded List

We compared the proportion of individuals' stock ownership that consists of stocks featured on a top traded list in Group 3 with the proportions derived using those same stocks in Groups 1 and 2. This fraction was computed separately for each simulated trading week as shown below, prior to being averaged across these weeks

$$\frac{\text{\# stocks held from top-traded list (a value between 0 and 3)}}{\text{total \# stocks held (a value between 1 and 6)}}$$

Individual participants' fractions (which we termed stock ratios; SR) then served as inputs for an OLS regression model as follows:

$$\mathbf{SR = \alpha + \beta T_i + e}$$

Where:

i represents the individual, with Var_i representing the value of hypothetical variable Var for the i^{th} participant

SR is our outcome variable, which represents a fraction varying continuously between 0 and 1 (where 1 represents 100% of all stock ownership being confined to the top traded list)

T is a binary indicator for the treatment groups, which is to be used as a predictor of the outcome variable and can take on the value of 0 (given to all participants in Groups 1 and 2) or 1 (given to participants in Group 3, which are 'positive' for the top traded stock list exposure)

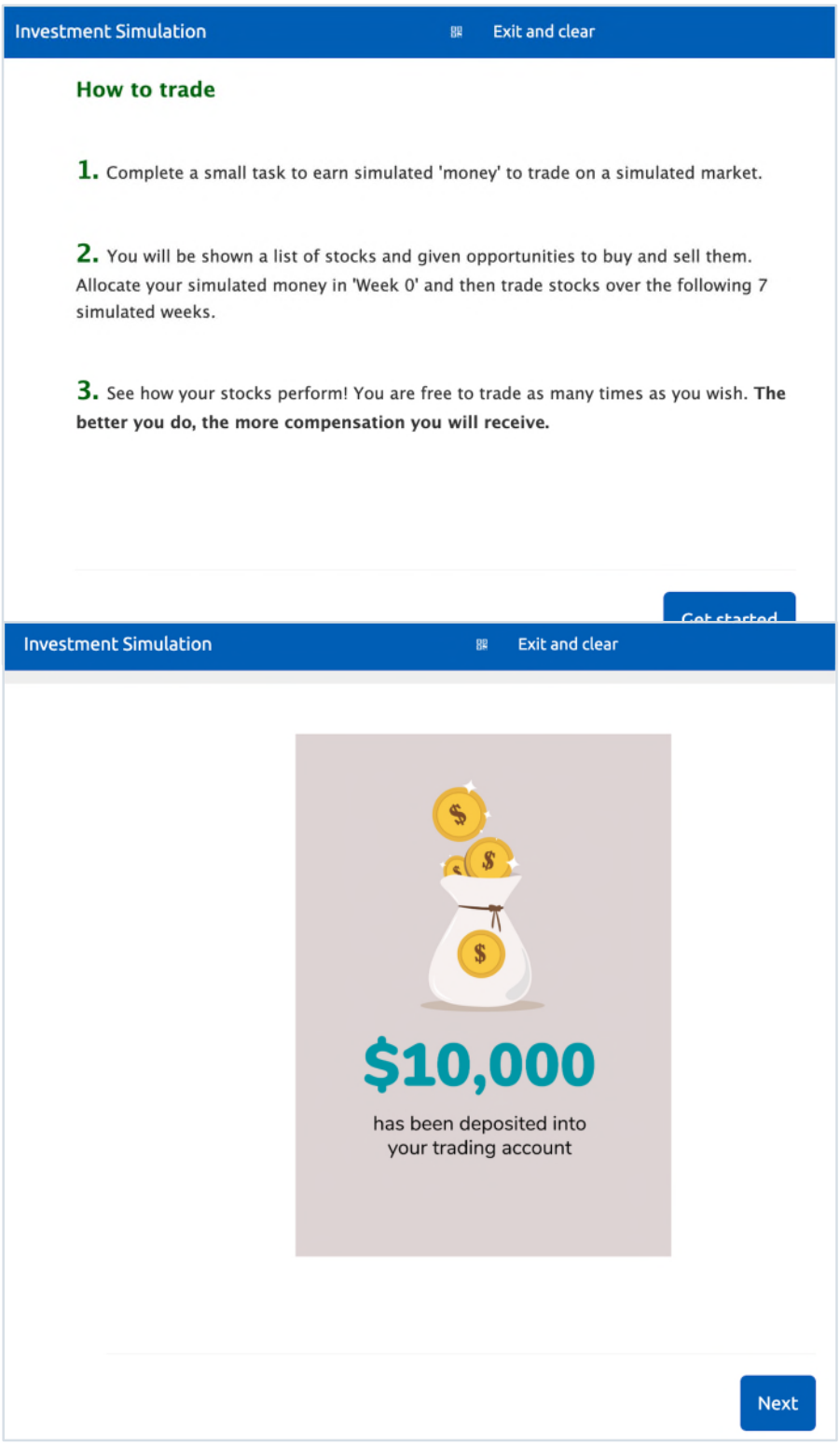
β is the coefficient of interest – a scalar which represents the impact of the presence or absence of a top traded list on purchasing decisions

α is the regression constant

e is the error term

Appendix D: Experimental Research Screens

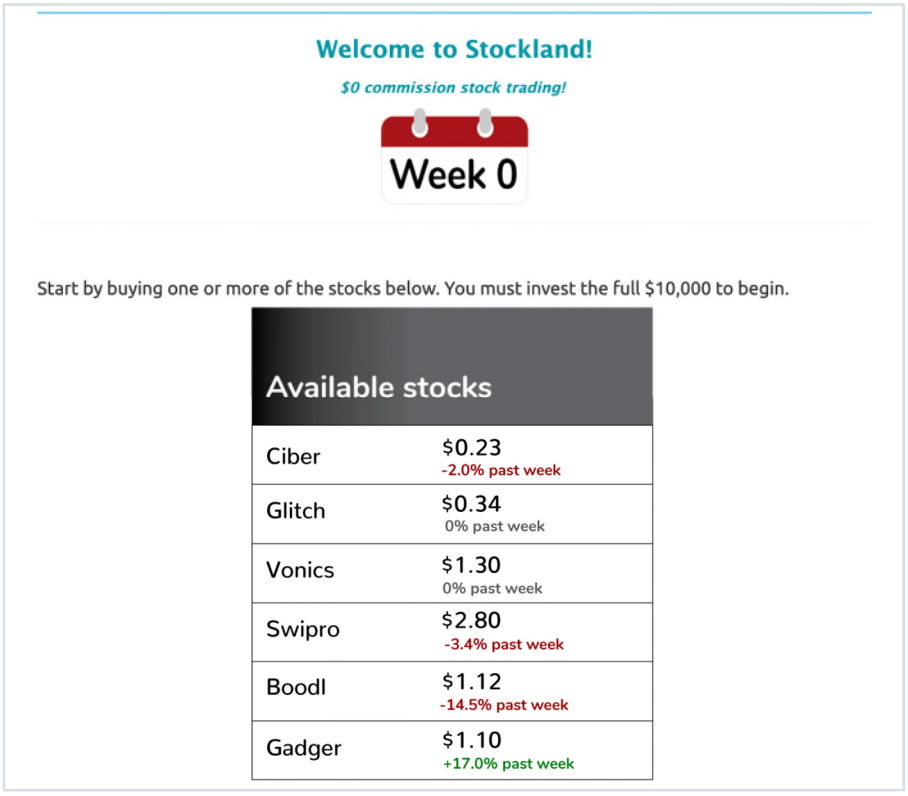
Introduction screens (all conditions)

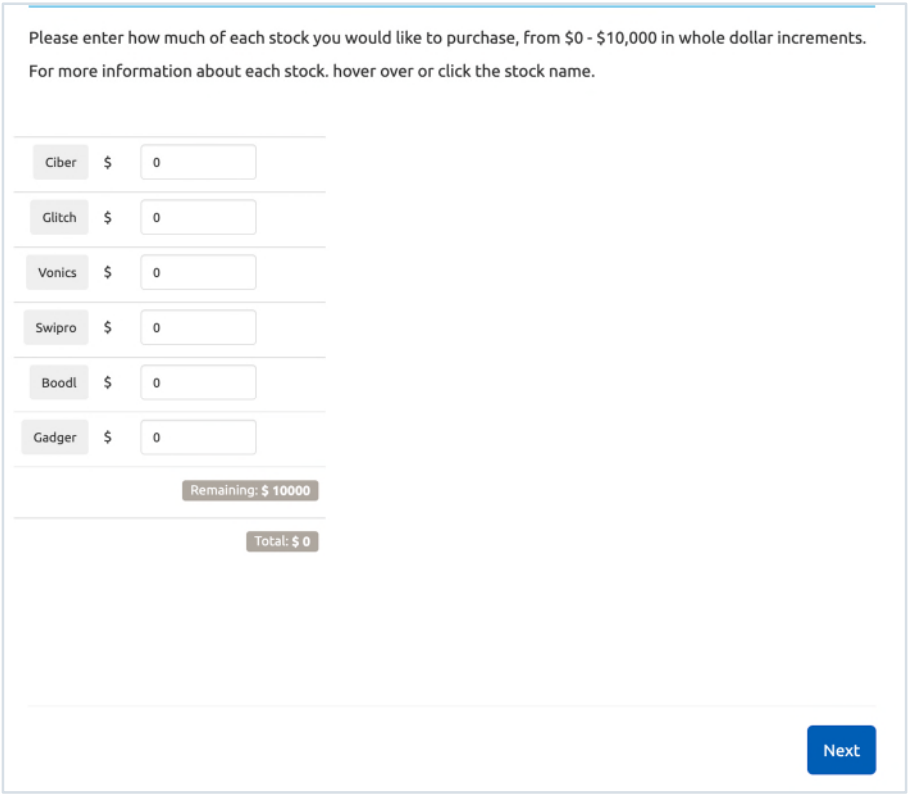


Trading screens

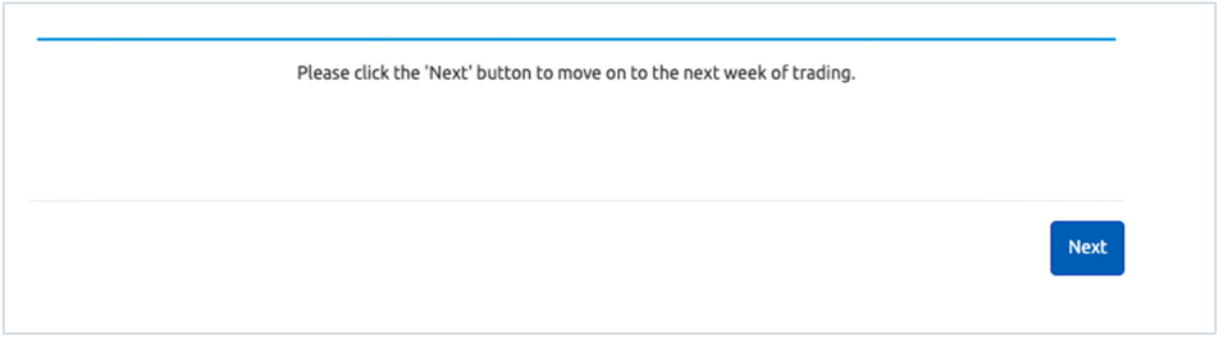
Control condition

Control condition initial allocation of funds

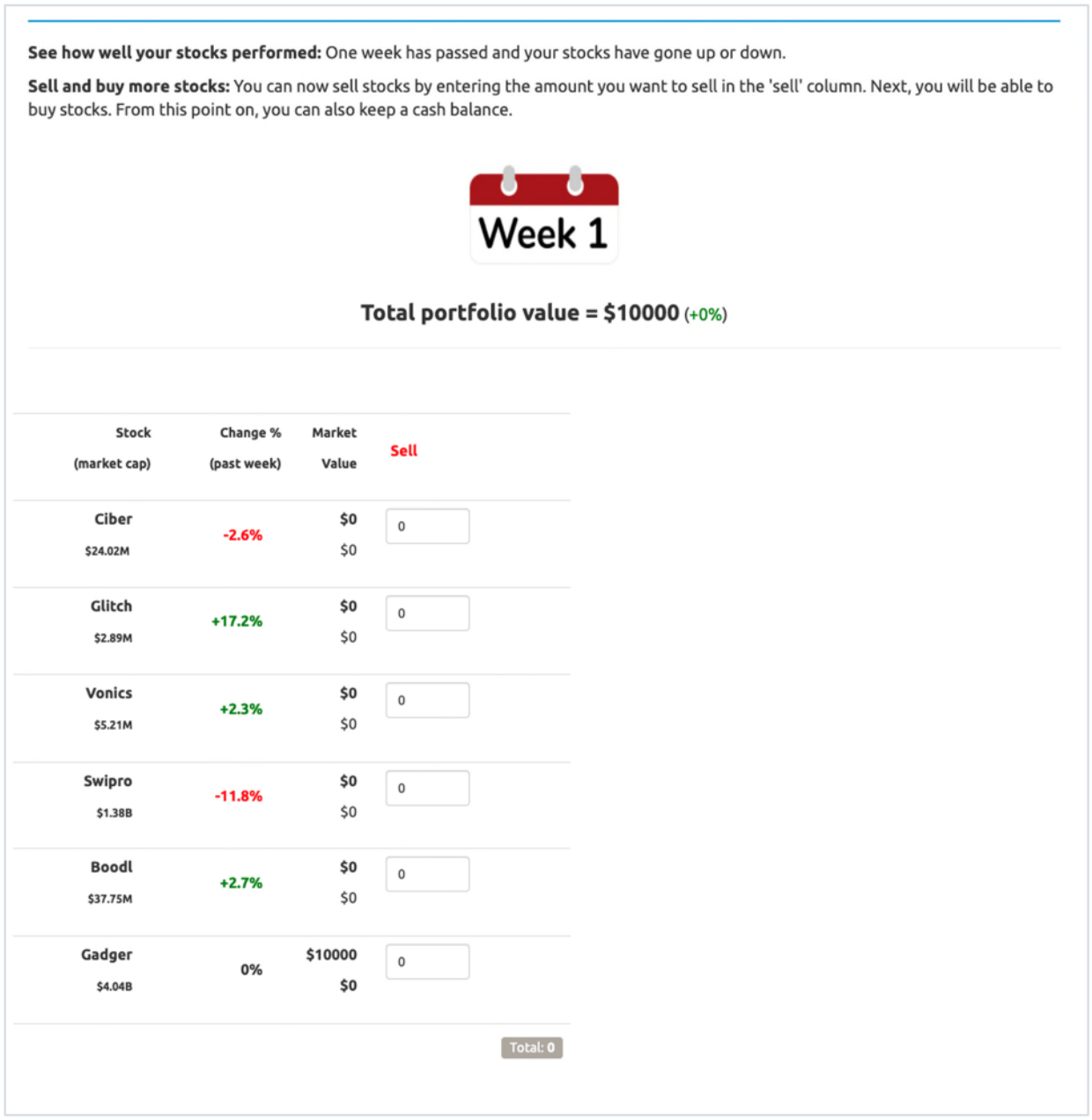




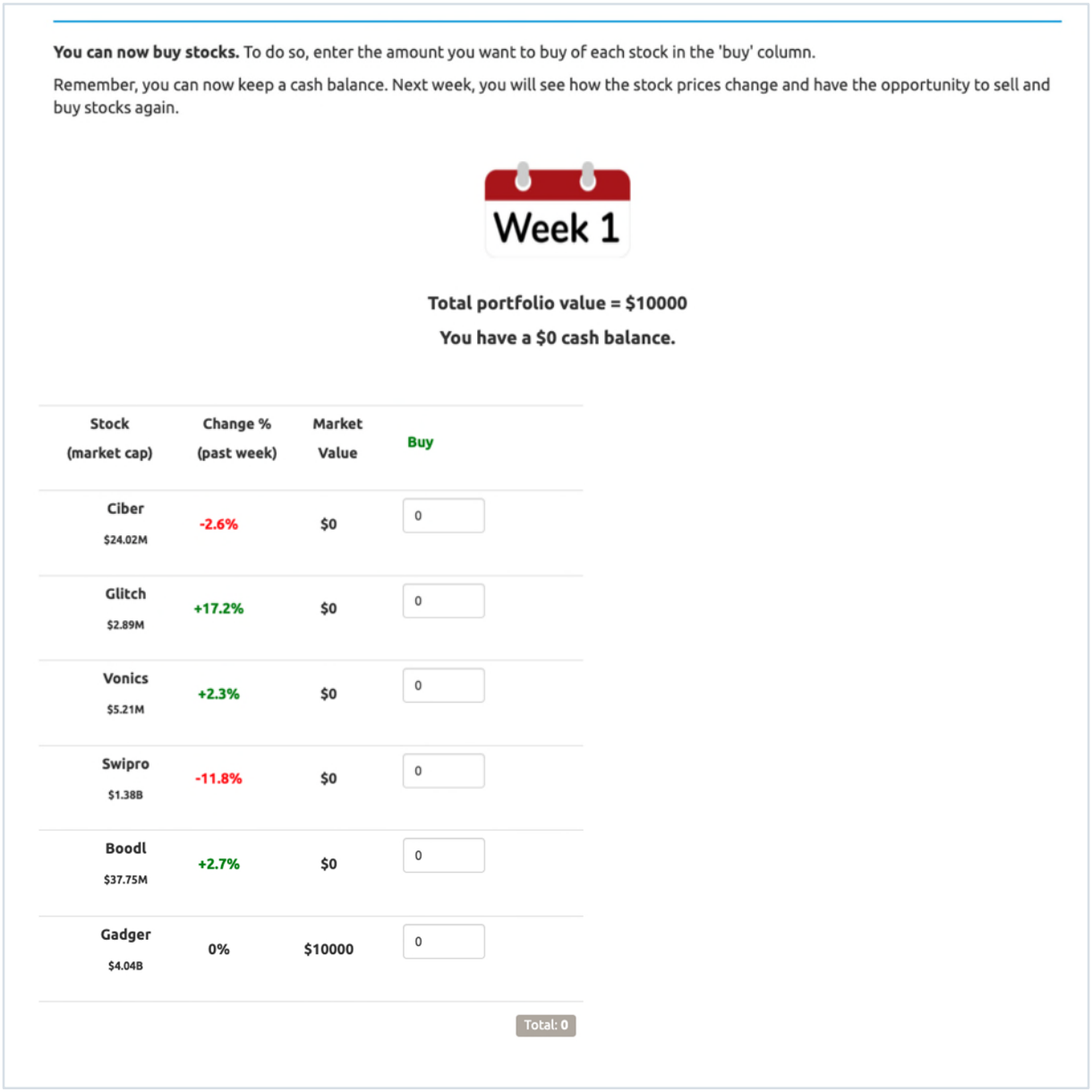
Control condition transition screen (included between all ‘weeks’ of trading)



Sample control condition selling screen

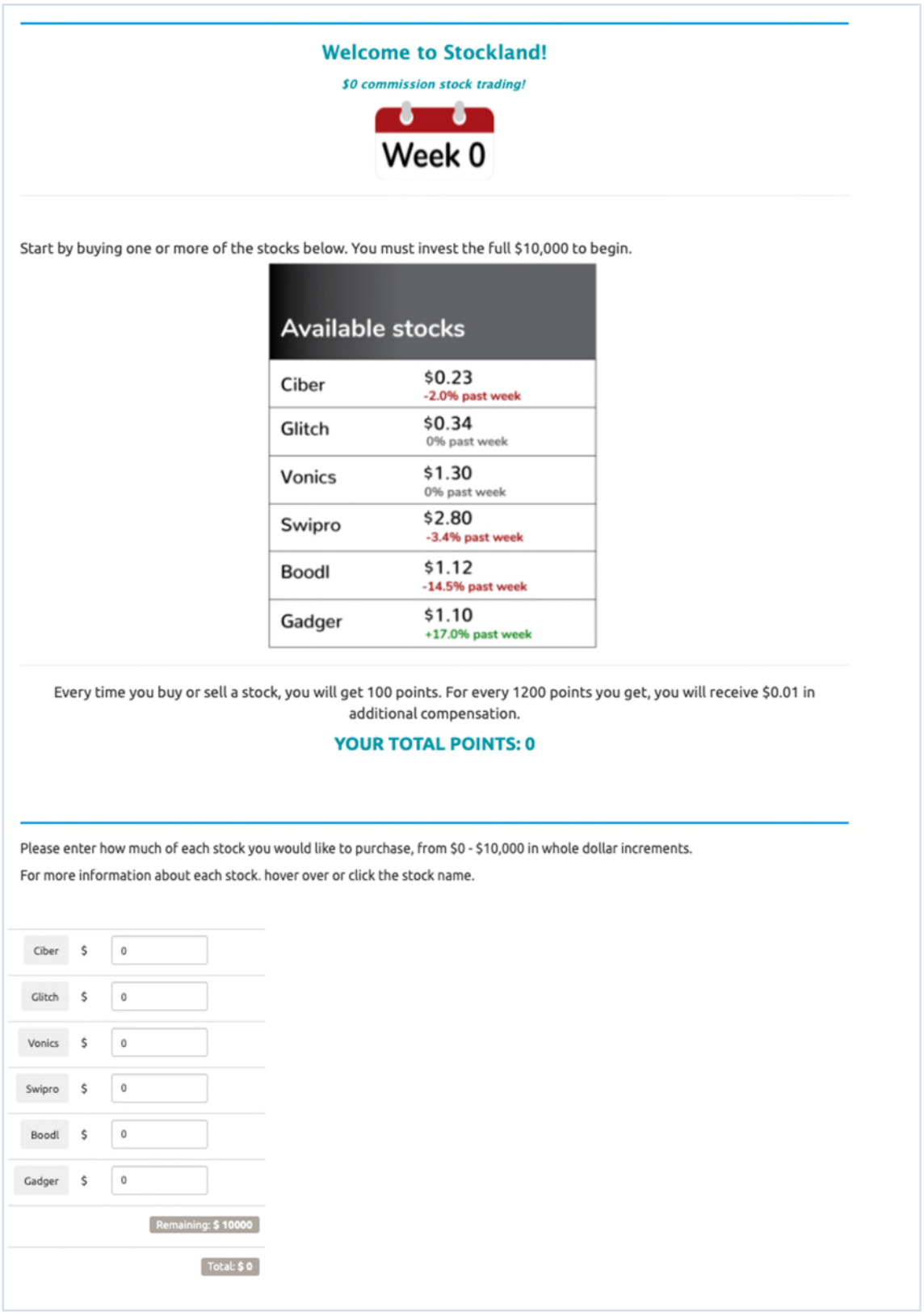


Sample control condition buying screen

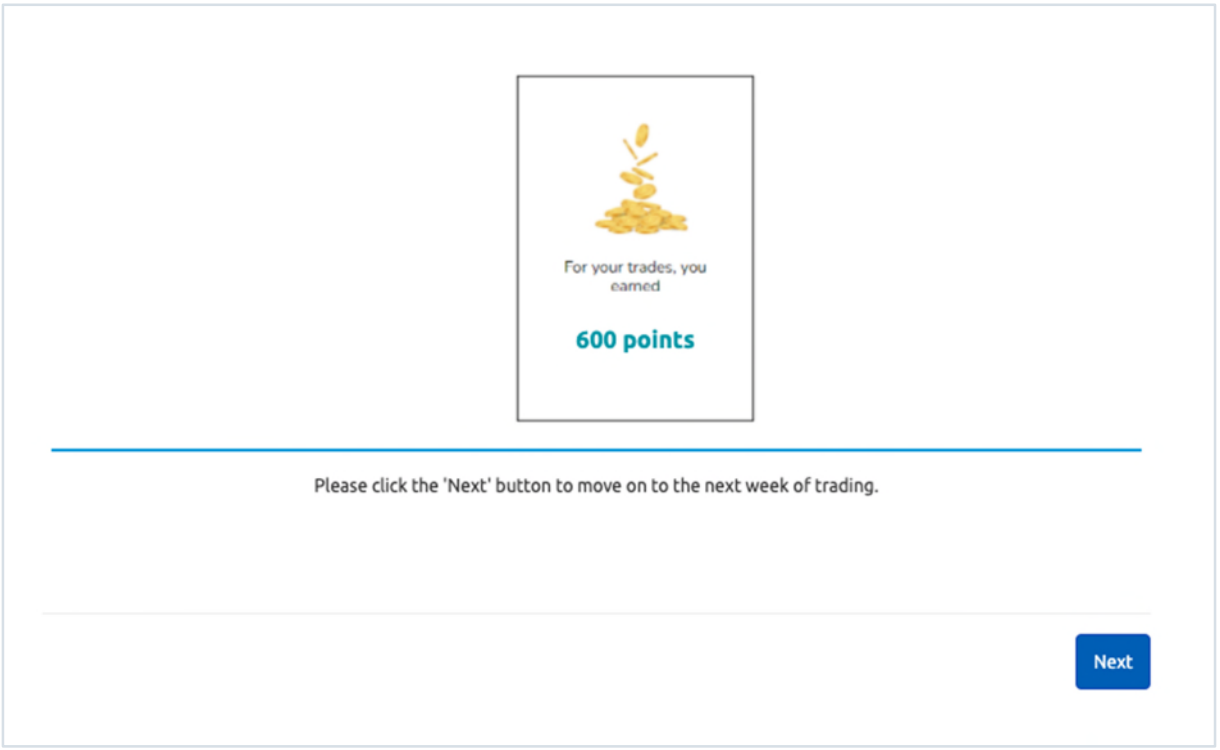


Points condition

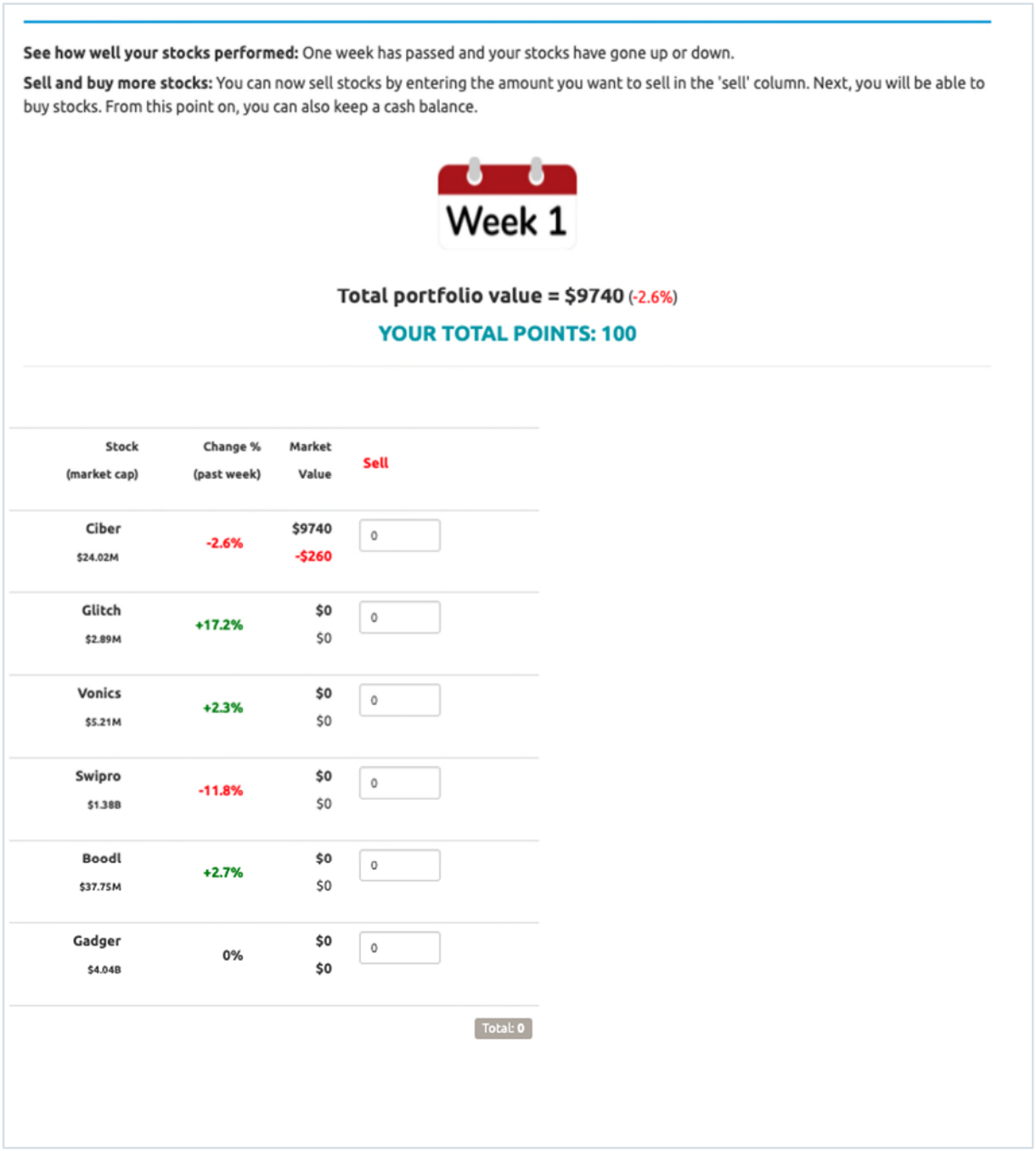
Points condition initial allocation of funds



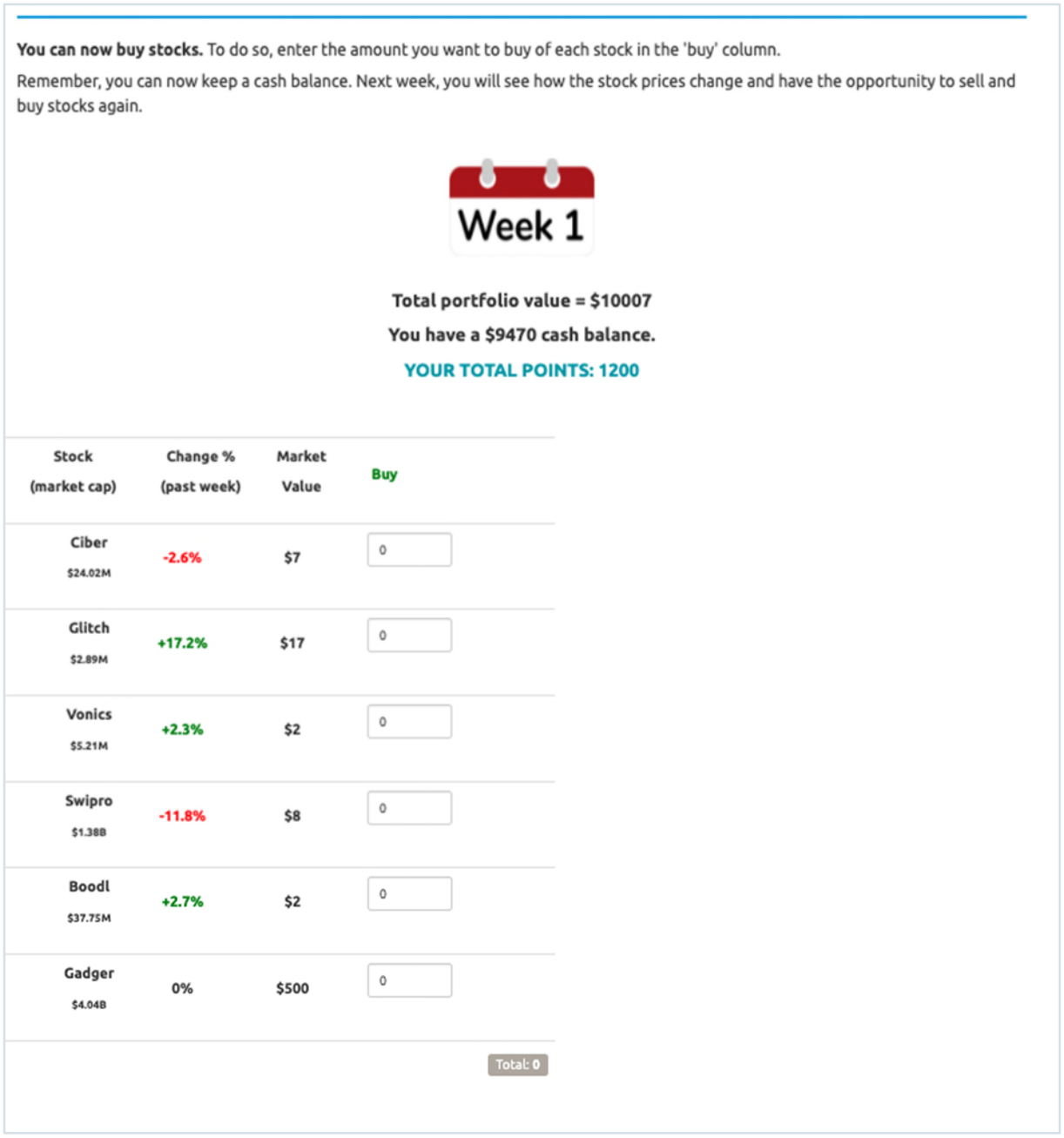
Points condition transition screen (included between all ‘weeks’ of trading)



Sample control condition selling screen

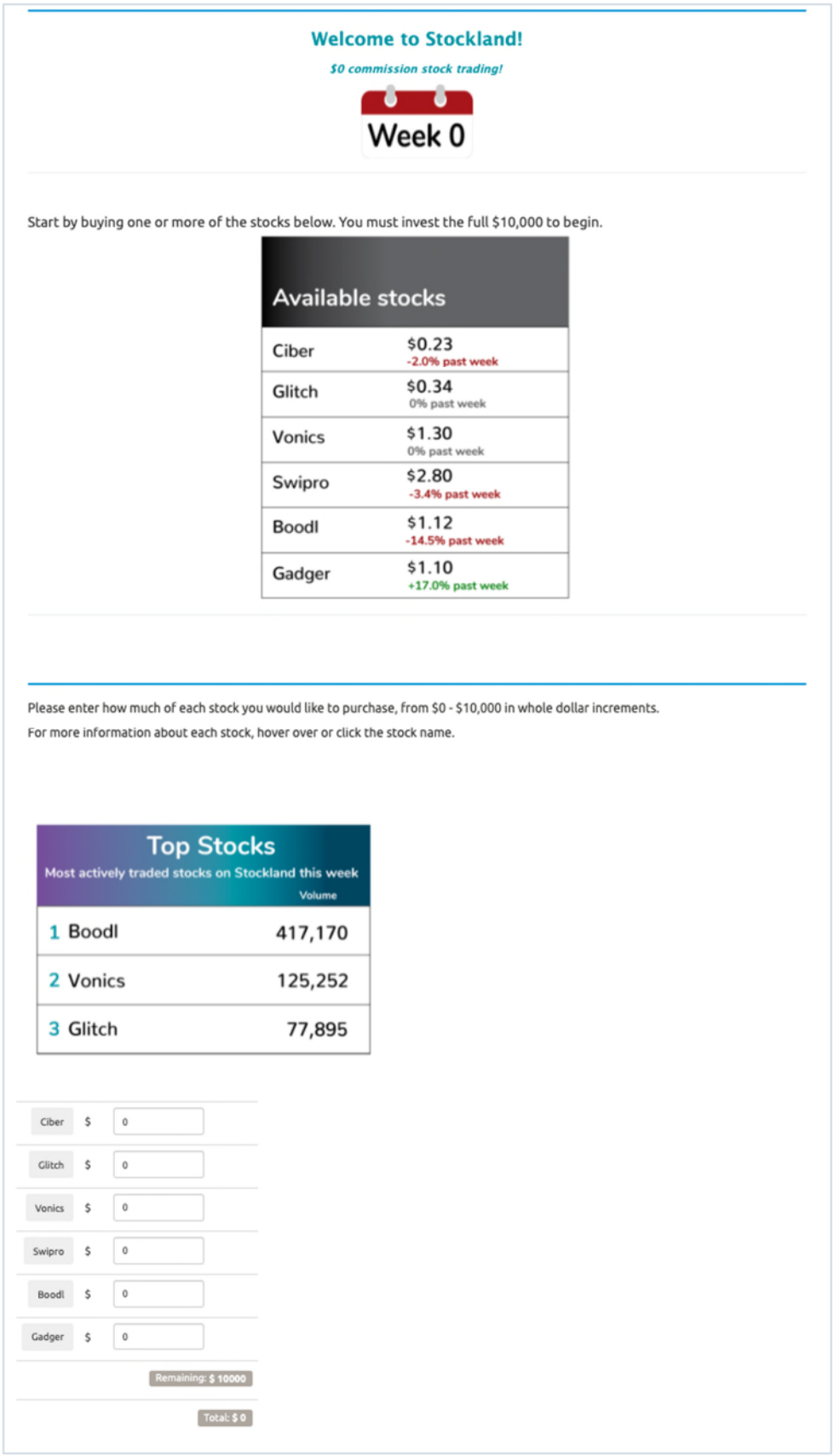


Sample control condition buying screen

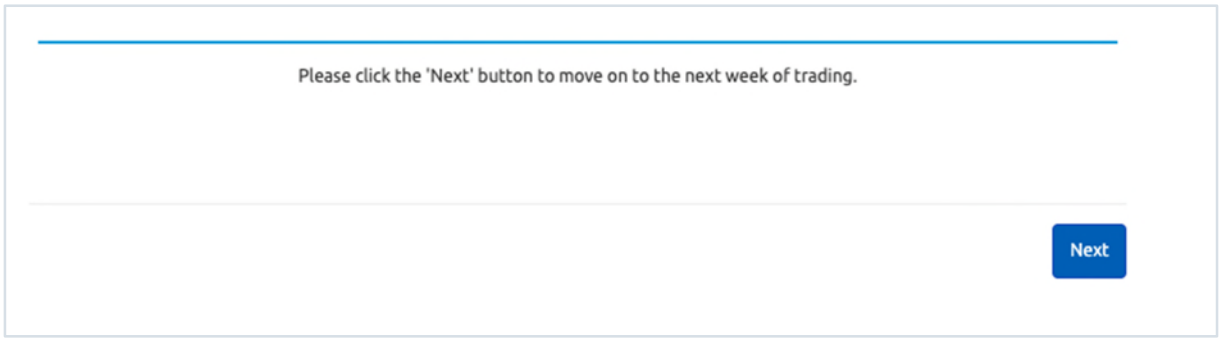


Top Traded List condition

Top traded condition initial allocation of funds



Top traded condition transition screen (included between all ‘weeks’ of trading)



Sample top traded condition selling screen

One week has passed and your stocks have gone up or down. You can now sell stocks by entering the amount you want to sell in the 'sell' column. Next, you will be able to buy stocks. From this point on, you can also keep a cash balance.

Total portfolio value = $9740 (-2.6%)

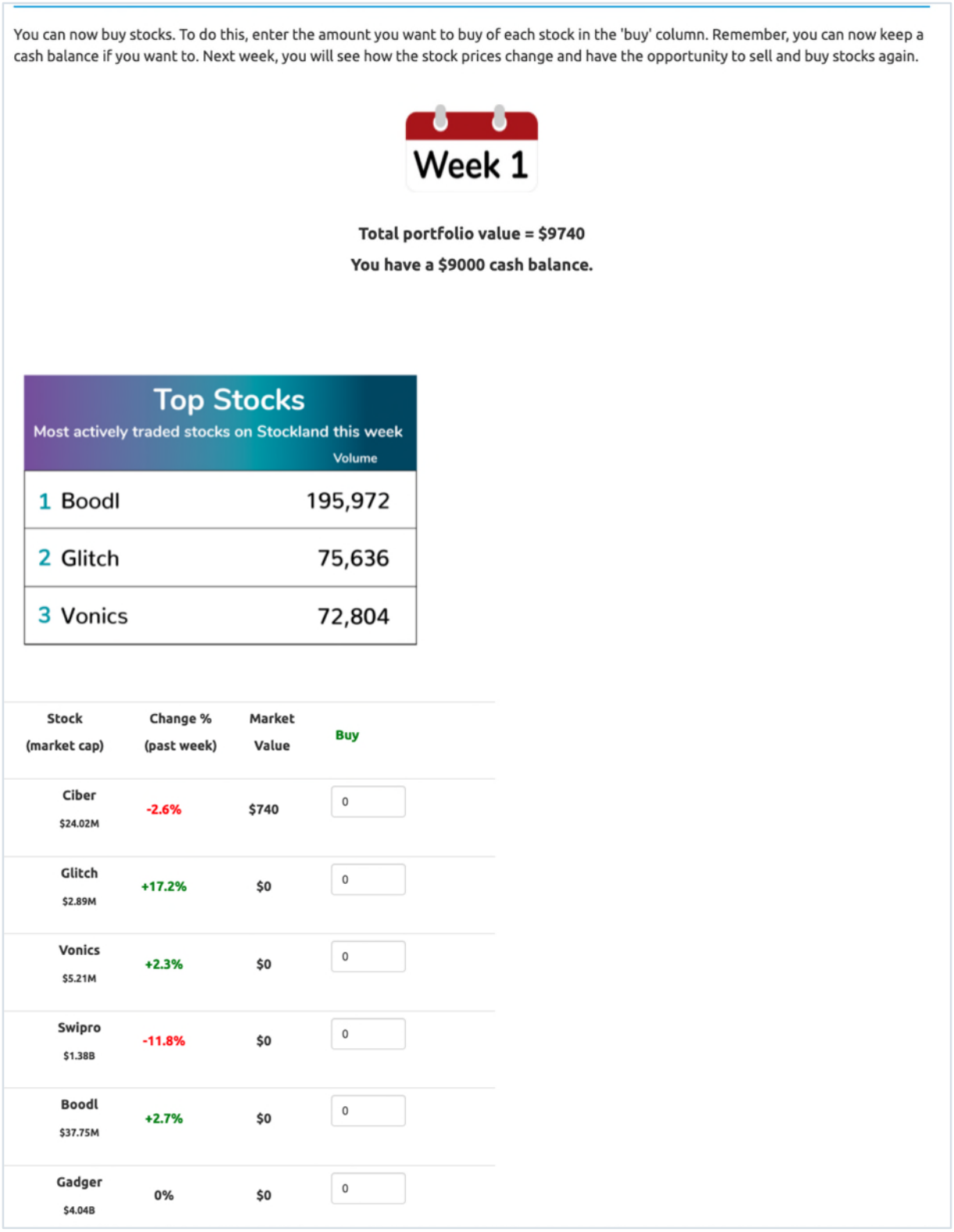
Top Stocks

Most actively traded stocks on Stockland this week

		Volume
1	Boodl	195,972
2	Glitch	75,636
3	Vonics	72,804

Stock (market cap)	Change % (past week)	Market Value	Sell
Ciber $24.02M	-2.6%	$9740 -$260	0
Glitch $2.89M	+17.2%	$0 $0	0
Vonics $5.21M	+2.3%	$0 $0	0
Swipro $1.38B	-11.8%	$0 $0	0
Boodl $37.75M	+2.7%	$0 $0	0
Gadger $4.04B	0%	$0 $0	0

Sample top traded condition buying screen



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