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An Investigation of Financial Information and its Presentation in Online Investing

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Declaration:

This is to certify that the work I am submitting is my own and has not been submitted for another degree, either at University College Cork or elsewhere. All external references and sources are clearly acknowledged and identified within the contents. I have read and understood the regulations of University College Cork concerning plagiarism.

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Finally, I would like to thank my family and particularly my parents for the support throughout the year.

Abstract:

Online financial investing has progressed in many ways since it first emerged as a practice two and a half decades ago. Much has changed in that time, nothing more so than the information needed to make financial decisions and the mediums through which this financial information is obtained. While investors have traditionally made decisions on stocks based on advice from financial advisors or through their own in-depth research, new developments have led to a whole new array of methods to obtain this financial information. This thesis studies how investors get their financial information and how this information is presented. In addition, this thesis looks at the medium through which investors obtain their financial information. Traditionally this has been visually but recent developments in audio technology has allowed financial companies to provide information audibly as multimodal systems that combine audio and visual information together have become available. While looking at how investors get their financial information, this thesis also examines whether these multimodal systems can be beneficial in providing the financial information to investors.

This thesis contains three core chapters, each tackling a separate research question as part of the overarching research objective which examines how investors receive their financial information. The thesis begins with an examination of the new practice of social trading - acquiring financial information over a social network. It investigates how people use this information to copy other people's trades - a practice known as copy trading, and what motivates them to do so. The results suggest that for a participant in a social trading network to engage in copy trading, they must be provided with information that leads to affect-based and cognition-based signals of trustworthiness of the investor they are copying.

As the study develops, it moves into examining multimodality and how investors receive their financial information, specifically examining how multimodal systems compare to their single modality counterparts for imparting financial information.

In total four Proofs of Concepts systems were developed for this thesis. Two separate comparison tests used these proof of concept systems, comparing a multimodal system against a single modality system. The results of each of these tests are analysed in order to derive conclusions about the effects of multimodality in online investing. The results of this thesis show how retail investors now have more ways of obtaining financial information. The thesis also shows how, by presenting financial information using multimodal systems, investor confidence can be increased. In doing so, it demonstrates how the multimodal presentation of financial information can be both beneficial to investors and preferred to single modality systems. Finally, the results found that the addition of multimodality to systems can help create informating systems from what were previously automating systems.

1. Introduction

The chapter gives an overview of the research carried out over twelve months in the State Street Advanced Technology Centre in UCC. It starts by giving a description of how the research objective was formed. From there, it provides details on the individual chapters and how each chapter answered the specific research questions. The introduction concludes by discussing the different research methodologies used in this thesis.

1.1 Introduction Overview

Since the world's first online retail trading platform E*Trades came into being in 1994 (Konana et. al, 2000), the amount of people investing online has dramatically increased. Online trading platforms connect buyers and sellers to conduct transactions from any location with internet access. Online trading platforms gave people, who previously had no access to trading, the opportunity to invest. By making retail investing more accessible, the practice has grown significantly. The Federal Reserve's study of consumer finance in 2017 found that 54% of US households own stocks, much of this purchased through online investing (Bricker et.al, 2017). With more people having access to retail investing, there is an increased amount of inexperienced online investors. While traditional institutional investors use extensive resources and analysis to make financial decisions, retail investors can be far less experienced and do not have access to the same information with which to make their financial decisions. As well as not having access to the information, research has shown that many retail investors have relatively low financial literacy (Jiang et al., 2011). Because of this, they can make financial decisions with little information or not fully

understanding the information that they have. Financial research in the past indicated that the closer a financial investor can get to achieving complete information, the more likely they are to make the best possible decision (Gibson, 1992). With many platforms charging fees based on the profits made by customers, it is in the platform's interest to have investors making the best possible decisions. In order to do this, it is important to understand the information that they use to make decisions and how they obtain this information. In the past, this information would have very often been obtained through financial advisors. However, new retail investors have been seeking information in alternative ways. This can include looking at other investors in social trading platforms, where investors can copy their counterpart's trades.

As well as the financial information itself that is being used by retail investors, the method through which information is delivered is also important. While traditionally investors would have received their information through visual modes i.e. text/graphs on a screen, recent developments in voice technology have provided an extra medium through which investors can receive information. Amazon's Alexa, Google's Voice Assistant and Apple's Siri are all capable of providing financial information when asked specific questions. Financial institutions are starting to adopt this mode of communication as well, with many of the big banks releasing apps for these devices. It is therefore important to understand how investors are getting their financial information and through what mediums the information is presented.

1.2 Objective and Research Questions

The objective of this thesis was to understand how investors receive their financial information and through what medium is the information presented. To do this, three

research questions were explored. The following section outlines these research questions:

Research Question 1

What drives retail investors to seek information from, and participate in copy trading?

In chapter two, this research question is addressed. Copy trading is a practice "that allows traders in social networks to receive information on the success of other agents in financial markets and to directly copy their trades" (Apesteguia et. al, 2019). This chapter examines the financial information used by investors and how it can influence them to make decisions. In this case, it specifically looks at how this information influences investors to copy other traders on social trading platforms.

Research Question 2

Can the modality effect enhance an investor's ability to learn from financial information and ultimately better inform their investment decision?

Chapter three explores this research question. While Research Question 1 investigated the types of financial information investors can use, specifically in copy trading, this question examines the presentation modes for financial information. It aims to determine if the use of concurrent audio and visual information presentation, as opposed to just visual information, can enhance a user's ability to understand their financial information and subsequently make better financial decisions.

Research Question 3

Can multimodal systems enable informating in financial investing and further enhance a user's understanding of the financial information being presented to them?

In chapter four of this thesis, this question delves further into the modes of presentation for financial information. It examines whether systems that present financial

information using both audio and visual capabilities, can enable informating in these systems. Systems that informate capture the information created by automating systems and use it to educate the user on the work being done by the system, enabling them to do their job better.

These three questions are explored in chapters two, three, and four of this thesis. All three questions aim to provide a better of understanding of the information used to make financial decisions and how this financial information is presented to investors.

1.3 Individual Contribution

The research presented in this thesis was undertaken over a period of 12 months in Cork University Business School. This was conducted as part of a research masters in the area of financial technology within the State Street Advanced Technology Centre in UCC. The research was conducted for State Street and focused on the broad subject of the future of investing. This involved writing industry reports, presenting to State Street and their clients, and developing a proof of concept for online investing. State Street guided the direction of this industry research and provided industry advisors. These industry advisors were situated throughout Europe and came from many different departments within the organisation. State Street Global Advisors (SSGA) were the main entity dealt with. SSGA is the investment management division of State Street. SSGA guided the direction of this industry report and provided senior members of their management to advise on the research. The industry report, titled ‘Future of Investing: An Industry Report’, can be seen in Appendix A of this thesis. This report discussed new and emerging trends in the world of investing such as ESG, Initial Coin Offerings and social trading platforms.

Appendix B contains slides from a presentation given in State Street's Dublin offices. This presentation was given to many high-ranking employees of State Street including their EMEA head of innovation and was also streamed live to other State Street Offices worldwide. The presentation also demoed an Amazon Echo Show proof of concept. This POC took the user through an experience of buying stocks using voice technology and was presented to State Street as a possible avenue for presenting information to their clients. It utilised both the audio and visual capabilities of the device to buy stocks, provide information on SSGA, and email information on the user's portfolio. The POC was developed solely by the thesis author.

This research for State Street fed into the chapters in this thesis. As mentioned, the POC designed for State Street was multimodal, which was similar to the POCs created for the research in chapters three and four. Also the industry report discussed social trading, a topic covered in depth in chapter two.

The research carried out in this thesis, changed as the year progressed. Starting with the broad topic of the future of investing, the scope narrowed throughout, with each chapter narrowing in focus. For this reason, elements of the research were conducted collaboratively. Chapters two and three were collaborative pieces of research, with chapter four being completed entirely by the thesis author.

With the research covering the broad topic of online investing to begin with, three researchers took part. Initially a systematic literature review was conducted collaboratively to analyse the literature as broadly as possible. Three main steps were required to conduct the review. The thesis author performed the first step of the review, investigating online investing literature in leading journals and databases. One researcher performed the second step, reviewing citations from articles identified

during step one. A third researcher conducted the final step of using the Web of Science and Google Scholar to identify studies that cite the key articles identified in steps one and two. Following this, one researcher further investigated literature on perceived usefulness and ease of use as underlying drivers in investor engagement in copy trading. The thesis author further investigated literature on perceived enjoyment and signal provider trustworthiness as the two remaining underlying drivers in investor engagement in copy trading. The three researchers designed the framework modelling investor engagement in copy trading based on these underlying drivers.

In chapter three, the scope of the research was narrower due to the complex nature of designing and developing multimodal systems; three individuals were required to carry out parts of this research. One researcher designed the interviews and tests, while a second researcher conducted the interviews and tests used to gather data. The thesis author developed the Amazon Echo Show POCs used in the research. This involved developing Alexa Skills using Amazon Web Services' Lambda service and Amazon's Alexa Developer Portal.

Chapter four focused on acquiring system requirements for the design of another new multimodal POC based initially on an analysis of existing literature. This POC was subsequently developed and tested against an audio only POC on retail investors. Qualitative interviews were then carried out on the retail investors to see if there was a benefits of using one system over the other. The research carried out in chapter four was carried out exclusively by the thesis author.

1.4 Thesis Structure

In this section the structure of the thesis is described. There are three different chapters focussing on each of the research questions. This section of the introduction outlines each of these chapters and provides an overview of the research conducted.

1.4.1 Chapter Two: The delegation of Investor Decision Making

In chapter two, the first research question is examined: *What drives retail investors to seek information from and participate in copy trading?*

The study analyses existing literature to identify the financial information sought by online investors and how this information drives participants in social trading networks to engage in copy trading. A concept-centric review of literature extracted recurring, relevant concepts and builds insights. This led to the creation of an Investor Engagement Framework which models the drivers of investor engagement in copy trading. This literature review provided a solid base of research on online investing and financial information which was used in the following chapters when discussing how financial information is presented to online investors.

1.4.2 Chapter Three: Modality effect

Chapter three looks at the second research question: *Can the modality effect enhance an investor's ability to learn from financial information and ultimately better inform their investment decision?*

This chapter starts with the premise that the modality effect can enhance an investor's ability to learn from financial information and ultimately better inform their investment decision. The modality effect states that learning is enhanced when processing audible and visual information concurrently. To test this, two separate

systems were designed using a Repertory Grid analysis conducted with key informants to elicit the types of information to be used and the functionalities of the systems. Each system provided the same financial information about a fictional stock to two separate groups of retail investors. One system provided solely visual information and the other provided a combination of audible and visual information. Each groups' ability to retain and transfer information was then examined. This chapter concentrated on how financial information is presented to investors.

1.4.3 Chapter Four: Informating System in Online Retail Investing

Chapter four looks at the final research question '*Can multimodal systems enable informating in financial investing and further enhance a user's understanding of the financial information being presented to them?*

The third study examines whether informating systems can be more beneficial than automating systems in online financial investing. Automation in businesses can save money on labour; however it can often lead to valuable information within an organisation being lost. Systems that informate use the information created by automation to enhance a worker's ability to understand their work. The research tested whether multimodal systems can be used to enable informating. Two separate systems were created: one an automating system and the other an informating system. These systems were designed using system features derived through an analysis of existing literature. The first system exclusively used audible information to simulate the process of buying a financial product. The second system combined visual and audible information to create an informating system that reached the same end-goal as the first system while also educating the user on the process of trading online. These systems

were tested on key informants and qualitative questionnaires were used to establish the effectiveness of each system.

The thesis concludes by summarising the main findings across the body of research and provides insights in the use of information in financial investing. The conclusion chapter will discuss the contributions for research, the contributions for practice, the research limitations and discuss future research opportunities.

1.5 Research Methodology

This thesis has utilised different methods of research throughout. These included concept centric literature reviews, Repertory Grid Analysis, qualitative questionnaires, key informant interviews, and POC development and testing.

The first chapter conducts an analysis of existing literature to establish what drives investors to participate in social trading. This was a systematic literature review and followed the guidelines set out by Webster and Watson (2002). It involved searching the various relevant journals and databases for key terms related to the topics being researched, in this case social trading. As this was the first section of research within this thesis, a conclusive literature review looking at online investing provided a solid theoretical grounding for the following chapters. Three main steps were required to conduct the review. First, an investigation of online investing literature in leading journals and databases was carried out. Next, a review of the citations from articles identified was undertaken. Finally, a review used the Web of Science and Google Scholar to identify studies that cite the key articles identified in steps one and two. Based on the analysis of the literature, key concepts were identified and used to create a framework for investor engagement in social trading.

Chapter two begins with an analysis of existing literature. The goal was to identify features required to create an audio/visual system for testing the modality effect in finance. This literature review was subsequently used to populate the elements in a RepGrid analysis. The RepGrid is an interview technique that improves the interpretability of an interview participant's thoughts and opinions (Kelly, 1977). Participants aren't asked for their direct opinions on a topic. Instead, their thoughts on the topic are teased out using a defined interview method. This aims to remove bias and allows the person being interviewed to interpret the topics being studied in a less restrictive manner. From the results of this RepGrid analysis, the methods of information presentation in this audio/visual system were derived. Using these methods of presentation, two different POCs were designed: one solely visual and one multimodal. Both were developed for the Amazon Echo Show device. This device combines Amazon's voice assistant Alexa, with a visual screen so that further information can be portrayed. Key informant interviews were then conducted. Key informants are individuals who do not represent the population statistically but instead are experts in their field. Investors with an in-depth knowledge of retail trading tested each of these POCs and they were subsequently tested on both their retention and information application based on their experience with their respective POC.

In chapter four of this thesis, a similar approach was taken to chapter three. A systematic literature review was conducted to determine the relevant system features for two further Proofs of Concepts. This study designed and developed one automating system and one system that informates. These were once again developed on the Amazon Echo Show. Similarly, these new POCs were tested by key informants and, following this, they completed qualitative questionnaires to establish whether visual information could enable informating in financial online investing. The key

informants tested both POCs to determine if one was preferred over the other. This methodology was similar to chapter three as two systems were tested against each other: one multimodal the other utilising only one form of information.

2. The Delegation of Investor Decision Making: How Information Drives Investors to Engage in Social Trading.

2.1 Introduction

Social trading networks are described by Wohlgemuth, Berger, and Wenzel (2016) as online communities in which investors can follow others and directly copy their investment decisions. The transparent nature of these networks has led to their quick growth in popularity (Glaser & Risius, 2018). Participants make investments based upon information gathered in online communities. Copy trading within these communities allows participants in the network to replicate others' trades (Doering, Neumann, & Paul, 2015). Copy trading investors are split into two separate categories: signal providers and followers. Signal providers are individual investors whose investment decisions are available for followers to track and analyse. Followers are also individual investors; however, they copy the investment decisions of signal providers. Copy trading allows for instant and automated replication of signal provider trades by followers; therefore, this allows the delegation of the investment decision. Following signal providers allows followers to efficiently gather appropriate amounts of information in a cost-effective way. Essentially, by engaging in copy trading, investors avoid excessive analysis by identifying their preferred signal providers and copying their trades (Oehler, Horn, & Wendt, 2016). This study builds a framework which models the intention of participants in social trading networks to engage in copy trading.

The framework is based on an analysis of literature, from different domains, which discuss online trading, the growth of social trading networks, and the adoption of copy trading among retail investors (Barber & Odean, 2001b, 2002; Berger, Wenzel, & Wohlgemuth, 2018; Doering et al., 2015; Konana & Balasubramanian, 2005; Wohlgemuth et al., 2016). The framework created in this study is referred to as the

Investor Engagement Framework (IEF). Monsuwé, Dellaert, and De Ruyter (2004)'s research in online consumers' adoption of e-commerce describes perceived utilitarian gains as ease of use and usefulness and describes perceived hedonic gains as enjoyment. This study builds on existing research, such as Konana and Balasubramanian (2005), which suggests that satisfaction among online investors is largely driven by perceived utilitarian gains and perceived hedonic gains. The framework in this study similarly categorises ease of use and usefulness with utilitarian gains and categorises enjoyment with hedonic gains to extend Davis' (1989) Technology Acceptance Model (TAM) to the context of online investing. Analysing existing literature highlighted that the core constructs of TAM alone are, at times, not sufficient in modelling user acceptance (Pikkarainen et al., 2004). This study's framework extends existing research by including signal provider trustworthiness (Wohlgemuth et al., 2016) as an extension of TAM in the context of copy trading. Signal provider trustworthiness is included as an exogenous factor to mediate the relationships between TAM's core constructs and investors' intentions to engage in copy trading.

The next section of the chapter addresses the methodology used to review and analyse relevant literature. Following that, the framework is introduced containing constructs that impact online investors' attitudes and intentions to engage in copy trading. The chapter then describes usefulness, ease of use, and enjoyment as basic determinants of online investor intentions. The next section of the chapter describes how signal provider trustworthiness mediates the relationship between usefulness, ease of use, and enjoyment and the intentions of online investors to engage in copy trading. The final section of the chapter discusses the findings of the study, future research avenues, implications for researchers and implications for practitioners.

2.2 Methodology for Literature Review:

In order to complete a comprehensive literature review, this study followed the guidelines and instructions of Webster and Watson (2002). The review specifically focuses on literature in the field of copy trading. The intention of this review is to propose a framework to accurately synthesize and extend the existing literature, shed light on avenues for future research, and ultimately provide practical implications within the area of copy trading. To fulfil this intention and provide a complete review of literature, concepts identified within existing literature are the focus of the study.

In order to identify the source material for the literature review, the major contributions from leading journals in the Information Systems field (generally referred to as the 'basket of eight' information systems journals) were examined. This basket consists of the European Journal of Information Systems, Information Systems Journal, Information Systems Research, Journal of AIS, Journal of Information Technology, Journal of MIS, Journal of Strategic Information Systems, and MIS Quarterly. Within these journals, the table of contents were reviewed to identify and highlight articles within the scope of copy trading. From there, literature and journals from outside the information systems field were also examined and highlighted as important due to the interconnected nature of information systems with other disciplines. Journals such as European Financial Management, Journal of Business Research, Review of Financial Studies, Decision Support Systems, International Journal of Service Industry Management and Journal of Decision Sciences were also examined. In addition to the examination of each journal's table of contents, academic databases were used to efficiently filter and identify relevant articles. The databases examined included EBSCO, ProQuest, Science Direct, JSTOR and SSRN.

Step 1: Investigation of leading journals and journal databases:

The first step in reviewing existing literature involved searching relevant, leading journals and journal databases (Melville, Kraemer, & Gurbaxani, 2004). The investigation of the basket of eight information systems journals used keywords to identify relevant articles (Hamari, Koivisto, & Sarsa, 2014). Searches were conducted in titles and abstracts of papers using the following keywords: 'online investing', 'online investors', 'online platforms', 'social trading', 'social influence in trading' and 'copy trading'. Following the search through titles and abstracts, each journal's table of content was examined to identify any relevant research not identified by the initial keyword search.

This was followed by an extended search using the same keywords outside the basket of eight and information systems field of literature. Searches were also conducted in titles and abstracts of papers using the same keywords as above. Following the search through titles and abstracts, each journal's table of content was examined as per Webster and Watson (2002) to identify any relevant research not identified by the initial keyword search. The additional search through these journals allowed for the identification of additional literature relevant to copy trading. By searching this additional layer of journals, literature was found that allowed the review to more holistically synthesize existing literature within the boundaries of this study.

In total, following the searches of the basket of eight information systems journals and relevant additional journals mentioned above, 12 articles were identified within the field of copy trading. These 12 articles included only 1 article from within the basket of eight Information Systems journals. A likely explanation for this is the relatively recent emergence of literature in the field of copy trading. The extended search for

literature outside the basket of eight accounted for the other 11 relevant articles identified. Following the analysis of each article's abstract, keywords, or the full article when necessary, 3 articles were deemed to be outside the scope of the research and were therefore excluded. The exclusion of these articles resulted in a total of 9 articles deemed relevant for an in-depth review.

Step 2: Backward review:

During this step, the citations in the articles identified in step 1 were reviewed to identify prior studies in the field of copy trading. Within these citations, the same keywords were once again used to identify relevant articles. Reviewing the citations of articles from step 1 facilitated the chronologically backwards investigation of articles within the scope of the review (Levy & Ellis, 2006). This identified the initial literature in the field of online investing and, more recently, copy trading. A further set of 18 articles from journals and conference proceedings other than those formally searched were collected. Each of these articles was reviewed in full.

Step 3: Forward review:

The third and final step involved using the Web of Science and Google Scholar to identify studies that cite the key articles identified in steps 1 and 2. Articles identified were searched using the keywords: 'online investing', 'online investors', 'online platforms', 'social trading', 'social influence in trading' and 'copy trading' to further refine the relevant articles. Reviewing the articles that cite those from step 1 and 2 facilitated the chronologically forward investigation of articles within the scope of the review (Levy & Ellis, 2006). This identified the more recent literature within the field of copy trading. A further set of 7 articles from journals and conference proceedings

other than those reviewed in steps 1 and 2 were identified. Each of these articles was reviewed in full. In total, the 3 steps resulted in the full review of a set of 33 articles.

As per Webster and Watson (2002)'s guidelines, a concept-centric matrix was created using concepts from all articles identified in each of the 3 steps. Articles were reviewed in full and corresponding concepts were grouped. Concepts were then segregated by unit of analysis to keep each concept relevant and within the scope of copy trading. Articles referenced were grouped by concept. An example of the concept-centric matrix used is seen below in table 2.1, which illustrates usefulness as a concept derived from the review of existing literature in copy trading. The 4 articles referenced are grouped by the concept usefulness. This concept is then isolated by imitation, return on investment and risk management as units of analysis. Once new concepts were not being extracted during the review of relevant articles, the review was deemed to be nearing completion with a relatively complete account of the relevant literature (Webster & Watson, 2002). The table intends to convey key findings and relationships from existing literature.

Table 2.1: Concept Centric Matrix

Unit of analysis	**Concepts**	**Number of citations**	**Papers**
Usefulness	Imitation	3	(Wohlgemuth et al., 2016), (Pan, Altshuler, & Pentland, 2012), (Berger et al., 2018).
	Risk management	4	(Berger et al., 2018), (Sharpe, 1964), (Markowitz, 1952), (Fama & MacBeth, 1973).

	Return on investment	10	(Barney, 1991), (Peteraf, 1993), (Berger et al., 2018), (Grahovac & Miller, 2009), (Jonsson & Regnér, 2009), (Madhok, Li, & Priem, 2010), (Barber & Odean, 2000), (Barber & Odean, 2001b), (Barber & Odean, 2002), (Konana & Balasubramanian, 2005).
Ease of use	Transparency	5	(Glaser & Risius, 2018), (Stoughton, 1993).
	Experience level	5	(Barber & Odean, 2002), (Konana & Balasubramanian, 2005), (Singh, Sandhu, & Kundu, 2010), (Pentland, 2013), (Berger et al., 2018).
	Reduced overtrading	9	(Barber & Odean, 2000), (Barber & Odean, 2001b), (Barber & Odean, 2001a), (Barber & Odean, 2002), (Choi, Laibson, & Metrick, 2002) (Konana & Balasubramanian, 2005), (Anderson, 2007), (Berger et al., 2018), (Pelster, 2019).
	Reduced fees	6	(Barber & Odean, 2001b), (Konana & Balasubramanian, 2005), (Berger et al., 2018), (Glaser & Risius, 2018; Oehler et al., 2016), (Glaser & Risius, 2018), (Kromidha & Li, 2019).
Enjoyment	Self-attribution	4	(Konana & Balasubramanian, 2005), (Kahneman & Riepe, 1998), (Gervais & Odean, 2001), (Berger et al., 2018).
	Illusion of knowledge	4	(Konana & Balasubramanian, 2005) , (Barber & Odean, 2001b), (Barber & Odean, 2002), (Glaser & Risius, 2018).
	Illusion of control	3	(Langer, 1975), (Konana & Balasubramanian, 2005), (Barber & Odean, 2002), (Barber & Odean, 2001b).
Signal provider trustworthi-ness	Cognition-based signals	3	(McAllister, 1995), (Doering et al., 2015), (Wohlgemuth et al., 2016).
	Affect-based signals	4	(McAllister, 1995), (Pan et al., 2012), (Wohlgemuth et al., 2016) (Mesch, 2012).

2.3 Investor Engagement Framework core constructs

This study's framework intends to illustrate online investors' intention to engage in copy trading through the lens of previous research on consumer adoption of new technologies. As described above, the core constructs of the framework are adapted from TAM (Davis, 1989). While TAM has been used generally as a method to gauge a user's willingness to accept emerging technology, previous literature has validated TAM as a predictor of technology adoption in the context of online investing (Balasubramanian, Konana, & Menon, 2003; Konana & Balasubramanian, 2005). Therefore, TAM constructs are considered to be appropriate as an initial basis for this study's framework.

TAM identifies two determinants, according to previous research, that play an important role in people's acceptance or rejection of information technology. The first determinant referred to as perceived usefulness, describes how people tend to use or not use an application to the extent that they believe it will help them improve performance. The second determinant referred to as perceived ease of use describes how an application that is easy to use is more likely to be accepted. Therefore, in addition to perceived usefulness, usage is theorized to be influenced by perceived ease of use. To align the core constructs of this study's framework with the core constructs of TAM, perceived usefulness is defined as the degree to which a person believes that using copy trading would enhance their online trading performance. Similarly, perceived ease of use is defined as the degree to which a person believes engaging in copy trading would be free of effort. Davis, Bagozzi, and Warshaw (1992) extend TAM with enjoyment as an additional basic determinant of technology user acceptance. This study's framework includes enjoyment as a core construct as per this more recent version of TAM. During the study, enjoyment is defined as the extent to

which copy trading provides satisfaction among investors, despite any negative impacts on investment performance. In summary, the three basic determinants of user acceptance within this study's framework are perceived usefulness, perceived ease of use and enjoyment. Throughout this study, these basic determinants will be referred to as the core constructs of the framework. Therefore, in a similar fashion to prior research based on online technology adoption (Konana & Balasubramanian, 2005; Monsuwé et al., 2004), this study's framework includes both utilitarian and hedonic basic determinants of investors' attitude towards copy trading. TAM core constructs are illustrated below in figure 2.1. The next section of the chapter extends TAM by examining each core construct and identifying the corresponding underlying drivers in the context of copy trading.

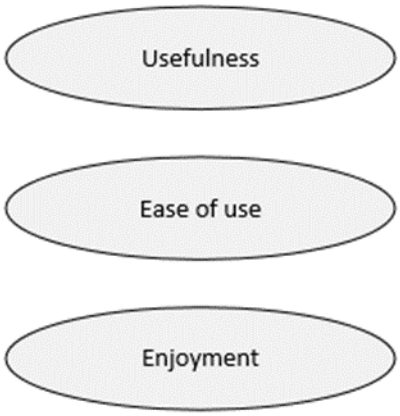

Figure 2.1: The core constructs of TAM

2.4 Underlying Drivers of Core Constructs

This section of the chapter intends to discuss copy trading through the lens of TAM's core constructs of usefulness, ease of use and enjoyment. Each core construct is defined, applied to the context of a certain system and broken down into separate subcomponents referred to as underlying drivers of the core construct. While TAM and its core constructs are generally applied to user acceptance of emerging technology, this study considers TAM's core constructs as determinants of investors'

adoption of copy trading. The following sections address each core construct and the corresponding underlying drivers in this context.

2.4.1 Usefulness:

Perceived usefulness as identified by TAM plays an important role in a user's acceptance or rejection of new technology and in the context of this study is defined as the degree to which an investor believes that by engaging in social trading, they will improve their investment performance and outcomes Davis (1989, p. 320). In this study's framework, three underlying drivers of the usefulness construct are included: imitation, return on investment and risk management (Berger et al., 2018) as illustrated by figure 2.2. The framework refers to these underlying drivers as key characteristics of usefulness in online social trading, each is described separately below.

Imitation in social trading is facilitated by the copy-trading functionality of social trading platforms. Copy-trading refers to "automatically, simultaneously, and unconditionally replicate other investors' trades" (Wohlgemuth et al., 2016, p. 1). This feature enables investors to imitate more experienced and competent investors and benefit from more profitable opportunities (Pan et al., 2012). Copy trading also allows for investors to bypass typical transactional costs and costs in gathering information making it very attractive and practical for less-experienced traders. By engaging in imitation, inexperienced investors can realise higher returns from the beginning and subsequently develop domain knowledge and expertise (Berger et al., 2018).

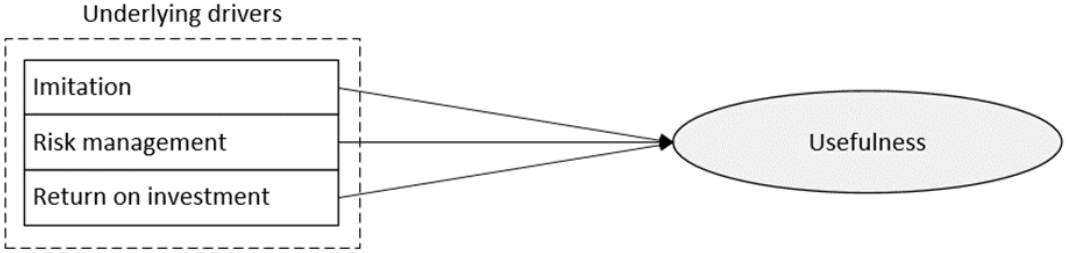

Figure 2.2: Usefulness underlying drivers.

Enhancing investors' profitability through imitation aligns with the framework's definition of perceived usefulness in that imitation allows investors to enhance returns.

Risk management in social trading is highlighted by Berger et al. (2018) as playing a primary role in explaining performance outcomes. In investment contexts, risk refers to the potential deviation of returns from expected outcomes (Sharpe, 1964). Previous literature identifies diversification as a primary method of investment risk mitigation (Markowitz, 1952). In tailoring a portfolio to a particular risk appetite, investors' decisions are considered to be influenced by the risk-return trade-off of a particular investment (Fama & MacBeth, 1973). Berger et al. (2018) describe how investors can build portfolios diversified by imitated investors in accordance with their own objectives and risk appetite. Signal providers are assigned a risk score by the social trading platform to portray their risk exposure to imitators. Imitators can then select to imitate signal providers with risk scores aligning with their own preferences. The research of Berger et al. (2018) solidifies the idea that by identifying signal providers with similar risk appetites, followers can achieve improved returns via imitation. Therefore, risk management in a social trading context aligns with the framework's definition of usefulness as the investor can believe social trading could improve risk management via the diversification of signal providers enhancing portfolio performance.

Return on investments in social trading is primarily influenced by the resource-based view as described by Berger et al. (2018). Barney (1991, p. 1) and Peteraf (1993)'s resource-based view posits that uniqueness among firms allows for "sustained competitive advantage". Their research also points out that inimitable resources are likely to produce increased returns; thus, if competitors can imitate these resources, equally improved returns are realised. Grahovac and Miller (2009) identify the

significant cost of imitation and the cost of emulating resources outweighing expected returns. Other barriers to imitation are identified by Jonsson and Regnér (2009) such as the cost of acquiring alternative resources outweighing others. The combined strategical impact and cost of rearranging resources is also considered to be a deterrent for competitor imitation (Madhok et al., 2010). Social trading platforms allow inexperienced investors to undermine these barriers to imitation by avoiding typical transactional costs and costs in gathering information when imitating more experienced investors' trades. Early research in online investing discusses how overtrading causes retail investors online to underperform more traditional investment strategies (Barber & Odean, 2000, 2001b, 2002; Konana & Balasubramanian, 2005). Social trading offers a solution to these inexperienced online retail investors by neutralising their lack of experience via imitation and realising returns comparable to those of more competent investors (Berger et al., 2018). This aligns with the framework's definition of usefulness in that by engaging in copy trading, investors can enhance their returns.

In summary imitation, risk management and returns are enhanced by social trading according to previous literature. This study's framework defines usefulness as the degree to which an online investor can enhance their investment performance as per TAM. By incorporating the analysis of existing literature on online investing and social trading, the framework posits that imitation, risk management and return on investments are the foundational underlying drivers of perceived usefulness among investors in a social trading context.

2.4.2 Ease of Use:

Perceived ease of use, as identified by TAM, plays an important role in a user's acceptance or rejection of new technology and is defined in this study as the ease with

which investors can copy trades and realise improved returns. In this study's framework, four underlying dimensions of the ease of use core construct are identified and included: transparency (Glaser & Risius, 2018), experience level (Balasubramanian et al., 2003; Berger et al., 2018), reduced overtrading (Anderson, 2006; Barber & Odean, 2000; Choi et al., 2002) and reduced fees (Barber & Odean, 2001b; Berger et al., 2018; Glaser & Risius, 2018; Konana & Balasubramanian, 2005; Kromidha & Li, 2019; Oehler et al., 2016) as illustrated by figure 2.3. The framework refers to these underlying drivers as key characteristics of ease of use in online copy trading; each is described separately below.

Transparent social trading networks are becoming increasingly relevant as disintermediating platforms. Signal provider transparency in these networks combined with automated and immediate replication of their decisions allows for extensive control over investments (Glaser & Risius, 2018). The study of Stoughton (1993) highlights the bias of investment managers in prioritising their own profits over the underlying investor. A fundamental difference of copy trading to traditional investment manager-client relationships is the degree of transparency regarding signal provider decisions. In traditional delegated portfolio management, investors receive periodic updates on returns. Copy trading in comparison is fully transparent in that investors can see every decision made by signal providers in real-time. Due to the visibility of signal provider performance, followers can identify more competent investors with more conservative approaches, and in doing so, increasing their chance of improved returns (Glaser & Risius, 2018). The degree of transparency in copy trading platforms allows investors to easily choose a signal provider based on the information available, aligning with the framework's core construct - ease of use.

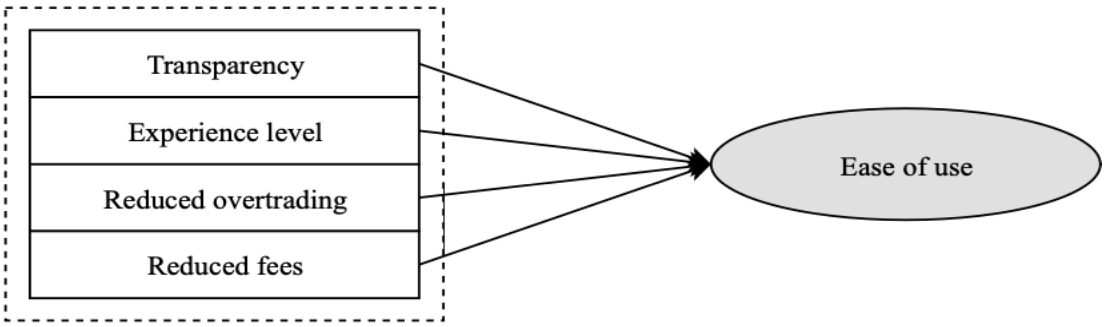

Figure 2.3: Ease of use underlying drivers

In terms of online investors' *experience level*, Barber and Odean (2002) point out that the democratisation of information online means investors have access to data similar to investment professionals; however, a clear disparity with regard to experience level exists. Their study goes on to point out that the more overconfident an investor is, the more likely they are to overstate their experience level and ultimately the more likely they are to begin investing online. Overconfidence is then highlighted among these online investors who trade excessively resulting in subpar returns. The study ultimately suggests that rational investors would not engage in overtrading. Konana and Balasubramanian (2005) describe how, traditionally, competent brokers with superior knowledge are used to manage investments. Their study also identifies that overconfidence is evident among inexperienced investors; however, this overconfidence is corrected by experience. The work of Singh et al. (2010) highlights a disparity in experience level between adopters and non-adopters of investing online. However, the study goes on to identify that younger investors value information obtained online more than older, more experienced, investors. Ultimately, the study finds that inexperienced investors are more likely to adopt online investing. Existing research after the emergence of copy trading, such as Pentland (2013)'s study of the social trading platform eToro, reveals that followers who imitate investors with diversified portfolios can achieve higher returns. This finding highlights that imitation can allow average or inexperienced investors to realise improved and in some cases

above-average returns. Berger et al. (2018) further consolidate this finding by presenting empirical evidence that inexperienced investors can achieve returns comparable to those of experienced investors. Therefore, the disparity in experience levels among online investors identified by Barber and Odean (2002), Konana and Balasubramanian (2005) and Singh et al. (2010) is somewhat bridged by copy trading and improved returns are realised with relatively lower levels of effort aligning with this framework's core construct of usefulness.

Overtrading as described above is a destructive attribute of overconfident online investors who trade excessively and therefore reduce returns (Anderson, 2007; Barber & Odean, 2000, 2001a, 2001b, 2002; Choi et al., 2002; Konana & Balasubramanian, 2005). Online investing reduces traditional costs associated with liquidity, transactions and commissions. However, Barber and Odean (2002) identify that increased speculation among investors online offsets these cost reductions. These speculative losses are a result of overconfident, irrational, investors. Copy trading has the potential to neutralise this irrationality. This is pointed out by the research of Berger et al. (2018) who propose that less competent, excessive traders can imitate more rational and competent traders, resulting in improved returns. The findings of Pelster (2019) highlight attention from peers and an increase in followers results in an increase in trading volumes; however, these volumes decrease in time. In summary, by identifying rational and more competent investors, less rational and less competent investors can delegate their decisions to signal providers and to a certain extent, reduce irrational overtrading. This reduction in irrational overtrading via copy trading requires a lower level of effort from investors to realise higher returns, aligning with this framework's core construct, usefulness.

Reduced fees are pointed out in early online investing literature by Barber and Odean (2001b) and Konana and Balasubramanian (2005) as a benefit for investors using disintermediated online platforms that significantly reduce the cost of executing trades and gathering investment information. However, overtrading stems partially from these reduced costs which, while lower per transaction, can accumulate with increased trading volume (Barber & Odean, 2001a). Copy trading has been identified as a method for less competent investors to imitate more rational investors and, therefore, reduce irrational overtrading (Berger et al., 2018) and reduce costs accumulated from increased trading volume. In combination with rational trading volumes reducing costs, recent literature focusing on copy trading highlights cost efficiency with regard to transactions and acquiring information via copy trading (Glaser & Risius, 2018; Oehler et al., 2016). This observation is reiterated by Berger et al. (2018) who point out that costs in transacting and gathering information are incurred by the signal provider, not the follower. Kromidha and Li (2019) highlight the low cost of choosing between alternative signal providers. Generally, copy trading has proven to be cost-effective and free of significant effort relative to traditional investing. This aligns with the framework's core construct of usefulness.

In summary, based on an analysis of previous literature, copy trading's increased transparency, reduction of fees and reduction of overtrading among inexperienced investors allows for an investing experience that generally requires less effort than traditional methods. This study's framework defines ease of use as the ease with which investors can copy trades and realise improved returns as per TAM. By incorporating the analysis of existing literature on online investing and copy trading, the framework posits that transparency, experience level, reduced overtrading and reduced fees are

the foundational underlying drivers of perceived ease of use among investors in copy trading.

2.4.3 Enjoyment:

Enjoyment is an extension of TAM identified by Davis et al. (1992) which acts as an additional basic determinant of a user's acceptance or rejection of new technology. Enjoyment is defined during this study as the extent to which copy trading provides satisfaction among investors, despite any negative impacts on investment performance. In this study's framework, three underlying dimensions of the enjoyment core construct are identified and included: self-attribution, illusion of knowledge, and illusion of control (Anderson, 2006; Barber & Odean, 2000, 2001b, 2002; Konana & Balasubramanian, 2005; Looney, Valacich, Todd, & Morris, 2006; Uchida, 2006; Unsal & Movassaghi, 2001) as illustrated by figure 2.4. The framework refers to these underlying drivers as key characteristics of enjoyment for copy trading. Each is described separately below.

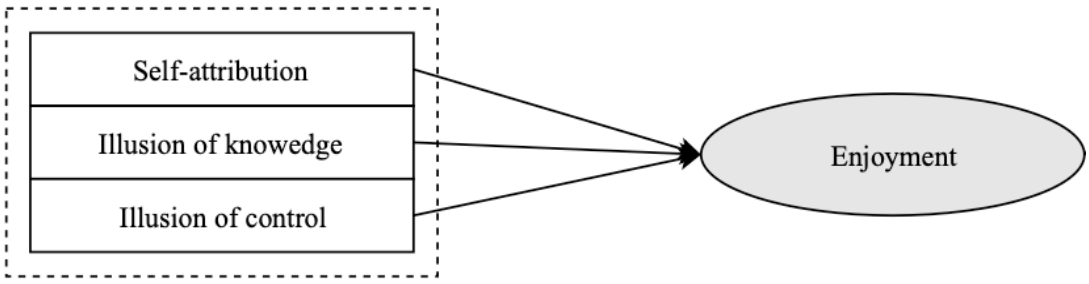

Figure 2.4: Enjoyment underlying drivers.

Self-attribution is evident when investors attribute decisions with positive outcomes to themselves, and negative outcomes elsewhere (Konana & Balasubramanian, 2005). The applicability of self-attribution to online investing is particularly evident with investors using traditional brokers. The perceived competence and experience levels of brokers result in an assumption among investors that broker decisions are well informed (Kahneman & Riepe, 1998). Volatility in financial markets can result in

undesirable broker decisions; in this case, self-attribution is evident when investors assign the responsibility of their losses to a broker (Konana & Balasubramanian, 2005). Gervais and Odean (2001) find that investors often relate their own insights to increased returns and as a result recognise failures less and overemphasise successes. Konana and Balasubramanian (2005) go on to point out that investors exaggerate the quality of their own decisions due to the vast amount of information available online. Ultimately this allows for investors to overemphasise decisions with positive outcomes and relieve decisions with negative outcomes. Their study goes on to highlight that overconfident investors, subject to self-attribution, will be satisfied with a lower return. Berger et al. (2018) describe how by imitating signal providers in copy trading, investors can delegate investment decisions to more experienced or more competent investors. Therefore, the investor's decision shifts from being between trades to between signal providers. Considering the decision made by followers between signal providers ultimately results in either positive or negative financial returns, self-attribution can be applied to the context of copy trading. Investors can associate successful investment outcomes with their own choice of signal provider and can associate unsuccessful investment outcomes with the decisions of the signal providers they follow. Overconfidence stemming from self-attribution ultimately derives greater satisfaction for investors (Konana & Balasubramanian, 2005), aligning with the framework's core construct of enjoyment.

The illusion of knowledge is referred to by Konana and Balasubramanian (2005) as an investor's excessive perception of their own competence and expertise. This stems from the study of Barber and Odean (2001b) who suggest that online investors have access to far more information than previously, often in disintermediated environments. The proposition that the volume of information available correlates

with increased knowledge and better decision-making appeals to investors. However, the relevance of the information and the ability of the investor to use the information is more important. Therefore, a greater volume and variety of information is likely to feed the illusion of knowledge and ultimately promote overconfidence (Barber & Odean, 2002). With regard to information in copy trading, Glaser and Risius (2018, p. 2) highlight the high degree of transparency for investors. When engaging in copy trading, investors have "real-time resolution control" over their invested capital and full visibility over signal provider trading decisions along with the wealth of financial information provided online outside social trading platforms. Due to this volume of information available on social trading platforms, it is reasonable to assume that online investors' illusion of knowledge does not deteriorate in the context of copy trading. Konana and Balasubramanian (2005) associate investors' satisfaction levels with the illusion of knowledge, again aligning with this framework's core construct of enjoyment.

The illusion of control is defined by Langer (1975, p. 3) as an excessively high "expectancy of personal success". Essentially, the illusion of control in copy trading is observed when an investor overestimates their ability to control an investment outcome (Konana & Balasubramanian, 2005). In the online investing domain, Barber and Odean (2002) have identified involvement as a catalyst for the illusion of control among online investors. In a survey, their study observed that one of the main reasons investors began trading online was due to a feeling of empowerment. Barber and Odean (2001b) highlight that online investors are likely to trade excessively and speculatively as a result of the illusion of control when making investments, ultimately decreasing returns. Konana and Balasubramanian (2005) describe how the illusion of control among investors results in overconfident trading, consistent with the findings

of Barber and Odean (2001b). In the context of copy trading, control among followers can be transferred from choosing between trades to choosing between signal providers via copy trading. As such, control in the traditional sense of online investing remains. However, trades are executed by signal providers via imitation (Berger et al., 2018). Konana and Balasubramanian (2005) identify that the illusion of control among online investors results in overconfident trading and increased self-attribution, ultimately deriving satisfaction for investors, aligning with this framework's core construct of enjoyment.

In summary, according to previous literature, self-attribution among participants in copy trading, combined with an illusion of knowledge and an illusion of control provides satisfaction for investors. This study's framework defines enjoyment as the extent to which the activity of using a new application is perceived to provide reinforcement, apart from any performance consequences that may be anticipated as per TAM. By incorporating the analysis of existing literature on online investing and copy trading, the framework suggests that self-attribution, the illusion of knowledge and illusion of control are the foundational underlying drivers of enjoyment among investors in copy trading.

2.5 Signal Provider Trustworthiness

Usefulness, ease of use and enjoyment were adapted from TAM (Davis, 1989, 1993) as the core constructs for this research's framework. These core constructs, as per TAM, are considered basic determinants of a user's acceptance or rejection of a new technology. While these constructs and their underlying drivers illustrate to a certain extent why an online investor would engage in copy trading, the framework suggests that the TAM core constructs alone aren't enough to engage online investors. Previous literature has identified that for TAM to accurately reflect a user's acceptance of

certain technology, additional factors of acceptance must be considered (Pikkarainen et al., 2004). This study considers signal provider trustworthiness as a mediator for the relationship between TAM's core constructs and an online investor's intention to engage in copy trading. By adding signal provider trustworthiness as a core construct, the framework is refined specifically to the context of copy trading. Therefore, signal provider trustworthiness and its subcomponents, cognition-based signals and affect-based signals, are added to TAM's core constructs to model investors' intention to engage in copy trading. This is illustrated in figure 2.5.

Existing literature has identified the importance of signalling trustworthiness, in a variety of contexts in online communities, to overcome the difficulties of developing trust online (O'Sullivan, 2015; Pagani, Hofacker, & Goldsmith, 2011; Shankar, Urban, & Sultan, 2002; Yousafzai, Pallister, & Foxall, 2005). While trust online has been highlighted and researched in varying contexts, the work of Wohlgemuth et al. (2016) highlight the importance of signalling trustworthiness specifically within social trading networks. Their research describes how trustworthiness plays a particularly relevant and important role in the context of copy trading. Copy trading allows investors to directly imitate a signal provider's financial decisions and, by copying these decisions without evaluation beforehand, investors must trust these signal providers. Considering the financial responsibility of each decision within social trading networks, trust and signal provider trustworthiness plays a particularly significant role. Pan et al. (2012) also point out that the lack of offline interaction in copy trading means investors solely rely on signals sent by other participants in social trading networks; therefore, the trustworthiness of signal providers is critical.

McAllister (1995) examines interpersonal trust among managers and professionals in organisations. The study found that trust is both cognition-based and affect-based.

Previous literature describes how cognition-based trust is a result of "good reasons" for trust such as reliability, dependency and competency (Lewis and Weigert (1985). Affect-based trust is described as a result of interpersonal, emotional connections (McAllister (1995). Cognition-based and affect-based trust has since been applied to the interpersonal trust of investors engaging in copy trading (Wohlgemuth et al., 2016). The complex nature of financial trading requires cognition-based signals of trustworthiness to establish trust among participants in copy trading. The integration of social networks in social trading platforms means affect-based signals are also required to establish trust between signal providers and participants. Neither cognition-based nor affect-based signals on their own are deemed enough to establish trust between signal providers and followers. Trust, therefore, is modelled in the context of copy trading as a combination of cognition-based signals and affect-based signals from the signal provider. This model is conceptualised and tested in Wohlgemuth et al. (2016)'s study of signal provider trustworthiness on the social trading network eToro.

2.5.1 Cognition Signals:

Cognition-based signals of trustworthiness indicate the technical competence of a trusted individual in a specific field or for a specific task. In the context of copy trading, the domain-specific task and indicator of technical competence are referred to as the identification and execution of profitable investment decisions (Doering et al., 2015).

In Wohlgemuth et al. (2016)'s study, four cognition-based signals of trustworthiness were identified. The first signal was "profitable trades", referring to the number of trades with positive outcomes. The second cognition-based signal of trustworthiness was "return", referring to the annual return on investment. The third cognition-based

signal of trustworthiness was “maximum drawdown”, referring to an investor’s greatest loss over the course of one week as a percentage of the account’s balance. The fourth cognition-based signal of trustworthiness was “risk level”, referring to the risk appetite of the signal provider in question. These four cognition-based signals of trustworthiness provide a detailed picture of the signal provider’s trustworthiness.

2.5.2 Affect-Based Signals:

Affect-based signals of trustworthiness indicate that a trusted individual shares similar values with the trustor (McAllister, 1995). The social component of affect-based signalling complements the technical cognition-based signals of trust. A differentiating factor between cognition-based and affect-based signals of trustworthiness is the ability to transfer affect-based signals between tasks. As a result, affect-based signals of trustworthiness generate interpersonal trust as a result of demonstrating social competence (Pan et al., 2012). Examples of these include full name, personal pictures, number of followers, and previous performance.

In Wohlgemuth et al. (2016)’s study, two affect-based signals of trustworthiness were identified. Building on the study of McAllister (1995, p. 30), the first two affect-based signals were derived from “citizenship behaviour”; in the context of social trading. This refers to the behaviour of participants with the intention of “effective community functioning not directly resulting from self-interest or reward-seeking behaviour” (Wohlgemuth et al., 2016, p. 3). In the study, the disclosure of both a personal picture and full name, in addition to a username, were affect-based signals of trustworthiness and enough to portray a signal provider’s identity to followers. This aligns with the findings of Mesch (2012), who associate the disclosure of personally identifiable information with online trust. The second indicator of affect-based signals of trustworthiness was interaction frequency (Wohlgemuth et al. (2016). In the context

of copy trading, interaction frequency referred to the trading frequency of members in the online community. This signal was quantified by identifying a trader's number of active days on the investment platform.

The results of Wohlgemuth et al. (2016) highlight the complementary nature of cognition-based signals and affect-based signals in establishing trust and prompting decisions among followers in the context of copy trading. Specifically, in terms of signalling, the results of their study illustrate that "profitable trades", "return" and "maximum drawdown" are cognition-based signals. In conjunction with these is the presence of a picture, full name and interaction frequency, which are affect-based signals enabling followers to establish trust in signal providers.

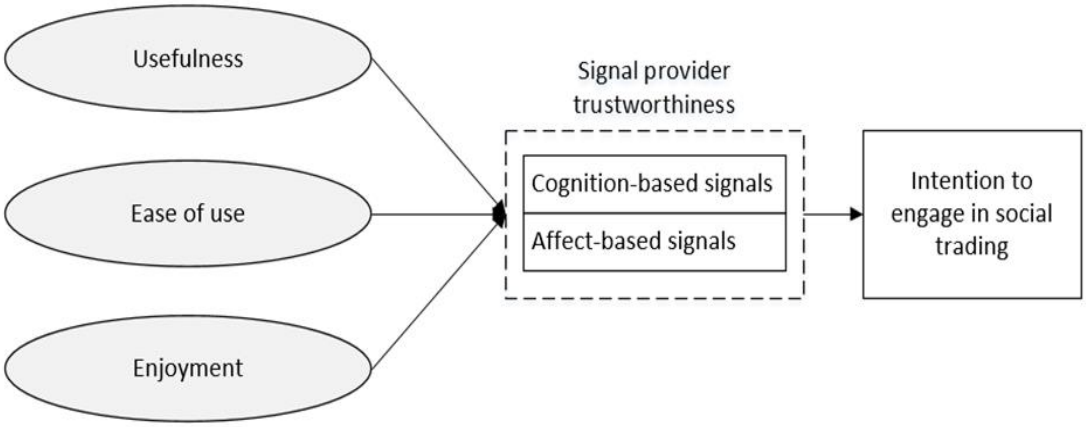

Figure 2.5: Signal provider trustworthiness as a mediator.

In summary, financial performance matters when establishing trust among followers, however signal providers must also demonstrate each appropriate affect-based signal. Followers do not rely on the cognition-based signal, "risk level", to establish trust. Wohlgemuth et al. (2016) refer to the risk-return trade-off associated with trading and corresponding follower preferences as a plausible explanation for this finding. Their findings also highlight the importance of trustors preferences in establishing trust.

2.6 Investor Engagement Framework discussion

This study's framework intends to model online investors' intention to engage in copy trading; this is illustrated in full in figure 2.6. Three of the framework's core constructs are derived from TAM: usefulness; ease of use; and enjoyment. These core constructs are used as a basis to examine investor intentions to engage in copy trading. To contextualise the constructs, features of copy trading are identified as underlying drivers of each core construct. Firstly, the framework identifies that imitation, risk management and return on investment are deemed to enhance investor performance, therefore, increase the perceived usefulness of copy trading. This suggests that for investors to engage in copy trading, it must be emphasised and clear that financial performance will be increased. Secondly, the framework highlights that transparency, experience level, reduced overtrading and reduced fees drive perceived ease of use. This suggests that copy trading appeals more to investors when it is perceived to be free of effort. Thirdly, the framework suggests that self-attribution, the illusion of knowledge and illusion of control make copy trading more enjoyable for investors regardless of the investment outcome.

Finally, the framework includes signal provider trustworthiness as an additional core construct which mediates the relationship between TAM's core constructs and an investor's intention to engage in copy trading. The inclusion of signal provider trustworthiness builds on TAM's core constructs in the specific context of copy trading. This trustworthiness is broken down into two separate forms of signalling, cognition based-signalling and affect-based signalling. The framework suggests that when delivered effectively, cognition-based signals and affect-based signals of trustworthiness form the trust necessary for investors to engage in copy trading.

While usefulness, ease of use, enjoyment and signal provider trustworthiness are highlighted individually as core constructs of investor engagement in copy trading, the framework's overall contribution is that the core constructs and their underlying drivers must work interdependently. It is considered that an investor's intention to engage in copy trading is nullified when any of the core constructs or their underlying drivers are absent.

2.7 Implications for Practitioners and Researchers

The framework proposed in this study ultimately details the copy trading features that specifically attract investors and build trust. These details primarily benefit practitioners. Understanding what impacts trust among investors in copy trading is important in the development of strategic and technological advancements to increase investor satisfaction and outcomes. The framework suggests that platform providers and marketers should identify and emphasise the features that users find easy to use, benefit from, and enjoy: for example, increased returns as a result of copy trading. Finally, the framework shows that platform and signal providers must emphasise the availability of signal providers' personal information and performance information to build trust with investors.

A further benefit of this chapter's framework is in helping researchers understand the drivers of online investors to engage in copy trading and delegate their investment decisions to others online. The framework is based upon TAM's core constructs. However, this study extends TAM with the introduction of signal provider trustworthiness as an exogenous factor and by identifying drivers of the core constructs. Signal provider trustworthiness mediates the relationship between investors' decisions to engage in copy trading and TAM's core constructs of user acceptance. Therefore, the framework emphasises the importance of building trust

between participants in copy trading. While the framework discusses each of the core constructs and their corresponding underlying drivers, it does not rank or weigh the constructs and drivers in terms of relevance or importance. To further understand what drives user acceptance of copy trading, future research could explore which specific features of this framework have the most significant effect on user intentions to engage in copy trading and intentions to delegate investment decisions to others. While objectives generally vary from investor to investor, an attempt could be made to filter out less significant factors in engaging in copy trading to further refine the framework presented in this study.

2.8 Conclusions

Existing research on copy trading identifies individual features that drive its growing popularity. This chapter proposes a conceptual framework to accurately synthesize and extend this existing literature. This framework builds on the Technology Acceptance Model. With the main function of TAM being to establish why users adopt certain technologies, it was deemed a very suitable tool to build this framework on. However for TAM to identify what drives users to participate in copy trading, it had to be adapted. Firstly, the research identifies that TAM's core constructs must be extended when applied to the context of copy trading engagement. Trust is considered paramount in investment decisions, particularly when the decision is influenced by others. As a result of this, signal provider trustworthiness is identified as an appropriate core construct to extend TAM. In total, perceived usefulness, perceived ease of use, enjoyment and signal provider trustworthiness make up the framework's core constructs. Finally, the overall contribution of the framework proposed in this study is that the combination of perceived usefulness, ease of use, enjoyment and signal provider trustworthiness drive investor engagement in copy trading. By extending

TAM to include these drivers and constructs, it provided insight into what drives people to seek information from and participate in copy trading.

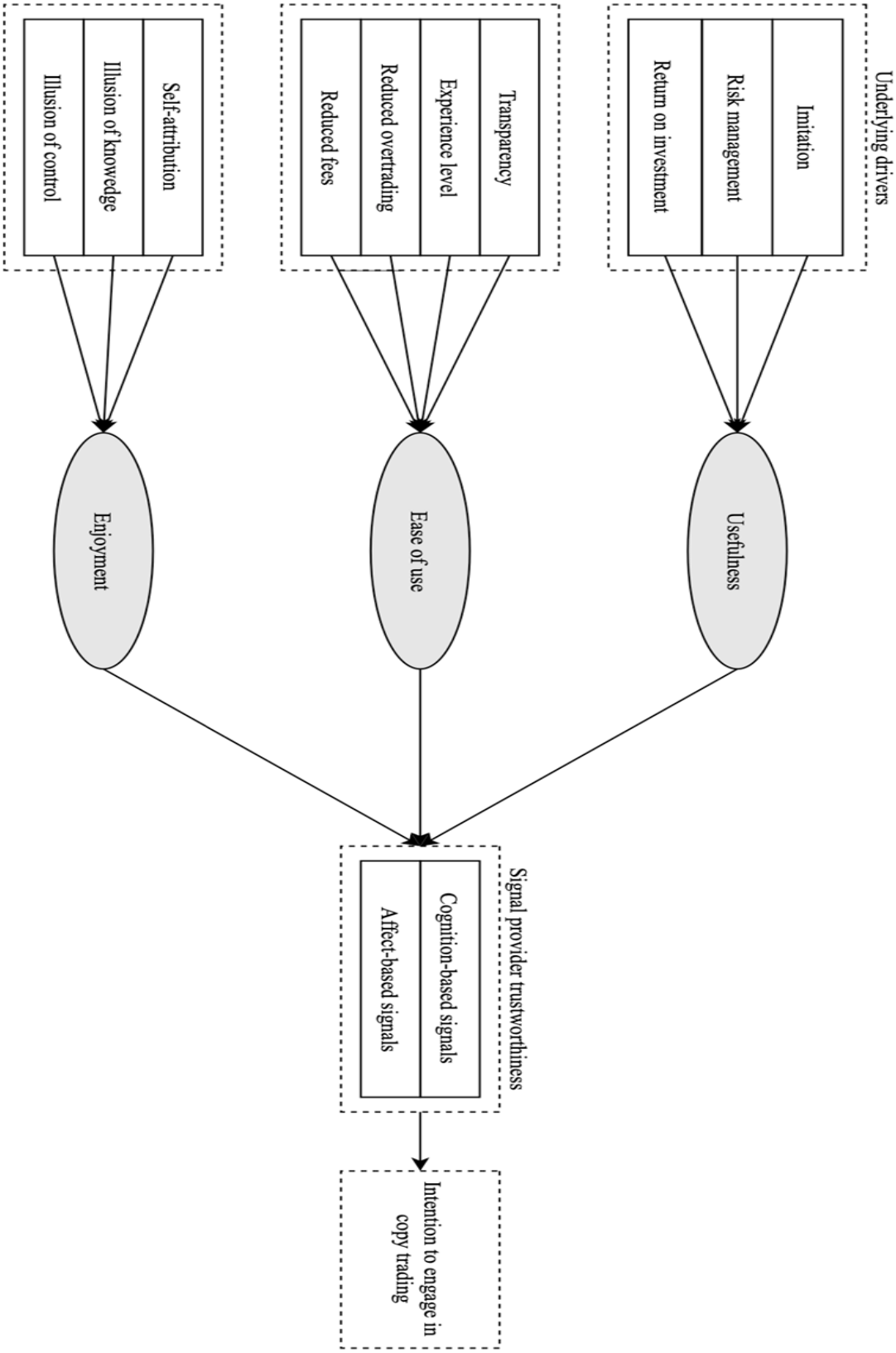

Figure 2.6: Full IEF modelling investors' intention to engage in copy trading.

3. Investor decision making: an investigation of the modality effect.

3.1 Introduction

In Gibson (1992, p. 2)'s study of financial information for decision making, a model is derived in which individuals consider the "utility of outcomes" before making the decision. This model is built on the core assumption that complete information is available to the decision-maker. Therefore, in the absence of complete and perfect information, the decision made may not result in the optimum outcome. The question remains as to how to ensure that the required information is available to those making financial decisions.

Information modality refers to the use of different "sensory channel used to process information" (Moreno, 2006, p. 1); an example of this is the processing of audible or visual information. Instances of audible information are voice assistants such as Apple's Siri, Microsoft's Cortana and Amazon's Alexa (Hoy, 2018) utilising advancements in natural language processing (Hirschberg & Manning, 2015) and Voice-based User Interfaces (Ghosh, Foong, Zhang, & Zhao, 2018). While advances in this technology are evident, existing literature that compares voice and text in questioning answering (QA) systems has shown mixed results. While research has been conducted comparing singular modes of information communication, Sharma, Pavlović, and Huang (2002) suggest that multimodal human-computer interaction can improve the flow of information between the user and computer systems. In the context of this study, multimodal human-computer interaction refers to human-computer interaction both audibly and visually.

Amazon's Echo Show uses two separate modes of information communication: visual when information is displayed on the Echo Show screen and audible when interacting verbally with Alexa - Amazon's voice-based personal assistant. Previous research has identified the modality effect, which describes how learning is enhanced when text is

replaced by audible information accompanying a related piece of visual information (Ginns, 2005). To date, the modality effect has not been considered in the area of investors making investment decisions. This study hypothesizes that the modality effect can enhance an investor's ability to learn from investment-related information and ultimately better inform their investment decision. This will be tested by using the Amazon Echo Show which can display investment-related information both visually onscreen and audibly using Alexa. By using the Amazon Echo Show, the study applies the findings of previous modality effect literature to the specific context of retail investor decision making. During this study, retail investors are defined as "individuals who own stock by any means" (O'Hare, 2007, p. 3).

The study begins by describing information modality through an examination of existing literature. The following section identifies features of electronic systems that are used in previous literature to test for the modality effect. From there a Repertory Grid analysis is performed with key informants to derive features and functionality for this study's Amazon Echo Show system. Following this, the testing procedure is described in which the Amazon Echo Show is used with another group of key informants to test investor decision-making through the lens of the modality effect. The next section outlines the results and analysis of the tests performed. Following this, the implications of these results from testing are discussed. Finally, the study concludes with practical implications and avenues for future research.

3.2 Information Modality

Baddeley (1992, p. 1) developed a working memory model consisting of several interrelated subsystems. Two of these subsystems process visual and audible information separately: these are the "visuo-spatial scratch pad" and "articulatory loop respectively". The visuo-spatial scratch pad processes visual information and has

recently also been referred to as the visual-spatial sketchpad (Leahy & Sweller, 2011, p. 2). The articulatory loop is divided into two subcomponents: the phonological input store and the articulatory rehearsal process which both process audible information.

Van Merrienboer and Ayres (2005, p. 1) describe "extraneous cognitive load" as excessive amounts of information being processed by certain components of working memory such as the articulatory loop or visual-spatial sketchpad. An example of this is the work of Leahy and Sweller (2011), where a group of subjects process visual-only information, in the form of a diagram and on-screen text, less effectively than when the same diagram is displayed with the text replaced by audible information. This demonstrates that when working memory is split between visual and auditory processors, the ability to deal with information may be increased by using both processors concurrently rather than just one.

This demonstration of increased capacity in working memory is referred to as the modality effect. The modality effect is evident when audible information displayed concurrently with related visual information enhances learning more effectively than visual information on its own. The audio/visual information presented must be directly related; if the information only complements other information in a different modality, the modality effect will not be obtained (Low & Sweller, 2005). The modality effect is also referred to as the "separate stream hypothesis" (Penney, 1989, p. 1) or "split attention effect" (Mousavi, Low, & Sweller, 1995, p. 1). A reverse modality effect is obtained when visual information on its own enhances learning more effectively than audible information displayed concurrently with related, visual information (Inan et al., 2015; Leahy & Sweller, 2011). To test for the modality effect among retail investors, we examine existing literature to determine which system features are likely or unlikely to result in a modality effect with financial decision making.

3.3 System Features in Modality Effect Literature

To determine what features are required in an audio/visual system to optimise financial decision making, a systematic review (Webster & Watson, 2002) of existing literature on the modality effect was carried out. Article databases such as the AIS Electronic Library, Google Scholar, ScienceDirect, SSRN, and Web of Science were explored for relevant literature using the following keywords: 'financial decision making', 'online investing', 'voice-based user interface', 'natural language processing', 'information modality' and 'modality *effect'. Leading research journals were then examined. The journals examined included Learning and Instruction, British Journal of Educational Technology, Journal of Computer Assisted Learning, Journal of Experimental Psychology, and Educational Technology Research and Development*. Citations of identified articles were used as further research sources.

During the systematic literature review, recurring core features of audio/visual systems are identified that can result in a modality effect with participants. This study considers that investor decisions will be enhanced as a result of the modality effect. In order to examine this, the core features that result in a modality effect are incorporated in the design of a system to test for the modality effect among investors. These features are described in detail below (with the core concepts identified by italics).

In the literature, there is an emphasis on the importance of information length when testing for the modality effect. While displaying an instructional diagram in experiments, Mayer and Moreno (1998) obtained a modality effect when related audible narration accompanied the diagram. Results of this study revealed that concise and highly concentrated audible narration of visual diagrams allowed participants to process the information most effectively when in parallel in working memory. This

study, and others such as Inan et al. (2015), prove that for the modality effect to be present, *audible information must be short and concise*.

Leahy and Sweller (2011) observed that long and complex information transmitted audibly and visually resulted in a reverse modality effect. Their study revealed that detailed, longer pieces of information may excessively load working memory when presented in audible form rather than written form. Inan et al. (2015) reiterate this by observing that learning improved when long, spoken text was replaced by written text when presenting unfamiliar information to participants. This suggests that *long and detailed information should be communicated in a solely visual way*; however, *the modality effect was evident with shorter pieces of information* when transmitted both audibly and visually.

The timing of audible information impacts the performance of participants according to previous literature (Mayer & Anderson, 1992). For example, Mayer (1997)'s study identifies that subjects perform better when visual information is processed with concurrent rather than sequential narration. Moreno and Mayer (1999) tested the modality effect by providing participants in their study with a visual describing the formation of lightning narrated with audible information both before and after the visual in different tests. Findings revealed the modality effect was present as participants' connections between corresponding visual and verbal information more effectively. This suggests *audible information displayed concurrently with visual information assists with the modality effect*. In another study, Moreno and Mayer (1999) provided audible narration and text either concurrently or sequentially in different tests with participants. Findings revealed an advantage of audible narration over text; however, *this advantage did not disappear when presentations were made*

sequential contrasting previous findings suggesting the superiority of concurrent audible information.

Moreno and Mayer (1999)'s study tests the idea that the modality effect is achieved more effectively when visual information is close in proximity (Mayer & Anderson, 1992). This was done by presenting concurrent visual text and related animations to participants. The text was displayed at the bottom of the screen for one test and next to the corresponding part of the diagram for the other. Results showed that the interpretation of information is impaired when on-screen text is spatially separated from the visual materials. This is consistent with results from Inan et al. (2015)'s study that suggests information that isn't displayed in close proximity can plausibly result in a reverse modality effect. In summary, to effectively display and communicate information in an audio/visual way, *the information should be condensed into a smaller visual field*.

Rummer et. al (2010) investigate the modality effect by testing each subject's ability to recall sentences and unrelated visual diagrams (matrices), one simple, one more complex. The study examines the impact of eye-movement on the participants' ability to recall sentences by displaying the sentence for one group word-by-word in the centre of the screen, followed by the matrices. Results suggest participants listening to sentences or reading with less eye-movement outperformed those in the standard reading group regarding matrix recognition. This demonstrated that eye-movements during reading hamper participant's ability to process information and reiterate the previous findings that *visual information should be condense*d (Moreno & Mayer, 1999).

Tabbers, Martens, and Van Merrienboer (2001) investigate the modality effect with an interactive system where either the user or the system controls the pace of the information displayed depending on the experiment. In one experiment, participants used a system with a predetermined pace for displaying information, results suggested the superiority of audio over visual text as narration, essentially yielding a modality effect. In a second experiment, where users had control over the pacing of the instructions, retention of information by participants with visual information outperformed those with audible information, yielding no modality effect. This result is replicated more recently by Tabbers, Martens, and Van Merriënboer (2004) and Inan et al. (2015), suggesting that *when participants have more time or control the pace of the information displayed, a reverse modality effect can be demonstrated*.

Tabbers et al. (2004) investigate the impact of visual cues on the modality effect; in this case visual cues refer to certain pieces of visual information. They are utilised to reduce visual search in multimedia presentations, thus increasing effectiveness. The testing involved a non-technical diagram accompanied by either visual text or audible instructions. To reduce visual search, visual cues in the form of bright red colours referring to specific parts of the diagram were applied. Results highlighted *that visual cues were only effective in terms of retaining the information* portrayed by the diagram, however *no difference in terms of mental effort spent or ability to transfer information* was noticed, yielding an overall reverse modality effect.

In summary, the system features and functionalities identified during this review have been tested in previous literature on the modality effect. This analysis of existing research has determined which features are essential to building an effective audio/visual system even when the context of the systems and its users vary. This study investigates the modality effect specifically in the context of retail investing,

therefore system features identified as relevant to the modality effect will be presented to a group of retail investors during interviews. The results of these interviews with key informants will inform the functionality of an audio/visual system that presents investment information to retail investors. Table 3.1 illustrates which system features yield either a modality effect or a reverse modality effect according to the literature described above. These system features are used as elements in a RepGrid analysis (Bernard & Flitman, 2002) with investors, from which system functionality is derived during interviews. This is described in detail in the next section below.

Table 3.1 Potential system features found in previous literature and corresponding modality effect outcomes.

System Features	Modality Effect	Reverse Modality Effect
Short, concise information	✓	
Long, detailed information		✓
Concurrent audio/visual information	✓	
Sequential audio/visual information	✓	
Visually condensed information	✓	
System-paced information	✓	
User-paced information		✓
Visual cues		✓

3.4 RepGrid Analysis

To test for the impact of audio/visual information on retail investor decision making, a visual and audio/visual system was required for comparative testing. These systems were built using an Amazon Echo Show which displayed information about a fictional stock onscreen for visual-only testing. For audio/visual testing, audible information was presented using Amazon's voice assistant Alexa, and visual information was presented onscreen. The RepGrid analysis was used as an interviewing technique with the targeted user group, retail investors, to elicit how information should best be presented by the system.

Kelly (1977) derived the RepGrid analysis from his personal construct theory which improves the interpretability of an interview participant's views and opinions. Further literature describes how RepGrid interviews reduce bias and allow for participants to interpret certain topics in a less restricted way (Hunter, 1997). In the context of information systems, the RepGrid analysis has been validated as a useful method for the cognitive analysis of users (Tan & Hunter, 2002). The RepGrid analysis has also been described as a useful qualitative interviewing technique to gather unbiased information systems data (Hunter, 1997).

There are four components to the RepGrid analysis: the topic, the elements, the constructs, and ratings (Easterby-Smith, 1980). The topic of this analysis is the impact of audio/visual information on investor decision making. Elements are considered to be instances of the topic, in this case: ways of communicating audio/visual information to investors. The elements were derived from the systematic literature review and are outlined in table 3.1. Constructs are considered to be opposing opinions of elements (Coshall, 2000; Kelly, 1977). Constructs are derived during the construct elicitation stage of the interview in which a triadic comparison is used (Kelly, 1955; Kelly, 1970). A triadic comparison occurs when the interviewer presents the participant with three elements from the RepGrid and asks the participant to identify a "way in which two of the elements are similar yet different from the third". Bernard and Flitman (2002, p. 3) state the way in which two of the three elements are similar in a positive way forms the likeness pole and the way in which the third element differs negatively forms the contrast pole. In order to understand the context and meaning of a particular construct, Hinkle (1965) conceived laddering as a technique to further explore relationships between constructs by identifying and developing a hierarchy. In this study, laddering up was used to reveal superior constructs within the hierarchy

(Stewart, Stewart, & Fonda, 1981). In interviews, participants are asked "Which pole do you prefer and why?" to ladder up (Bernard & Flitman, 2002). Ratings are then used to link constructs and elements (Hunter, 1997). A Likert scale with five intervals is used to allow participants rate the elements based on the constructs, with one being the likeness pole on the left and five being the contrast pole on the right (Fransella, Bell, & Bannister, 2004). Typically, the lower numbers relate to the more positive pole (Harter, Erbes, & Hart, 2004).

3.4.1 RepGrid Interviewing Procedure

The RepGrid analysis interviews were conducted over three weeks in March 2019. These interviews were conducted with a group of four key informants (McAvoy, 2006). Each participant was selected from a group of investors running and managing a retail investment fund. Key informants aren't intended to represent a certain population statistically (George and Reve, 1982). Instead, they have a higher level of knowledge in the field being researched and are willing to communicate this knowledge (Campbell, 1955). Babbie (1998) describes how key informants are particularly effective when research targets theoretical concepts that aren't well understood. This study considers that retail investors can enhance their ability to learn from investment-related information via the modality effect, resulting in better-informed decisions. While investor decision making has been thoroughly researched, the application of the modality effect to the context of investor decision making hasn't been researched previously, therefore, it isn't well understood. With this in mind, key informants are deemed appropriate to interview. As per Campbell (1955)'s description, key informants are selected from a group of investors running and managing a retail investment fund and who are willing to share their experiences with systems they've used to receive investment information. These investors were

predominantly in their mid-twenties and had varying levels of expertise. However all members of the investment group had some formal education in finance with over fifty per cent having either finance or economics degrees. A number of the participants also had masters degrees in asset management. Participants had invested varying levels of their own money into their own retail investing accounts. Preference was given to those with the most experience in retail investing. The gender split in the retail investment fund as whole was eighty percent men which meant that the majority of participants in the testing were men.

The interviews were conducted individually. Initially, the context of the research was explained to participants. The description of this context involved explaining how the research was focused on the presentation of information to retail investors during a comparative analysis of a fictional stock. It was then explained that the purpose of the interviews was to identify the format in which retail investors preferred to receive information.

The RepGrid was presented to participants populated with just the elements as shown in figure 3.1. The elements were described to participants as being derived from existing literature and are ways of presenting audio/visual information. An information sheet containing examples of each of the elements was given to the participants so that they could have a better grasp of them. This sheet provided context of what the particular elements were (e.g ‘A visual cue is an onscreen indicator that signals something to the user. Negative stock prices being shown in red is an example of this’). Participants completed a triadic comparison in which the interviewer presented three separate cards, each with one element from the RepGrid. The interviewer then asked: “In what way are two of these three elements similar to each other and different from the third?” The corresponding answers were written by the

interviewer in the RepGrid forming constructs. An example of this from interviewing was the triadic comparison of the elements: long and complex information, visually condensed information, and visual cues. Each element refers to how information is presented to the retail investor. One participant described how visually condensed information and visual cues are similar in that they are visual and that long and complex information differs in that longer, complex information is more often text-based and non-visual. Therefore, the construct <visual – non-visual> was formed as shown in figure 3.1. The triadic comparison process was repeated with different combinations of elements until similar constructs started emerging. Laddering was then used as a technique to identify hierarchical relationships amongst the constructs. Participants were asked: "Which pole do you prefer and why?". Figure 3.1 illustrates that the participant preferred "Visual" as it allows information to be more easily interpreted, this resulted in the superordinate construct <easily interpreted – hard to interpret>. Following laddering, the respondent was asked to rate all information regarding each construct, using the Likert scale discussed above with one referring to the likeness pole and five referring to the contrast pole.

	Elements								
Likeness Pole	**Long & Complex Information**	**Short & Concise Information**	**Visually Condensed Information**	**Concurrent Display**	**Successive Display**	**User-paced Interaction**	**System-paced Interaction**	**Visual Cues**	Contrast Pole
Easily Interpreted	3	2	2	1	3	1	4	1	Hard to interpret
Visual	4	1	1	2	2	3	3	1	Non-visual
Total	**7**	**3**	**3**	**3**	**5**	**4**	**7**	**2**	

Figure 3.1 Sample RepGrid from interviews

3.4.2 RepGrid Interview Results and Elicitation of System Features

To derive system features and functionality for the financial decision-making system, RepGrid interview results were analysed based on participant ratings of elements. For each element, ratings were summed and noted at the bottom of the column as can be seen in figure 3.1. Five triadic comparisons of elements resulted in five constructs

describing elements positively in the likeness pole and negatively in the contrast pole according to participants. Laddering up followed the triadic comparisons to derive superordinate constructs, which explained why certain elements are positive in the likeness pole or negative in the contrast pole. While rating each element, one referred to the likeness pole and five referred to the contrast pole as described above, therefore lower total ratings indicated a participant's preference for a certain element. The ratings were totalled for each element, total ratings from each interview were then added together to provide an overall rating for each element. The overall total was then used to quantify priority amongst elements with the lowest total being of the highest priority and the highest total being of the lowest priority as system features. Figure 3.1 shows the total for each element per interview, an overall total rating and a priority ranking.

	Long & Complex Information	Short & Concise Information	Visually Condensed Information	Concurrent Display	Sucessive Display	User - Paced Interaction	System-Paced Interaction	Visual Cues
Participant 1	40	29	21	27	31	30	32	25
Participant 2	26	27	31	28	31	28	26	25
Participant 3	21	24	20	19	22	18	29	21
Participant 4	28	33	25	35	32	30	33	34
Total Rating	115	113	97	109	116	106	120	105
Priority Ranking	**6**	**5**	**1**	**4**	**7**	**3**	**8**	**2**

Figure 3.2: RepGrid results including total rating for each element per interview, an overall total rating and a priority ranking.

Based on the requirements identified and prioritised in the RepGrid interviews, two proof of concept (POC) systems were developed which displayed information about a fictional stock to a group of retail investors. Elicitation of system features was based on priority rankings of elements as shown in figure 3.2. System features were prioritised as follows; visually condensed information, visual cues, user-paced interaction, concurrent display, short and concise information, long and complex

information, successive display and system-paced interaction. One POC was created that presented information onscreen in a solely visual way, the second POC was created to present information in an audio/visual way - visually onscreen and audibly through the Amazon Echo Show's voice assistant, Alexa. Both systems were tested with separate groups of key informants to investigate the modality effect and its impact on retail investor information.

3.5 Testing Procedure

The participants chosen for testing were a different group of key informants from the group of investors who took part in the RepGrid analysis. Considering the purpose of the RepGrid analysis was to derive suitable system features for testing both visual and audio/visual systems, different key informants were chosen for testing to remove any potential bias. During testing, participants received information about a fictional stock (STK). The stock was fictional to allow participants to focus solely on the information presented during testing. One group of participants viewed the information onscreen in a solely visual way (Visual Test Group), with no audible information available, and no ability to interact with Alexa once the information was displayed. Another group of participants viewed the information onscreen with audible interaction (Audio/Visual Test Group). Audible information was available upon request by speaking to Alexa. Participants were allocated to either the Visual Test Group or the Audio/Visual Test Group at random, each group consisted of seven participants.

3.5.1 Visual Test Group Testing Procedure

Figure 3.3 displays the information provided to participants in the Visual Test Group. The price change of this stock included visual cues to allow participants to interpret the price-performance more easily as suggested by the RepGrid analysis. Font colour was used as a visual cue with any negative change in price percentage represented by red font, and any positive change in price percentage represented by green font.

A chart displaying price movement of the stock over one day was located close in proximity to the price percentage changes to align with the results of the RepGrid analysis suggesting information should be condensed visually.

Revenue and market capitalisation information was displayed on the right-hand side of the chart. Bold text was used as a visual cue to emphasise the figures for revenue and market capitalisation. Information regarding peer performance and historical comparison of revenue and market capitalisation was displayed with short and concise pieces of information, condensed visually using bullet points and narrow margins. The inclusion of visual cues, visually condensed, and short and concise information was again, in line with findings of the RepGrid analysis.

News headlines were displayed in close proximity beneath the chart. These headlines were also short and concise with italic font used as a visual cue to allow participants to make a distinction between headlines and other information.

Participants began processing the information onscreen. Participants could finish processing the information whenever they felt ready to move onto the next section of testing. This aligns with results of the RepGrid analysis that suggest a priority should be placed on user-paced system interaction.

Figure 3.3: Information presented to Visual Test Group during testing.

3.5.2 Audio/Visual Test Group Testing Procedure

Figure 3.4 displays the information provided to participants in the Audio/Visual Test Group. Similar to the previous visual group testing procedure, visual cues and visually condensed information were prioritised in order to apply the findings of the RepGrid analysis to the Audio/Visual testing procedure. Green and red font colours were used as a visual cue to inform the participant about positive and negative price changes respectively. Bold text was used as a visual cue to emphasise the figures for revenue and market capitalisation. For the condensed visual information, again the stock's price chart was located close in proximity to the changes in price percentage.

While the audio/visual test group used similar features to the visual test group such as visual cues and visually condensed information, participants in the audio/visual test group interacted with the system using their voice, i.e. audibly. To view the information in figure 3.4 and initiate testing participants stated: "Alexa, ask State Street app to show the stock." Alexa then audibly stated the information displayed onscreen. Additional information for peer performance, historical comparisons and news was available to participants with further questioning described below. Additional information delivered audibly was exactly the same as the information provided visually for the Visual Test Group.

For a participant to request revenue information they would state: “Alexa, tell me about the revenue”. Alexa would then respond audibly: “This was the highest revenue of all technology companies in the S&P 500. S&P 500 technology companies average revenue growth over the last 5 years is 1.8%. Revenue is down 1% on last year. Revenue is up 2% on average in the last 5 years.”

For a participant to request market capitalisation information they would state: “Alexa, tell me about the market cap”. Alexa would then respond audibly: “This is the third-largest technology company by market cap. The market cap is up 1% on last year. Market cap is up 5% on average over the last 5 years.”

For a participant to request information from the news they would state; “Alexa, tell me about the news”. Alexa would then respond audibly: “Report shows STK streaming service has lost subscribers in the last 6 months. STK earnings report indicates growth and success of recent products. Ground-breaking STK payments product doubles its market share in the last year.”

Participants began processing information both onscreen and audibly. Participants could finish processing this information whenever they felt ready to move onto the next section of testing. Again, this aligns with results of the RepGrid analysis that suggest a priority should be placed on user-paced system interaction and to ensure consistency with the test for the visual test group. All information provided audibly was short and concise, consistent with RepGrid findings. Participants could ask Alexa for additional, audible information as many times as they deemed necessary.

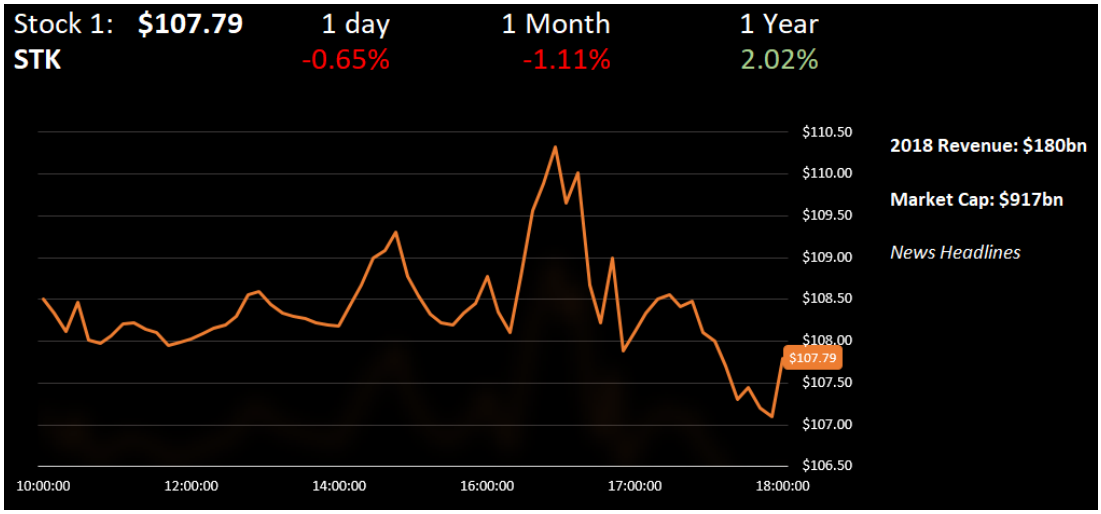

Figure 3.4: Information presented to the Audio/Visual Test Group during testing, additional audible information was available when requested from Alexa.

3.5.3 Retention Test

To reveal a modality or reverse modality effect, each participant's ability to retain information from testing was assessed. Six questions were asked regarding the information presented during both visual and audio/visual tests, and the answers were scored for accuracy. Figure 5 presents each question asked during the retention test, possible correct answers and the corresponding points awarded. For example, for question 1, "What is the stock price?", participants received two points for writing "$107.79". Any other answer received no points. Each participant's points were added for the six questions and then divided by a total possible 44 points. This figure was then multiplied by 100 and rounded to the nearest whole number to result in a percentage representing the participant's overall retention score.

Table 3.2: Questions, answers and corresponding points awarded during the retention test.

Question		Answers	Points
1	What is the stock price?	$107.79	2
2	What is the 1 day, 1 month & 1 year stock price percentage change?	1 day: -0.65% 1 month: -1.11% 1 year: 2.02%	2 2 2
3	What is the market cap? Describe its ranking amongst peers and percentage change over 1 and 5 years.	$917bn total market cap 3rd amongst peers 1% change over 1 year 5% change over 5 years	2 2 2 2
4	What was the 2018 revenue? Describe its ranking amongst peers and percentage change over 1 and 5 years.	$810bn in revenue in 2018 1st amongst peers 1% change over 1 year 2% on average over 5 years	2 2 2 2
5	What is the average percentage change in revenue of technology companies in the S&P 500 over the last 5 years?	1.8%	2
6	Describe the news headlines.	Streaming Lost subscribers Growth in earnings Successful products Payments product Doubled market share	2 4 4 2 2 4
			44

3.5.4 Transfer Test

To reveal whether a modality effect was present or not, a transfer test was carried out. This involved assessing each participant's ability to apply information received during testing to solve problems. Three questions were asked regarding the information presented during both visual and audio/visual presentations. Figure 6 presents each question asked during the transfer test, possible correct answers and the corresponding points awarded. Each participant's points were added for the three questions and then divided by a total possible 30 points. This figure was then multiplied by 100 and rounded to the nearest whole number to result in a percentage representing the participant's overall transfer score.

Table 3.3: Questions, answers and corresponding points awarded during the transfer test.

Question		**Answers**	**Points**
1	How would you describe the stock price performance over the short and long term?	<u>Short term:</u> Any negative wording 1 day/short term <u>Long term:</u> Any positive wording 1 month/1 year/long term	 2 2 2 2
2	How would you describe the stock's performance against its peers?	<u>Regarding revenue:</u> Any positive wording Revenue <u>Regarding market cap:</u> Any positive wording Market cap	 2 2 2 2
3	How do you interpret the news headlines in relation to this stock?	<u>Regarding overall sentiment:</u> Any positive wording	 2

		Regarding the first headline: Any negative wording Streaming Regarding the second headline: Any positive wording Earnings Regarding the third headline: Any positive wording Payment products	 2 2 2 2 2 2
			30

3.6 Testing Results

According to modality effect literature, audible information displayed concurrently with related, visual information enhances learning more effectively than visual information on its own. A reverse modality effect is obtained when only visual information enhances learning more effectively than audible information displayed concurrently with related, visual information. Following testing with both the Visual Test Group and the Audio/Visual Test Group, results were noted from transfer and retention tests. The results were then compared to identify any disparity between each testing group's performance during the experiment. Retention of information and transfer of information were tested in order to identify whether the modality effect was present or not, and to investigate how effectively each group processed the information presented.

Table 3.4 illustrates how the Visual Test Group outperformed the Audio/Visual Test Group on average regarding retention of information (Audio/Visual Test Group 23% vs. Visual Test Group 39%). Previous modality effect findings suggest that participants should retain more information during testing when verbal information related to onscreen visuals is presented audibly instead of visually. This finding suggests a reverse modality effect in the case of information retention. Considering the Audio/Visual Test Group, who received verbal information related to onscreen visuals during testing, were outperformed by the Visual Test group who received only onscreen information, a reverse modality effect is evident. This result is the opposite of what was expected with the modality effect.

Table 3.4 further illustrates how the Visual Test Group outperformed the Audio/Visual Test Group on average regarding transferring information (Audio/Visual Test Group 30% vs. Visual Test Group 46%). Previous modality effect findings suggest that participants should transfer information to provide problem-solving solutions during testing when verbal information related to onscreen visuals is presented audibly instead of visually. Again, the Audio/Visual Test Group, who received verbal information related to onscreen visuals during testing, were outperformed by the Visual Test group who received only onscreen information. As a result, these findings also reveal a reverse modality effect; this is inconsistent with the predictions of the modality effect.

While retention and transfer of information amongst both groups yielded a reverse modality effect, the time spent processing information and answering questions during testing revealed an interesting disparity between the groups. On average, the Audio/Visual Test Group took 24 seconds less to process information, 22 seconds less to answer retention questions and 2 minutes less to answer transfer questions, than the

Visual Test Group. Considering the Audio/Visual Test Group were outperformed by the Visual Test Group in retention and transfer of information, it is plausible that the lower average time spent answering the corresponding questions is a result of less detailed answers. However, the Audio/Visual Test Group's lower average time spent processing information provides potentially interesting implications. Participants from both test groups could finish processing the information provided whenever they felt ready to move onto the next section of testing. Participants' from the Audio/Visual Test Group felt adequately prepared to answer questions based on the information displayed in less time than participants from the Visual Test Group. This suggests that combined audible and visual information results in quicker response times than solely visual information. However, lower retention and transfer scores suggest that while Audio/Visual Test Group are quicker to respond when processing audible and visual information, they are less accurate when transferring and retaining this information. Given this information is intended to be retained and transferred to inform an investment decision, this trade-off of accuracy for speed can result in erroneous investment decisions and subsequent financial loss.

Table 3.4: Results for the Audio/Visual Test Group and the Visual Test Group following testing of retention and transfer of information with audio/visual and visual systems respectively.

Averages	**Audio/Visual Test Group**	**Visual Test Group**
Time processing information before questioning	00:02:51	00:03:15
Retention score	23%	39%
Time answering retention questions	00:02:59	00:03:21
Transfer score	30%	46%
Time answering transfer questions	00:01:38	00:03:08

3.7 Discussion

The chapter contributes a number of findings to the evaluation of information modality in the context of retail investors. Through a RepGrid analysis with key informant interviews, preferable system features and requirements were gathered to build a POC for testing. The findings of the RepGrid analysis suggested retail investors prioritise visually condensed information, the use of visual cues, user-paced system interaction and a concurrent presentation of audio and visual information for the audio/visual system. The RepGrid analysis also suggests a priority of short and concise information over longer detailed information when analysing a stock's performance historically and its comparison to peers. Results from the RepGrid analysis also revealed a disinclination amongst participants towards the successive display of audio/visual information and system-paced interaction.

In testing retention and transfer of information, it was initially predicted that the combination of concurrent and related audio/visual investment information would allow participants to retain and transfer information more effectively than participants receiving solely visual investment information. This would be consistent with the modality effect which states that learning is enhanced when related audio/visual information is processed concurrently. This study examines whether or not the modality effect can enhance the ability of retail investors to learn from investment-related information and improve subsequent investment decisions. The opposite was observed, with participants receiving solely visual investment information outperforming participants who received concurrent and related audio/visual investment information in both retention and transfer. This finding is referred to as a reverse modality effect. This implies that an investor's ability to learn from investment-related information is impaired when information is provided in an

audio/visual format and will result in subsequently less informed investment decisions. Further evidence that investor decisions are diminished by audio/visual information is suggested by the quicker response times of participants in the Audio/Visual Test Group. While quicker to process information, lower retention and transfer scores are observed. This suggests that investors processing audio/visual information are less accurate when transferring and retaining this information. Given this information is intended to be retained and transferred to inform an investment decision, this trade of accuracy for quicker responses can be at the expense of less informed decisions.

Based on previous literature it is plausible that these findings can be attributed to the inclusion of visual cues. Visual cues were used primarily with numerical, text-based information onscreen; for example, a decrease in price percentage change was displayed with red font and an increase in price percentage change was displayed with green font in both the visual and the audio/visual POC. Market capitalisation and revenue figures were highlighted using bold font. The intention of these visual cues was to reduce the visual search for participants. Considering the use of visual cues was associated primarily with numerical information, i.e. percentage changes in price, market capitalisation and revenue figures, it is reasonable to consider the presentation of numerical information to be more beneficial and effectively processed when presented visually. The audible information presented to the Audio/Visual Test Group contained a substantial amount of numerical information relative to what was displayed onscreen. Audible information regarding market capitalisation, revenue and news were largely numerical; the lower test scores for retention and transfer of information for the Audio/Visual Test Group could be to a certain extent, attributable to this. In order to improve the performance of the Audio/Visual Test Group, all

numerical information could be presented onscreen using visual cues, supplemented by relevant audible information.

It is also plausible that these findings can be attributed to insufficiently short and concise information. The intention of the audio/visual POC was to provide audible information that was as short and concise as possible, but sufficient for participants to answer questions appropriately during testing. Despite this, responses from Alexa averaged 37 words in length to provide full answers to each participant's question. While the intention was to provide short and concise audible information, it is plausible that 37 words per answer is excessively long regardless of complexity. This finding is consistent with the reverse modality effect which, in the context of this study, suggests that longer, audible information impairs an investor's ability to learn from investment-related information and results in less informed investment decisions. With this in mind, it is reasonable to emphasise that in the context of retail investor decision-making, for audio/visual information to be effective, audible information must be shorter in length than in this study's testing scenarios. It is also plausible that audible information may be effectively used as a supplement to text, reiterating certain important pieces of visual information instead of presenting the information in a solely audible mode.

One noticeable limitation of this study is the use of the RepGrid analysis as an interviewing technique. While the RepGrid analysis has been considered as applicable and beneficial in the context of information systems (Bernard & Flitman, 2002), the interviewing procedure requires participants to recall experiences and preferences with familiar systems. This study derived requirements from this feedback and built system features and functionality accordingly. Considering the recency of voice assistant technology and its relatively unexplored use in the context of retail investing,

RepGrid participants are more likely to inform what system features are preferred when using a more familiar visual system. Perhaps in order to identify additional benefits of audio/visual systems in a retail investing context, features identified as beneficial outside the context of retail investing should be considered. The discussion of this limitation is intended to suggest directions for future research and shed light on areas and methodologies to further explore findings.

Another limitation of this study, is the lack of qualitative data from the participants involved. With a reverse modality effect being observed with the audio/visual group, it could be worth looking into the reason why the participants themselves felt they were not performing as well in these tests. A possible suggestion for this is the lack of familiarity with systems that encourage such dialogue. While investors are used to systems where they receive information visually, they would not be as familiar with a device where they receive audio and visual information at the same time, causing the participants to be overwhelmed. It is possible that with time, users could become more comfortable with these audio/visual systems and a modality effect could potentially be observed.

3.8 Conclusion

From a practical implication perspective, this study identifies that following further research and refinements, the inclusion of audible information to retail investment platforms is an area of significant potential. The audible information used in this study was considered excessive in length despite efforts to remain as concise as possible. The length of audible information needs to be further reduced. Similar findings were noted during the study regarding numerical information. Numerical information was regularly presented audibly; however, it was shown to be more effective when presented visually. This suggests that for audible information to be presented and

processed effectively, non-numerical audible information should be used to supplement visual numerical information highlighted with visual cues. In summary, a major advance in this study was determining the inferiority of audible information over visual information with retail investors. However, these findings should not be taken as a rejection of the use of audible information with retail investors. Adjustments in information length and the priority of non-numerical, audible information could be of significant benefit when designing future systems and could lead to interesting and applicable findings following further research.

Another interesting finding of this study highlights how the inclusion of audible information decreases an investor's time spent processing information. This tendency among investors to make quicker decisions suggests increased confidence in the information received. At each decision-making stage in an investment process, the inclusion of supplementary, verbal and shorter pieces of audible information may encourage the investor to act quickly, making decisions with more confidence than when processing solely visual information. This emerging evidence suggests that for the design of future retail investing information systems and further research, indecisive investors can gain confidence with effective, audible information.

4. Informating Systems for Online Investing

4.1 Introduction

While automation allows businesses to significantly increase their productivity and output, it has also led to us living in a time where human jobs are at serious risk to automated systems (Arntz & Gregory, 2016). Because of this, it can be worthwhile to look at ways in which information systems can be used to enable workers rather than replace them.

Automation can have a large impact on organisations by allowing technology to perform jobs that were previously carried out by humans. However, it can lead to knowledge within organisations being lost and not getting to the people that need it most; this is due to the information not being documented and quantifiable (Spinuzzi, 2005). Zuboff (1988) observed, however, that if the information created by these automating systems could be collected and harnessed, it would enhance worker's and manager's ability to understand their work. She called the harnessing of this information "informating".

Zuboff's work is widely acknowledged in information systems academia and she is one of the most-cited authors in the field (Willcocks, 2004). However, despite this, there are very few studies that actually look at the concepts she discussed at more than a cursory level and even fewer papers that have applied these concepts to modern-day information systems (Burton-Jones, 2014). The few that have looked in-depth at Zuboff's concepts have tried to determine how informating the systems, which workers use in different fields, can enable the workers and managers to make better decisions for the business. These papers include Kohli & Kettinger (2004) seeking to informate a group of physicians, Bowling & Iyer (2019) who informated a police force using body cameras, and more recently, Surendra & Nazir (2019) who sought to create

informating systems for HR professionals. Informating systems in the field of finance is a topic that is under-researched.

With the huge advancements in processing power allowing for better manipulation of data, decision automation is becoming much more effective (Watson, 2017). In finance, decision-support-systems have become prevalent through the use of improved financial modelling and robo-advisors (Ruhr, Berger & Hess, 2019). While financial automation has been proven to be effective (Fisch & Turner 2017), the effectiveness of informating financial systems is not as clear. For this reason, this chapter will seek to determine if an informating system can be beneficial in addition to, or over, an automating system in financial investing. In doing this, this chapter draws from the previous chapter where multimodal systems were tested to see if they could improve a retail investor's ability to learn. This chapter examines if multimodal systems can help to create informating systems out of what were previously automating systems. This should enhance retail investors' ability to understand their work.

In order to do this, two different Proof of Concepts (POCs) are developed: one focusing on carrying out purely automating functionalities; the other carrying out informating functionalities in addition to the automation of retail investing. These POCs are developed for the Amazon Echo Show. This is a multimodal device that can be used to present data visually and audibly. Once the two POCs are been developed, testing is performed using these two POCs on retail investors. In this study a retail investor is defined as an individual who buys stocks and shares for their own use (Moita, 2017). The retail investors are then interviewed on their experience. The results of these tests are then assessed to determine whether informating systems can be of benefit to retail investors in financial investing.

4.2 Automating and Informating in Finance

Zuboff (1985) describes how there are two "faces" to modern information systems. These faces represent the two overarching types of functionalities that these information systems carry out: automating and informating. The goal of automating functionalities in information technology is to save cost and provide more control to the organisation through the removal of the human effort from a process by allowing to computers take over the work (Amidon et. al 2018). Systems that exclusively automate, while very common, can either make a worker redundant, or limit them to monitoring on-screen displays (Evans, 1991). Meanwhile, Zuboff describes how systems that have informating functionalities "provide information about the underlying processes to the organisation, creating a resource which organisations can learn and improve" while carrying out their function (Zuboff, 1985, p.8). If organisations can harness the data their automating systems create, they can learn and benefit from it.

There are many obvious benefits of having automating systems within organisations; an example of this would be saving on labour costs. What is less obvious are the advantages of informating systems; there are, however, some studies that show potential advantages. Burton-Jones & Grange (2013) observed how informating systems can enable innovation in the organisation and can potentially improve the process of production. As well as this, Anderson et. al (2003), in their study of IT expenditure within organisations, observed that in organisations where IT spending was focused on informating systems, there was much higher return-on-investment compared to organisations where IT spending was focused purely on automating. They attribute this to informating firms being able to use their information more effectively than competing firms.

One industry where it is vital for businesses to be able to use their information in an effective manner is the finance industry. In finance, in order to make decisions with the maximum expected return, complete information is needed (Friedman & Savage, 1952). The closer a financial investor can get to achieving complete information, the more likely they are to make the optimum decision (Gibson, 1992). In today's environment this process of investor decision-making is being increasingly automated, mainly through the use of robo-advisors (Jung et. al, 2018). However, there are serious concerns about investors not understanding the investment advice provided to them due to the lack of human involvement in the advice given (U.S. Security and Exchange Commission, 2015). This can lead to investors not being aware of the consequences of their decisions due to them not fully understanding the information provided (Fein, 2015). If these automating systems could incorporate informating functionalities, users could potentially have a better grasp of the information being created and be able to use it more effectively. This would be of benefit to the business and its customers.

Another problem that financial automation suffers from is that users of these systems are depending entirely on written information (Salo and Haapio, 2017). However, Salo and Haapio (2017) conclude their paper on robo-advisor interaction by stating that in the future, the use of audio assistants to supplement the visual information, could improve robo-advisors. This use of dual modality could shift these automating systems across the spectrum and allow them to informate. If this audio could guide the user through the processes that are being automated, allowing the user to learn, it could be of benefit to the investor, thus becoming an informating system. Similarly, using multimodal systems can enable informating by using visuals to educate users on the processes being carried out by voice assistants. Current voice technology is making people's lives easier through automation, by carrying out everyday tasks (Sen et. al,

2015). This is true in finance with financial institutions releasing applications for audio assistants like Alexa that provide financial information audibly (Marino-Nachison, 2019). In doing this they are automating the process of acquiring financial data. This chapter will seek to examine if supplementing these systems with visuals, making them multimodal systems, can help them to become informating systems.

4.3 System Design

In order to test whether multimodal systems can help informate, two Proof of Concepts were required. One of these (Automating POC) focused on automating functionalities, the other, (Informating POC) took the automating POC and added informating characteristics to it. These were created for the Amazon Echo Show device. This system can portray information both visually and audibly making it an ideal tool for this research. Furthermore, as finance is the subject of this testing, it was deemed a suitable device as the addition of verbal information to the visual screen can encourage confident investor decision-making. The benefit of the addition of visual to audio is discussed in the previous chapter of this thesis.

Upon reviewing the literature, it was determined there is currently a paucity of research on what characteristics make up an informting system. Burton-Jones (2014) completed an in-depth reanalysis of Zuboff's book, Age of the Smart Machine, where she initially outlined the concepts of informating and automating. This reanalysis also looked at the subsequent literature that cited it. Burton-Jones stated that the concept of informating is widely referenced at a cursory level in Information Systems literature and there are many benefits to incorporating informating functionalities into an organisation's information systems. However, there are very few studies that actually examine the defining characteristics of informating systems. For this reason, the research in this chapter will use the work of Surendra & Nazir (2019) and the

informating characteristics that they set out in their paper. They found that system functionalities move from automating to informating along a continuum. Because of this, they believe at times it could be difficult to determine the defining characteristics of either. They did however identify certain informating characteristics that can be used for the informating POC. These include making functionalities ready-to-hand, user controlled and inviting the user to have an informating perspective when using the system. Therefore, the informating POC would include these characteristics when providing financial information. The addition of these characteristics combined with visual information were what differentiated the two POCs.

With financial investing being the scope of this research, Exchange-Traded Funds (ETF) were used as a potential beneficiary of informating systems, as they are a popular product in today's markets. ETFs are index funds that "aim at replicating the performance of their benchmark indices as closely as possible… and are listed on an exchange and can be traded intradaily" (Deville, 2008, p.67). As of 2015, the ETF market as a whole was worth over $1 trillion (Puelz et al., 2015) and they are becoming increasingly popular in financial investing with over $27.5 billion in new investor cash being invested into them in 2018 alone (Loder, 2019).

Both POCs utilised the voice aspect of the Echo Show device to allow retail investing. An Amazon Alexa 'skill' was developed for this. The POCs would automate ETF purchasing for a user by recommending to them a suitable ETF based on their choice of answers to certain questions. This decision-automation was modelled off TDAmeritrade's own Alexa skill. In 2019, TDAmeritrade became the first retail investment platform to allow users to purchase stock using voice-technology (Marino-Nachison, 2019). This skill essentially allowed their users to automate the process of purchasing stock solely through the use of their voice.

The user of both POCs would be given a choice of "*high or low-risk investments*", "*long or short-term investments"* and "*equity or cash investments*" products: e.g. "*Are you looking for short or long-term investments?".* Based on the answers to these questions a suitable ETF product would be returned to the user. They would then be provided with the opportunity to purchase any amount of the ETF that they wanted.

The **Automating POC** merely automates the process of buying an ETF. Other than suggesting an ETF and a brief description of it, no alternative information is returned to the user. All of the decision-making is done by the system with no information of why a specific product is returned. Furthermore, only audio is returned to the user. When the user provides a suitable answer to each of the above question e.g. "*I would like long-term investments*", an ETF product is returned as a recommendation. The system then asks the user how much of the ETF would they like to buy. Upon receiving a request for the amount, the system confirms the order and tells the user the ETF has been added to their portfolio. This automation is all done using voice technology and no visuals are used whatsoever.

The **Informating POC**, on the other hand, utilises the visual aspect of the Echo Show as well as the audible. It also incorporates the informating characteristics with the help of this visual functionality. Using visuals combined with audio information, the informating POC seeks to inform the user about the ETFs they are deciding to purchase and seeks to educate them on the process. It explains why it has recommended the particular ETF to the user. The informating POC, while adding informating functionality, still carries out the same automating functionality as the automating POC. The characteristics of informating systems are now examined and included as functionality in the informating POC.

The first distinguishing characteristic of informating systems is that informating functionalities are *ready-to-hand*, meaning that the information they provide is readily available to the user and they do not have to actively seek it out. In the automating POC the ETF was merely recommended with a brief description on what it was. In the informating POC the visual aspect was combined with the audio. As well as a much more in-depth description of the ETF audibly and an explanation as to why it was chosen, the use of price-graphs, visual cues (the colouring of the numbers indicating price movements) and news headlines were provided to the users. An example of this screen can be seen in Figure 4.1. This information was just given to the user of the informating POC, they did not have to go looking for it. It was ready-to-hand. The research in the previous chapter found that users were not well able to retain figures and numbers that were give audibly. In the informating POC it was possible to make these figures ready-to-hand using the visual aspect of the Echo Show.

According to Surendra & Nazir, informating systems allow for greater *user-control*. In the automating POC, all of the questions led straight into in one another in the ETF purchasing process. In the informating POC, after each step it paused and gave the user the option of when to move onto the next step. This is similar to the previous chapter where users were asked to compare user-paced systems against system-paced systems in the RepGrid analysis; in this case informating POC was user-paced. This combined with the onscreen visuals informated as users were given all the time that they needed to intake the information on-screen and were then able to utilise this information in the next steps.

Next, Surendra & Nazir said that for a system to informate, it must invite the user to have an informating perspective when using the system. This is done through a series of on-screen prompts in the informating POC. In the automating POC an accompanying sheet was given to users that contained the Alexa commands. Without this, users wouldn't have been able to work the system as specific 'utterances' are required to communicate with Alexa. In the informating POC, the only information that the users were told was how to open the Alexa skill. From there, there were a series of prompts, both audible and visual, that told the user the specific utterance required to move onto the next step. As well as guiding them through the system, it prompted them to find out more and be further educated on the process. For example, one on-screen prompt said "Say '*Tell me More*' to find out more information about this skill". In response to this Alexa would provide information about the Alexa skill as well as information about the ETF market. In doing this, the informating POC invited the user to have an informating perspective while using the system.

Figure 4.1: Informating System Display

The development of the POCs was primarily carried out using Amazon Web Services. Amazon provides a front-end developer platform specifically for Alexa that allows you to manually input the phrases that your skill can recognise. Once these phrases have been predetermined, you can link each phrase to a backend function. These functions are stored in an AWS Lambda script, written in Node.js. Lambda, is an AWS platform that allows a user to store and run their own scripts using Amazon's servers. These Node.js scripts contain the responses to the Alexa commands.. The POCs were recommending Exchange Traded Funds. These are investment funds traded on stock exchanges. The ETFs used in these POCs had been previously researched and based on there being three questions with two possible outcomes meaning there were nine possible ETFs that could be recommended. A series of IF statements were used to determine which was the best possible recommendation for each participant. From here, the information to be returned would be pulled from both AWS E3 and the static variable list and returned to the user.

4.4 Study Design

This goal of this chapter is to test if multimodality can help in creating informating systems and if these systems can be beneficial over automating systems. In order to do this, participants were asked to engage with two POCs within a in controlled testing environment. They would run through a predetermined scenario where they would have ETFs recommended to them and then be allowed to purchase the ETF at the end. Following on from this, participants completed a qualitative questionnaire which assessed how they found the experiences. The test started with a brief introduction and then the participants would be advised on the process and ETFs. However, as the participants were already retail investors the majority were already well educated on the ETF market.

4.4.1 Participants

Those involved in testing had to be knowledgeable in the field of retail investing. This study specifically sourced the participants from a local retail investment group. Like with chapter three, the most experienced were given preference here. These retail investors were viewed as key informants. Key informants are individuals who do not represent the population statistically; they are chosen for the study based on the fact that they are well-informed on the topic that is being researched (George & Reve, 1982). The participants in this study are considered key informants as they had an in-depth relevant knowledge of retail investing. They were taken from the same retail investing group used for the test in Chapter three of this thesis. However, a different selection of people was chosen from the group this time around. This was done to provide a greater variety of people and ideas. These key informants are people who manage retail investing funds and therefore were very suited to this particular study. Twelve key informants were used in total from this group for these tests.

4.4.2 Tasks

The testing for this chapter involved the participants carrying out the process of purchasing an ETF using the POCs. This process is outlined above in the System Design above. Each participant went through the process with both of the POCs.

In order to remove bias in the testing, the participants tested the POCs in an alternating pattern. Therefore, only every second participant would start with the automating POC, with the rest starting with informating POC. As both POCs are carrying out the same end-goal, the user will always be more attuned to the system the second time around, so it is essential that there be an even number of people who tested each POC first. Table 4.1 shows the order in which the participants tested the POCS. This is known as counterbalancing (Tullis & Albert, 2013). This is similar to the testing

carried out by Lane et.al (2019) where they tested two similar Natural Language Processing systems against each other.

Table 4.1:Participant Test Order

Participant	First POC Tested	Second POC Tested
Participant 1	Automating	Informating
Participant 2	Informating	Automating
Participant 3	Automating	Informating
Participant 4	Informating	Automating
Participant 5	Automating	Informating
Participant 6	Informating	Automating
Participant 7	Automating	Informating
Participant 8	Informating	Automating
Participant 9	Automating	Informating
Participant 10	Informating	Automating
Participant 11	Automating	Informating
Participant 12	Informating	Automating

4.4.3 Data-Collection

To establish if the multimodality was effective in informating and what the perceived benefits of one POC over the other were, a qualitative questionnaire was devised which asked the participants about their experience with each of the POCs. Qualitative research in information systems research can help us understand how users perceive and evaluate a system (Kaplan & Shaw, 2004).

This qualitative questionnaire came in three parts: one asking about the automating POC, the second about the informating POC, and the final one asking about the comparison between them.

The first two questionnaire sheets asked about each of the two respective POCs. This questionnaire would ask the key informants to identify what they felt were the standout features of the system that they had used. Following on from this, they would be asked whether or not they would use this POC in a real-life context.

The comparison questionnaire asked each participant what key features they thought distinguished the two POCs. Following this, they were asked to give their preference of the two systems and what were the benefits of using one system over the other. The final question asked the participants for any additional comments that they may have. This is an important step in a qualitative questionnaire as it ensures feedback to questions that may not have been asked but are still relevant can be explored (Kaplan & Maxwell, 2005).

4.5 Results

The answers to the questionnaires provided some interesting responses and insights into the two POCs and the users' perceptions of them. In addition, there were interesting insights into how different information modalities enabled different functionalities. The primary data and the feedback provided was analysed and the following are key findings:

The first questionnaire analysed was on automating POC. Participants found the decision-automation process itself to be clear as the parameters were very 'black and white' and the explanations guiding the participants through the process were easy to understand. 50% of participants used the word 'clear information' in their description of the stand-out features of the automating POC. Another feature of the automating POC that participants mentioned frequently was the speed of the transaction. The process of purchasing the ETF was fast and 'smooth' which participants said made the system 'convenient'. While some users were impressed with the speed of the transaction, many of the other key informants stated that the process felt rushed. Just under half of all participants stated that the information was very hard to take in through an exclusively audible format despite it being so concise. Even the brief descriptions of the recommended ETFs led to people wondering what was said. As

there was no ability within the system to replay what had been said; one key informant described the information as ‘fleeting’.

When asked whether they would use the automating POC in a real-life scenario, 67% of participants said they would not. The prevailing theme among their reasoning for this was the rushed nature of the transaction. The remainder of key informants who said they would use it in future said it would need improvements for them to do so, such as the ability to replay what had been said so that it can be processed more in the mind of the user.

The results for the informating POC were more positive overall. When asked what the stand-out features of this system were, the main one was the visuals which this system provided with every key informant remarking on them in their questionnaire. One participant called them ‘refreshing’ compared to the audio only information. It was also a common theme in the questionnaires that the ability to take your time over the information stood out. This was prevalent particularly in the retail investors who had tested the automating POC first, as they had something to compare it to. A re-occuring answer in the questionnaires was that the visual information allowed for a better understanding of the process, especially while being simultaneously guided through it audibly. Having felt rushed when using the automating POC, one participant said the informating POC was ‘more patient’. Another common theme in the answers was the on-screen prompts. Many participants found these to be of benefit. The information on screen was described as ‘concise’ by two participants and that this was a positive feature. This can be attributed to the small screen where there was no option but to have short nuggets of information. This, once again, resonates with the previous chapter where the key informants who completed the Rep-Grid analysis favoured short-concise information. However, the increased length of the audio information in

this POC was noted as a negative feature. When describing the suggested ETF, a long audible explanation was given which participants claimed was too long and struggled to retain because of this. This concurs with the findings in the previous chapter where it was found short concise information is required when the information is being presented audibly.

When asked if they would consider using this system in the future, 83% said yes. The participants who completely ruled out using such a system in the future attributed their negative sentiments to security concerns about spending money through verbal commands. When asked what they thought the benefits of using such a system were, the convenience of it and how it allowed "quick access to concise information" were mentioned. Improvements were sought though. Enhancements like the ability to access "market consensus on the recommended ETF" and improved "security features" were mentioned as areas where this system needed to be amended in order for future adoption.

The final questionnaire sheet that the retail investors were asked to fill out was comparing the two POCs against each other. The main distinguishing features that were noted were the visuals, with all the participants citing it as the main difference between the two POCs. It was noted that these visuals allowed better understanding of the process of investing through these sorts of systems. This aligns with Zuboff's description of informating systems. Other differentiating features included the pace of the system, which users were able to control much more in the informating POC.

This led onto 92% of participants saying that they preferred the informating POC over the automating POC. There were many reasons why the key informants favoured overwhelmingly with this system. The addition of visual information was the main

one. Retail investors stated that using short concise visual information led to them grasping the information better and subsequently feeling more comfortable with the information and trusting the system more. The fact that only the device was needed to operate it was another reason stated for the preference, whereas in the automating POC a sheet was needed to guide the user through the process. The one participant who sided with the automating POC, referenced the sheer speed and convenience as their reason for doing so. They also stated it could be used while driving which would not be possible with the informating POC. They did state however that more security would be needed within the system for it to be feasible in a real-life scenario.

Table 4.2: Preferred POC

System	Automating POC	Informating POC
% Preferred	8%	92%

4.6 Discussion

After studying the results of these qualitative questionnaires, they show a clear preference for the informating POC. This study, which aimed to see if informating systems could be beneficial over automating systems in financial investing, has indicated that they can. This chapter also looked to establish if the addition of visual information to audible information could help financial automating systems becoming informating systems. The evidence in the results, shows that the addition of visual information can enable informating within audio only systems.

While both POCs were carrying out the same automating function in recommending an ETF product, the majority of key informants preferred the informating system. It is worth looking at the reasons why the informating system was preferred over the automating one. The obvious reason illustrated by the results is the addition of visual information. This in itself is not an informating characteristic, it is the functionalities

that the visuals enabled that allowed this POC to become informating. An example of this are the prompts which invited user interaction. The prompts were a common reason given in the results for preference of the informating POC over the automating POC. Informating systems invite user interaction and these prompts invited the user to ask extra questions which would enable them to attain more information. An example of this can be seen in Figure 4.1, where the appropriate command to buy a stock is written on screen. This prompt led the users onto the next step of the process and was enabled by the visuals. The addition of this visual information was pivotal in shifting the process of making this purchase to be an informating functionality within the system.

The visual information in informating POC also allowed users to seamlessly have access to information. Having this information ready-to-hand is another informating benefit that led to the key informants preferring informating POC over the automating POC. Users of the automating POC, when hearing about their recommended product, did not have access to extended information on the product or why it was recommended to them. Once again, the visual capabilities of the Echo Show allowed the users of informating POC to receive information without having to search for it. An example of this is the price movements in the form of a graph. This is something a user might not necessarily search for when investing, but when provided to them, it is a useful asset they will use in the investing process. The graphs were frequently mentioned in the questionnaires as standout feature in the informating POC. These two points indicate that the addition of visual information to audio-only systems, can enable informating in these systems.

With the above benefits of informating POC, it is still important to note that the visuals were still only aiding the automation that was being carried out by the audible

functionalities of the Echo Show. The main process of ETF investing was being carried out by the audible interaction, the visuals were supplementary to this in order to allow the user to understand the process better. Based on the feedback in the qualitative questionnaires, this was effective. In the introduction it is noted how the closer to complete information that an investor is, the more likely they are to make better financial decisions. Through the additional visual information, users are closer to achieving this complete information.

An interesting result the research found was how, despite the lack of details in the automating POC, participants were still keen on the automation of financial investing. Users of the system still found it to be useful due to the speed of the transaction. This shows there is potential for these types of systems in the future. The fact that trading platforms are already beginning to create these voice automated systems further confirms this. 67% of users said they would not use the automating system in its present state. The pacing was a big reason for this. If system designers could build in the informating characteristic of user-control, it could be of benefit to their system.

The users of the automating POC liked the concise audible information while the users of the informating POC were not keen on the long audible description. In an attempt to further informate, additional audible information was provided with the visuals. This indicates that the audible information should still be concise. There is a trade-off between informating and overloading the user with information.

One key point that emerged in many of the questionnaires was how the issue of trust in these systems and whether retail investors, when spending their own money, would be willing to invest their money using verbal commands. This concern appeared much more frequently in the automating POC questionnaires indicating that informating

functionalities may be able to help build trust in investment automation. While this study looked to see if informating systems could be beneficial in the investing process, further research could look to see if informating functionalities could help build trust in these systems.

A key limitation of this study is that while it focussed on financial investing, the money being used to purchase the end-product, in this case the ETF, was virtual. The participants in the study were not using their own money so were at no risk of financial loss when deciding on how much to invest in an ETF as they would be in a real-life context. For this reason, these figures were not discussed in the findings of this research.

4.7 Conclusion

This chapter examines if multimodal devices can help to create informating systems from what were previously automating systems, and whether they can be beneficial to users. The findings in this chapter indicate that they can. With the vast majority of key informants preferring the informating system over the automating one, and the multimodality of the informating system being given as the main reason for this preference, it can be said that there are benefits to using an informating system over an automating one. This chapter has also shown that the addition of visual information to audible information can enable informating in an automation system with numerous key informants citing this as a reason for the preference.

The previous chapter of this thesis indicated that audible information within retail investing platforms is an area with potential. Retail investing platforms have begun adopting voice technology, in order to automate financial systems. If they could incorporate informating functionalities into these systems, they could see an increase in their return on investment. As well as the advantages for the platforms, users

themselves, through understanding the processes that are occurring, will have more complete information and are more likely to make better financial decisions. The research in this chapter shows that informating these systems by making them multimodal, is an effective way of doing this.

5. Conclusions

This chapter concludes and summarises the work presented in the thesis. It will re-examine the research questions outlined at the beginning of this thesis and discuss how they were answered and what has been learned. After this, a section will look at the contributions to the research area and the contributions to practice. The limitations associated with the research are then discussed, with future avenues of research finishing the thesis.

5.1 Summary of Chapters and Core Themes

The objective of this thesis was to understand how investors receive their financial information and through what medium it is presented. Based on this objective, three separate research questions were answered in three respective chapters. They first of these was:

What drives retail investors to seek information from and participate in copy trading?

This question was answered in chapter two of this thesis. This chapter investigated the financial information used by investors to make financial decisions. This was achieved through an analysis of existing literature, looking specifically at copy trading within social trading platforms. This systematic literature review was used to create an Investor Engagement Framework that models the financial information that is needed to drive investor engagement in copy trading. To determine why individuals take part in copy trading, the underlying drivers of the Technology Acceptance Model were not sufficient. The results of this study outlined that for the investor to participate, the investor that is being copied must provide both affect-based signals and cognition-based signals of trustworthiness. Having an understanding of the financial information

required by investors in trusting others to help make their financial decisions, led onto the next research question on understanding how this information can be presented to the investor.

Can the modality effect enhance an investor's ability to learn from financial information and ultimately better inform their investment decision?

In chapter three, this question was addressed. Having looked at financial information and the type of information sought by investors in chapter two, this chapter narrowed the scope, specifically examining how this financial information is presented to the users. The research examined how the modality effect could potentially impact an investor's decision making. Two proof of concepts were developed: one audio and the other audio/visual. Having interviewed key informants to derive the system requirements for these, the same key informants were then used to test the POCs. The chapter analysed whether the modality effect was present in financial decision making. The results found that there was a reverse modality effect which suggested that there is no benefit to investors by replacing text with audio when accompanying related visual financial information. However, a higher level of confidence is plausibly demonstrated by participants' shorter processing time of combined audible and visual information. This is not necessarily a positive, though, as shorter processing time for financial information does not equate with better decision making. The next chapter looks further into how this financial information is presented to users.

Can multimodal systems be used to create informating systems in finance and can these be of benefit to the user?

Chapter four examined this research question. With audio systems becoming increasingly popular in financial decision making, this chapter looked at how

multimodal systems could benefit the process of financial investing while simultaneously looking at how it could help make these systems into informating systems. Once again two systems were built and tested: one solely audio and the other multimodal (audio/visual). The participants in this chapter's research carried out the process of making an investment by buying a stock, as opposed to chapter three, where they only provided information on a stock. The multimodal system utilised visual and audio elements to enable informating characteristics. The results in this chapter showed that multimodal devices are beneficial in creating informating systems and that these were of benefit to the end user, the retail investor.

5.2 Contribution to Research and Practice

This thesis contributes to both research and practice in the field of online investing and the presentation of financial information.

Initially this thesis examined how financial information was used by participants in social trading platforms. With the concept of copy trading becoming more and more popular in retail investing, the paucity of research investigating its drivers, was addressed in chapter two. This chapter adds significant insights into this area by establishing what causes one retail investor to copy the investments of another. The Investor Engagement framework created to model these drivers can be utilised by future researchers. For practice, the framework emphasises how the platforms that provide access to copy trading need to focus on features that users find easy to use, benefit from, and enjoy. Equally important, the platforms need to focus on the trust aspect, by providing performance-based financial information on the signal providers. If more users trust the platform and signal providers, they will be more likely to use the platform.

This research also contributes a number of findings to the evaluation of financial information modality in the context of online retail investing. This is discussed in chapter three of this thesis. In this chapter it was found, through the use of a RepGrid analysis, that retail investors prioritise visually condensed information, the use of visual cues, user-paced system interaction, and a concurrent presentation of audio and visual information for the audio/visual system. It was also established that the use of multimodal systems can lead to increased user confidence in the system that they are using. As well as increasing confidence, chapter four found that users can benefit if this multimodality is used to incorporate informating characteristics into the system. From a practical perspective, this is important factor to consider for the designers of these online retail investing platforms.

Following on from this, this thesis contributed to the practice of online investing by showing that, in system design of multimodal devices for financial use, the use of long audible information should be avoided. In chapters three and four, it was determined that when information is being presented audibly, it needs to be short and concise. Similarly, the results showed numerical information should be presented visually where possible. Users tested in both chapters found the use of long and detailed audible information to be overwhelming and as a result they did not retain much of the information. As these systems are becoming more prevalent in industry, it is important for system designers to consider this.

5.3 Limitations of Research

As in any research, this body of work has limitations that creates opportunities and possible questions for future research. Firstly, in chapter two, while the study discusses the core constructs and their underlying drivers of copy trading, it does not weight or

rank these in terms of importance. These rankings could potentially help to design platforms for online social trading.

In the third chapter, there were certain limitations to using the RepGrid as an interview technique. This method of interviewing relies on participants to call on their past experiences in order to inform the system design. However, in this context, the key informants had experience using visual systems for retail investing and had little experience in using audio systems for investing. This meant that the system design would have been weighted more towards a visual system.

In chapter four, while testing financial investing, there was no tangible currency being used, which meant when deciding whether or to invest, there was no risk to the investor. This meant that their decision on how much to invest was not as realistic as it would be in real life. This can lead to investors making more confident decisions whereas the investor themselves may, in a real-life context, be more conservative.

As a whole, within the body of research it could be said that the sample sizes of the participants used for the tests was low. The limited number of participants used can be attributed to the fact that all of these participants were key informants and were extremely knowledgeable in their field. This thesis accepted this limitation and decided that the use of key informants was the better option.

5.4 Future Research Opportunities

Based on the research in this thesis, several avenues of further research could be explored. First of all, as mentioned in the previous section, the number of participants used in this body of research was low. While these were experts in their fields, in order to form more generalizable conclusions, future research could be extended by using a greater number of participants. Chapter two, investigates the drivers of user

acceptance in copy trading. The outcome of the research was a framework modelling the constructs and drivers. Each of these are discussed in the chapter however they are all treated as equal for the purposes of this research. Future investigation could study the weighting of these constructs and drivers in terms of relevance and importance.

Another interesting potential research avenue would be to measure the effectiveness of multimodality on investor decision making. While chapter three measured how multiple mediums could enhance an investor's ability to retain and comprehend information, and chapter four looked at if multimodality could be of benefit to the investor in online investing, neither chapter actually measured the effectiveness of using multiple mediums on the decisions being made. Future research could measure how having multimodal systems supplying financial information can lead to better financial decision making.

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Appendices: Appendix A – Future of Investing: Industry Report

CONTENTS

The Past: Dawn of Online Investing

Online investing is the act of traders and investors using online services and trading platforms offered by brokers. While it has had an undoubted boom in the twenty-first century, the history and dawn of the industry stems back years.

The first web brokerage firms broke into the industry of online trading in 1994 when K. Aufhauser & Company Inc. launched their online trading platform: WealthWEB. This company was later acquired by TD Ameritrade which is today, one of the world's most popular online trading platforms. By 1999 there was more than twelve million users of these platforms as more than one-hundred and twenty e-brokerage platforms were available. This increase in users was aided by the fact commissions on trades had dropped by 50% since the initial platform had been launched in 1994, making the service much cheaper and accessible for the regular user. Other benefits drawing in new users was the fact people felt much more in control and they had greater ability to access global markets.

Users were however, inexperienced for the most part and had over confidence in online materials. This led in part to DOTCOM stocks inflating massively. Then when DELL and CISCO stock were sold in large number it caused the whole bubble to burst which caused losses of $1.7 trillion.

Current Technologies used to Invest

The primary technologies used to invest in finance at the moment are all visual. Laptops and PCs are primarily used with 162 million sold worldwide in 2018. The larger processing power of PCs was even more attractive with 260 million sold worldwide.

While investing from the office desk is still the preferred method, tablets and smartphones in todays day and age are also being used. This is a big development in recent years as before investing from the palm of your hand would have been impossible.

This allows investors to make decisions much easier and allows quicker access to the information. All of these devices heavily rely on the visual element (although smartphones do now have Voice Assistants) which shows the neglect of the audio function. This extra mode of communication has the ability to increase the personalization of an individual's investment

experience. Research into information modality has shown effectiveness of providing audio and visual information in tandem with each other.

Current Methods of Information

Presently, financial information comes from three different sources: Traditional intermediaries, self-diligence and social media. While the traditional intermediary was the main option for years, social media and websites providing financial info have begun to gain a foothold recently.

Traditional Intermediary: Well established sources of information. Providing a trustworthy platform to invest. Fidelity and TD Ameritrade offer financial advisors, ranging from Hedge funds to private equity.

Self-Diligence: Spawned from the creation of internet- 1997. Provides overview of the general market. This valuable information is free to access to anyone with an internet connection. Offering information such as current news and price changes.

Social Media: New social platforms for investors to access information. Reddit allows you join specific investment communities where you can interact with like-minded individuals. You can follow experienced investors on Twitter or certain investment news outlets.

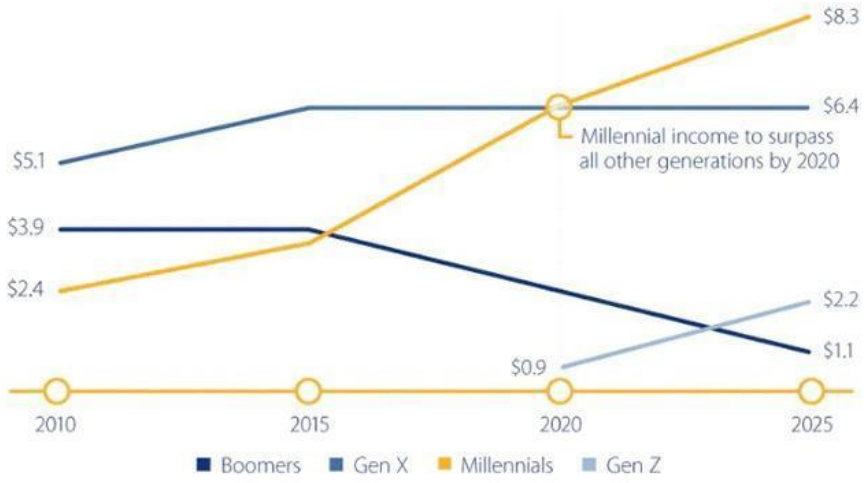
Industry Disruption

Value of Information: Costs of advanced technology reducing (smartphones) and the speed at which an individual can access information (internet). Institutions who previously held the majority of sought after financial information, have had the industry disrupted by the democratization of this information. With the aforementioned social media growth, the digestion of investment information has never been easier with relevant information being so easily distributed. Deloitte's investment management outlook 2016 viewed advances in technology as a method to reduce the cost of portfolio management.

A method of combatting this rapid shift is for these institutions to acquire new innovative FinTech businesses to integrate with the processes that exist already. This allows cheaper entry into the retail investment market that traditionally would be far too expensive to enter.

Emerging Investors

The emerging investors of the next 5-10 years will be people born between 1980-1995. These people are now classified as millennial investors and they are a vital market in the future. In the USA alone, there are 76 million people within this demographic.



Graphic taken from VISA.com

This demographic is extremely important to factor into future investing as by 2020 they will make up one third of the US population and by 2025 they will comprise three quarters of the US workforce, meaning future of investing will be dominated by them.

This generation are the first to have grown up with the internet and modern technology properly integrated into their lives. However, they show a distinct lack of social trust due to the fact many grew up during the financial crash of 2008.

This has led to new investors straying from the regular investment instruments and veering towards more innovative ways of making money. Social trading and Initial Coin offerings are just two of these new products emerging that have seen significant investment in recent years.

Disintermediated, transparent and socially responsible investments are appearing to be appealing to these millennial investors. These can come in the form of ICO investments or Environmental, Social and Governance investments. Traditional Investment Intermediaries are having to adapt to the demands of these new investors.

Emerging Investments

ICOs

Who are the people investing: Poll by crypto finance company Circle showed that 25 percent of millennials said they are interested in purchasing digital currencies over the next 12 months, which sets them apart from other generations by more than 10 percent.

Valuation: Web browser Brave's ICO generated $35 million in less than 30 seconds. ICO value in October 2017 year-to-date (YTD) was $2.3 billion, ten times greater than calendar year 2016.

What is their appeal: It is possible to reduce the costs of capital raising, avoiding intermediaries and payment agents. Blockchain possesses the ability to replace middlemen with mathematics, this is achieved by transfer the ownership of assets directly from one party to another. The use of Cryptography makes the chances of fraud and theft almost impossible, providing a high level of security to investors.

What concerns are there: Little to no standard regulation exists over this investment area. China, South Korea among countries to outright ban ICOs. "An ICO must be conducted in a

manner that promotes investor trust and confidence" - Australian market authority. Facilitated the use of Bitcoin in the WannaCry ransomware virus. The market is also extremely volatile with huge swings in price occurring regularly with no apparent reason.

Outlook: With Europe, America, and most of Asia set to increase regulation and accountability of ICOs [8]. The future of this investment method is positive, albeit without the huge market fluctuations.

ICOs- Ready for the Institutional Investors?

If the ICO market has seen so much potential for enormous profits, why hasn't the institutional investors shown more interest?

Risk: This new method is extremely volatile and seems to swing massively without proper validation.

Regulation: As mentioned earlier, the lack of regulation and outright ban in certain countries is a huge reason for the hesitation to adopt.

Perception: Public perception views ICOs as enabling cyber-crime and as a gimmick.

Potential: Some large companies are investing in the Blockchain technology behind ICOs and betting on the market becoming more mainstream. As more companies back this technology, the greater the potential returns will be, along with an increase in public trust.

Examples: Facebook, JP Morgan, Bank of America, Apple, Axa Group.

Alternative Investments- An Institutional Perspective

Alternative investments such as Crowdfunding, P2P lending, and ICOs have been commonly associated with the retail investors. This type of investment is, for the most part, not within the scope of institutional investors. Alternative Investments that appeal to this group include private debt/equity, and infrastructure. A report into the alternative investment sector was conducted by Prequin in 2018, based on surveys from 300 fund managers and 120 institutional investors. This report revealed this market could be worth over $14 trillion by 2023.

Their data shows that investors plan to increase their allocations to three major categories in the next five years: 79 percent said they would increase their private equity allocation, 70 percent plan to boost allocations to infrastructure, and 62 percent plan to increase allocations to private debt. Private equity assets are expected to increase by 58 percent over the next five years, overtaking hedge funds as the largest alternative asset class, according to the report. The private debt market is expected to double in size, reaching $1.4 trillion in size by 2023, according to Preqin.

With this increase in alternative investment options, the amount of investment firms is set to grow substantially and an increased level of competition will be seen, there are expected to be more fund managers available for allocators to choose from in 2023. Preqin data show a projected 21 percent increase, bringing the total number of fund management firms to 34,000 in 2023.

Future Growth: Developing economies such as Africa and South-East Asia are set to become major markets in the alternative investment ecosystem. 84% of investors plan to increase their allocation to alternatives in the next five years. By 2020, emerging economies will likely make up over 60% of the world's GDP.46% of fund managers plan to increase their investment in Africa by 2023.

Social Influence and Peer referral

81% of people aged 20-35 are on Facebook, where their generation's median friend count is 250. Many firms have begun to use Twitter as a form of communicating news to consumers and investors because of its appeal and focus on the 140 characters enabling people to communicate concise, valuable information. ''Wisdom of the crowds'' mind-set, potential investors can discuss openly across many different mediums to help them make a financial decision.

Social media and specialized trading websites are making the exchange industry more accessible and approachable. They are helping to simplify terms and conditions. Also, these online social communities of traders are offering support where necessary to educate their audiences. Those with minimum experience can rely heavily on people they perceive have insider knowledge on a potential investment. In 2013, one tweet from billionaire Carl Icahn was all it took to see Apple's stock soar. In fact, the stock gained $17 billion in a matter of minutes.

Reddit, a social discussion platform, has become the primary research point for many investors. The ability to discuss with like-minded individuals is a major benefit. Communities such as r/investing boasts over 700'000 active members. Social Trading has become increasingly popular as more people are influenced by what other investors are trading.

Social Trading Platforms

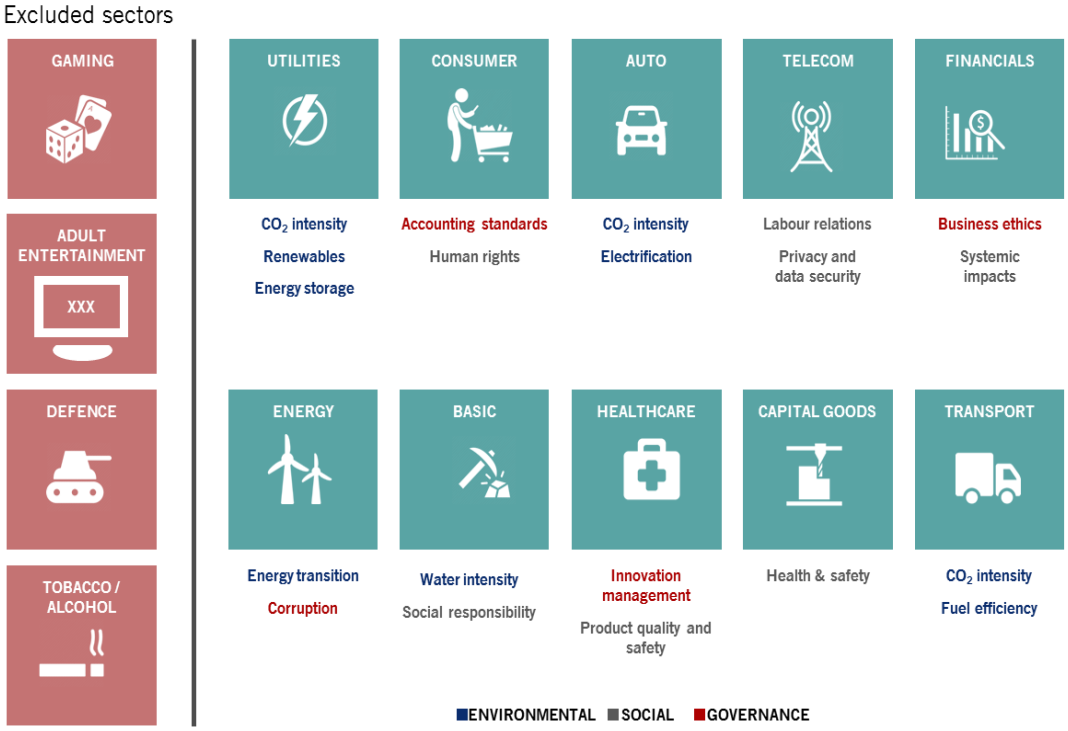
EToro: By depositing funds with the site, you can execute trades based on strategies developed by other members. Strategies include asset classes such as FX, indices, commodities, stocks, ETFs, and others. Fees are captured in the bid/ask spread rather than through a monthly payment.

Scutify: It features a scroll of posts from various members with their commentary on stocks. Post are broken up into channels and hashtags. 'Scutify Sentiment Indicator'. It allows you to quickly see the sentiment of members for a particular stock.

StockTwits: The platform integrates with Twitter, so you are getting posts from people posting on Twitter and to StockTwits. A heatmap allows you to see many stocks at once. The redder the heatmap, the more negative prices there are for stocks listed. You can drill down further into different groups of stocks.

Environmental, Social, Governance (ESG)

Environmental criteria consider how a company performs as a steward of nature. Social criteria examine how it manages relationships with employees, suppliers, customers, and the communities where it operates. Governance deals with a company's leadership, executive pay, audits, internal controls, and shareholder rights.



The above image describes all the sectors of business that fall under each section. Such as Human rights, Renewable Energy, and Ethics. Investors are becoming increasingly aware of all these factors when looking to invest. For younger investors, Climate Change has become the most important ESG factor. The people investing in these products are a generation that is willing to pay more for a product if they know the investment is going to a good cause. With the massive reach social media has provided, companies must factor in massively social responsibility.

Companies have had to adapt to this demand for ESG information on the investment options they supply. In private markets, the UN Principles for Responsible Investment (PRI) reports that two out of every three LPs consider responsible investment in their selection of fund managers, while Preqin's data shows that nearly half of alternative fund managers will consider ESG principles in every investment they make by 2023. In private capital, ESG will become more polarized around "E" and "G", casting light on managing environmental and climate-related risks and governance issues. Green and specialized ESG funds will proliferate, many seeking to meet growing demand from LPs for such "clear-cut" ESG investments.

Businesses with better environmental, social and governance standards typically record stronger financial performance and beat their benchmarks, according to research from Axioma. The risk and portfolio analytics provider said the majority of portfolios weighted in favour of companies with better ESG scores outperformed their benchmarks by between 81 and 243 basis points in the four years to March 2018. Financial services companies such as JPMorgan Chase, Wells Fargo, and Goldman

Sachs have published annual reports that extensively review their ESG approaches and the bottom-line results.

Goldman Sachs- Report in 2018. 'Green ETFs' have seen their numbers rise. From 2004-2014 only 24 were launched compared to 22 and 18 for 2016 and 2017 respectively.

JPMorgan- 2018 report. Aim to facilitate over $100bln in clean financing by 2025 and achieve 100% renewable energy usage by 2020.

Wells Fargo- 5-year goal covering diversity and social inclusion, economic empowerment, and environmental sustainability. Reported that 100% of global operational needs is met by renewable energy.

BlackRock - released an ESG report in February 2019. They discuss how sustainable investing is no longer a niche area and is becoming more mainstream for investors' portfolios.

State Street - Adapting to this need with the introduction of its R-Factor. This is State Street's internal measuring of the ESG level of investment options. They have conducted a survey and found Sixty-seven percent of Millennials place a higher value on making an impact, and they are investing to pursue values over the long term.

Future Technology

Voice Assistants

In the last 5 years the prominence of voice technology has grown significantly. The market is now worth $49 billion and this figure will only rise in the future. These devices allow for increased personalisation as the system learns from your responses and takes your personal information into account. This can be applied in future to financial setting which will allow the devices to recommend stocks and shares and share relevant news stories to the user. Some of the main products on the market are:

Amazon Echo Show:

Bloomberg, Fidelity have developed Investment apps on Echo Show. Currently developing a POC looking at aiding financial decisions for retail Investors.

Google Home:

Ability to ask Google Home about the stock market and have it return any big news in the current financial world.

Robo-advisory

Robo-advisory is another future technology sure to have a huge impact on the future of investing. Robot-Advisory allows the investor to interact with a system instead of a person, which then offers advice based on parameters entered. Mainly deals in the

ETF Market. This market is worth $1bln, with potential to grow over $2.5bln by 2023. As Artificial Intelligence (AI) continues to become smarter, these recommendations will increase in accuracy. People will trust these Robo-advisors more and use traditional financial services less. Some companies have countered this by creating their own Robo-advisor.

Schaub Intelligent Portfolios- Min. of $5,000 to start. No commission.

Betterment Robo-Advisors. $15lbm AUM, 40,000 users.

Wealth Front Advisor. Suited for young investors due to $500 min investment.

Virtual Augmented Reality

Virtual Reality has seen significant growth in the entertainment sector, such as video games and providing a safe virtual environment for doctors, engineers, and architects. This industry is still very immature for use in the financial sector, specifically for trading.

Concerns: A major issue is the price of a system with one Oculus Rift costing $400, leading to limited adoption. Investors have been accustomed to viewing information on a screen or physical sheet, it will take some time for the idea of a virtual environment to become mainstream.

Future: Some features of everyday office life, such as Microsoft excel have been visualized. However, State Street is examining the viability of this technology as an aid in finance, using it to tackle the problem of data literacy.

In Conclusion

The information presented in this report has explored the vast topic: The Future of Investing. Viewing the landscape in 5-10 years, all aspects were explored. Ranging from who will be the investors of the future, what they will be investing in, and how will they invest. The main takeaways from this report are:

- Investors no longer see ESG investment as a 'nice-to-have': The majority of investors now expect to see ESG information when making their investment decision. The Environmental aspect of investing is the largest sector with the rise of protests and demonstrations demanding decision makers take rapid action. In the next 5-10 years, this trend is only set to exponentially increase.

- Social Influence and Peer-Referral is playing a larger role: With the emergence of social media, the information gap between institutional and retail investors has decreased substantially. This access to investment information has drawn inexperienced investors which has helped spawn Social trading. Sites such as

Etoro will continue to expand. Institutions still provide much richer information for decision making and will continue to own a large market share. However, these institutions would benefit from inserting themselves into the investment process of these inexperienced investors.

- Alternative Investments are set to exponentially grow: Equity/private debt, etc. are expected to become a major investment option in the next 5-10 years. Particularly for emerging economies which are set to take 60% of the world's GDP by 2023. Current institutions would benefit from exploring this market further and capitalizing on this opportunity.

Some Technologies are here, some still have a way to go: For investors, technology such as Voice Assistant Interaction (Alexa, Siri) are being integrated into the information search with the ability to personalize for each investor being a major advantage. AI/Robot-Advisory is already an established sector and positive growth signs. Virtual Reality use for investing is still at the infantile stage with current R&D projects exploring the use-cases. In the future, this technology may be available for investment decision making, but not in the current state.

Appendix B – Future of Investing: Presentation

Investors of the Future

Aodán Cotter
Anthony Creed
Luke Merriman

STATE STREET GLOBAL ADVISORS

Todays Presentation

The purpose of this research was to identify and explore how emerging technologies help investors make financial decisions.

Approach: Amazon Alexa Echo Show POC
Industry Report
Academic Research Papers

STATE STREET GLOBAL ADVISORS

Amazon Alexa Echo Show

Developed a 'State Street' experience for the Echo Show.

SSGA want to use the Echo Show to open up a new channel for customers to view & interact with.

Key Functionality

- General Queries about State Street products and key definitions (ex. KIID)
- Email documents to the user.
- SSGA videos can be viewed.
- View stock prices.
- Display the users profile.
- Examine current portfolio
- Invest in a stock

Industry report

- Examined the state-of-play and future trends for the investment ecosystem

Key Findings:

- Future investors (23-35) are increasingly interested in ESG investing
- Social media and social trading playing larger role in decisions. Reddit, Twitter, eToro.
- Alternative Investments 5-10 years. Equity/Private Debt growth. Emerging economies 60% world GDP 2023.
- Technology: Voice Assistant Interaction offering personalisation, Robo-Advisory continually growing. AR/VR still in developmental stages with potential use-cases.

Academic Research Conducted.

- Investor Decision making: The Impact of Modality on Investor Decision Making
- The Delegation of Investor Decision Making: What Drives Investors to Engage in Social Trading.
- The Impact of Social Media on Investor Trust. (Anthony paper)

Overall findings

- Amazon Alexa Echo Show has massive potential for SSGA.
- ESG and Equity/Private Debt investing continuing to grow.
- Combination of Audio/Visual information enables better investor decision making.

Amazon showcase

- General information queries
- Playing a SSGA Video
- Document email
- User profile
- Viewing portfolio
- Buying shares.