Technology-Facilitated Customer Engagement and Actor Networks in Financial Services – A Retirement Planning Perspective

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ABSTRACT

This thesis contributes to the emerging debate in the financial services literature on digital technology, consumer engagement, and service actor ecosystems. Comprising of one systematic literature review and two empirical papers, the overall aim of this thesis is to develop a deeper understanding of the impact of digital technology on the financial services industry and the effects on both service providers and consumers. Using artificial intelligence and mobile apps as suitable exemplars of digital technology, the focus of this thesis is the Australian retirement context.

The first paper is titled ‘Artificial Intelligence in Customer-Facing Financial Services - A Systematic Literature Review and Agenda for Future Research’. Through the application of a systematic literature review methodology guided by the TCCM (Theory, Context, Characteristics, Methodology) framework, this study provides an overview of academic research to date while simultaneously identifying gaps in the existing literature and offering a comprehensive agenda for future research. The findings of the review suggest that select financial services have experienced greater academic research interest (e.g., banking) than others (i.e., retirement planning). Additionally, more than half of the sampled studies adopt a data-driven approach, as opposed to a theory-driven approach, thus rendering the calls for future research to refocus on developing relevant theory and conceptualizations.

The second paper is titled ‘The Role of Digital Technology in Communication and Information Flow in the Australian Superannuation Industry: A Multi-Actor Service Ecosystem Perspective’ and empirically examines the impact of digital technology on the Australian retirement ecosystem. Accordingly, the study adopts a qualitative research methodology using 21 semi-structured interviews to investigate the impact of digital technology on both actor communication as well as information search and avoidance behaviours related to Superannuation. The findings highlight a need for ecosystem actors to improve their resource and knowledge sharing capabilities to enable

a seamless information flow and consequently improve consumer experience and foster retirement planning.

The third and final paper included in the thesis is titled ‘Which consumers are more likely to adopt a retirement app and how does it explain mobile technology-enabled retirement engagement?’ This study focuses on mobile technology-enabled retirement planning. That is, it empirically examines the drivers of consumer’s intention to and anticipated engagement with a mobile retirement planning app. Data is collected from 440 Australian consumers, and analysed using PLS-SEM. Results highlight that consumers’ perceived skills (i.e., financial self-efficacy), information/ usage avoidance (i.e., perceived financial security), and perceived relevance (i.e., consideration of future consequences, retirement planning involvement, and perceived usefulness) have direct effects on their anticipated engagement with a mobile retirement app as well as indirect effects through their intention to adopt the app. Additionally, the findings demonstrate that the closer the consumer is to retirement, the more likely they are to use a mobile retirement app.

Overall, the research of this thesis contributes to the understanding of the importance of digital technology in fostering financial behaviours such as retirement planning, and service provider and consumer relationships, as well as its impact on the broader financial services industry.

CHAPTER ONE: INTRODUCTION

Background

Digital technology and technological innovations continue to transform industries, organizations, and consumer behaviour (Agnew and Mitchell 2019; Sklyar et al. 2019b). New digital technology has the potential to not only disrupt but also transform the services sector, including changing business models, firm and consumer relationships, as well as overall service ecosystem (Keating et al. 2018; Manser Payne et al. 2021). A prime example of a rapidly transforming services sector is the financial services industry (Deloitte and Institute of International Finance 2020; KPMG 2020b). Financial services (e.g., banking, insurance, and investment) are traditionally considered a high-involvement context, due to large number of interactions with the consumer and the significant financial implications of the choices for current and future consumer well-being (Netemeyer et al. 2018). Specifically, the banking and financial investments industry are at the forefront of adopting and developing new technologies, further driving the push for innovative financial technology or “FinTech” (Callaway 2018; Manser Payne et al. 2021).

However, select financial services do not receive equally high consumer involvement. The retirement industry for example, is considered a low-involvement but high-importance context, which refers to consumers lack of consideration of retirement-related matters despite the necessity of retirement planning to ensure financial security and well-being upon retirement (Brüggen et al. 2019). Globally, the retirement industry is experiencing rapid changes and challenges, in part due to changing societal, economic, and political factors (Aegon 2019; Mercer 2018). Increasing life expectancies, financial crises, decreasing governmental support (i.e., reduced pension benefits), a continuous shift from defined benefit (DB) to defined contributions (DC) systems, as well as the COVID-19 pandemic, all place increasing pressure on pension systems around the world (Aegon 2020; Monash University 2020). These factors consequently place both increasing risk and responsibility on the individual consumer, requiring everyone to familiarize themselves with financial and retirement terminology, investment principles and monitor the performance of their pension fund. As such, policy makers, industry managers, and academics alike highlight the growing need for consumers to become more involved in their personal retirement planning (Bateman et al. 2014; Deetlefs et al. 2018). Consumers who fail to adequately plan for their retirement are estimated to have insufficient retirement savings, which not only may affect their future well-being and financial security, but also will place an increasing burden on already strained government systems (de Vielliers and Roux 2019). To encourage consumers to be increasingly involved in their retirement planning, growing interest and efforts are paid towards initiatives aimed at increasing financial literacy (Alsemgeest 2015; Garcia Mata 2021), and making retirement information and financial advice more accessible (Nam and Loibl 2021). Subsequently, new technological innovations and communication tools have emerged that seek to support these efforts in increasing both retirement awareness and consumer engagement and retirement planning (Brüggen et al. 2019; Eberhardt et al. 2020; Hoffmann and Otteby 2018).

For example, retirement funds and investment firms have recently commenced with employing AI to assist with risk management, predicting member outcome options, and providing basic financial advice (i.e., through so called Robo-advisors) (Mercer 2020b). Additionally, pension funds have also invested considerable efforts in enhancing their online presence and digitally available information (IQ Group 2019), and including online tools such as pension calculators. More recently, attention is being paid to offering mobile apps as a means of providing additional points of access and engagement (Australian Government Productivity Commission 2018). Whether that be mobile investment apps targeted towards retirement planning such as the Vanguard Retirement Nest Egg Calculator or Mint (Shorvath 2021), or specific retirement fund apps which allow the consumer to stay on top of their retirement savings with their selected retirement fund (e.g., Australian Super or Mercer Super app) (IQ Group 2019).

Although the retirement industry and financial services sector are making considerable progress, academic research is only recently gaining traction (Molina-Collado et al. 2021). Apart from a few key studies (e.g., Brüggen et al. 2019; Dellaert 2010; Eberhardt et al. 2020) limited research attention has been paid to the impact of digital technology on consumers' retirement planning behaviour or how technology will shape the retirement process (Henkens et al. 2018). In practice, technology is already used in the retirement space to not only enhance interactions with pension members, but also improve internal processes such as investment management and regulatory compliance (KPMG 2020c; OECD 2017).

Digital technology can alter firm-consumer relationships, improve service provision and management processes, as well as alter overall business models and strategies (Lusch and Nambisan 2015; Nambisan 2013). Therefore, a key question that arises is how digital technology can facilitate consumer retirement engagement, as well as how this might impact the overall retirement ecosystem. The main topics of this thesis are thus: (i) digital technology, (ii) consumer retirement planning engagement, and (iii) the retirement planning service ecosystem. These three topics are explored in two separate empirical papers and one systematic literature review, respectively. As such, this research contributes to the emerging stream of digital technology, multi-actor service ecosystem, and customer engagement.

Research Questions and Objectives

This research seeks to expand our knowledge of the complexities of digital technology employed in financial services, and more specifically, retirement planning. Furthermore, this research aims to develop a deeper understanding of the impact of digital technology on the retirement ecosystem and the effects on both service providers and consumers. Multiple questions have remained unanswered to date in the retirement planning and services literature regarding digital technology, leading to the following research questions, which are supplemented by supporting research objectives and methodologies as outlined in Figure 1. Collectively, the objectives of this thesis seek to provide a better understanding of the influence and impact of digital technology on customer engagement, and information search and flow within the retirement industry.

Studies Overview and Methods

This thesis seeks to collectively examine the role of digital technology on financial services, with a specific focus on the retirement industry. As such, the thesis contains three sub-studies each addressing one overarching research question, adopting a different research methodology, and culminating in a thesis jointly informed by mixed methods. Mixed methods research is "research in which the investigator collects and analyses data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or a program of inquiry" (Tashakkori and Creswell 2007, p. 4). Its primary philosophy is rooted in the research paradigm of pragmatism, which seeks to consider various viewpoints and perspectives, guided by the researchers' goal of producing socially relevant and useful knowledge (Feilzer 2010; Johnson et al. 2007). Driven by the underlying philosophy of pragmatism, this thesis demonstrates the researchers' acceptance of multiple realities and orientation towards "solving practical problems in the real world" (Creswell and Plano Clark 2007). The three sub studies each adopt a different research methodology, and a different perspective (i.e., macro, meso, and micro), to provide a more holistic investigation of the research phenomenon in question (see Figure 2). The macro lens adopts a broad perspective on technology's (i.e., Artificial Intelligence) use by financial services globally. Following, the meso lens further zooms in on one specific financial service ecosystem (i.e., retirement planning), limited to the Australian context. Lastly, the micro perspective further focuses on a specific technological tool (i.e., mobile app) in the Australian retirement context.

Figure 1. Research questions and objectives

Research Question: Study 1

What is the current state of the literature on artificial intelligence in customer-facing financial services and what research areas require further exploration?

Key Objectives

- To adopt a macro perspective investigating the current use of digital technology (i.e., AI) in the financial services industry
- To provide a systematic review of the literature, explored contexts, and research foci on artificial intelligence (AI) in customer-facing financial services
- To identify the knowledge gaps in the extant literature and provide a comprehensive agenda for future research

Methodology

Systematic Literature Review → Sample included n=90 articles published in ABDC journals and analyzed using the TCCM (Theory, Context, Characteristics, and Methodology) framework

Research Question: Study 2

How does digital technology facilitate information search and information flow within the multi-actor retirement service ecosystem?

Key Objectives

- To adopt a meso perspective and examine the influence of digital technology in facilitating communication and information flow amongst the various ecosystem actors in the Australian Superannuation industry

Methodology

Qualitative research method → Semi-structured interviews (n=21) administered to Superannuation industry experts (n=10) and Superfund members (n=11)

Research Question: Study 3

Which factors drive the adoption of and engagement with mobile retirement apps?

Key Objectives

- To adopt a micro perspective to investigate the applicability of a digital communication tool in increasing retirement planning engagement behaviour
- To explore drivers of mobile retirement app adoption
- To examine how these explain mobile technology-enabled retirement engagement

Methodology

Quantitative research method → Online survey (n=440) administered to individuals aged between 18 and 65 years living in Australia

The first paper[1] (Chapter Two) of the thesis adopts a macro lens to explore digital technology in financial services. The aim of this paper is to provide a better understanding of the current state of research on digital technology in the financial services context. More specifically, the paper provides a systematic review of the literature on artificial intelligence (AI) in customer-facing financial services. Following the identification and classification of 90 articles published in ABDC journals, I employ the TCCM (Theory, Context, Characteristics and Methodology) framework to provide an overview of explored contexts, studied factors, and research foci. The paper concludes with a comprehensive agenda for future research, which among other things highlights a paucity of research on digital technology (including artificial intelligence) in the context of pensions and retirement.

Building on paper one, which highlights a lack of research on digital technology in a retirement context, study two (Chapter Three) adopts a meso lens to investigate the role of digital technology in communication and information flow within the retirement sector. Prior studies have emphasized that the services industry is increasingly becoming more digital, which further beckons the need for increased industry collaboration, changing business models, and established organizational partnerships (Deloitte and Institute of International Finance 2020). That is, digital technology is increasingly fostering the emergence and growth of new service ecosystems (Frow et al. 2019; Payne et al. 2021b). Consequently, using a meso-lens, study two seeks to better understand the role of digital technology on the retirement ecosystem. More specifically, the focus of this study was to investigate how digital technology impacts communication and information flow within the Australian retirement industry and overall service ecosystem. As such, this research draws on multi-actor service ecosystem and retirement planning literature (Baccarani and Cassia 2017;

[1] Hentzen, J., Hoffmann, A., Dolan, R., & Pala, E. (2021). Artificial intelligence in customer-facing financial services: a systematic literature review and agenda for future research. *International Journal of Bank Marketing (in press)*.

Eberhardt et al. 2019; Kohtamäki et al. 2019). Study two adopts a qualitative research methodology, comprising of 21 semi-structured interviews with various ecosystem actors. Using the Gioia methodology (2013), I analysed the interview data in a systematic manner. Study two concludes with a conceptual framework categorizing the numerous insights gained from the interviews into six themes and two aggregate dimensions, as well as an agenda for future research, with the hopes of encouraging additional research on retirement ecosystems and digital technology.

Lastly, paper three[2] (Chapter Four) adopts a micro view of the role of digital technology (i.e., mobile apps) on increasing retirement planning engagement. As such, the aim is to investigate potential factors influencing consumers' mobile technology-enabled retirement engagement. In this study, this is operationalized as consumer's intention to adopt as well as engage with a mobile retirement app. I draw on the technology adoption and retirement planning literature, and while previous studies acknowledge the increasing importance and use of digital technology for the retirement industry (Henkens et al. 2018), little is known about which factors drive mobile app adoption and engagement. I address this gap in the literature by adopting a quantitative research methodology. Using an online survey, I capture and analyse the responses of our sample of n=440 consumers and empirically test our proposed hypotheses. Data was processed and analysed using IBM SPSS and SmartPLS 2.0 (Hair et al. 2014; Hair Jr et al. 2014). Study three concludes with a conceptual framework and respective findings partially explaining consumers' mobile technology-enabled retirement planning.

[2] Hentzen, J., Hoffmann, A., & Dolan, R. (2021). Which consumers are more likely to adopt a retirement app and how does it explain mobile technology-enabled retirement engagement?. *International Journal of Consumer Studies, 46*(2), 368-390.

Contributions

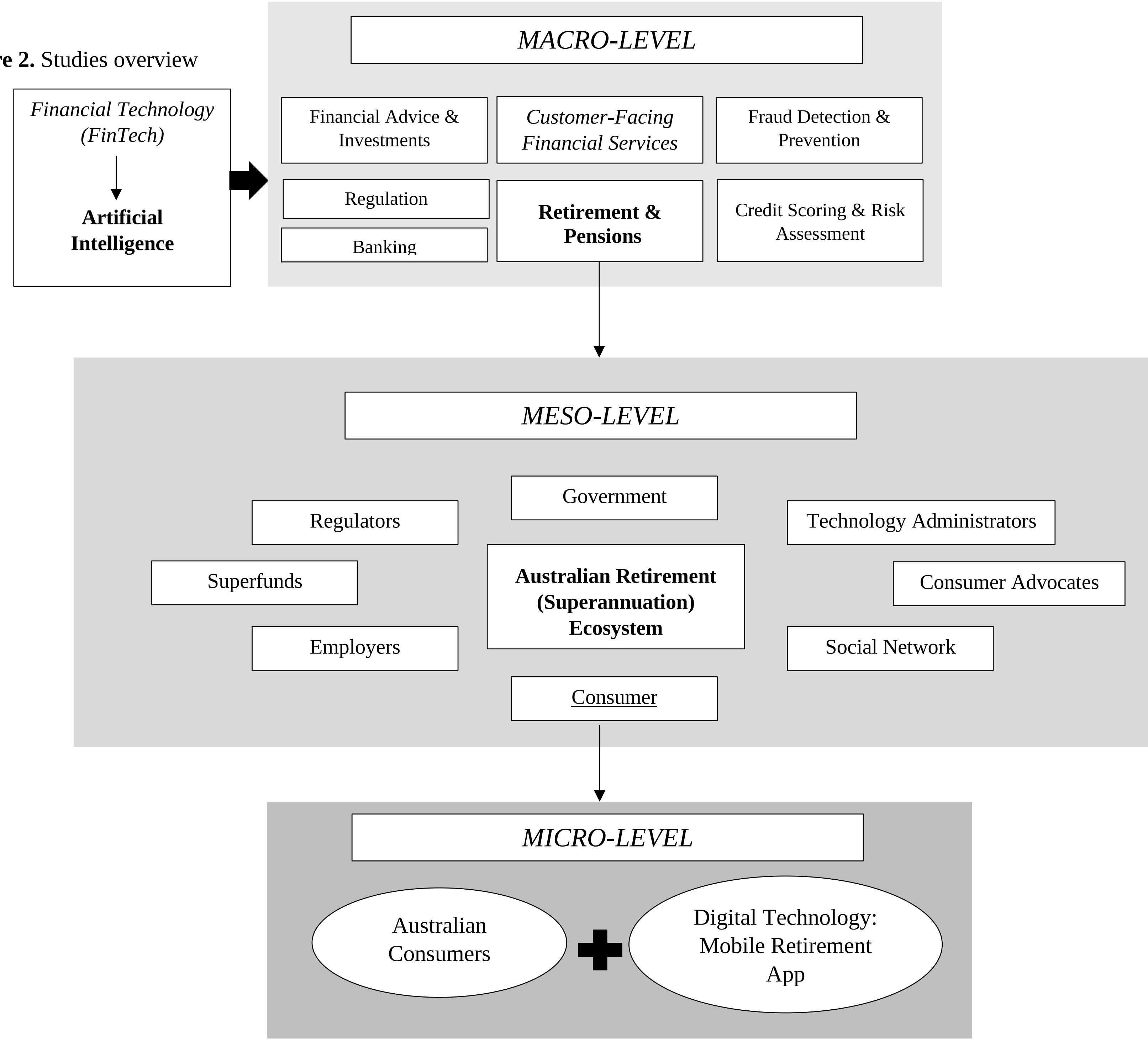
The three studies included in this thesis make several key contributions to the fields of retirement planning, digital technology, and financial services marketing. Overall, these contributions extend our understanding of the impact of digital technologies such as Artificial Intelligence and mobile apps on the financial services industry and consumer retirement planning engagement, respectively, as well as their role in facilitating communication and information flow in a multi-actor service ecosystem.

Study one establishes the current state of research on artificial intelligence in customer-facing financial services. More specifically, the study finds that amongst the analysed studies, most adopt a data-driven research approach, resulting in less than half of all studies making theoretical contributions to the research stream. Theoretical foundations and development are essential to academic research and the advancement of a research domain (Hunt 2018), and as such, these findings highlight a need for increased attention for theory-driven research on AI in financial services. Additionally, the findings demonstrate that banking, financial advice and investment, and credit scoring and risk assessment remain the primary context of investigations, resulting in a call for further research on financial services such as insurance, retirement, and regulation. Accordingly, this study makes another major contribution to the research stream by providing an agenda for future research. The future research agenda, comprised of 58 research questions, encourages future research, whilst also guiding researchers in identifying evolving research topics and areas of concerns.

Study one highlights a need for further research on how technology affects actors within a financial services ecosystem (i.e., Australian Superannuation), laying the foundation for study two. As a result, study two contributes to the literature on service ecosystems and digital information search (Dahl et al. 2021), by demonstrating the effect of retirement information complexity on both information search behaviour and use of digital technology. This study contributes to the multi-actor communication literature, by highlighting the need for inter-actor relationships and ability and willingness of actors to integrate resources and systems. Following calls for further research to move beyond investigations around dyadic relationships between consumer and service provider (Fehrer et al. 2018), the research findings contribute to the literature on digital information flow by offering insights into the impact of digital technology. That is, the results suggest that information flow is affected by ecosystem integration efforts, regulatory compliance, and innovation challenges. Lastly, this study highlights the need for Superannuation ecosystem actors to increase collaboration efforts and commence with process and system integration. Failure to do so has to date resulted in conflicting member communication, which further increased perceived information complexity and reduced retirement planning engagement.

Having considered the implications of digital technology on the overall retirement ecosystem, study three empirically examines the impact of mobile app technology on increasing individual consumers' retirement planning engagement behaviour. That is, study three contributes to three main research areas, that is, retirement planning involvement, mobile financial services technology adoption, and digital customer engagement. First, I make contributions to the retirement planning involvement literature by identifying factors driving the intention to adopt and engage with a mobile retirement app. By doing so, this study answers the calls to study how technology shapes the retirement process (Henkens et al. 2018). In particular, this study highlights the efficacy of mobile retirement apps to increase customer engagement in a low-involvement context such as retirement planning. Lastly, this paper provides a clearer exploration of technology-enabled retirement planning engagement, which is still in its conceptual infancy. Paper three also provides valuable insights for practitioners and policy makers.

Figure 2. Studies overview



Thesis Structure

The following section outlines the structure of this thesis. This thesis adopts a “Thesis by Publication” format following the University of Adelaide’s requirements and guidelines and includes three papers in manuscript format (two published and one unpublished). In the content chapters, reference is made to the authorship team through the use of ‘we’. The thesis is sectioned into 5 chapters. Chapter 1 provides an introduces the research background, research questions and objectives, studies overview and contributions to the literature. Chapter 2 presents *Paper 1* titled “Which consumers are more likely to adopt a retirement app and how does it explain mobile technology-enabled retirement engagement?”. Following this, Chapter 3 presents *Paper 2* titled “The role of digital technology in communication and information flow in the Australian superannuation industry: A multi-actor service ecosystem perspective”. Chapter 4 introduces *Paper 3* labelled “Which consumers are more likely to adopt a retirement app and how does it explain mobile technology-enabled retirement engagement?” Chapter 5 provides the conclusion to this thesis, including a summary of findings and implications for research and practice.

CHAPTER TWO: ARTIFICIAL INTELLIGENCE IN CUSTOMER-FACING FINANCIAL SERVICES - A SYSTEMATIC LITERATURE REVIEW AND AGENDA FOR FUTURE RESEARCH

Statement of Authorship

Statement of Authorship

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Name of Principal Author (Candidate)	Janin Hentzen		
Contribution to the Paper	Conceptualization of research topic, literature search and analysis, writing of manuscript.		
Overall percentage (%)	65%		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	08/03/2022

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);
ii. permission is granted for the candidate in include the publication in the thesis; and
iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Prof. Arvid O. I. Hoffmann		
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Signature		Date	4/03/2022

Name of Co-Author	Erol Pala		
Contribution to the Paper	Assisted with data analysis through provision of inter-coder reliability. Percentage of contribution: 5%		
Signature		Date	28/02/2022

Abstract

Purpose: The objective of this study is to provide a systematic review of the literature on artificial intelligence (AI) in customer-facing financial services, providing an overview of explored contexts and research foci, identifying gaps in the literature, and setting a comprehensive agenda for future research.

Design/methodology/approach: Combining database (i.e., Scopus, Web of Science, EBSCO, ScienceDirect) and manual journal search, we identify 90 articles published in ABDC journals for investigation, using the TCCM (Theory, Context, Characteristics, and Methodology) framework.

Findings: The results indicate a split between data-driven and theory-driven research, with most studies either adopting an experimental research design focused on testing the accuracy and performance of AI algorithms to assist with credit scoring or investigating AI consumer adoption behaviours in a banking context. We call for more research building overarching theories or extending existing theoretical perspectives such as actor networks. More empirical research is required, especially focusing on consumers' financial behaviours as well as the role of regulation, ethics, and policy concerned with AI in financial service contexts such as insurance or pensions.

Research limitations/ implications: Our review focuses on artificial intelligence in customer-facing financial services. Future work may want to investigate back-office and operations contexts.

Originality/Value: We are the first to systematically synthesize the literature on the use of artificial intelligence in customer-facing financial services, offering a valuable agenda for future research.

Keywords: systematic literature review, artificial intelligence, financial services, bank marketing.

Paper type: literature review.

Introduction

Human intelligence refers to a person's ability to learn and adapt from their experience and environment (Schlinger 2003). Components include reasoning, decision-making, learning, problem-solving, and communicating (Russell and Norvig 2010). While human intelligence continues to be a highly debated topic, non-human or artificial intelligence has intrigued many great minds over the past centuries, including philosophers, mathematicians, writers, and scientists. Intelligent machines have ignited the search for answers as to what defines human intelligence and attempts to replicate and improve such intelligence. Despite the occasional conceptualizations of non-human intelligence throughout the centuries, scholars consider 1956 as the beginning of artificial intelligence as an academic research area. Specifically, it is all believed to have started with a conference at Dartmouth College in the U.S. (Haenlein and Kaplan 2019).

Since then, artificial intelligence (hereafter: AI) research has undergone slow development, little research attention, and low industry adoption. However, with recent advances in computational technology, Big Data, and increased industry demand, AI is rapidly transforming customer experiences, organizations, and industries (Xu et al. 2020). While services industries are usually considered more difficult to automate due to the contextual understanding of communicational cues (i.e., non-verbal cues and human interaction), it is subject to radical technological transformation (Davenport et al. 2020; Huang and Rust 2018; van Doorn et al. 2016). AI has the potential to alter healthcare services, retail and consumer services, communication and entertainment services, and financial services (Pemer 2020; PWC 2017; van Esch et al. 2020).

Financial services are traditionally considered a high-involvement context, with the industry moving to the forefront of adopting new technologies, leading to the rapid development of "FinTech", including AI (Citi Group 2018). For example, spending on AI by the financial services sector in the Asia Pacific is expected to reach US$ 4.29 billion in 2024 (Kapoor and Bisht 2020).

So far, AI is used in fraud detection, risk management and cybersecurity, chatbots, algorithmic trading, Robo-advisory, credit scoring, asset and wealth management, as well as relationship management and regulation (Buchanan 2019; Chan et al. 2019; Deloitte 2018). AI has thus become an important issue in financial services marketing, warranting a systematic review of the literature (Cubric 2020). Such a review is indispensable for informing (future) empirical research, aiding policy makers and business practitioners, and setting the foundation for theoretical conceptualizations (Snyder 2019). The number of academic studies around AI and its applications in financial services (marketing) has risen significantly in the past five years. However, the expected rise in systematic literature reviews has not followed. Our study addresses this gap.

Similar to Payne et al. (2021a) and Fernandes and Oliveira (2021), we contend that the application of AI within the financial services context is diverse and includes a wide range of activities, including customer-facing applications, such as chatbots, and non-customer-facing applications, such as auditing. We limit the scope of our review to customer-facing AI applications to match the readership of this journal and avoid our review becoming overly technically complex. Our study is motivated by several limitations of the existing literature. First, prior literature reviews typically focus on one specific aspect of financial services, such as credit scoring (e.g., Bhatore et al. 2020; Dastile et al. 2020) and blockchain technology (Ali et al. 2020). Second, literature reviews that do have an expanded scope fail to adopt a systematic approach (e.g., Cavalcante et al. 2016; Konigstorfer and Thalmann 2020; Milana and Ashta 2021). Against this backdrop, our systematic literature review complements and extends prior reviews by providing the first review of studies on artificial intelligence in customer-facing financial services and outlining future research directions to support the advancement of this research field. We employ the Theory, Context, Characteristics, and Methodology (TCCM) framework (Paul and Rosado-Serrano 2019), which has been argued to generate more informative, insightful, and robust insights compared to other approaches (Paul and Criado 2020). Specifically, our systematic literature review seeks to answer the following questions: What *theories* are applied to study the impact of AI on customer-facing financial services? In what *context* (e.g., type of financial service) did prior investigations take place? What *characteristics* (e.g., variables) are studied in prior research? What are the most frequently applied research *methods* in previous work? And, finally, what are particularly promising opportunities for *future research* that arise from a systematic review of the extant literature?

We contribute to the literature on the intersection of artificial intelligence and financial services marketing in multiple ways. First, our study provides a comprehensive overview of the current state of AI in financial services research. In total, we review 90 articles pertaining to both empirical and theoretical characteristics, of which some have not been considered previously. Based on the TCCM framework, our review finds that most of the included studies follow a data-driven approach, with less than half relying on theories to explain AI-related effects. Most research is set in developed countries and focuses on AI applications in banking and credit risk scoring, studied using quantitative methods such as surveys or experiments. Our analysis of independent, dependent, mediating, and moderating variables suggests that AI research has primarily studied consumer-technology and service-experience related variables, whereas promising variables related to actor-networks or consumer behaviour have received only limited research attention to date.

Second, based on the insights gained from our literature review, we develop an agenda for future research, outlining topics and potential research questions based on the TCCM framework. We suggest future research to combine data- and theory-driven research and use diverse theoretical perspectives to better account for the broader impact of AI on the financial services ecosystem, including non-banking contexts related to insurance and pensions. Finally, we call for future research to empirically investigate AI's ethical, legal, and regulatory implications in financial services.

Research Methodology

Systematic reviews seek to summarize research findings and general literature in a transparent, systematic, and reproducible way (Davis et al. 2014). While traditionally not overly prevalent, the number of systematic literature reviews in business journals is increasing. Select journals such as the *International Journal of Bank Marketing* (Fernández-Olit et al. 2019; Kumar et al. 2019), the *International Journal of Consumer Studies* (Paul et al. 2021a), and the *Journal of Business Research* (Mandler et al. 2021; Paul et al. 2021b) have recognized the value of systematic literature reviews for the development of the field and are increasingly publishing these types of articles.

Inclusion and Exclusion Criteria

As mentioned, we limit the scope of our review to AI in customer-facing financial services. The term AI is often interchangeably used with machine learning (ML) or deep learning (DL), but they are not the same (Ashta and Herrmann 2021). AI is considered an umbrella term, encompassing both ML and DL, which differ theoretically and in application. While AI is described as "a system's ability to interpret external data correctly, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation" (Haenlein and Kaplan 2019, p. 5), machine learning "is a subset of AI, which uses statistical tools to learn from data and then applies algorithms to solve problems" (Ashta and Herrmann 2021, p. 212). ML can take data and algorithms and apply these to new scenarios without being programmed directly to do so (Buchanan 2019). On the other hand, DL aims to understand underlying principles and patterns of data, which it can then combine with algorithms to learn on its own. ML classifications include supervised, semi-supervised, unsupervised, and reinforcement learning, and the algorithms can be categorized into classifiers, regression, and clustering (Campesato 2020). While we did include articles applying ML, we did not include machine learning, deep learning, or specific algorithms (e.g., neural networks, support vector machines) as separate search terms given the scope of our literature review. Table 1 summarizes the inclusion and exclusion criteria we used.

Table 1. Search strategy and criteria

1	Scopus	"AI" OR "artificial intelligence" AND "financial service" OR "financial services marketing" OR "banking" OR "loan" OR "credit" OR "financial advice" OR "financial planning" OR "wealth management" OR "investment" OR "retirement" AND "customer" OR "consumer"	Jun-21	722
			Oct- 21	57 [3]
2	WoS		Jun-21	374
			Oct-21	365 [3]
3	EBSCO		Jun-21	389
4	ScienceDirect		Jun-21	97
			Total	**2,004**

Inclusion Criteria	
Topic	Accepted articles need to investigate artificial intelligence in the context of customer-facing financial services (B2C)
	Authors must be able to contextually place research articles through title and abstract review, that is, financial services and artificial intelligence or related terminology must be mentioned in either article title, abstract, or keywords
Document type	Empirical and conceptual articles published in peer-reviewed journals
	As suggested by Paul and Criado (2020); Paul et al. (2021b), articles must be published in journals ranked on the 2019 ABDC list
Language	All included articles are published in English
Exclusion Criteria	
Topic	Articles focused on a Business-to-Business (B2B) context such as corporate bankruptcy prediction or auditing
Document type	Books, book chapters, and conference papers are excluded from the review
Language	Articles written in a language other than English

Search Strategy

Following prior literature (e.g., Chen et al. 2021b; Mandler et al. 2021; Payne et al. 2021a), our data search and collection comprise two phases: (i) an electronic database search and (ii) a manual Google Scholar citation and key journal search. For the electronic database search, we identify relevant keywords based on the authors' expertise and agreement. We then enter the

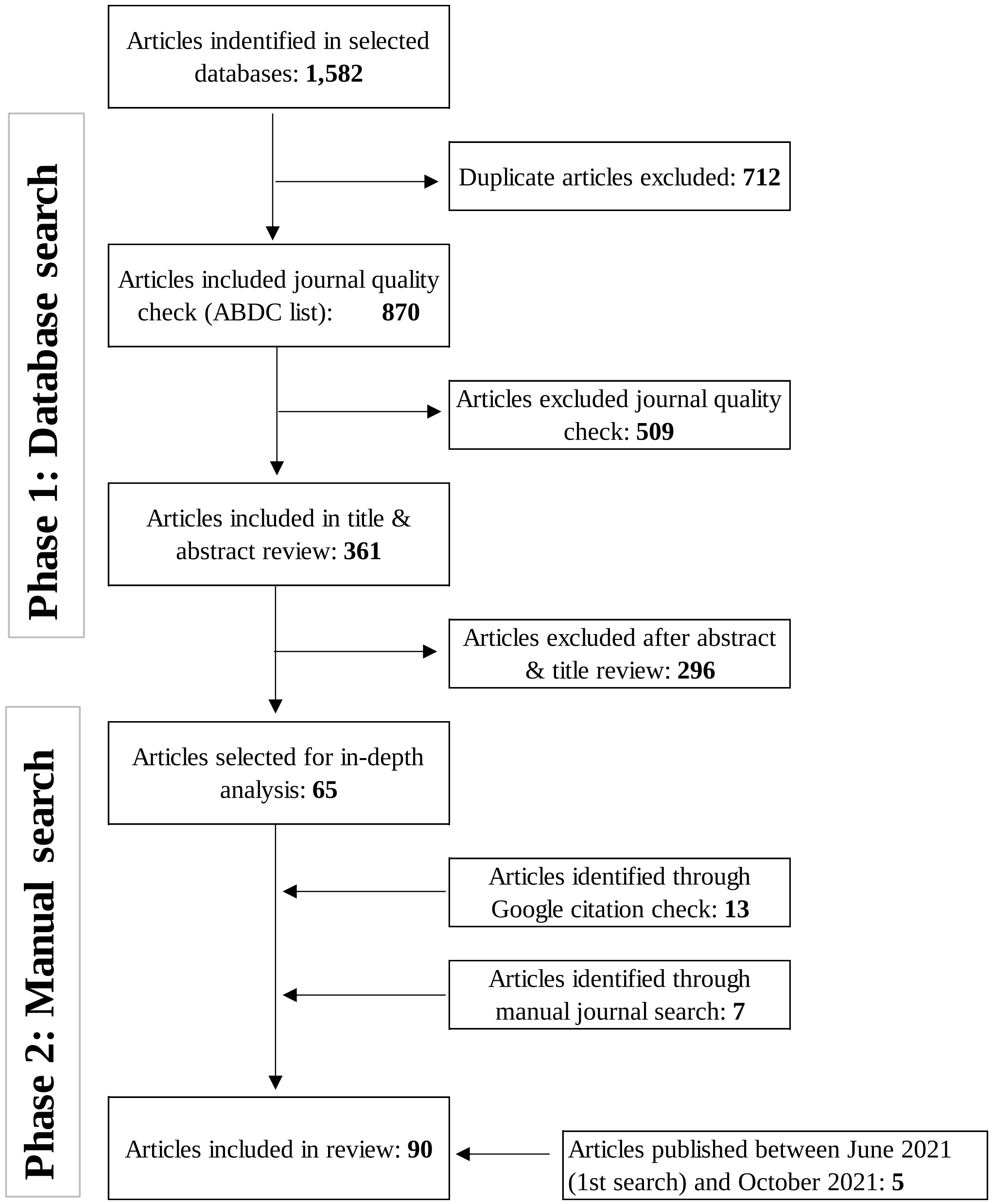
[3] **Note:** A second search was conducted in October 2021, to account for articles published during the journal review process between the first search in June 2021 and October 2021.

resulting search string, consisting of keyword combinations using Boolean operators “AND” and “OR” (see Table 1), into four electronic databases: Scopus, Web of Science, EBSCO, and Science Direct. We restrict our search to the papers’ abstract, title, or keywords and limit it to only include academic journal articles published in peer-reviewed journals and written in English.

The first phase of the data collection process yields 1,582 articles. After removing duplicates, this becomes 870 articles. We then proceed with a journal quality check, only keeping articles in journals ranked by the ABDC 2019 Journal Quality List, resulting in 361 articles to be included in an initial title and abstract review. All authors then commence reading the title and abstracts of these articles, after which 65 articles are selected for further investigation (98% author agreement). The authors then progress with the second phase of the data collection process, which includes a manual search checking the Google Scholar citations of the selected articles, resulting in an additional 13 articles to be included. In the third phase of the data collection process, the authors manually searched the archives of six leading service research journals (i.e., *Journal of Service Management*, *Journal of Service Research, Journal of Services Marketing, Journal of Service Theory and Practice, Service Science,* and *Service Industries Journal*), five leading marketing journals *(*i.e., *Journal of Marketing, Journal of Marketing Research, Marketing Science, Journal of the Academy of Marketing Science*, and *International Journal of Research in Marketing*) as well as the *International Journal of Bank Marketing* to acknowledge our target readership. The manual journal search results in an additional 7 articles, bringing the total number to 85. To account for articles published during the journal review process after the first data collection in June 2021, a second search was conducted in October 2021. While the second search applies the same inclusion and exclusion criteria, the authors limited the search to articles published in 2021. Five additional articles were identified, bringing the total number of articles included in the review to 90 (see

Appendix A), which is within the recommended range (Paul and Criado 2020). Figure 3 visualizes how we arrived from the initial 2,004 articles to the final 90 articles included in the review.

Figure 3. Overview of systematic review process

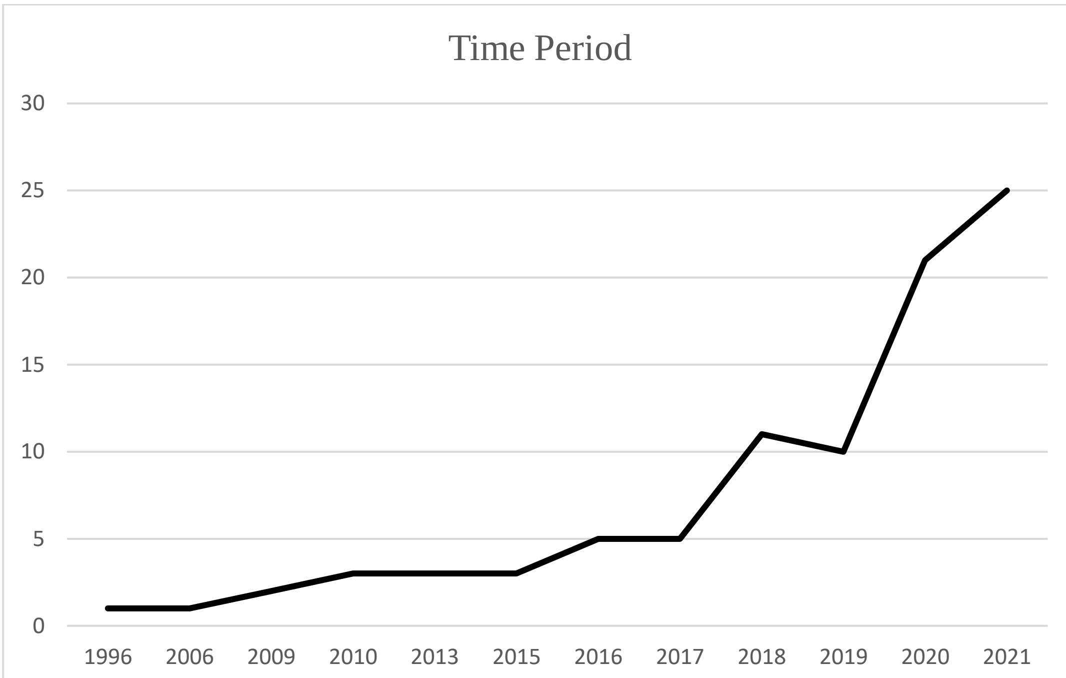


Publication Trends

Year and Country of Publication

We organize the articles based on year and country of publication. Figure 4 details the distribution of the studies' publication dates, spanning from 1996 to 2021. Since 2016-2017, the domain has gained increasing momentum, culminating in 25 new publications in the year 2021.

Figure 4. Time frame covered by systematic review and # of articles published



Due to the nature of the studies, we considered both country of analysis and the source of data. Numerous studies conducting experiments or simulations utilize publicly available data from specified countries (i.e., Zhang et al. 2019). Some studies cover multiple countries of analysis, which leads to the total count exceeding the number of studies. As indicated in Table 2, most studies are based on data from North America (n=17), which includes the USA and Canada, as well as DACH countries (n=16), which include Germany, Switzerland, and Austria. However, most of the latter studies use German data (n=14). These are closely followed by studies conducted in East Asian countries (n=13), including China, Taiwan, Japan, and South Korea. Also represented are studies from the United Kingdom (n=10), Mediterranean countries such as Italy, Spain, Portugal, and Malta (n=8), and Australia (n=8). Many Middle Eastern countries were present (n=9), with most studies based on Iranian data (n=4). Somewhat underrepresented were African (n=4) and Latin American countries (n=1). Numerous studies did not report a country of analysis (n=18), partly due to these studies' conceptual nature (Payne et al. 2021a).

It is not surprising that many studies focus on the USA and Germany, as both countries are at the forefront of AI-technology development and investment. While the USA invested US$ 18.2 billion into AI between 2012 and 2016 (Buchanan 2019), Germany is set to spend €5 billion by 2025 (European Commission 2020). Surprisingly, although China aims to become the world's primary AI innovation center, with estimated investments between $1.7 to $5.7 billion in 2018 (Acharya and Arnold 2019), comparatively few articles include Chinese data. Finally, although some studies focused on the effectiveness of AI in enhancing financial inclusion, only a few articles are set within the context of developing nations (e.g., Abdulquadri et al. 2021; Bhatia et al. 2020).

Table 2. Country of analysis

Country	#	%	Exemplar Studies
Africa			
Egypt	1	1%	Abdelazim and Wahba (2006)*
Nigeria	2	2%	Abdulquadri et al. (2021); Mogaji et al. (2021)
Tunisia	1	1%	Khemakhem et al. (2018)
Americas			
North America (USA and Canada)	17	19%	Abdelazim and Wahba (2006); Ashta and Herrmann (2021); Bai (2021); Bejou et al. (1996); Belanche et al. (2019); Brenner and Meyll (2020); Flavián et al. (2021); Fulk et al. (2018); Lee and Shin (2020); Leung et al. (2009); Payne et al. (2021c); Payne et al. (2018);

			Ramanathan and Wechsler (2013); Shanmuganathan (2020); Tokic (2018); Tubadji et al. (2021*); Zhang et al. (2021a)
Latin America (Brazil)	1	1%	Sun and Vasarhelyi (2018)
Asia and Oceania			
Australia	8	9%	Abellán and Castellano (2017); Ala'raj and Abbod (2016); Ashta and Herrmann (2021); Singh et al. (2021a*); Tubadji et al. (2021*); Zhang et al. (2019); Zhang et al. (2021b)
East Asia (China, Taiwan, Japan, and South Korea)	13	14%	Ala'raj and Abbod (2016*); Ashta and Herrmann (2021*); Guo (2020); (Huang and Pan 2010); Jang et al. (2021); Xu et al. (2020); Yu et al. (2009*); Zhang et al. (2019*); Zhang et al. (2021b*)
South Asia (India and Indonesia)	5	6%	Bhatia et al. (2020); Kaur et al. (2020); Mor and Gupta (2021); Philip et al. (2018); Rasiwala and Kohl (2021); Suhartanto et al. (2021)
Non-disclosed Asian country	1	1%	Luo et al. (2019)
Europe			
Benelux (Netherlands and Luxembourg)	6	7%	Correa Bahnsen et al. (2016*); Henkel et al. (2020); Tubadji et al. (2021*); van Thiel and van Raaij (2019*)
DACH countries (Germany, Austria, and Switzerland)	16	18%	Abellán and Castellano (2017*); Adam et al. (2020); (Atwal and Bryson 2021); Correa Bahnsen et al. (2016*); Hildebrand and Bergner (2020); Kraus and Feuerriegel (2017); Singh et al. (2021a*); Trivedi (2019); Tubadji et al. (2021*); Yu et al. (2009*); Zhang et al. (2019*); Zhang et al. (2021b*)
Eastern Europe (Czech Republic, Poland, and Romania)	7	8%	Abellán and Castellano (2017*); Ala'raj and Abbod (2016*); Iiie et al. (2017); Ładyżyński et al. (2019); Tubadji et al. (2021*)
EU (unspecified)	4	4%	Ashta and Herrmann (2021*); Borgogno and Colangelo (2019); Kapsis (2020); Kruppa et al. (2013)

France	1	1%	Tubadji et al. (2021*)
Mediterranean countries (Italy, Malta, Spain, and Portugal)	8	9%	Belanche et al. (2019*); Castillo et al. (2020); Gallego-Gomez and De-Pablos-Heredero (2020); Lu et al. (2016); Paleologo et al. (2010); Tubadji et al. (2021*)
United Kingdom	10	11%	Aggarwal (2021); Belanche et al. (2019*); Chiu (2019); Lee (2020); Lui and Lamb (2018); Punniyamoorthy and Sridevi (2016); Ramanathan and Wechsler (2013*); Tubadji et al. (2021*); van Thiel and van Raaij (2019*); Yu et al. (2009*)
Global	3	3%	Kumar and Balaramachandran (2018); Lightbourne (2017); Mhlanga (2021)
Middle East			
Armenia	1	1%	Baghdasaryan et al. (2021)
Iran	4	5%	Abellán and Castellano (2017*); Ala'raj and Abbod (2016*); Koutanaei et al. (2015); Zeinalizadeh et al. (2015)
Lebanon	1	1%	Boustani (2021)
Saudi Arabia	1	1%	Aloud (2018)
Turkey	2	2%	Eren (2021); Tubadji et al. (2021*)
Country not reported	18	21%	Cavalcante et al. (2016); Huang and Philp (2020); Jakšič and Marinč (2019); Jung et al. (2018); Khandani et al. (2010); Konigstorfer and Thalmann (2020); Mhlanga (2020); Milana and Ashta (2021); Mogaji et al. (2020); Moscato et al. (2021); Mosteanu (2019); Payne et al. (2021a); Riikkinen et al. (2018); Truby (2020); Truby et al. (2020); Wall (2018); West and Bhattacharya (2016); Wexler and Oberlander (2021)

Note: * = indicates multiple countries of analysis/data sources.

Publication Outlet

The 90 articles included in the review span over 60 separate journals from various disciplines, including marketing, management, finance, business, economics, law, social sciences, and information systems management. Table 3 provides an overview of the 13 journals with the most publications, showing that articles on AI in customer-facing financial services are yet to find a footing in top-tier journals. That is, 39% (n=35) of articles are published in C and 23% (n=21) in B-ranked journals, compared to only 9% (n=8) in A*, and 29% (n=26) in A-ranked journals.

Table 3. Top 13 journals with most published articles

Journal	**#**	**ABDC Ranking**
Expert Systems with Applications	8	C
Strategic Change	6	C
Journal of Behavioral and Experimental Finance	5	A
International Journal of Bank Marketing	3	A
Journal of Research in Interactive Marketing	3	B
Australasian Marketing Journal	2	A
Computers And Security	2	A
Electronic Markets	2	A
European Business Organization Law Review	2	B
European Journal of Operational Research	2	A*
Journal Of Business Research	2	A
Knowledge-Based Systems	2	A
Service Industries Journal	2	B

Keyword Analysis

Keywords aim to provide vital insight into the content of a particular journal article. Analysing authors' specified keywords may shed light on the dominant focus of an area of research while simultaneously confirming the visibility of select articles. We provide a visualized summary of the most frequently used keywords employed in the sample articles in Figure 5. The most noticeable keywords (e.g., *artificial intelligence, financial*,* and *service*) match the search string used by the researchers, supporting the choice of the search terms employed. Other frequently used keywords include *customer, learning, credit, machine, bank* and scoring*. While the keywords indicate a strong focus on information systems and computational technology (e.g., *algorithm, classification, ensemble, neural*), we also find many keywords that draw attention to customer behaviours (e.g., *decision, advice, satisfaction*) and the service context (e.g., *value, experience, quality, and industry*).

Figure 5. Keywords word cloud

General Overview

The most important characteristics of systematic literature reviews include transparency, rigor, and replicability (Snyder 2019). However, authors can use different types of review structures, including framework-based (i.e., Paul and Benito 2018), structured (i.e., Kahiya 2018), bibliometric (i.e., Krishen et al. 2021), or hybrid reviews (i.e., Vlačić et al. 2021). For this study, we conducted a framework-based review, employing the *Theory, Context, Characteristics,* and *Method* (TCCM) framework, pioneered by Paul and Rosado-Serrano (2019). While relatively new, these authors' article is cited over 135 times and numerous other studies use this framework (see Buitrago and Barbosa Camargo 2021; Chen et al. 2021b; Lim et al. 2021; Srivastava et al. 2020).

Theory

Theoretical foundations and theory development are essential to academic research, as they foster avenues for further research and can contribute to the advancement of the discipline (Hunt 2018). A theory refers to a "systematically related set of statements, including some lawlike generalizations, that is empirically testable. The purpose of theory is to increase scientific understanding through a systematized structure capable of both explaining and predicting phenomena" (Hunt 2010, p. 6). To better understand the underlying theoretical foundations of the reviewed papers, we have identified the theories applied or referred to, and grouped them into related clusters: (i) economics and finance theories, (ii) information systems theories, (iii) organizational behaviour theories, (iv) psychological theories, (v) technology adoption theories, (vi) value creation theories, and (vi) other theories. Prominent theories include the technology acceptance model (Davis et al. 1989), diffusion of innovation theory (Rogers 1995), and modern portfolio theory (Markowitz 1959). While 39% of studies use a single theory, 7% draw on multiple theories (e.g., Payne et al. 2018; Xu et al. 2020). Notably, most studies included in the review (n=58) do not explicitly mention or apply a specific theory or theoretical framework (see Table 4).

The findings suggest a split between data-driven and theory-driven research. Theory-driven research in the traditional sense includes scientific inquiry, which begins with hypothesis development, data collection, data analysis, and hypothesis testing. Researchers then draw theoretical conclusions from the results (Maass et al. 2018). Data-driven research adopts an exploratory approach by applying analytical techniques and modes of reasoning to analyse data and obtain scientifically relevant insights (Maass et al. 2018). While theory-driven research dominates the organization and social sciences, data-driven research is the primary research perspective in the natural and information systems sciences (Elragal and Klischewski 2017).

Table 4. Key theories and theoretical frameworks

Category	**Key theory used**	**#**	**Exemplar studies**
Agency	Contemporary financial intermediation theory	1	(Jakšič and Marinč 2019)
	Agency theory	1	(Bai 2021)
	General agency law	1	(Lightbourne 2017)
Biology	Immune network theory	1	(Lu et al. 2016)
Economics and Finance	Credit rationing theory	1	(Mhlanga 2020)
	Economic theory	2	(Boustani 2021; Tubadji et al. 2021)
	EMH theory (efficient market hypothesis)	1	(Tokic 2018)
	Financial management theory*	1	(Boustani 2021)
	Modern portfolio theory	3	(Abdelazim and Wahba 2006; Chiu 2019; Shanmuganathan 2020)
	Rational choice theory	1	(Bai 2021)
	Theory of financial innovation*	1	(Boustani 2021)
	Contract theory	1	(Mhlanga 2021)
	Adverse selection theory	1	(Mhlanga 2021)
	Moral hazard theory	1	(Mhlanga 2021)
Information Systems	Affordance- experimentation actualization theory*	1	(Xu et al. 2020)
	Social response theory*	1	(Adam et al. 2020)
	Transactive relationship theory*	1	(Xu et al. 2020)
	Affective events theory	1	(Henkel et al. 2020)

Organizational Behavior	Substitution and Disruptive innovation theory	1	(Rasiwala and Kohl 2021)
	Frugal theory of innovation	1	(Abdulquadri et al. 2021)
	Theory of dynamic capabilities	1	(Gallego-Gomez and De-Pablos-Heredero 2020)
Psychology	Attribution theory	1	(Huang and Philp 2020)
	Commitment-consistency theory*	1	(Adam et al. 2020)
	Expectation confirmation theory	1	(Eren 2021)
	Theory of Planned Behavior	1	(Atwal and Bryson 2021)
	Social representations theory (SRT)	1	(Jang et al. 2021)
	Attitude-behaviour model	1	(Suhartanto et al. 2021)
Technology Adoption	Diffusion of Innovation theory*	3	(Xu et al. 2020)
	Self-service technology adoption theory	1	(Zhang et al. 2021a)
	Technology Acceptance Model*	6	(Atwal and Bryson 2021; Belanche et al. 2019; Flavián et al. 2021; Payne et al. 2018; Seiler and Fanenbruck 2021; Xu et al. 2020)
	UTAUT*	2	(Atwal and Bryson 2021; Mogaji et al. 2021)
Value creation	Value co-creation/ co-destruction	3	(Castillo et al. 2020; Payne et al. 2021a; Payne et al. 2021c)
No guiding theory		58	(Luo et al. 2019; Milana and Ashta 2021)

Note: * = the number of articles amounts to more than 90 as multiple articles draw on several theoretical perspectives.

Most articles employed theories categorized as either economics and finance (n=9) or technology adoption (n=9). In terms of technology adoption, most studies combined two or more theories, with some extending their frameworks with a third theory. In their application of the technology acceptance model (TAM) combined with the unified theory of acceptance and use of technology (UTAUT), Atwal and Bryson (2021) seek to identify the determinants of consumer intentions to use Robo-advisors. In a similar context, Zhang et al. (2021a) extend the self-service technology adoption theory. Meanwhile, Xu et al. (2020) draw on both the TAM and diffusion of innovation theory to investigate consumers' service preferences of AI vs. humans, as well as the affordance-experimentation-actualization theory to demonstrate the numerous types of AI-enabled service encounters in a financial and banking context. With similar intent, Payne et al. (2018) also combine the TAM with the diffusion of innovation theory to identify explanatory factors influencing both consumers' attitudes and perceptions about AI-enabled mobile banking. While Flavián et al. (2021) do not explicitly employ the TAM, they include the key variables as control variables while studying the effect of technology readiness variables on consumer's intentions to use Robo-advisors. Other studies supplement agency theory with rational choice theory to examine the relationship between Robo-advisory use and credit card debt (Bai 2021), or adopt the attitude-behaviour model lens to investigate AI-enabled mobile banking loyalty (Suhartanto et al. 2021).

Context

Table 5 summarizes the contexts or types of customer-facing financial services investigated in the reviewed articles. The articles describe the investigated AI technology to varying degrees. While some discuss AI-enabled chatbots, Robo-advisors, or view AI in a general manner, others describe and apply technical terminology including machine and deep learning algorithms (e.g., random forest, support vector machines, artificial neural networks). Identifying and explaining the different types of artificial intelligence and machine learning methods is beyond the scope of this review and intended audience. Interested readers may consult Campesato (2020) and/or Sterne (2017).

Banking. Most studies (n=27) focused on AI in the banking context. This is not surprising, given that banks represent the main financial service accessible to the wider population. Banks are increasingly relying on AI to improve the customer experience and expand their use of AI through conversational chatbots to assist customers with basic services or virtual assistants. Most banks consider AI technologies beneficial to the institution in various ways, including increasing revenues through improved customer service and reduced costs due to enhanced efficiencies, lower error rates, and improved resource utilization (McKinsey & Company 2020). Studies included in the review with a focus on banking included an investigation of the benefits and challenges of conversational software agents or chatbots (Adam et al. 2020), whether chatbots can facilitate financial inclusion (Abdulquadri et al. 2021), emerging market consumers' interaction and engagement with banking chatbots (Mogaji et al. 2021), and how AI affects bank employees and customer behaviours when seeking out financial services (Boustani 2021). Other studies use natural language processing to increase understanding of customer satisfaction (Piris and Gay 2021), test AI's potential to reduce technical inefficiencies in commercial banks (Mor and Gupta 2021), investigate consumer loyalty towards AI-enabled mobile banking (Suhartanto et al. 2021), and study whether customers prefer AI or human online customer service applications (Xu et al. 2020).

Financial advice and investment. One dominant area of AI research in financial services focuses on financial and investment advice using AI and Robo-advisors. This was the second most dominant context in the reviewed articles (n=24). Robo-advisors are used in the context of digital advisory services and rely on AI systems, which include automated platforms. Although Robo-advisors provide numerous benefits, including service fee reductions and 24/7 consumer access, consumer adoption has been slow (Jung et al. 2018). Bhatia et al. (2020) investigate whether and how Robo-advisors could mitigate retail investors' behavioural biases. Brenner and Meyll (2020) find that Robo-advice reduces the demand for human financial advice, especially for investors who fear investment fraud. Similarly, Atwal and Bryson (2021) explore private investors' Robo-advisor adoption intentions, whereas Flavián et al. (2021) investigate the effect of customers' service awareness and technology readiness on their intention to use Robo-advisors. However, not all articles focused on financial advice and investment management were concerned with Robo-advisors, with some investigating AI applications in trading systems and forecasting financial markets (Aloud 2018) or portfolio selection and management (Abdelazim and Wahba 2006) instead.

Credit scoring and risk assessment. Another dominant research context (n=22) included studies investigating AI and ML techniques to assist financial institutions in identifying credit risks and providing overall customer credit scores. In this context, AI methods are implemented to assess the probability of customers failing to repay a loan or debt, which would result in losses for the financial institution. All the reviewed studies focusing on credit scoring and risk assessment involved technical analysis of the effectiveness and accuracy of different AI and ML algorithms (Ala'raj and Abbod 2016; Correa Bahnsen et al. 2016; Singh et al. 2021a; Trivedi 2019; Zhu et al. 2013), except for Aggarwal (2021), who discusses algorithmic credit scoring from a regulatory perspective instead and Mhlanga (2021), who reviews the literature on credit risk assessment in the context of financial inclusion and emerging economies.

General financial services. Select articles (n=10) refer to AI in the general context of financial services. For example, Ashta and Herrmann (2021) investigated the role of AI in creating various opportunities for financial organizations while also highlighting the inherent risks associated with this new technology. Henkel et al. (2020) examine whether an AI-based emotion recognition software can support service employees in customer emotion management. Taking a value creation perspective, Castillo et al. (2020) considered the consequences of AI-powered chatbot service failures, including financial technology support, investment, and banking support.

Regulation. The fifth and final context we identified focuses on regulation. Although AI brings many benefits, increasingly sophisticated technologies also increase the potential for abuse. Financial institutions are concerned with data ownership, consumer privacy, and cybersecurity (Truby et al. 2020). Regulation is needed to address these concerns, as uncontrolled innovation can have devastating consequences (Accenture 2019). Although an increasingly important research area, only n=10 articles included in the review adopted a regulatory focus. Regulation affects all areas of financial services, including banking, investment, credit scoring, and financial advice. For example, Chiu (2019) discusses different regulatory frameworks to improve trust and credibility perceptions in the financial advice industry, including Robo-advisors' implications and current limitations (Lightbourne 2017). Guo (2020) highlights legitimacy issues concerning Robo-advisors, which they in part attribute to a lack of investor protection and information asymmetry. Select studies investigate the role of AI in increasing financial inclusion, with some focusing on the regulatory environment. For example, both Lee (2020) and Truby (2020) discuss the design of regulatory and legal frameworks focusing on the use of AI, stressing that clear policies are needed to ensure fair and equitable access to finance.

Characteristics

For this review, we have separately reviewed the characteristics (variables) tested in the quantitative studies, (n=51), and themes identified in the qualitative studies (n=39), including conceptual and mixed method studies. We commence with a discussion of the quantitative article variables, followed by a review of qualitative themes.

Researchers have conducted quantitative research to investigate several variables relating to consumers, service firms, and technology (see Figure 6). We categorize these according to their role, distinguishing between independent, mediating, moderating, and dependent variables. Within each group, we further classify variables into separate groups based on the entities they primarily relate to (e.g., consumer-related variables, firm-related variables, technology-related variables).

Table 5. Type of financial service

Article	**General financial service** *11% (n=10)*	**Banking** 30% (n=27)	**Financial advice and investment** 27% (n=24)	**Credit scoring and risk assessment** 24% (n=22)	**Regulation** 11% (n=10)	**Fraud detection and prevention** 1% (n=1)
Abdelazim and Wahba (2006)			✓			
Abdulquadri et al. (2021)		✓				
Abellán and Castellano (2017)				✓		
Adam et al. (2020)		✓				
Aggarwal (2021)				✓		
Ala'raj and Abbod (2016)				✓		
Aloud (2018)			✓			
Ashta and Herrmann (2021)		✓	✓			
Atwal and Bryson (2021)			✓			
Baghdasaryan et al. (2021)				✓		
Bai (2021)			✓	✓		
Bejou et al. (1996)	✓					
Belanche et al. (2019)			✓			
Bhatia et al. (2020)			✓			
Borgogno and Colangelo (2019)					✓	
Boustani (2021)		✓				
Brenner and Meyll (2020)			✓			
Castillo et al. (2020)	✓					
Cavalcante et al. (2016)	✓					
Chiu (2019)					✓	
Correa Bahnsen et al. (2016)				✓		
Eren (2021)		✓				

Flavián et al. (2021)			✓		
Fulk et al. (2018)			✓		
Gallego-Gomez and De-Pablos-Heredero (2020)		✓			
Guo (2020)					✓
Henkel et al. (2020)	✓				
Hildebrand and Bergner (2020)			✓		
Huang and Pan (2010)			✓		
Huang and Philp (2020)			✓		
Iiie et al. (2017)		✓			
Jakšič and Marinč (2019)		✓			
Jang et al. (2021)		✓			
Jung et al. (2018)			✓		
Kapsis (2020)					✓
Kaur et al. (2020)		✓			
Khandani et al. (2010)				✓	
Khemakhem et al. (2018)				✓	
Konigstorfer and Thalmann (2020)		✓			
Koutanaei et al. (2015)				✓	
Kraus and Feuerriegel (2017)			✓		
Kruppa et al. (2013)				✓	
Kumar and Balaramachandran (2018)		✓			
Ładyżyński et al. (2019)		✓			
Lee (2020)					✓
Lee and Shin (2020)		✓	✓		
Leung et al. (2009)			✓		

Lightbourne (2017)					✓
Lu et al. (2016)		✓			
Lui and Lamb (2018)		✓			
Luo et al. (2019)	✓				
Mhlanga (2020)	✓				
Mhlanga (2021)				✓	
Milana and Ashta (2021)	✓				
Mogaji et al. (2020)	✓				
Mogaji et al. (2021)		✓			
Mor and Gupta (2021)		✓			
Moscato et al. (2021)				✓	
Mosteanu (2019)			✓		
Paleologo et al. (2010)				✓	
Payne et al. (2021a)					
Payne et al. (2018)		✓			
Payne et al. (2021c)	✓				
Philip et al. (2018)		✓			
Piris and Gay (2021)		✓			
Punniyamoorthy and Sridevi (2016)				✓	
Ramanathan and Wechsler (2013)	✓				
Rasiwala and Kohl (2021)			✓		
Riikkinen et al. (2018)		✓			
Seiler and Fanenbruck (2021)			✓		
Shanmuganathan (2020)			✓		
Singh et al. (2021a)				✓	
Suhartanto et al. (2021)		✓			

Sun and Vasarhelyi (2018)			✓		
Tokic (2018)		✓			
Trivedi (2019)			✓		
Truby (2020)				✓	
Truby et al. (2020)				✓	
Tubadji et al. (2021)	✓				
van Thiel and van Raaij (2019)			✓		
Wall (2018)				✓	
West and Bhattacharya (2016)					✓
Wexler and Oberlander (2021)	✓	✓			
Xu et al. (2020)	✓				
Yu et al. (2009)			✓		
Zeinalizadeh et al. (2015)	✓				
Zhang et al. (2019)			✓		
Zhang et al. (2021a)		✓			
Zhang et al. (2021b)			✓		
Zhu et al. (2013)			✓		

Note: * = the number of articles amounts to more than 90, as select articles fall within two groups

Independent Variables

Figure 6 shows the different subgroups of typically investigated independent variables. Consumer-related variables are grouped into five sub-groups, including technology perceptions (n=6; 12%), consumer beliefs (n=7; 14%), service experience (n=10; 20%), financial behaviour (n=3; 6%), and socio-demographic variables (n=2; 4%). Several studies test independent variables belonging to separate groups. For example, Payne et al. (2018) test both subjective norms as a consumer belief variable and quality of service as a service experience variable. Studies focusing on consumer-related variables show that consumer attitudes, interpersonal subjective norms/social influences, perceived ease of use, and usefulness are key determinants of Robo-advisor adoption (Belanche et al. 2019). Fulk et al. (2018) demonstrate that Robo-advisory users differ in income, net worth, being an inheritance recipient or not, and financial impulsivity, while Zhang et al. (2021a) find that consumers continue to prefer expert human financial advisors as opposed to Robo-advisors, while they find no significant differences between Robo-advisors and novice human advisors in terms of performance expectancy and hiring intentions. Additionally, select studies find that once AI is introduced to a digital self-service channel, such as mobile banking, both service delivery and the customer's value co-creation role change (Payne et al. 2021c), while others find that consumers perceive AI's problem-solving abilities with less complex tasks to be greater than that of humans, however, human customer service is viewed as superior for more complex problems. Apart from service quality, technology attitudes, and perceived trust, Suhartanto et al. (2021) also reveal religiosity as an important driver of Indonesian Millennials' loyalty regarding AI-enabled mobile banking. Lastly, Huang and Philp (2020) show that consumers are less likely to share negative word of mouth after AI-caused service failure compared to human-caused service failure.

In total, 34% of independent variables were consumer-related, whereas only 6% were firm-related, including firm characteristics (n=2; 4%) and employee/job-related variables (n=1; 2%). Study results suggest that customer satisfaction depends on the experience and ethics of the salesperson as well as the degree of customer orientation (Bejou et al. 1996) and corporate reputation (Eren 2021). Henkel et al. (2020) find that service employees' interpersonal emotion regulation skills are significantly enhanced in their effectiveness after being augmented by AI.

Lastly, select studies included in the third group consisting of technology-related variables examined variables concerning interface specifications (n=4; 8%) and technology characteristics (n=4; 8%), resulting in an overall relative frequency of 14% of technology-related variables.

Hildebrand and Bergner (2020) find that conversational Robo-advisors, as opposed to non-conversational/static ones, increase consumers' trust and affirm their positive evaluations of the firm. Additionally, anthropomorphic design cues including identity, empathy and small talk increase the likelihood of users' compliance with chatbot service requests (Adam et al. 2020).

Mediating Variables

We found that 9 out of 50 articles (18%) include mediating variables. While researchers have long recognized the importance of mediating variables to explain the underlying mechanism of findings (Baron and Kenny 1986), several studies did not include any mediators (Bejou et al. 1996; Eren 2021; Payne et al. 2018). Mediation is concerned with the intervening effect of a third variable on the main effect between independent and dependent variables. Most included mediators concern (i) psychological factors, followed by (ii) service perception variables, and (iii) technology-related factors. Psychological factors include attitude (Belanche et al. 2019), interpersonal emotion regulation goal attainment and stress (Henkel et al. 2020), affective trust towards Robo-advisors (Hildebrand and Bergner 2020) as well as self-AI connection (Huang and Philp 2020). Service perception mediators include confirmation of customer expectations (Eren 2021) and perceptions of AI service delivery (Payne 2021). Technology-related factors include service delivery configuration benefits and general data security (Payne et al. 2021c), as well as AI's perceived problem-solving ability (Xu et al. 2020). Adam et al. (2020) find that social presence mediates the relationship between anthropomorphic design cues and user compliance with chatbot requests.

Moderating Variables

Our review indicates that 7 out of 50 (14%) studies consider moderating variables, which can affect the strength or direction of the relationship between an independent and dependent variable (Baron and Kenny 1986).

Figure 6. Summary of quantitative variables

Independent Variables/ Antecedents

Consumer-related (34%; 17 articles)*

- *Technology perceptions (12%; 6 articles)*
  - Perceived usefulness
  - Perceived ease of use
  - Performance expectancy
  - Use of AI as a financial innovation
  - Technology readiness (optimism, innovativeness, discomfort, insecurity)
- *Consumer beliefs (14%; 7 articles)*
  - Subjective norms
  - Perceived trust
  - Attitudes
  - Fear of investment fraud
  - Religiosity
- *Service experience (20%; 10 articles)*
  - Customer expectations
  - Perceived performance
  - Confirmation of customer expectations
  - Service outcome
  - Convenience, equipment, cleanness, appearance & atmosphere of the bank
  - Quality & Tariffs
  - Availability & performance of e-banking
  - Enhanced (online) customer experience
  - Need for service
  - Relative advantage
  - Baseline perception of service delivery
  - Service awareness
- *Financial behavior (6%; 3 articles)*
  - Perceived ability as investor
  - Feelings of earning enough money
  - Financial & investment acumen
  - Saving behaviour
  - Impulsivity
  - Financial satisfaction
  - Number of credit cards
  - Online loan inquiries
  - Loan amount
  - Credit card spending
  - Online spending
  - Customer voice pitch
  - Robo-user
- *Sociodemographic (4%; 2 articles)*
  - Age, gender, education, household income, net worth, inheritance, marital status

Firm-related (6%; 3 articles)

- *Firm characteristics (4%; 2 articles)*
  - Seller's ethical orientation
  - Seller's expertise
  - Relationship duration
  - Customer & selling orientation
  - Corporate reputation
- *Employee/ Job characteristics (2%; 1 article)*
  - AI augmentations vs. control

Technology-related (13%; 6 articles)

- *Interface specifications (9%; 4 articles)*
  - Interface conditions: Conversational vs. Non-Conversational Robo Advisor
  - Anthropomorphic design cues (Identity, Empathy & Smalltalk)
  - Quantity of online devices (other than AI) that the consumer uses
- *Technology characteristics (8%; 4 articles)*
  - Security, privacy and risk
  - Reliability
  - Human-like interaction

Moderating variables

- *Social factors (4%; 2 articles)*
  - Social presence
- *Sociodemographic factors (2%; 1 article)*
  - Age, gender, country
- *Technology-related factors (12%; 6 articles)*
  - Perceived performance
  - Perceived trust
  - Interpersonal emotion regulation (IER) activity
  - AI system personalization (Yes vs No)
  - Task complexity
  - Familiarity with robots
- *Firm-related factors (2%; 1 article)*
  - Corporate reputation
- *No moderator (21%; 10 articles)*

Mediating variables

- *Social factors (2%; 1 article)*
  - Social presence
- *Psychological factors (9%; 4 articles)*
  - Attitude
  - IER goal attainment,
  - Perceived stress related to AI exposure
  - Affective trust towards robo-advisor
  - Self-AI connection
- *Service perceptions (4%; 2 articles)*
  - Confirmation of Customer Expectations
  - Perceptions of AI Service Delivery
- *Technology-related factors (4%; 2 articles)*
  - Service delivery configuration benefits
  - General data security
  - Perceived problem-solving ability of AI
- *No mediator (17%; 8 articles)*

Dependent Variables/ Outcome

Consumer-related (34%; 16 articles)

- *Adoption intention & usage (20%; 10 articles)*
  - User compliance
  - Intention to adopt/ use/ hire AI
  - MB usage & comfort using AI mobile banking services
  - Value-in-use perceptions
  - Bank client's acceptance
  - Appeal that AI technology has for the consumer
  - Human financial advice
- *Satisfaction (9%; 4 articles)*
  - Customer satisfaction
  - Negative word of mouth
  - Time efficiency on clients
- *Financial behaviour (6%; 3 articles)*
  - Help seeking behaviour
  - Purchase (loan renewal)
  - Banking loyalty
- *Value creation/ destruction (2%; 1 article)*
  - Customer resource loses (role clarity, emotional, relational, temporal & informational)
- *Well-being (2%; 1 article)*
  - Affective well-being

Firm-related (6%; 3 articles)

- *Firm characteristics (2%; 1 article)*
  - Transformation of the banking profession
  - Fluctuations in banking jobs removal & creation
  - Soft competence jobs requirements
- *Firm perception (2%; 1 article)*
  - Benevolence attribution toward financial services firm
  - Recommendation acceptance
  - Portfolio allocation
- *Firm-consumer relationship (2%; 1 article)*
  - Relationship quality

Most included moderating variables fall within the technology category, such as perceived performance and trust (Eren 2021), interpersonal emotion regulation activity (Henkel et al. 2020), task complexity (Xu et al. 2020), and previous experience (Flavián et al. 2021) or familiarity with Robots (Belanche et al. 2019). Through a moderated mediation analysis, Huang and Philp (2020) find that AI system personalization moderates the service outcome (independent) and self-AI connection (mediator) effect. This suggests that due to the personalized nature of AI, consumers have a closer connection with it and are less likely to share negative word of mouth in response to AI-caused service failure. Adam et al. (2020) find that social presence mediates the effects of anthropomorphic design cues on user compliance but did not find a moderating effect of social presence on the same relationship.

Dependent Variables

Our review of dependent variables shows that most studies focus on consumer-related outcomes (n=18; 36%), while only few (n=3; 6%) focus on firm-related outcomes. Consumer-related outcomes include (i) adoption intention and usage, (ii) satisfaction, (iii) financial behaviour, (iv) value creation/destruction, and (v) well-being groups. We group firm-related outcomes into (i) firm characteristics, (ii) firm perception, and (iii) the firm-consumer relationship.

Referring to consumer-related outcomes, prior studies primarily focused on adoption intention and usage (n=10; 20%), considering dependent variables such as user compliance (Adam et al. 2020), intention to use (Belanche et al. 2019; Flavián et al. 2021; Seiler and Fanenbruck 2021; Xu et al. 2020), mobile banking usage and comfort using AI-mobile banking services (Payne et al. 2018), intention to hire (Zhang et al. 2021a), bank clients' acceptance (Boustani 2021) and the appeal AI has for consumers (Tubadji et al. 2021). Dependent variables in the satisfaction group (n=4; 8%) included customer satisfaction (Eren 2021), negative word of mouth (Huang and Philp 2020), and bank clients' satisfaction and time efficiency effects on clients (Boustani 2021). Few studies considered consumer financial behaviours as outcome variables. Only three financial behaviours were investigated, namely help-seeking behaviour (Fulk et al. 2018), purchase (customers' loan renewal) (Luo et al. 2019) and banking loyalty (Suhartanto et al. 2021). Both Castillo et al. (2020) and Payne et al. (2021c) focus on value creation/destruction outcomes by investigating antecedents of customer resource losses and value-in-use perceptions of AI-based mobile banking applications.

While the majority of studies investigated consumer-related dependent variables, three studied firm-related outcomes, including the transformation of the banking profession, fluctuations in banking jobs removal/creation and soft competence job requirements (Boustani 2021), firm perception (benevolence attribution toward financial services firm, recommendation acceptance and portfolio allocation) (Hildebrand and Bergner 2020), and relationship quality (Bejou et al. 1996).

As we did not limit our data collection to quantitative articles, our review also includes numerous qualitative and conceptual studies (n=40), which are not concerned with empirically testing hypothesized relationships. Instead, qualitative studies seek to develop themes to gain new insights into a research domain, while conceptual articles aim to advance theoretical considerations (Fossey et al. 2002). Table 6 provides an overview of identified themes, including (i) perceptions on innovation/digital disruption (Rasiwala and Kohl 2021), (ii) customer satisfaction (Piris and Gay 2021), (iii) service failure (Castillo et al. 2020), (iv) Robo-advisor (Bhatia et al. 2020; Wexler and Oberlander 2021), (v) regulation (Aggarwal 2021), (vi) AI implications for digital marketing (Mogaji et al. 2020), and (vii) value creation (Payne et al. 2021a; Riikkinen et al. 2018).

While we considered all 51 quantitative studies, including survey-based and experimental studies, articles investigating and contrasting the specific applicability and functionalities of AI and ML algorithms did not provide identifiable independent or dependent variables (n=26). Given that a discussion regarding the details on the types of algorithms investigated is beyond the scope of the present review, we provide a list of these articles for interested readers in Appendix B.

Table 6. Qualitative research themes and conceptualizations

Category	#	% *	List of themes
Perceptions on innovation/ digital disruption	4	10%	1. Disruptors in the financial sector and their business models; 2. Level of competition, threat of substitution; 3. Technological capabilities and Omni-channel strategies for consumers; 4. Support provided by regulators and government; 5. Entrepreneurship and innovation; 6. The Future of the two sectors (Finance and technology) (Rasiwala and Kohl 2021) 1. Technology innovation; 2. Social innovation; 3. Institutional innovation -> Banks, Chatbot, Customers -> Financial services provision and financial inclusion (Abdulquadri et al. 2021) 1. Technological immatureness; 2. Improving customer experience; 3. Supportive role; 4. Lack of Organizational capability; 5. Organizational resistance; 6. Improving operational efficiency; 7. Experiment; 8. Collaboration with tech firm; 9. Extensive investment; 10. Substitute role; 11. Artificial intelligence (AI); 12. Developing new service model; 13. Strict government regulation; 14. Responding to customers who prefer non-facing channels; 15. Facilitating digital transformation (Jang et al. 2021) 1. Performance expectancy (sense of accomplishment and enhanced engagement); 2. Effort expectancy (task accomplishment, perceived ease and access); 3. Social influence (user interface, no public display, and bank's influence); 4. Facilitating conditions (Chatbot's features, bank's features and country features); 5. Moderating factors with chatbots (age, experience, and voluntariness) (Mogaji et al. 2021)
Customer satisfaction	1	3%	1. Internet site and mobile applications, 2. Day-to-day operations of the accounts and contracts 3. The relational and human dimension, 4. Means of communication 5. Attitude towards the institution, 6. The brick-and mortar branch, 7. Mortgages, 8. Pricing policy (Piris and Gay 2021)

Service failure	1	3%	5 antecedents of failed interactions between customers and chatbots: 1. authenticity issues, 2. cognition challenges, 3. affective issues, 4. functionality issues, and 5. integration conflicts (Castillo et al. 2020)
Robo-advisor	5	13%	(1) Present state of Robo-advisory: 1. Usage of Robo-advisory, 2. Educating investors on Robo-advisory services 3. Trust and branding: essential for acceptance of Robo-advisors, 4. A consortium of banks for untapped segments (2) Risk Profiling: 1. Framework for risk profiling, 2. Risk Profiling through a psychological perspective, 3. Risk Appetite should be linked to investment goals, 4. Different Models of Risk Profilers, 5. Measuring investor's risk appetite, 6. Difficult to track Financial goals of investors (3) Mitigation of behavioural biases: 1. Less Biased Robo Advisors mitigates more Behavioral Biases, 2. A hybrid model for non tech savvy and financially illiterate investors, 3. Biases in questionnaire 4. Biases in Architecture (Bhatia et al. 2020)) 1. Characteristics of RAs: Disembodied, programmed, calculation rationality, client-controlled, current, trustworthy, big data, AI; 2. RA introductions: Experiment, voluntary, auxiliary, knowledge worker friendly, client friendly, investor friendly, centrality of industry, on trend; 3. Knowledge features: Technological augmentation, coded programs, digitalization, trending, do-it yourself, active learning, customizable, credentialled (Wexler and Oberlander 2021) 1. Platform; 2. Ease of navigation; 3. Controllability; 4. Structural consistency; 5. Error tolerance; 6. Effectiveness; 7. Efficiency; 8. Expectation conformity; 9. Understanding; 10. Social presence; 11. Cost; 12. Infrastructure; 13. Process (Jung et al. 2018) 1. Quantitative inputs (financial statement and other relevant data); 2. Subjective inputs (corporate governance and knowledge-base); 3. Algorithms-based learning model; 4. Robo-advisors; 5. Feedback; 6. Clients investment decision (Shanmuganathan 2020) 1. Perceived risk; 2. Perceived usefulness; 3. Perceived ease of use; 4. Social influences; 5. Intention to use (Robo-advisors) (Atwal and Bryson 2021)

			Allocative efficiency, distributional fairness, privacy (autonomy) (Aggarwal 2021)**
Regulation	2	5%	1. Regulation of algorithms of Robo-advisors; 2. Improvement of information disclosure requirements; 3. Refinement of fiduciary duties of Robo-advisors (Guo 2020)
AI implications on digital marketing	1	3%	Four processes: 1. AI (data extraction, processing and learning), 2. AI integration with digital marketing (algorithmic content creation and delivery, customer identification, personalized messaging), 3. AI integration with digital financial services marketing, 4. Financial services use of AI to serve vulnerable customers (positive and negative) (Mogaji et al. 2020)
Value creation	2	5%	AI-Service exchange antecedents: consumer characteristics (utilitarian and hedonic value), financial industry characteristics, FinTech's - Supporting institutional actor characteristics; Context of AI usage: lower and higher value-in-use AI contexts; Digital servitization consequences: consumer outcomes and firm performance outcomes (Payne et al. 2021a)
			Using AI and chatbots to create value: Technological perspective (AI and leveraging customer data), theoretical perspectives (service logic and customer data as a resource), industry phenomenon (transfer of resources and processes/ digitalization) (Riikkinen et al. 2018)
No clear themes/ categories identified	24	61%	(Ashta and Herrmann 2021; Borgogno and Colangelo 2019; Cavalcante et al. 2016; Chiu 2019; Gallego-Gomez and De-Pablos-Heredero 2020; Jakšič and Marinč 2019; Kapsis 2020; Kaur et al. 2020; Khemakhem et al. 2018; Konigstorfer and Thalmann 2020; Lee and Shin 2020; Lee 2020; Lightbourne 2017; Lui and Lamb 2018; Mhlanga 2020, 2021; Milana and Ashta 2021; Mosteanu 2019; Paleologo et al. 2010; Philip et al. 2018; Tokic 2018; Truby 2020; Truby et al. 2020; Wall 2018; West and Bhattacharya 2016)

Note: * = relative frequencies based on 39 qualitative articles (including interviews, conceptual, case study, review, and mixed methods), ** = normative contests on regulation.

Methods

Table 7 summarizes the research design characteristics of the reviewed studies, including the adopted empirical approach, target sample, and sample size. Among the 90 studies, 57% conducted quantitative research, 29% were qualitative, 7% were conceptual, and 8% employed mixed methods. The use of experimental and survey data is unequally distributed, with 32 articles (38%) employing an experimental and 17 (20%) employing a survey research approach. Experimental studies are further divided into data-driven and theory-driven research. That is, 22 experimental studies employed algorithms and IS software for data collection and/or data analysis (e.g., Correa Bahnsen et al. 2016; Huang and Pan 2010; Kraus and Feuerriegel 2017), whereas the remaining 10 used either 2x2 experimental designs (Adam et al. 2020) or randomized controlled trial field experiments (Luo et al. 2019; Xu et al. 2020). Lastly. Abdulquadri et al. (2021) employ the S-A-T model, a novel research methodology combining user experience design and netnography.

Most studies include secondary data from publicly available datasets. Due to this, sample sizes for certain studies exceeded 1,000 observations. For example, Correa Bahnsen et al. (2016) conducted experiments using a dataset of 236,735 credit/debit card transactions obtained from a large European card processing company, whereas Philip et al. (2018) used a sample of 100,000 loan accounts, consisting of monthly loan repayment data. Interestingly, several studies appear to have utilized similar datasets to test their AI technique (e.g., Abellán and Castellano 2017; Ala'raj and Abbod 2016; Zhang et al. 2019; Zhang et al. 2021b). These articles focused on testing the applicability of different AI techniques on credit scoring using data sets obtained from the UCI Machine Learning Repository at the University of California (Asuncion and Newman 2007).

Table 7. Research design characteristics

Design element	#	%
Empirical approach		
Quantitative		
Survey	17	20%
Experiment	32	38%
Field study	1	1%
S-A-T (novel methodology)	1	1%
Qualitative		
Case study	4	5%
Interviews	6	7%
Review	7	8%
Regulatory Review	6	7%
Opinion paper	1	1%
Document analysis	1	1%
Exploratory research	1	1%
Conceptual	6	7%
Mixed methods	7	8%
Type of sample		
Customers/ Investors	24	28%
Managers/ Experts/ Employees	6	7%
Companies	6	7%
Datasets	22	26%
Other	11	13%
Not specified	19	22%
Sample size		
1-100	22	26%
101-500	15	18%
501-1000	8	9%
1000+	25	29%
Not specified	20	24%

Directions for Future Research

Our systematic literature review yields a broader understanding of various theoretical aspects and different applications of artificial intelligence in the financial services industry (van Esch et al. 2020). While the present literature offers different perspectives on the applicability and usefulness of AI, we posit that the field offers many unexplored yet fruitful areas for further research. We suggest that researchers use the proposed research topics and questions as guides to develop and empirically test propositions and hypotheses, while others may wish to consider theory development. In line with previous reviews (Chen et al. 2021b; Mandler et al. 2021; Paul et al. 2017), we organize our recommendations as per the structure of the preceding analysis along the TCCM framework. We thus divide the future research agenda into four segments: (i) new theoretical perspectives (*theory),* (ii) new research settings (*context),* (iii) new constructs and relationships (*characteristics),* and (iv) new data and methods (*methodology).* Table 8 provides an overview of suggested research directions for each area, along with examples of potential research questions.

New Theoretical Perspectives

Most studies included in the review (64%) adopt a data-driven approach and lack a strong theoretical foundation, providing researchers with ample future research opportunities. We suggest several theories and conceptual lenses for future investigations, including theories from marketing communication, organizational behaviour, decision-making, and services marketing (van Esch and Stewart Black 2021). Advances in big data and computational processing allow social sciences research to combine theory- and data-driven research, increasing its validity and reliability (Maass et al. 2018). The following section summarizes each proposed theory and its applicability to the research domain under investigation.

Resource integration and service ecosystem lens (S-D Logic): Given the service-focused nature of the research domain, select studies have adopted a service-dominant logic lens to investigate value co-creation processes in banking (Payne et al. 2021a) and insurance (Riikkinen et al. 2018). However, these studies are limited, in part due to their conceptual nature as empirical examinations are required to further and support a theoretical concept (Larivière et al. 2017). Vargo and Lusch

(2017) recommend future research to subject SD logic-generated theory to increasing empirical scrutiny. While some studies in the review have commenced empirically testing value co-creation through the lens of SD logic and ecosystem perspective (Castillo et al. 2020; Payne et al. 2021c), many research avenues remain open. Future research may wish to investigate service innovation focusing on resource integration, resource liquefaction, density creation, or actor networks (Lusch and Nambisan 2015). Additionally, technology acts as an enabler of relationships and connections amongst various actors within an ecosystem (Larivière et al. 2017). However, the impact of AI on creating or destroying these connections remains unexplored to date.

Customer-Dominant Logic (CDL) and Value-in-Use: Heinonen et al. (2010) posit that the SD logic (Vargo and Lusch 2004) continues to apply a production- and interaction-focused lens to service, thus viewing service co-creation primarily from the service provider's perspective. According to Vargo and Lusch (2008, p. 213), value is "always uniquely and phenomenologically determined by the beneficiary." As the objective of service provision, in part, is to increase value for the consumer, we suggest future marketing and service research to adopt a customer-dominant logic (CDL) lens. CDL recognizes marketing to be foundational for business instead of a mere functional unit within an organization (Heinonen and Strandvik 2015). Much is yet to be understood about this perspective, but research using CDL in the context of AI in financial services is largely missing, which provides researchers with numerous opportunities for future research. For example, future researchers may wish to explore the concepts of co-creation, by focusing on consumer involvement and control, or customer experience (van Esch and Cui 2021) and value-in-use, with the latter focusing on visibility and consumer competence (Heinonen et al. 2010; Sandstrom et al. 2008).

Actor-network theory and activity theory: While some researchers may want to adopt an SD logic or CD logic lens to examine AI in financial services, others may turn to actor networks. While studying the impact of technology on actor networks and ecosystems is not a new area of research, ongoing technological developments continue to demand research attention. For example, actor-network theory (ANT) seeks to explain socio-technological development and change, with its main tenets including actors and networks, where actors can be both human and non-human (Baiocchi et al. 2013). According to Latour (1987), ANT combines elements of science and technology, allowing researchers to unpack and investigate basic components, including networks, actors, environments, policies, and processes. AI poses an interesting viewpoint, as it is considered a non-human actor, but with human capabilities. Using the ANT, future research may analyse the constructed network of financial service actors and explore how well AI fits the role of an actor therein or examine the process of translation in the context of AI-augmented financial services.

Activity theory (AT) is another socio-technical theory, which focuses on interpreting human consciousness as a result of an individual's everyday interactions and practical activity (Nehemia-Maletzky et al. 2018). It suggests that human-computer interactions are driven by social motives, and recognizes the increasingly digitalized nature of human activity (Karanasios et al. 2021). AI increases the complexity of human-machine conglomerations in many organizational contexts, including financial services. As such, it requires researchers to investigate the increasingly complex forms of agency and different types of collaboration and inter-connecting activity systems (Balyone 2019). Future research could study the role of AT in addressing practical and theoretical challenges and opportunities resulting from the increased application of AI in financial services.

Grounded theory: Due to the innovative nature of artificial intelligence and the utilitarian attributes of financial services, we propose researchers adopt a grounded theory approach (Gioia et al. 2013). To date, marketing scholars employ and extend existing theories, borrowing from related disciplines such as psychology and economics. However, theory development is critical to the advancement of marketing as a research domain (MacInnis 2011), and grounded theory researchers could explore how AI can improve consumer decision-making and financial well-being.

New Research Settings

Concerning the investigated contexts, our review identified banking and credit scoring/risk assessment to be well-represented. However, studies exploring other contexts remain scarce. While some reviewed studies started to investigate the role of AI in the context of insurance, pension, and financial inclusion, much remains unknown.

Insurance: Few studies investigated AI in the insurance context. Included research analysed chatbots in supporting customer value creation (Riikkinen et al. 2018), assessed managers' perspectives on chatbots (Jang et al. 2021), reviewed the applicability of AI in insurance fraud detection (West and Bhattacharya 2016), and conceptualized the role of insurance Robo-advisors (Wexler and Oberlander 2021). Various avenues for future research remain unexplored. Researchers may wish to investigate how AI can augment/replace current insurance claim systems and processes or investigate the impact of data and open-source protocols on ecosystems.

Financial well-being: While several researchers have investigated interventions aimed at increasing financial well-being, including education, counselling, and nudging (Fernandes et al. 2014), others have studied how different personal factors such as socio-demographic factors, traits, skills, or life events affect individuals' financial well-being (Luhamnn et al. 2012). Context is crucial for research on financial well-being, and as such the role of technology such as AI requires more attention in future research (Brüggen et al. 2017). While select studies included in the review highlighted the implications of AI in enhancing financial inclusion, providing low-cost personal advice options, and increased accessibility (Lee 2020; Mhlanga 2020), researchers could further explore how AI can be employed to improve individuals' financial capability or how consumer (financial) literacy and information asymmetry affect the adoption of AI-augmented services such as Robo-advisors or chatbots. Mogaji et al. (2020) examined the ethical implications, data modelling challenges, and overall relationship between AI and financial services from the perspective of vulnerable consumers. Future research may wish to empirically test whether AI adoption benefits vulnerable individuals or if they might be subject to increased exclusion instead. How AI can reduce financial vulnerability, mitigate emotional distress experienced by consumers, and assist in crisis management are just some of the many potential avenues for further research.

Pension industry: The pension industry is already adopting AI. For example, investment firm Mercer launched an AI-powered tool to assist defined benefit schemes in predicting member outcome options, support risk management, and optimize member offer structures (Mercer 2020b). Retirement decision-making differs from other private investment decisions in its long-term nature and significance. Much research on retirement planning and savings can be found in the literature, but the supporting role of technology has only recently garnered research interest (Eberhardt et al. 2020; Hentzen et al. 2022), and research on how AI can impact the pension industry is scarce with only one study (Henkel et al. 2020). Future research may wish to investigate how AI can increase pension member engagement through customer journey mapping or personalization efforts. Other topics could be members' willingness to accept AI in pension investment selection and how AI would perform in comparison to investment managers (Arli et al. 2020).

Digital economy: One research area that has garnered limited attention to date is the role of financial institutions and services in building up and supporting the development of digital economies (Agyapong 2021). The digital economy includes "all economic activity reliant on, or significantly enhanced through the use of digital inputs, including digital technologies, digital infrastructure, digital services, and data. It refers to all producers and consumers, including government, that are utilizing these digital inputs in their economic activities" (OECD 2020b, p. 34). By adopting a macro-environmental view of financial services and their role in the digital economy, researchers may be able to study the implications of AI in a broader, globalized context. Future research could investigate how AI can facilitate cross-country information/data exchange and management, enhance international financial fraud detection systems focusing on tax evasion or illegal offshore accounts, or investigate whether AI can reduce financial cybercrime. Employees' digital skill set, and organizations' digital capabilities may also warrant further investigation, as well as legal and regulatory implications of AI-implementation cross-countries.

Ethics, legal, and policy: Research on regulation, policy, data protection, and ethics should be viewed as underlying the research contexts discussed above. While numerous studies included in the review focused on regulation in the context of AI and financial services, many questions remain unanswered. For example, the studies included in our review analysed general financial regulatory implications of AI (Wall 2018), proposed regulatory approaches to Robo-advisory (Chiu 2019; Guo 2020; Lightbourne 2017), and conceptualized regulatory responsibility of credit scoring and bias reduction (Aggarwal 2021). However, little research has attempted to answer questions related to third-party AI vendor management and its implications for consumers' financial data protection. Numerous studies have emphasized the need for ethical standards when using AI in financial services. However, the question of what constitutes ethical and socially responsible AI provision from a firm's or consumers' perspective remains open.

New Research Constructs and Relationships

Our systematic review reveals that the literature has adopted various investigative perspectives, employing predictor variables related to technology, consumer beliefs, service experiences, and firm characteristics. However, although numerous studies have applied consumer-related variables as independent, mediator, moderator, or dependent variables, we identified gaps around the concepts of customer engagement and consumer financial behaviour.

Customer engagement: To date, few studies have explicitly considered the role of AI in fostering customer engagement with financial services (for exceptions see Chiu 2019; van Thiel and van Raaij 2019; Xu et al. 2020). It would be interesting to investigate the impact of AI on customer engagement behaviour and its consequences (Pala et al. 2021). Variables of interest could include consumer outcomes such as cognitive, emotional, and attitudinal behaviour and firm-related outcomes such as competitiveness, financial and reputational consequences (van Doorn et al. 2010). Furthermore, while some studies have commenced with investigations into how gamification and personalization can enhance customer engagement (Anshari et al. 2019; Eisingerich et al. 2019), further research is needed in the context of AI-enabled financial services regarding variables such as consumers' sense of control, progress tracking, journey mapping, rewards, nudges, or prompts to facilitate engagement. Meanwhile, researchers looking to investigate the role of AI in personalization efforts may want to investigate relationships between explanatory variables such as transparency, privacy, frequency of personalized communication, and outcome variables such as customer loyalty, relationship quality, and improved financial behaviours (Wang et al. 2016).

Financial knowledge and behaviour: Given the financial services context, surprisingly few studies analysed the relationship between consumer financial behaviours and AI-acceptance or how AI can improve consumer financial behaviours (Fulk et al. 2018; Luo et al. 2019). Researchers seeking to investigate AI and financial investments could thus study the relationship between consumers' risk tolerance, risk perception, perceived financial security, or perceived financial uncertainty and acceptance of Robo-advice (Hoffmann et al. 2015; Hoffmann and Plotkina 2020). Additionally, it would be interesting to study the impact of AI on increasing financial well-being. Explanatory variables demonstrated to affect consumer well-being include materialism, (lack of) self-control, long-term money planning (Netemeyer et al. 2018), involvement, anxiety, and literacy

(Mende and van Doorn 2014). How AI can reduce negative financial behaviours and support positive behaviours is also yet to be explored. One exciting avenue for future research concerns studying the effect of AI on consumer financial literacy and information asymmetry.

Technology acceptance: We call for research that revisits technology acceptance through a digital marketing and communication lens (van Esch and Stewart Black 2021). By adopting a customer-dominant logic, we suggest researchers to study the effects of branding and relationship marketing (Steinhoff et al. 2019) on AI acceptance. One may also wish to delve deeper into analysing the effect of different message types, consumer sense-making, and external influences such as competitor communication and customer-to-customer communication on AI acceptance and use (Finne and Grönroos 2017). Lastly, researchers may wish to investigate the role of AI in enhancing and facilitating information flow, including consumer information-seeking behaviours, considering explanatory constructs such as financial service provider created digital information, external provider and consumer co-created financial information, information avoidance, and informational social support (Peltier et al. 2020).

Conceptual propositions: Finally, future research should empirically test the proposed relationships considered in various conceptual articles (Aggarwal 2021; Mogaji et al. 2020; Payne et al. 2021a; Riikkinen et al. 2018; Wexler and Oberlander 2021). For example, Payne et al. (2021a) propose numerous AI-service exchange antecedents, including consumer characteristics such as risk tolerance, need for human interaction or enjoyment, or supporting institutional actor characteristics such as AI technology infrastructure and data sharing among network actors. On the other hand, Wexler and Oberlander (2021) provide conceptualizations around Robo-advisory characteristics including trustworthiness, disembodiment, customizability, and user-friendliness. Lastly, future research can further examine the framework and relationships proposed by Mogaji et al. (2020), by empirically testing how AI can assist financially vulnerable customers.

New Data and Methods

Methodological improvements and bias testing: Regarding studies that employed a survey-design approach, we call for methodological improvements to better account for response bias, sample selection bias, and common method bias (Bickman and Rog 2008; Podsakoff et al. 2003). Only a few articles included in our review addressed common method (Adam et al. 2020; Payne et al. 2021c) or response bias (Bejou et al. 1996). While Fulk et al. (2018) referred to sample selection bias, they do not go into detail as to how they attempted to mitigate it. Various methods have been proposed to detect and remedy common method variance (CMV), including procedural remedies such as (i) obtaining predictor and criterion variable measures from different sources, (ii) counterbalancing question orders, and (iii) improving scale items. Potential statistical remedies include (i) Harman's single factor test, (ii) partial correlation procedures, and (iii) using multiple-method factors (Podsakoff et al. 2003).

Alternative methods: Another rich source of consumer data is comments and posts on social media and other consumer interfaces (Heinonen and Medberg 2018). Textual analysis can be used to measure consumer's AI-related attitudes and sentiments on a larger scale, while simultaneously mitigating biases of conventional surveys (e.g., social desirability). Data collection and analysis can be simplified using advanced text mining tools and even AI and ML algorithms, which aid in the reduction of substantive and psychometric properties of texts (Berger et al. 2020; Heinonen and Medberg 2018). While Medberg and Heinonen (2014) applied netnography to study value formation in retail banking, future research may wish to use netnography as a tool to investigate why consumers may prefer human financial advisors over Robo-advisors, combine netnography with other data collection methods, or adopt a longitudinal approach to netnography.

Longitudinal research design: Our review shows that with a single exception (Shanmuganathan 2020), no study adopted a longitudinal approach. However, several authors recognize the need for longitudinal research, highlighting avenues for further research. Researchers may want to track consumers wishing to use Robo-advisors over a longer period, to investigate how consumer resources and help-seeking behaviours may impact Robo-advisory adoption (Fulk et al. 2018). Adam et al. (2020) suggest adopting a longitudinal design to measure whether consumers get used to chatbots over time and whether firm-consumer relationships may degrade due to the nature of self-service channels.

Meta-analyses: Lastly, this review identifies the need for a meta-analysis. While there are some recent meta-analyses on AI in the accounting and finance (Singh et al. 2021b) or investment context (von Stumm and Ackermann 2013), we encourage studies to conduct meta-analyses from a consumer or organizational point of view on trust in or acceptance of Robo-advisors and AI adoption in banking (Arli et al. 2020).

Table 8. Future research agenda

Potential Research Topics and Guiding Questions	
New theoretical foundations (*Theory*)	
Resource integration and service ecosystem lens (S-D Logic)	How can AI be used to facilitate information creation, dissemination, and sharing amongst ecosystem actors?
	What constitutes AI-enabled financial service encounters?
	How does the coordination of engagement between different actors in the context of financial services take place?
	Ecosystem integration: What are the challenges of integrating AI into existing systems and processes of financial institutions?
	How is value-in-use expressed in the context of AI adoption in financial services?
	How and when can AI-augmented financial service value-in-use be measured?

Customer-Dominant Logic (CDL) and Value-in-Use	What role does marketing play in enhancing consumer acceptance of AI in financial service provision?
	How does AI affect the value co-creation process (will control shift to the consumer)?
	What role should financial services managers/marketers take in designing AI-based services?
Actor-network theory and activity theory	How does Artificial Intelligence drive the digital transformation of the financial services industry?
	What impact does AI have on all aspects of the activity system, including the subject, object, or community?
	How can activity theory and ANT be applied to study the role of AI in developing new activity system networks?
	What constitutes algorithmic culture and what are the implications for financial institutions?
Grounded theory	Adopting a holistic approach, how should do we describe AI/ Robo-advisor capabilities in a financial service context?
	What constitutes AI-supplemented financial advice and how does AI-augmented customer service differ conceptually from human-provided customer experience?
New research settings (*Context*)	
Insurance	How can artificial intelligence and augment or replace current insurance claim systems and processes?
	What is the impact of data and open-source protocols on AI implementation in an insurance context?
	To what extent does AI influence insurance ecosystem creation or extension?
Financial Well-Being and Behavior	How can AI reduce financial vulnerability?
	To what extent can AI mitigate the emotional distress experienced by consumers?
	How can AI assist consumers in the management of a crisis?
	How can Artificial Intelligence be employed to improve an individual's financial capability and overall financial well-being?

	How can AI empower consumers with disabilities/vulnerable people? How can AI be used to increase pension member engagement through customer journey mapping or personalization efforts? To what extent do consumer (financial) literacy and information asymmetry affect their anticipated adoption of AI-augmented services such as Robo-advisors or chatbots?
Pensions	How can AI be used to increase pension member engagement through customer journey mapping or personalization efforts? How willing are consumers in accepting AI application of pension investment selection? How does AI perform in comparison to traditional investment managers/ funds? To what extent can AI be employed as a tool to monitor fund and investment performance?
Digital Economy	To what extent does AI facilitate the growth of financial services in the context of the digital economy? In what ways does AI shape financial service ecosystems and the digital economy, and what are the consequences for financial institutions and consumers? How can AI be applied to align and integrate cross-country financial data? To what extent can AI ensure transparency and equity between merging and developed economies?
Ethics, Legal and Policy	What constitutes ethical and socially responsible AI provision (firm) or adoption (consumer)? How can AI be used to enhance personalization efforts in financial service? What type of data is required and can be acquired? To what extent are consumers willing to share additional information in exchange for increased personalization? What regulation is required to address the potential risks posed by third-party vendor management? The privacy-security gap: How can AI be utilized to monitor and detect financial crime/ fraud while not infringing consumer privacy?

	What role do individuals/employees/ managers/developers play in ethical considerations of AI?
New research constructs and relationships (*Characteristics*)	
Customer engagement	What role do interactivity and personalization play in stimulating customer engagement with AI? How can financial services firms use AI to optimize the customer experience in an omnichannel environment? How can AI-generated real-time insights of transactional service interactions be used to increase customer engagement?
Financial knowledge and behaviour	What role do information asymmetry, literacy, and self-directedness have on AI-enhanced financial decision-making? What effects do self-efficacy and perceived financial security have on AI-augmented service experiences? Does AI-augmented service uptake depend on the different types of financial decisions (routine vs consequential)? What role does AI play in improving financial risk tolerance and savings goal clarity; conscientiousness and proactivity; emotional stability, financial anxiety, and money management stress? What role do behavioural biases, herding behaviour, bounded rationality, and people's emotions play in AI acceptance? Will individuals with low literacy make worse or better financial decisions if assisted by AI?
Technology acceptance	How can integrated marketing communication be used to increase consumer's acceptance of AI in financial services? How does AI affect the (digital) information flow, and what roles do consumer information avoidance and information-seeking behaviours play?
New Data and Methods (*Methodology*)	
Bias testing	Future quantitative research studies should analyse and account for various biases to ensure increased validity of research findings. Apply post-hoc, procedural, and statistical remedies to detect and remedy common method variance (CMV).

Alternative methods (netnography)	Utilizing netnography and text mining techniques, future research can measure consumer's AI-related attitudes and sentiments.
Longitudinal data	Future research may collect longitudinal data to test if consumer's AI-augmented financial services experience changes over time and how? How long does it take for artificial intelligence to ensure financial inclusion? To what extent can artificial intelligence assist in ensuring long-term financial well-being?
Meta-analysis	Call for an updated meta-analysis on the efficacy of AI in investment banking. Additional topics for meta-analysis include trust in or acceptance of Robo-advisors, or meta-analysis on AI adoption in a banking context, either taking a consumer or an organizational point of view

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Appendix A

List of all articles included in the review

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Appendix B

AI and Machine Learning algorithms investigated

Study	Type of Algorithm employed/tested
Abdelazim and Wahba (2006)	Genetic Algorithms Technique (GA) and Neural Network
Abellán and Castellano (2017)	Decision trees/ classification trees and CDT procedure
Ala'raj and Abbod (2016)	Neural networks (NN), support vector machines (SVM), random forests (RF), decision trees (DT) and naïve Bayes (NB), logistic regression (LR) and multivariate adaptive regression splines (MARS)
Aloud (2018)	Genetic programming
Baghdasaryan et al. (2021)	Deep artificial neural networks (multilayer perceptrons- MLP)
Correa Bahnsen et al. (2016)	Machine Learning: decision tree (DT), logistic regression (LR)and a random forest (RF),
Huang and Pan (2010)	Probability neural network
Khandani et al. (2010)	Machine learning (generalized classification and regression trees (CART))
Khemakhem et al. (2018)	Classification was carried out according to three models widely applied for credit risk prediction: LR, ANN and SVM
Koutanaei et al. (2015)	Hybrid data mining model of feature selection and ensemble learning classification algorithms; principal component analysis (PCA), genetic algorithm (GA), information gain ratio, and relief attribute evaluation function; support vector machine (SVM) classification algorithm; artificial neural network (ANN) adaptive boosting (AdaBoost)
Kraus and Feuerriegel (2017)	Deep learning: Recurrent neural networks (RNN), Long short-term memory networks (LSTM)
Kruppa et al. (2013)	Machine Learning (random forests (RF), k-nearest neighbors (kNN), and bagged k-nearest neighbors (bNN)); Logistic regression
Ładyżyński et al. (2019)	Deep learning (deep neural networks) and random forests
Leung et al. (2009)	Hybrid neural network

Lu et al. (2016)	Artificial immune networks (AIN)
Moscato et al. (2021)	Logistic regression, random forest, multi-layer perception and XAI tools: LIME, Anchors, SHAP, BEEF and LORE
Punniyamoorthy and Sridevi (2016)	Neural network (NN) and fuzzy support vector machine (FSVM)
Ramanathan and Wechsler (2013)	Conditional Random Field (CRF) and (b) Latent Dirichlet Allocation (LDA)
Singh et al. (2021)	Multi-Level Classification and Cluster based Ensemble (MLCCE)
Sun and Vasarhelyi (2018)	Deep Neural Networks (logistic regression, naive Bayes, traditional artificial neural networks, and decision trees)
Trivedi (2019)	Different feature selection techniques (such as Information-gain, Gain-Ratio and Chi-Square) and machine learning classifiers (Bayesian, Naïve Bayes, Random Forest, Decision Tree (C5.0) and SVM (support Vector Machine)
van Thiel and van Raaij (2019)	Neural Networks and random forests
Yu et al. (2009)	Intelligent-agent-based fuzzy GDM
Zhang et al. (2019)	Enhanced multi-population niche genetic algorithm (EMPNGA)
Zhang et al. (2021b)	New hybrid ensemble model with voting-based outlier detection and balanced sampling (Base classifiers: XGBoost, GBDT, AdaBoost, RF, LR, Bagging, ExtraTree)
Zhu et al. (2013)	Classification approach named C-TOPSIS

CHAPTER THREE: THE ROLE OF DIGITAL TECHNOLOGY IN COMMUNICATION AND INFORMATION FLOW IN THE AUSTRALIAN SUPERANNUATION INDUSTRY: A MULTI-ACTOR SERVICE ECOSYSTEM PERSPECTIVE

Statement of Authorship

Statement of Authorship

Title of Paper	The Role of Digital Technology in Communication and Information Flow in the Australian Superannuation Industry: A Multi-Actor Service Ecosystem Perspective
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Contribution to the Paper	Conceptualization, literature review, data collection and analysis, as well as writing of manuscript and editing.		
Overall percentage (%)	65%		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
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Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);

ii. permission is granted for the candidate in include the publication in the thesis; and

iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

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Abstract

The Australian Superannuation industry has traditionally focused on the dyadic relationship between Superfunds and their members. Despite the importance of this relationship, this relatively narrow perspective fails to account for the influence of additional ecosystem actors and their role in improving members' retirement planning, retirement preparedness, and financial well-being. We empirically examine the influence of digital technology in facilitating communication and information flow amongst the various ecosystem actors in the Australian Superannuation industry. Using a qualitative research methodology, we conducted 21 semi-structured interviews with various ecosystem actors. Our findings highlight the need for ecosystem actors to enhance their resource and knowledge sharing capabilities, consumer need recognition, and seamless information flow to enable Superfund members to improve their retirement planning behaviours and therefore anticipated financial well-being during retirement.

Keywords: multi-actor, service ecosystem, Superannuation, information flow, digital technology

Introduction

Retirement planning is as important as ever, with pension reforms placing increased risks and responsibilities onto individuals (OECD 2020a), who need to become more involved in their personal retirement planning (Yeung 2018). Accordingly, Superfunds and governments continue efforts to increase financial literacy through targeted programs and campaigns (Atkinson et al. 2012; OECD 2015). Yet, data indicates that adequate planning and saving for retirement remains limited (Aegon 2019), resulting in continuous reliance on government-funded support (i.e., Australian age pension) and compromised living standards for many individuals (Ruthbah 2021).

To date, most of the retirement literature adopts a micro-lens, focusing on specific drivers and outcomes of retirement planning (Hentzen et al. 2022; Hoffmann and Plotkina 2020). Studies adopting a more holistic, multi-actor approach to investigate how individuals engage in the retirement industry are largely missing. The policy report by Altschwager and Evans (2019a) is amongst the first to adopt an ecosystem lens to map the Australian Superannuation ecosystem.

The concept of an 'ecosystem' is relatively new in both management and marketing research. A service ecosystem can be defined as "relatively self-contained self-adjusting systems of resource-integrating actors connected by shared institutional arrangements and mutual value creation through service exchange" (Vargo and Lusch 2016, pp. 10-11). The service ecosystem perspective provides a holistic, multi-actor perspective that emphasizes the dynamic and contextual interactions between ecosystem actors (Sklyar et al. 2019b), accounting for the various influences affecting service delivery, quality, and overall value of the service exchange (Edvardsson et al. 2011). In the context of our study, understanding the separate influences of individual actors in the Australian Superannuation ecosystem can aid in a better understanding of aspects of service delivery and consumer perceived service value (i.e., retirement preparedness).

Apart from actors, external influences, such as technological disruptions and innovation also shape the service ecosystem (Lusch and Nambisan 2015). Innovation facilitates value co-creation through information provision and access (Nambisan 2013). Service experiences have transitioned from dyadic (one-on-one) relationships and communication to multi-actor interactions (Sharma et al. 2020; Vargo and Lusch 2016). However, despite technologies' relevance and impact, little is known about how digital technology can facilitate information-seeking behaviour in a service ecosystem (Gruner et al. 2019). Specifically, limited research has focused on exploring the implications of digital technology innovation, as well as technology-enabled information flow and consumer information-seeking behaviours in the retirement planning context (Eberhardt et al. 2020; Hentzen et al. 2022; Pahlevan Sharif and Naghavi 2020). Following Ng et al. (2016) call for adopting an ecosystem perspective in complex service environments, our paper adds to the limited research on the technology-motivated evolution of service ecosystems (Manser Payne et al. 2021).

The current paper aims to investigate the role of digital technology in facilitating information flow in the Australian Superannuation industry as a multi-actor service ecosystem. Information flow between actors in an ecosystem is critical to its functioning and consumer value recognition and co-creation (Peltier et al. 2020). Our main research question therefore is: *How does digital technology facilitate information search and information flow within the multi-actor retirement service ecosystem?* We answer calls for future research that investigates how multi-actor communications and digital technology impact service ecosystems (Peltier et al. 2020; Vargo and Lusch 2016). Members experience ecosystem actor interactions in an isolated context, yet they view these varied interactions collectively, with each ecosystem actor affecting and contributing to the overall consumer experience and journey (Altschwager and Evans 2019a). Research exploring individuals' information search behaviours in the retirement planning context and the influence of other ecosystem actors on individuals' access to important streams of information (e.g., projected living standards, fund performance) from a variety of sources is lacking (Saghiri et al. 2017).

Our findings show that actors such as Superfunds, fund members, and administrators differ in the uptake of digital technology and innovation, preventing the integration of systems with other ecosystem actors such as regulators. Retirement information complexity continues to be a significant contributor to member confusion and lack of engagement, further enhanced by a poor digital presence and communication of ecosystem actors. These findings contribute to the growing stream of research on service ecosystems (Baccarani and Cassia 2017; Sklyar et al. 2019b), and digital information search (Dahl et al. 2021; Haluza et al. 2017). Our findings also extend the literature on digital information seeking and information flow (Dahl et al. 2021; Peltier et al. 2020) by highlighting opposing views on actor responsibilities, which negatively affect digital communication efforts. We find that the purpose and role of certain ecosystem actors and actor relationships, such as regulators and Superfunds, is unclear to fund members, affecting trust perceptions and increasing demands for service ecosystem transparency. Additionally, consumers are increasingly engaging in self-servicing behaviours, limiting communication efforts from Superfunds. Lastly, our findings add to prior research on ecosystem integration (Frow et al. 2019) by identifying gaps in the Australian Superannuation ecosystem's resource integration efforts, highlighting a lack of consideration for the role of digital technologies. Changing consumer expectations increase the pressure on key actors within the Superannuation ecosystem to improve communication, information access, and service value. We demonstrate that views on education, information acquisition, and dissemination differ amongst the ecosystem actors. For example, members look to employers to further educate them on Superannuation related matters, whereas Superfunds perceive themselves responsible for increasing members' Superannuation knowledge.

Background

Multi-Actor Ecosystem Perspective

From a traditional services marketing perspective, service encounters take place between consumer and service providers in dyadic interactions (Ostrom et al. 2015). However, digital technology has allowed this dyad to turn into multiple actor networks or ‘ecosystems’ (McColl-Kennedy et al. 2017). The accessibility of online service provision has increased drastically, forcing service providers to rethink and change their existing business models (Kohtamäki et al. 2019; Senyo et al. 2019). Companies (partially) delivering online services can use flexible, accessible, and synchronized systems, which facilitate multidirectional information exchanges.

Multi-actor interactions within a service ecosystem require collaboration and management of expectations (McColl-Kennedy et al. 2020). Some service ecosystems are more complex than others, which could be due to the nature of the service, the number of actors involved, or the individual actors’ differentiating goals and expectations. These challenges increase conflict and tension, negatively affecting the ecosystem’s efficacy (Banoun et al. 2016). The Superannuation ecosystem is a complex, multi-actor system that facilitates the delivery of positive financial outcomes for a multitude of diverse actors. According to Merton (2014, p. 11), “an effective retirement system must guide savers to good retirement outcomes through clear and meaningful communication and simplicity of choices, during both the accumulation phase and the postretirement pay-out phase.”

Research on digital pension ecosystems and communication is limited, either taking a consumer/member (Eberhardt et al. 2019, 2020) or Superfund/regulator perspective (Debets et al. 2020). Actors of an ecosystem are directly and indirectly connected, yet guided by their own norms and rules (McColl-Kennedy et al. 2020). Only once these different perspectives are accounted for, may we have a clearer understanding of the functioning of said ecosystem.

Digital Pension Communication and Information

According to Altschwager and Evans (2019a), the Australian Superannuation ecosystem comprises 117 unique ecosystem members/actors, therefore constituting a large and complex, multi-actor service ecosystem, with many relevant relationships and interactions. Specifically, these authors identified 17 qualified and impactful focal members within the ecosystem, including government actors, industry bodies, regulators, Superfunds, and Superfund members.

To date, Superfund communication to members and the subsequent flow of information are primarily unidirectional. For example, Superfunds may send quarterly statements to members. This view of Superfund providers as sole information providers facilitates low member involvement in decision-making processes (Ratner et al. 2008). Occasionally, other actors such as governments, consumer advocates, or financial advisors influence the availability and flow of information and overall communication. However, the lack of an integrated communication strategy leads to member confusion and misunderstanding of conflicting communication efforts by various industry actors (Atkinson et al. 2012). Effective communication and information disclosure are essential for members, as they increasingly bear the risk of and are required to make a variety of complex financial decisions (Eberhardt et al. 2019).

Unidirectional information flows are ineffective the more complex the information and the lower the knowledge or interest of the consumer (Bateman et al. 2014). Optimal service delivery can occur when ecosystem actors are engaged in bidirectional communication and resource exchange, allowing the service provider to adjust their communication strategies and service offerings to align with the changing needs of consumers (Gustafsson et al. 2012; Sklyar et al. 2019a). Digital technology has enabled ecosystem actors to facilitate information creation, dissemination, sharing, and coordination (Larivière et al. 2017; Nambisan 2013). However, failure to integrate technologies and systems negatively affects the speed and accuracy of information exchanges, thus limiting inter-actor collaboration in the ecosystem (Sklyar et al. 2019a).

Due to the complex nature of the retirement planning service ecosystem, service providers need to help consumers by integrating resources and knowledge exchange through improved information flows (Baccarani and Cassia 2017). The success of the Superannuation service ecosystem in terms of member retirement preparedness, depends on the interaction of actors, and their subsequent utilization of communication flows to improve the awareness and service experience (Vargo and Lusch 2016). In most service ecosystems, there is both a supply and demand-side. The supply side of the Superannuation ecosystem includes Superfunds, government, regulatory bodies (e.g., APRA, ATO, ASIC), industry bodies (e.g., AFA, AI, AIST), and independent financial planners and advisors (Altschwager and Evans 2019a).[4] On the demand-side of the ecosystem, we have the consumer and their network (e.g., family, friends).

While consumers can access information from any actor on the supply-side, business-to-consumer communication (B2C) is primarily unidirectional from the Superfund or employer to the member (Altschwager and Evans 2019a). Improving information flow in the ecosystem should result in it no longer being unidirectional, allowing Superfunds to provide more personalised services and advice to their members (Australian Government Productivity Commission 2018).

Information Seeking and Avoidance Behaviour

Although various studies have highlighted the importance of information seeking behaviour for increasing financial knowledge, decision-making, and financial well-being (Pahlevan Sharif et al. 2020; Pahlevan Sharif and Naghavi 2020), the topic has not been extensively investigated in the retirement planning literature (Hoffmann and Plotkina 2020; Sharif et al. 2020). Information can be acquired passively (e.g., an unsolicited service provider email) or actively (e.g., engaging oneself in an Internet search or discussion in one's personal network) (Sweeney et al. 2010).

[4] APRA: Australian Prudential Regulation Authority; ATO: Australian Taxation Office; ASIC: Australian Securities & Investments Commission; AFA: Association of Financial Advisers; AI: Actuaries Institute; AIST: Australian Institute of Superannuation Trustees.

Digital technology has enabled consumers to access vast amounts of information, and simultaneously complicated the information search process. Consumers become increasingly responsible for searching for, and interpreting information, which both affects their decision-making behaviour and perception of the service provided to them. To avoid being overwhelmed, consumers may engage in information avoidance behaviours (Golman et al. 2017). Information avoidance refers to an individual's failure to acquire information, in part, because that information would require them to think about or engage in undesired activities or experience unpleasant emotions (e.g., thinking about old age and associated health issues) (Sweeney et al. 2010).

Method

Research Context

The Superannuation industry provides a rich context for this study, for various reasons. First, it is relatively slow in terms of digital transformation efforts (ASFA 2017). Second, in addition to its long-term orientation, retirement planning is complex and member engagement is therefore often low (Dellaert 2010). Third, members often struggle to evaluate investment performance and overall quality of service provided by Superfunds (Eberhardt et al. 2019). Due to the large size and complexity of the Australian Superannuation ecosystem (Altschwager and Evans 2019a), this study will focus on those actors that are directly involved in developing and using digital technology.

Data Collection

This study adopts an exploratory qualitative research design using semi-structured interviews to investigate digital communication and information flow in the Australian Superannuation industry. We conduct the interviews in two phases. First, we interview 'industry experts', including Superfund managers and technology specialists. Second, we interview Superfund members. In both instances, interviewees are selected through purposive sampling, which increases the probability of uncovering insights from informed and experienced individuals with knowledge of the focal topic (Gioia et al. 2013). Due to the scope of this study, all participants in the first phase had to work within their organization's technology department or be employed by a company providing services to the Superannuation sector. As for members, they had to have at least one Superfund account. In total, we interviewed 21 participants resulting in 872 minutes of audio data.

Phase 1. Given the large number of Superfunds, namely 217 in June 2018 (Australian Government Productivity Commission 2018), the researchers contacted fund managers, including managing directors, heads of member engagement, and digital or technology managers, of the 30 largest Superfunds in Australia, via LinkedIn. While initially the response rate was slow, after the first two interviews, a snowball approach developed, with participants offering to pass on the project information and researcher contact details to their network and industry colleagues. We applied Shah and Corley (2006) constant comparison method throughout the data collection process, paying close attention to whether each interview contributed new information, and stopping when we reached theoretical saturation. The interviews were performed by the same researcher to ensure consistency (Turner 2010), and lasted between 30 and 65 minutes each. They were conducted online due to COVID-19 travel restrictions.

Phase 2. The interviews were conducted either in person or online and lasted between 20 and 42 minutes each. Superfund[5] members' age ranged between 21 and 50 years, and they were employed in professions ranging from consultant, dietician, secretary to engineer. Engagement with Super savings varied, with some being highly engaged, whereas others adopted a 'set and forget' approach. We had a relatively balanced gender distribution of 5 male and 7 female participants, with half having a diverse immigration background. We thus captured the opinions from interviewees with varying backgrounds, experiences, and engagement (see Table 9).

[5] Seven different Superfunds were named during the 11 member interviews, with three Superfunds being named at least twice. One consumer had three Superfund accounts, two consumers had two accounts, and the other eight all had only one account.

Table 9. Interview participants

Phase 1 of Interviews			
Occupation	**State**	**Ecosystem Actor**	**Interview Duration**
Project Manager	VIC	Superfund	01:03:24
Technology Officer	VIC	Superfund	00:35:33
Senior Manager Strategic Initiatives	SA	Superfund	00:56:16
Head of Member Experience	VIC	Superfund	01:04:57
Head of Superannuation	NSW	Consultant	00:43:40
Head of Product	VIC	IT/ Digital Solutions Provider	00:55:55
Consumer Advocate	NSW	Advocacy	01:02:38
Managing Director	VIC	IT/ Digital Solutions Provider	00:42:16
Head of Experience & Engagement	VIC	Superfund	00:45:28
Head of Digital & UX	VIC	Superfund	01:00:24

Phase 2 of Interviews					
Occupation	**Age**	**Gender**	**State**	**Ecosystem Actor**	**Interview Duration**
Lecturer	30-35 years	M	SA	Consumer/ Fund Member	00:42:20
Student	30-35 years	F	SA	Consumer/ Fund Member	00:32:23
Consultant	25-30 years	F	WA	Consumer/ Fund Member	00:30:29
Engineer	20-25 years	M	WA	Consumer/ Fund Member	00:29:21
Business Performance Analyst	25-30 years	M	SA	Consumer/ Fund Member	00:29:26
Accountant & Engineer (Couple)	45-50 years 40-45 years	M F	WA	Consumer/ Fund Member	00:39:41
Company Admin	20-25 years	F	WA	Consumer/ Fund Member	00:20:06
Dietician	30-35 years	F	WA	Consumer/ Fund Member	00:30:02
CEO Medical Start-up	50-55 years	F	WA	Consumer/ Fund Member	00:28:28
Financial Analyst	40-45 years	F	SA	Consumer/ Fund Member	00:23:34
MBA Student	30-35 years	M	SA	Consumer/ Fund Member	00:39:26

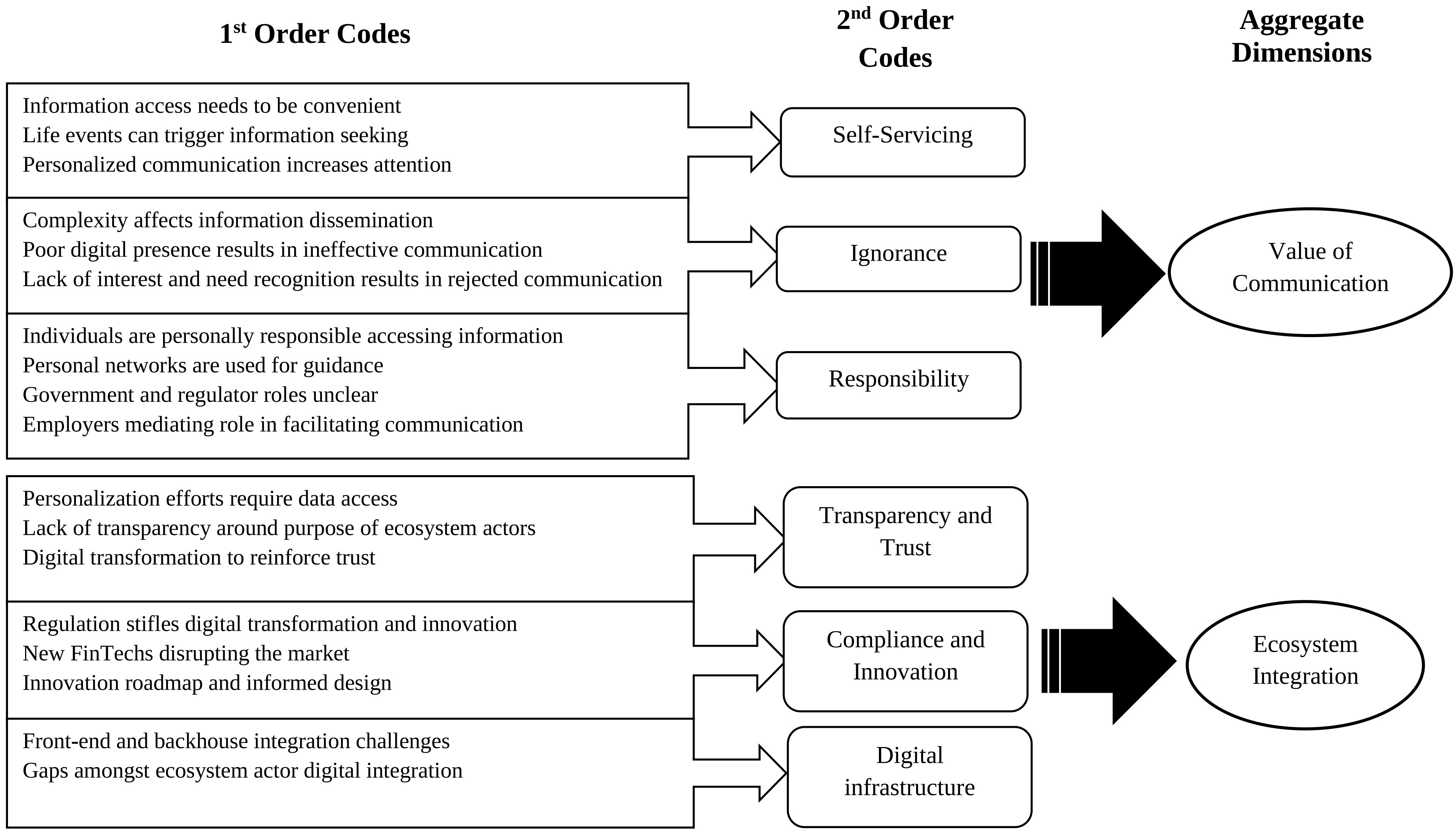
To ensure all relevant concepts were addressed, but not imposed on the interviewee, we used two semi-structured interview guides (see Appendix C), which provided initial guidance during the interviews while allowing participants to delve deeper into topics of particular interest to them.

Data Analysis

Due to the nature of this study, we draw on the Gioia methodology (Gioia et al. 2013), which recognizes people as knowledgeable agents with the ability to express and discuss their emotions and thoughts, as well as follow an iterative analysis approach as suggested by Pratt et al. (2006). The Gioia methodology comprises of a systematic and inductive approach, aiding in the development of concepts by referencing and drawing on expressed human experiences to develop several code orders, themes, and dimensions. First-order-codes enable the researcher to link the quotes extracted from the interview data to theory, while themes require the researcher to zoom-out, followed by higher level abstraction resulting in aggregate dimensions. To ensure that the data accurately reflected what each participant had said and thus achieved descriptive validity (Maxwell 1992), all audio recordings were transcribed and coded using the popular Nvivo (v12) software.

The coding process began with reading all transcripts twice, to get a general understanding and overview of the data and identify broader topics. Similar phrases expressed by the interviewees were subsequently grouped together, resulting in an initial grouping of 120 categories, with subsequent re-coding of similar or related categories, reducing the number into 18 first-order codes (Raja et al. 2018). Following Strauss and Corbin (1998) axial coding, the first-order codes were systematically examined to uncover relationships among the categories and then grouped into six second-order themes, thus reducing the number of first-order codes to a more manageable quantity (Gioia et al. 2013). Lastly, the emerging and overlapping findings informed the final themes (Archibald 2015) through investigator triangulation, which we then arranged into two aggregate dimensions. See Figure 7 for the coding structure of our study.

Figure 7. Coding structure



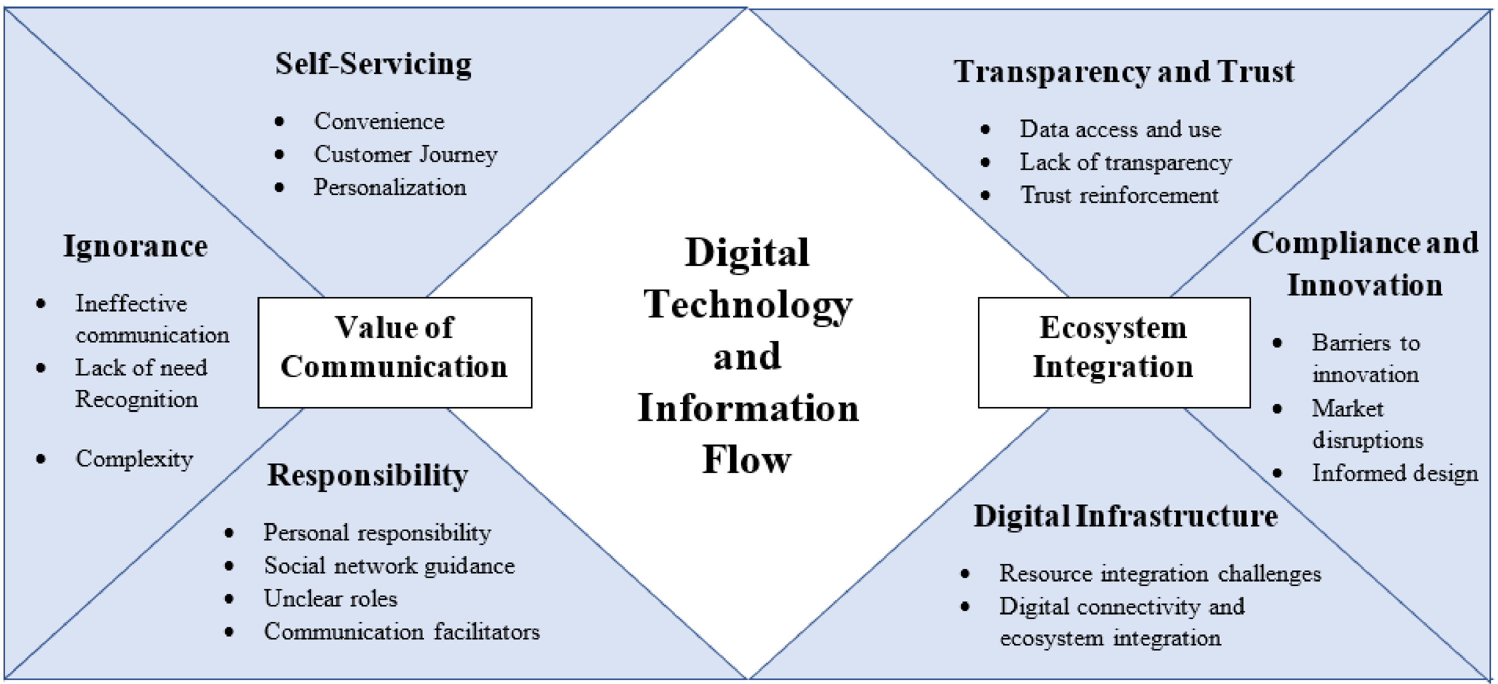
Findings and Discussion

Our study focuses on describing the information flow amongst six key actors, including members, their family, friends (social network), and employer(s), Superfunds, regulators, and technology administrators. As such, the following findings highlight the opinions and perceptions of both consumers and service providers, which ultimately drive their behaviour. While regulators and employers were not interviewed separately, they were included in the conceptual framework as the interviewed members and experts continuously referred to them. In line with Larivière et al. (2017), who suggest that service providers, technologies, and consumers are vital in creating, disseminating, and sharing information, we identified two dimensions and six themes that illustrate how digital technology influences the communication and information flow amongst actors in the Superannuation ecosystem. The dimensions and corresponding themes are Value of Communication (comprising Self-Servicing, Ignorance, and Responsibility) and Ecosystem Integration (comprising Transparency and Trust, Compliance and Innovation, and Digital Infrastructure). The conceptual framework in Figure 8 summarizes the findings.

Value of Communication

*Self-Servicing***.** One of the main challenges for the broader financial services industry is consumers' low financial literacy (Huston 2010). Making ill-informed financial decisions can have detrimental effects on the future financial well-being of individuals. Due to the consequential nature of financial decision-making (i.e., asset allocation or financial investments), consumers are recommended to seek out professional advice. A recent report from (ASIC 2019) revealed that nearly half (41%) of Australians want to get personal financial advice in the future, while 27% have already received financial advice in the past. However, personal financial advice and wealth management are often expensive and exclusive (Van Thiel and Van Raaij 2017). Following the demand for accessible financial advice services, technological innovations such as digital financial advisory services (i.e., Robo-advice) have become increasingly popular (Belanche et al. 2019; Hentzen et al. 2021). Easier and faster access to information reduces transaction costs and increases service transparency (Chen et al. 2021a; Ding et al. 2007).

Figure 8. Conceptual framework



This ease of access to information has initiated changes in consumer behaviour, one of which is increased self-servicing behaviour. As one interviewed Superfund manager stated:

"People would like to help themselves first before they go and ask someone else to help them".

In the context of retirement planning, self-servicing technology facilitates an increased sense of control for the consumer. However, our analysis revealed that the Superannuation service providers do not want consumers to make consequential financial decisions online. Instead, the technology aims to make information access more convenient. Technology is useful in facilitating decision-making, providing more options for education, and offering approachable advice. Yet, consumer self-servicing technology should restrict hasty and uninformed behaviour due to the consequential nature of retirement planning. While there is variation in how members want to be engaged, people are conditioned to 'self-diagnose'. For example, one manager suggested that:

"There's a digital transformation happening where services are moving online, where people are getting conditioned to self-diagnose, to self-service. So, you know, if you need to do a transfer in your banking, you're doing it yourself. You wouldn't even, [the Millennial] generation wouldn't even think about going to the bank".

Another challenge for the Superannuation industry regarding increased demand for self-servicing technology is the diminishing opportunity for industry actors to communicate with consumers. In response, Superfunds increasingly offer communication opportunities through various channels, leading to most funds adopting an omni-channel strategy. Omni-channel strategies focus on fostering and increasing consumer engagement by combining consistent messaging with the interactive features of multiple channels (both online and offline) (Storbacka et al. 2016). As emphasized by one interviewed Superfund manager:

"Ultimately the big drive right now in superannuation is omni-channel, which is to make sure that we want to communicate with our customers however they want us to communicate with them".

Our analysis of member interviews suggests that most want to have multiple contact options, preferring email for communication. Social media is mostly viewed as an educational tool, not an additional communication channel. While prior studies suggest that omni-channel marketing is merging various consumer touchpoints (Payne et al. 2017), our analysis reveals a contrast between the views of members and Superfunds. Members are satisfied with using one main communication channel, while for the Super industry, omni-channel marketing is viewed as a funnel tool to direct information flow. With multiple communication channels, Superfunds provide numerous sources of information, which they refer to in part as comprising of basic digital advice. Basic digital advice can be viewed as the first step in the online advice journey, as explained by a Superfund manager:

"A lot of these digital advice tools that channel in [...] leads for comprehensive advice."

Due to the long-term nature of retirement planning, communication between the core ecosystem actors (members and Superfunds) is sporadic. However, engagement with retirement savings is important, especially for younger individuals, who are at risk of having insufficient savings to support their desired lifestyle during retirement due to increased longevity and living costs (Garcia Mata 2021). Consequently, Superfunds continuously seek to develop communication strategies to facilitate engagement, through 'journey triggers' such as buying a first house. Consumer journey mapping requires marketers to track the touch points of the consumer-service provider interaction. As suggested by one Superfund manager:

"So, from your youngest to your oldest, [...] you might be getting engaged, getting married, buying a house, or your first child getting ready for retirement. And we use these moments of truth to form trigger journeys."

While relatively underexplored in the current literature, digital technology can assist service providers to capture these 'moments of truth' or life events. Consumer journey mapping seeks to inform service providers about how an interaction occurred and its influence on other moments and behaviours (Micheaux and Bosio 2019). Consumer data is needed for service providers to map a consumer's journey and offer personalised services. Our interviews revealed that most members want a more personalised retirement management experience. However, they are unaware of what personalisation entails. While research is limited on personalisation for Superannuation services, Lloyd (2020) state that trust and personalisation need to come together. Interviewed managers provided specific examples, when probed, of what information they would need to improve their consumer journey mapping and personalisation efforts. Examples included information about family planning, long-term health concerns as this relates to insurance considerations, or house ownership as mortgage payments affect the potential for voluntary Super contributions

(Altschwager and Evans 2019b). Additionally, as highlighted in a guide published by the Australian Securities & Investments Commission (ASIC 2012), service providers need to be aware of the type of information members need. That is, service providers should make a distinction between factual information, personal advice, and general advice. Personalisation provides numerous opportunities and benefits, however risks such as privacy and security concerns, remain a challenge (Chellappa and Sin 2005). One interviewed member in favour of sharing personal information put it simply as:

> *"So, […] either you don't get that personalised information, or you share information."*

While some interviewees were unclear about the benefit of personalisation, others seemed to have a different understanding of what personalisation of service entails. For example, when questioned about their need for more personalised service from their Superfund, a member said:

> "*Not necessarily. It is not, it's not that my relationship with online banks is personal. I have never met anyone from [example financial institution], you know, I wouldn't know them from about, so, that's not what makes it personal to me. What makes those personal to me is that, you know, I had them on my phone. I had the app on my phone. I can check the bank balance, I can, […] have control over the interest rates. So it's not so much about that, that to me is personalisation, not having a human attached to it and I don't have to be attached to a brand."*

Although most members favoured more personalised communication, the interviews also revealed that ecosystem actors such as Digital/IT and Superfund managers were concerned about the costs and complexity of managing consumer data although they recognized the educational opportunities of personalised communication. That is, value derived from personalisation efforts for both service provider and consumer, emerges from the margin between costs and benefits. Consumer costs include privacy risk, time commitment, or additional fees. Costs for the service provider include investments in digital technology and data analysis capabilities (Vesanen 2007).

Benefits for members include an improved consumer experience and overall retirement preparedness (Dellaert 2010; Lloyd 2020), while service providers may see an increase in consumer satisfaction, consumer loyalty, and competitive advantage (Vesanen 2007).

Ignorance. All interviewed members agreed that one main barrier to retirement planning is the complexity of the Australian Superannuation system and information. Similarly, they all identified challenges with information search and comprehension. Communication between ecosystem actors most often breaks down due to the consumer abandoning their search and giving up. As suggested by a consumer advocate:

> "*People kind of don't really, can't really engage very well with the amount of information that's out there. There is too much, there's too many superannuation funds. There's too many technical terms as a real financial literacy gap between what funds think you should know and what people actually know […].*"

In line with this view, interviewed Superfund managers recognized that the service provider's job is to simplify information and make it understandable to every consumer. Yet, most acknowledged that their funds still have a long way to go, with one manager highlighting:

> *"That is going to be a key focus of our new program of work, where we're really starting to transform the digital or […] the experience of our members and the way we communicate is a key component of that."*

Digital transformation in the Australian Superannuation industry is sporadic (KPMG 2020c). As McKenna (2019) highlights, technological innovation, changing regulatory requirements and member preferences and needs, and increased competition (i.e., through emerging FinTechs) continue to place pressure on ecosystem actors who are not yet focused on engaging in transformation efforts. Our findings suggest that some Superfunds have started to use digital technology to improve communication with their members. Interestingly, however, most interviewed members did not perceive any change in how their funds communicate. When questioned about it, one member stated:

"No, I, I actually haven't noticed. Um, and it is probably because if I get a letter in the mail from a superfund, I'm almost immediately not interested. So, um, yeah, if there has, has been a change, I haven't noticed."

The only change most interviewees noticed was the switch from postal to email statements and newsletters. The efforts of Superfunds in using digital technology to enhance communication with members seem to fall short of being actively noticed by the members.

One explanation for members not recognizing the value of digital technology in enhancing and facilitating communication and information flow may fall back to them not being interested in the information communicated and thus rejecting the funds' communication efforts. While some members explained that a low superannuation balance and slow growth of investments resulted in low motivation to engage, one Superfund manager suggested that Superfunds need to develop and communicate brand propositions and make Superannuation meaningful by relating to sustainability efforts (Linnenluecke et al. 2015), staying in touch with changing consumer needs:

"And that is to present them with options that line up with their personal values and allow them to unlock an altruistic benefit from the investment decisions that they're making today. So that means if you are a millennial at 25, whoever you can go to your superfund and you can have options to invest your money, that the government mandates you have to pay into a superfund, but you can invest into something sustainable or renewable global green options."

Individuals appear to actively avoid retirement information since a substantial amount of useful and free information is available, but they do not search for it (Golman et al. 2017). Consequently, members are not aware of how ill-prepared they are, potentially exposing them to a future with significant savings gaps, and reduced retirement well-being (Eberhardt et al. 2019).

*Responsibility***.** Education is an important foundation for effective communication (Eberhardt et al. 2020). However, during the interviews, the question about responsibility regarding the provision of retirement-related education revealed mixed opinions. Some members mentioned that they look to their network (e.g., a family member) for guidance, with one participant stating that:

"He (interviewee's father) bought properties and he also had shares and I think he looked at kind of that long-term investments and he's always expressed how important superannuation is as well as, making your money work for you, I suppose."

Another interviewee highlighted that they discuss retirement planning with their friends and life partner:

"I've been facilitating conversations with my partner about, so when would you want to retire? Which has really taken him aback, never thought of it. […] I have met a few friends who are very financially savvy […]. And then one of my partner's best friends is an accountant. And whenever we go out for meals, I pick his brain about all things finance."

While a person's social network may provide a valuable source of financial education, there are risks of deferring financial decision-making to others. Ward et al. (2019) suggest an uneven distribution of both decision-making and knowledge between partners in relationships, highlighting that off-loading information search and decision-making responsibilities to a partner affects the present financial well-being of the individual, and increases barriers for future educational efforts and development of expertise. Service providers appear to be aware of this happening and the risks involved, with one Superfund manager highlighting those individuals may:

"Defer all that thinking over to your superfund or over to your parents or over to your partner or over to your financial advisor. But to a degree you definitely need to be informed and educated because there is a limit to which you can have someone else make those decisions for you. You can't just defer all your decisions."

Apart from family and friends, interviewees also identified high schools, employers, and the government as actors responsible for financial education. Adopting a more critical perspective, one consumer advocate suggested that the Australian government is responsible for fixing the 'broken' business model, claiming that Superfunds are too conflicted concerning member engagement. Another finding revealed that most members thought employers could educate employees on superannuation matters, as they are the first direct link between funds and members:

"I think I first found out about retirement funds when I started working, I mean, we were immigrants from the States, so I didn't have a, I didn't grow up there. […] because like when you earn money and you understand that part of that money goes somewhere else, then you know, your brain will start clicking to it."

These views deviate from the Australian Government Productivity Commission (2018) key recommendation, which seeks to reduce employer involvement in default fund decision-making. No member suggested that Superfunds need to educate them on retirement planning matters, which highlights the disconnect between these two actors and the lack of understanding on the member's side as to the purpose of and services provided by Superfunds. The role and responsibilities of an employer also became evident during the analysis, for example regarding paying Superannuation into employees' designated fund. This responsibility, however, can involve challenges. As one Superfund manager highlighted:

"There's a huge problem with unpaid Super in our industry. So, and you know, when we did research on our app, you know, the key information that our members wanted to see, was there a balance and their last contribution and what date it was paid. So that's all they want to see up front."

Most employers have a default Superfund that they offer to new employees. Some Superfunds are not too concerned with attracting new members, as the influx generally comes from the employers they are associated with. Challenges with employer involvement around default fund selection was highlighted in the final report and supplemented documents of the Australian Royal Commission into Misconduct in the Banking, Superannuation and Financial Services Industry, which suggested that "at least to some extent, employers choose a default fund based on relationships with executives and employees of superannuation funds […] evidence suggests that performance of the fund, net benefits to members, and other product features are subsidiary considerations for employers in selecting a default fund, if they are considered at all" (Financial Services Royal Commission 2018, p. 91). Numerous interviewees stated that they went with their employer's default Superfund. At the same time, some admitted to having multiple Superfund accounts due to them having changed employers over the years, each with different default funds:

"I actually signed up with a [Superfund] because it's [employer]'s default provider. I didn't really do any research at the time because I wasn't too sure my future was in Australia. So, it's like no big deal."

While governments and employers are increasingly shifting the risks and responsibilities to the individual (Eberhardt et al. 2020), members appear not fully aware of this shift and its consequences. This stark contrast between members' responsibility perceptions and service actors' actual take-up of responsibility highlights a widening gap with potentially severe consequences such as reduced quality of life and well-being during retirement (Australian Government Productivity Commission 2018; Eberhardt et al. 2020).

Ecosystem Integration

Several Superfunds outsource their digital marketing and management to external companies such as digital agencies or other third-party vendors due to cost considerations or lack of in-house expertise or system infrastructure. Consequently, Superfunds are increasingly tasked with enhancing the effectiveness of such ecosystem actors through seamless, efficient, and agile integrations of processes and systems, as well as in contributing to an overall more collaborative ecosystem, centred around service provision, relationship building, and value creation (Lloyd 2020). For example, if a digital communication channel is managed by a third-party vendor, and a member reaches out to request specific information, the vendor must be able to quickly retrieve that information from the Superfund. However, if systems and processes are not integrated, this task might prove complicated and slow, which could negatively affect the service experience.

Although value creation comes in different forms (Sweeney et al. 2015), we focus on resource integration. Resource integration includes assembly, mastery, and optimization of resources such as information from multiple ecosystem actors (Bruce et al. 2019). Service providers such as Superfunds and government institutions can help individuals by integrating their resources (i.e., digital channels or member information) and facilitating continuous information flow. Sklyar et al. (2019a) argue that due to the increasingly complex nature of actor interactions, coordinating crucial activities within the ecosystem can be enhanced by creating a unifying platform, which provides access to business-critical information and data. These authors also suggest that the more strongly ecosystem actors are connected, the more trusting and collaborative action, in the form of efficient and effective resource integration, will occur. Extending these findings, we highlight the importance of transparency and trust, compliance, regulation, and overall digital infrastructure as being key determinants of successful Superannuation service ecosystem integration, discussed next.

*Transparency and Trust***.** For effective communication and information exchange to take place, ecosystem actors need to integrate their systems digitally. Trust is important to drive efficient and effective multi-actor information sharing and collaboration, reduce transaction costs, and increase flexibility in changing market conditions (Delina et al. 2012). As a precursor to trust (Busser and Shulga 2019), the importance of transparency has increased through the proliferation of the Internet (Hanna et al. 2019). In terms of transparency, members can now access retirement information via different channels and sources. One consumer advocate suggested that members:

"want to do it [communicate] through a channel where they already were as well. So, like they didn't want to have to necessarily engage with the fund via say a different platform, but a lot of the recommendations that came through in our qualitative research was, if we can engage through the MyGov platform, that's probably like a, was a place where we're at already. Just makes it kind of life admin of it all so much easier rather than say having to remember login details for a superannuation fund, have a separate app or do something like that."

Service providers need to ensure that information is available from multiple sources. Doing so raises the issue of resource integration, as digitalization modifies integration processes and strategies. Strongly connected ecosystem actors integrate more resources faster than those who have weaker ties (Sklyar et al. 2019a). This theoretical perspective corroborates Superfund manager statements on attempting to consolidate information and having a 'single source of truth'. Different member-facing actors need to be telling the same story and provide the same, consistent, and regulatory-compliant information. While digital technology can be useful in keeping track of member interactions and ensuring the information is as accurate and consistent as can be, it is a time-consuming and costly process. This notion is illustrated by the words of a Superfund member:

"Actually, I quite like that idea. Because I come on the myGov um, website. Um, so I like the fact that I can get into the ATO through that. So, you know, if, Super might even be in there, I don't know. But […] I think if there was a one-stop shop that can tap into all of the different organizations yes. I like that idea."

While most interviewees believe personalisation is helpful to increase the value of communication between Superfunds and members, our analysis revealed a lack of transparency of the industry and the available information as potential barriers. Superfunds believe that their organizational purpose is to act in the members' best interest, as emphasized by a manager:

"Because every fund I've dealt with whether it's retail or industry, they genuinely are looking for the best outcome for their members. You know, it's not like a banking or finance where it's about the bottom line. It's you know, there's a genuine interest in finding the best outcome for the member and doing whatever. If we can use technology to do that, then yeah, let's find the best way to do that."

However, members perceive (their) Superfunds as simply being another profit-oriented organization, with one member highlighting:

"I think, because it's like a, uh, it's like an organization, like any other, I think their best interest is their own profitability and their own, they're responsible to their own stakeholders."

These conflicting views on the service provider's purpose may be attributed to a lack of transparency and members' understanding of the functioning of the Superannuation system. Our analysis revealed that system and information complexity was associated with members either not searching for information, not knowing where to search, or giving up their search after a short time due to multiple frustrations. Superfunds are fully aware of the fact that a lack of financial education affects individuals' ability to make sound financial decisions, as explained by one manager:

"I think education is key, right. You know, I think that that's one of the biggest challenges that we face as an industry around Superannuation is education. I think education is you know, knowledge is power, I guess, and it facilitates engagement. The more people understand Superannuation, the more likely they are to engage and utilise it."

However, our analysis revealed that while most members initially use the Internet for information search, complexity remains. As highlighted by the Australian Government Productivity Commission (2018), regulators play an increasing role in enhancing transparency and reducing complexity of information. Digital technology can be used to increase transparency of information and thus set the foundation for inter-actor trust development (Venkatesh et al. 2016).

Compliance and Innovation. Due to the critical and financially sensitive nature of the Superannuation ecosystem, and to protect consumers from misappropriation of retirement savings, Superfunds and Digital/IT providers need to report to and comply with rules and legislations determined by various regulators, including the ATO, APRA, and ASIC. During the interview process, it became evident that although most Superfund managers viewed the regulations as necessary, they did highlight some challenges regarding digital transformation and member engagement. One of the interviewed software administrators suggested that:

> *"the pressure from the regulators definitely comes on us. There is a way of tackling it, which, we really try to handle the pressure. Why the pressure works negatively for the Superannuation sector is that a compliance person says, well, we've got this regulation here and you have to say this. Now a compliance person is not a copywriter. It is not their job to engage people. So they put it in legally safe terminology."*

We find that Superfund managers and Digital/IT providers view regulation as barriers to innovation, with most resources being allocated to the implementation of new regulatory changes. With the continuous influx of new regulation, many managers postpone committing more significant funds to develop digital technology to not risk spending members' money on something that regulation wants to change within a few months. In the words of a Superfund manager:

> "*And so that's another way that the regulation or the potential for regulation impacts us as industry and impacts our digital assets. Because people will steer away from things. If they get a sense or a feeling that they're over-regulated, or they're going to be regulated more heavily or the regulation is going to change fundamentally. And there's a lot of areas in Superannuation where there's constant conversation around how the regulations going to evolve and change. And we have enough on our plates to keep us up just to keep us up to date with changing*

regulation rather than to be concerning or considering how products might need to evolve because of regulation moving forward."

Another major hurdle for Superfunds in communicating with their members is the conflict between members' wants and the regulation regarding digital advice. Superfunds are limited in the type of advice they are permitted to provide through digital channels, whereas digital advice is something members are most interested in. For example, as one Superfund manager highlighted:

"There is a lot of red tape. So, there's guidelines of what you can and can't say. You've got to be very careful that you're not giving financial advice outside of anything that's in general".

Our analysis suggests that Superfunds perceive a lack of collaboration and communication among themselves and regulators. While regulation might seem to stifle innovation and digital transformation, competitors such as emerging FinTechs companies appear to have surpassed traditional Superfunds regarding communication and engagement efforts with consumers. Although these organizations can offer great user experience and education, expert opinion highlights a lack of true holistic disruption to the Superannuation industry (Stevens 2017). Or as our interviewed consumer advocate argued:

"Where they [FinTechs] fall down though is their kind of performance and fees. Some of them are like the highest fees Superannuation investment options on the market, […] their fees are pretty high."

Although mildly criticising FinTechs, the interviewed managers acknowledged that these competitors and other industries condition consumers and create demand for digital communication and information access. That is, FinTechs appear to have enhanced the Australian Superannuation value chain, as opposed to the anticipated disruption (Stevens 2017). It is the regulators' responsibility to collaborate with other service ecosystem actors to ensure that innovative ideas that can benefit consumers are not blocked by unnecessary regulation. However, regulators should also act with caution as not to overlook important aspects of consumer protection.

*Digital Infrastructure***.** According to Peltier et al. (2020, p. 726) "inter-actor communication encounters are key mechanisms that turn information reciprocity and collaboration into value co-creation of service innovations." For collaboration and value co-creation to take place, ecosystem actors need to be digitally interlinked. While initial steps have been taken to facilitate such linking, our analysis revealed shortcomings. One digital agency manager said that as a $3 trillion industry, he expected Superannuation:

> "*to be reasonably […] technologically advanced and it certainly isn't, sort of the back end isn't. You know, it's an industry that's run on Excel spreadsheets which really limited our ability to be able to build, […] real-time applications."*

This issue is not new to the Superannuation sector. In fact, following a review of the Super system in 2010 (i.e., the Cooper Review), the "SuperStream" program was introduced to modernise and automate data processing and transactions in the Super system (ATO, 2019). However, twelve years after the release of the Cooper Review, efficient system integration in the industry remains a work in progress. Information and data need to be passed from the fund to the IT provider and back-office. While most funds deal with multiple administrators, this disconnect has stimulated some Superfunds to 'insource' their administration back to their own firm. As described by one Superfund manager:

> "*And the biggest issue is […], there's about for [every] superannuation fund that outsources, there's at least five entities involved in your fund. Your trustee, your administrator, your insurer providing life insurance. And then the custodian, which is the one that actually holds the money and manages that. And they've all got different systems, often multiple different systems*".

Yet superfunds don't just need to be connected to administrators, they also need to link with other ecosystem actors such as regulators and employers. Apart from increased efficiency and reduced transactional cost, linking ecosystem actors also ensures that each actor involved in the service provision has access to the same view of the consumer (Sklyar et al. 2019a).

Contribution and Implications

Theoretical Contributions

We make several contributions to research on service ecosystems (Baccarani and Cassia 2017; Sklyar et al. 2019b) and digital information search (Dahl et al. 2021; Haluza et al. 2017). First, we highlight the effect of information complexity on information search behaviour and how poor utilization of digital technology can further widen the gap. Consumers, unaware of their increased personal responsibility, either fail to search for information due to lacking need recognition or active avoidance. Others may give up the search due to information complexity. Consequently, service providers perceive low consumer involvement and reduce digital communication efforts.

Second, we demonstrate that opposing views and expectations of ecosystem actors regarding responsibility for information search and dissemination affect both the perceived value of communication and ecosystem integration efforts. Service ecosystem actor engagement depends largely on inter-actor relationships and the ability and willingness of actors to integrate resources and facilitate information exchanges (Chandler and Lusch 2015). Failure to successfully integrate resources and systems negatively affects the effectiveness and performance of the service ecosystem and is thus a substantial concern (Vargo and Lusch 2016).

Third, we add to research on digital information flow (e.g., Peltier et al. (2020). It is important to compare multiple viewpoints, moving beyond investigations of the dyadic relationship between service provider and consumer and accounting for consumers' numerous information sources. Our findings on digital information flow offer insights on how digital technology impacts the complex service ecosystem of the Superannuation industry. Information flows are affected by ecosystem integration efforts, which in turn are impacted by regulatory compliance and innovation challenges.

Finally, we find that seamless resource integration and exchange amongst Superannuation ecosystem actors facilitated through digital technologies is still in its infancy. Needed collaboration amongst ecosystem actors to integrate through digital technology is lacking and the actors' failure to collaborate has resulted in an inefficient use of digital technology. As a result, conflicting information is communicated to Superfund members, which in turn can increase their perception of information complexity and eventually fuel active information avoidance (Sweeney et al. 2010).

Practical Implications

Our findings have several implications for marketers, managers, and policy makers. First, it is critical that service providers such as Superfunds, regulatory bodies, and digital agencies within the Australian Superannuation ecosystem increase collaboration and integration efforts to improve back-office efficiency and enhance consumer service experience and outcomes (Sklyar et al. 2019a). Especially in retirement planning, improved consumer outcomes and service quality are important, as failure to deliver implies that members will not have sufficient savings to fund their retirement, negatively affecting their future well-being (Sorgente and Lanz 2017). For example, the ATO Superannuation dashboard needs to accurately represent consumers' savings balance, which it currently does not in most instances. Digital technology needs to be the foundation of collaboration, with actors having to decide on what information is relevant to members, what information can be personalised, and what information members search for and where. Superfunds should invest in data capturing and analysis capabilities to enhance their personalization efforts.

Second, through resource integration, actors can enhance transparency and build trust within the Superannuation ecosystem (Sklyar et al. 2019a). Members will benefit from increased transparency around fees and fund performance to be better equipped to make informed decisions. Regulators may wish to consider where members go for information about Superfund performance and improve the communication on those platforms. Regulators should also have a greater understanding of innovation efforts and increase collaboration efforts with Superfunds instead of maintaining their current restrictive approach.

Third, Superfunds are advised to analyse the effectiveness of their communication strategies. If members avoid information sent by their Superfund and instead search for information from other sources, some of which may be incomplete or false, the Superfund will likely still be held responsible. Failure to engage consumers in retirement planning will fall back onto the service providers and affect members' future financial well-being. As such, we suggest that Superfund managers increase their efforts to utilize digital technology, big data, and consumer journey mapping to build stronger and more engaged relationships to enhance the overall member experience.

Finally, from a public policy perspective, regulators need to find a balance in their mandate between stifling innovation to protect consumers versus encouraging innovation so that firms can develop a better consumer experience (Australian Government Productivity Commission 2018). Regulators should not seek to primarily introduce regulation, but instead, work together with Superfunds to uncover the underlying reasons for when members encounter problems. Since the cost of uninformed members eventually falls on tax payers, increasing information access and facilitating information flow in the service ecosystem needs to be encouraged (Feltus et al. 2017).

Limitations and Future Research

Despite its contributions and implications, our study has some limitations. First, while we adopt a multi-actor service ecosystem perspective, due to the size and complexity of the Australian Superannuation ecosystem, this study is focused on member and Superfund manager interviews, with a few exceptions (i.e., Superannuation consultant, consumer advocate, and Digital/IT providers). Future researchers may want to build on our findings and investigate the role and responsibilities of other focal ecosystem actors (i.e., regulators, industry bodies, financial planners, or employers) in the digitalization of the Australian Superannuation ecosystem. Additionally, while the researchers attempted to compare consumers' perceptions of their Superfund with the managers' perceptions of the same Superfunds referenced by the members, ensuring this overlap of data proved challenging due to the limited response from Superfunds.

Second, while we are among the first to explore digital communication and information flow in the Australian Superannuation service ecosystem, further investigation is needed. In particular, consumer journey mapping research is still in its infancy, with little empirical work focused on the consumer journey and consumer experience (Lemon and Verhoef 2016). Future research may want to investigate in depth how journey mapping and event triggers can facilitate long-term financial planning behaviour (Altschwager and Evans 2019b). Additionally, the role of data in enabling journey mapping requires further exploration (Micheaux and Bosio 2019).

Third, while the researchers reached theoretical saturation during the interview process, the limited number of interview participants still poses a limitation. Additional qualitative research is needed to account for the perspectives of other ecosystem actors, while a quantitative research study may be suitable to contrast the perspectives of consumers and those of their respective Superfunds. That is, future research may wish to focus more on this interesting aspect and investigate how Superfund managers' perceptions around member needs differ or align with members perceptions and needs.

Lastly, an interviewed Superfund manager asked, "What do people want from a digitally enabled Superfund?" While ample research has focused on identifying factors encouraging or preventing consumer retirement planning and engagement with retirement savings, only recently has the attention shifted towards exploring the role of digital technology in this regard (Hentzen et al. 2022; Hoffmann and Otteby 2018). We therefore suggest researchers conduct both qualitative and quantitative studies to uncover the needs and wants of consumers, with a specific focus on digital technology and credence services such as Superannuation.

Despite these limitations, ours is the first study to illustrate the role of digital technology in the communication and information flow in the Australian Superannuation service ecosystem.

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APPENDIX C - INTERVIEW GUIDES

Service Provider Interviews

QUESTION 1: General

- Has the way in which you communicate with Superfund members changed in the past 5 years, and if so, how?
  - Technology has played a large role in changing the way many businesses interact with their customers. Can you tell me a bit about your organization's approach to going digital, and even more specifically, in terms of a mobile app?
  - What were the underlying motivations?
  - Could you please elaborate on your response? (If necessary)

QUESTION 2: Decision-making process

- Could you talk me through the decision-making process that led to your organization deciding on introducing a mobile app?
  - Who was involved in the process and why?
  - Who designed and developed the mobile app?
  - How involved have you been in the design and implementation of the mobile app?
  - How long did the process take, from initial idea pitch to final product available to the customer?
  - Which challenges did you experience that may have hindered the decision process?

QUESTION 3: Resources

- What motivated you – or your organization – to invest resources into developing a mobile app?
  - What financial resources did you invest in the development of the app?
  - Where there any limitations regarding available resources, if yes, which?

QUESTION 4: Stakeholders & Competitors

- Has the mobile app affected the collaboration with other stakeholders, if so how and why??
  - What challenges and restrictions did you experience from regulators?
  - How did other Superfunds react to you introducing a mobile app? Or was your organization the one to react to your competitor's mobile app?
  - If mentioned ENGAGEMENT: can you define it in your own words?

QUESTION 5: Members' retirement planning

- What do you expect/ hope to see from your members regarding their retirement planning and why is this important from your perspective?
  - How well are they doing that at the moment?
  - How do you know?
  - In your opinion, what age groups are least concerned about their retirement planning?
  - Why do you think that is the case?

QUESTION 6:

- Has anything changed after you introduced the app? If so, what, and why?
  - What are the main benefits your organization has experienced after introducing a mobile app?
  - What are the some disadvantages your organization has experienced after introducing a mobile app?
  - What are the benefits for your members when they use a mobile app?

- What kind of evidence do you have that shows how the members use and experience the app?
- How is the correctness of the information provided on the app being monitored?

QUESTION 7: Future digitalization

- From your perspective, how is a mobile app better/ inferior to a website?
  - What does your organization have planned in the future regarding digitalization and why?

Member Interviews

Topic 1: Digital Technology

- What is your opinion on digital technology? More specifically, how has digital technology impacted your daily life?
  - o What are the positive and negative aspects of digital technology on your life and/or society?
- How many digital devices do you have in your home? *(Define digital devices as equipment containing a computer or microcontroller and can connect to the Internet: desktop, laptop, smartphone, tablet, e-reader, smartwatch, voice-activated devices)*
  - o Which do you use most frequently and for what?
- How much time do you spend on your smartphone daily (approximately)?
  - o What types of apps do you use most frequently? *(Present participant with sheet displaying the types of apps?)*
  - o How frequently do you use financial apps? *(May need to explain what you 'include' as a financial app)*
  - o Do you prefer a desktop or your smartphone when searching for information?
  - o How important is it for you that a company's website is mobile friendly?

Topic: Future & Retirement

- Can you describe what you imagine your life will look like in 20 – 30 years, including where you will be, your lifestyle, work, and leisure?
- What excites you when you think about the future?
- What concerns you about the future?
- How do you feel about retirement? *(Probe: Why)*
- How often do you think about your retirement?
  - o What can your Superfund do to make you more involved with your Superannuation?
  - o What can the Government do to make you more involved?
  - o What can your employer do to make you more involved?
- In your opinion, have you noticed any changes in how your Superfund communicates with you over the past few years? (i.e., frequency, channel, tone?)
- To what extent do you think your Superfund uses digital technology well?
- Why do you think you Superfund has gone more digital/ has not increased its use of digital technology?
- When using your Superfund's app or website and you come across a technical issue, how does that affect your (1) view of your Superfund (2) overall digital experience? *(I.e., Quickly frustrated, search for other information source, submit complaint)*
- How often do you think about how much work goes into developing digital experiences?
- How expensive do you think is it for your Superfund to provide you with the digital service?

Topic: Information Complexity

- In your own words, can you explain the Australian pension and Superannuation system?

- How much do you know about what happens to your retirement savings, that is, what is the role of the Superfund?
- How easy or difficult do you perceive pension-related information?
- If you have any questions about retirement or your Super, where would you search for answers?
- Which source of information do you think is more reliable? Why is this? *(Source examples: government, third-party, family, superfund)*
- Which source of information is most easily accessible by you? Why is this?
- What challenges do you experience when you are looking for retirement-related information?
- Whose responsibility is it to educate you on retirement matters, and why? *(e.g., you (individual), school, your workplace, pension provider or the government/ independent organizations?)*
- Should your employer be more involved in your super? Perhaps pay the administration fees, pay higher contributions, or organize workshops?

Topic Personalisation & Trust

- To what extent do you feel that your Superfund has your best interest at heart?
- How much do you trust your Superfund?
- How can your Superfund make you trust them more?
- How much control do you want over your retirement savings investment? How much control should your Superfund have?
- How much do you care about where your Superfund invests your savings?
- Do you care more about financial returns or about what companies your Superfund invests in? Why?
- Would you like your interaction with your Superfund to be more personalised? If so, what would that entail?
- How do you feel about providing more personal information to your Superfund to enable more tailored communication? (I.e., marital status, info about lifestyle, family status, health history)
    - Do you trust your Superfund in managing your retirement savings?
    - Do you trust your Superfund in keeping your information secure?
    - Do you trust your Superfund in mitigating investment risks?
    - Do you trust your Superfund in charging you appropriate fees?
    - Do you trust your Superfund in being transparent in their actions?
- Any last remarks or comments on the Superannuation systema and your Superfund's digital presence?

APPENDIX D – ETHICS APPROVAL

THE UNIVERSITY of ADELAIDE

RESEARCH SERVICES
OFFICE OF RESEARCH ETHICS, COMPLIANCE AND INTEGRITY
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CRICOS Provider Number 00123M

Our reference 34409

04 May 2020

Professor Arvid Hoffmann
Marketing

Dear Professor Hoffmann

ETHICS APPROVAL No:	H-2020-064
PROJECT TITLE:	Mobile engagement design and retirement planning

The ethics application for the above project has been reviewed by the Low Risk Human Research Ethics Review Group (Faculty of Arts and Faculty of the Professions) and is deemed to meet the requirements of the *National Statement on Ethical Conduct in Human Research 2007 (Updated 2018)* involving no more than low risk for research participants.

You are authorised to commence your research on:	04/05/2020
The ethics expiry date for this project is:	31/05/2023

NAMED INVESTIGATORS:

Chief Investigator:	Professor Arvid Hoffmann
Student - Postgraduate Masters by Research:	Miss Janin Karoli Hentzen
Associate Investigator:	Dr Rebecca Marie Dolan

CONDITIONS OF APPROVAL: Thank you for addressing the feedback. The revised ethics application provided on the 29th of April 2020 has been approved.

Ethics approval is granted for three years and is subject to satisfactory annual reporting. The form titled Annual Report on Project Status is to be used when reporting annual progress and project completion and can be downloaded at http://www.adelaide.edu.au/research-services/oreci/human/reporting/. Prior to expiry, ethics approval may be extended for a further period.

Participants in the study are to be given a copy of the information sheet and the signed consent form to retain. It is also a condition of approval that you immediately report anything which might warrant review of ethical approval including:

- serious or unexpected adverse effects on participants,
- previously unforeseen events which might affect continued ethical acceptability of the project,
- proposed changes to the protocol or project investigators; and
- the project is discontinued before the expected date of completion.

CHAPTER FOUR: WHICH CONSUMERS ARE MORE LIKELY TO ADOPT A RETIREMENT APP AND HOW DOES IT EXPLAIN MOBILE TECHNOLOGY-ENABLED RETIREMENT ENGAGEMENT?

Statement of Authorship

Title of Paper	Which consumers are more likely to adopt a retirement app and how does it explain mobile technology-enabled retirement engagement?
Publication Status	☒ Published ☐ Accepted for Publication ☐ Submitted for Publication ☐ Unpublished and Unsubmitted work written in manuscript style
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Principal Author

Name of Principal Author (Candidate)	Janin Hentzen		
Contribution to the Paper	Conceptualization of research topic, literature review, data collection (survey), data analysis and interpretation, as well as writing of manuscript.		
Overall percentage (%)	65%		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	08/03/2022

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);

ii. permission is granted for the candidate in include the publication in the thesis; and

iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Prof. Arvid O. I. Hoffmann		
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Signature		Date	24/02/2022

Name of Co-Author	Dr. Rebecca M. Dolan		
Contribution to the Paper	Assisted with and supervised conceptualization of research topic and manuscript evaluation and revision. Percentage of contribution: 15%		
Signature		Date	04/03/2022

Please cut and paste additional co-author panels here as required.

Abstract

Although planning for retirement is fundamental for consumers' future well-being, individuals often fail to engage with it. Retirement engagement refers to one's initial interest in and active planning for one's retirement. In this study, we focus on mobile technology-enabled retirement engagement, operationalized as consumers' perception of how a retirement app can help them plan for retirement. While rapid advances in digital platforms and mobile technology show promising use to the financial services sector, little is known about the adoption drivers of mobile technology in stimulating retirement engagement as a unique low-involvement, yet high-importance context. We address this gap in the existing literature by analysing survey data from a representative sample of 440 Australian pension fund members. We find that consumers' financial self-efficacy, perceived financial security, consideration of future consequences, retirement planning involvement, and perceived usefulness have direct effects on their anticipated engagement with a mobile retirement app as well as indirect effects through their intention to adopt the app (financial self-efficacy and consideration of future consequences only have direct effects). We also find that mobile computing self-efficacy, prior finance app use, and perceived ease of use only have indirect effects through consumers' intention to adopt the app. Notably, the association between adoption intentions and anticipated engagement is stronger for those closer to retirement.

Keywords: Adoption Intentions; Consumer Financial Decision-Making; Mobile Apps; Retirement Engagement; Retirement Planning.

Introduction

"Retirement planning is undergoing a revolution as advances in financial technology proceed."

(Agnew and Mitchell 2019, p. 8)

Around the world, societal and economic factors, such as increased life expectancies and decreased employer contributions and governmental financial support, place increasing pressure on pension systems and highlight individuals' need to pro-actively plan for retirement (Aegon 2019; Anderson et al. 2016; Mercer 2018). However, making informed decisions about retirement goals and future needs are some of the most complex decisions that individuals make in their life. Planning for retirement involves overcoming several challenges, including low retirement knowledge, temporal separation (i.e., saving now, receiving benefits later), and product and investment performance uncertainty and risk (Lusardi and Mitchell 2011). Moreover, individuals need the ability to identify future needs and preferences related to their desired lifestyle, family and housing situation, and expected health (Dellaert 2010).

Aforementioned challenges create a barrier to effective retirement planning and are typically seen as underlying reasons for individuals' generally low retirement engagement and insufficient retirement saving, which can have detrimental effects on their future well-being (Deetlefs et al. 2018; Eberhardt et al. 2019). We posit that retirement engagement describes an individual's interest in and active planning for one's retirement, including behaviours such as choosing suitable pension fund provider(s), investment portfolios and insurance plans, monitoring employer contributions and making additional voluntary contributions, and assessing portfolio performance and management or account fees (Bateman et al. 2014; Deetlefs et al. 2018). Academics, governments, and business practitioners are giving growing attention to initiatives aimed at encouraging individuals to increase their retirement engagement and make timely and informed decisions about (managing and accumulating) their retirement savings (Aegon 2019; Atkinson et al. 2012). For example, Loibl et al. (2018) investigated consumer responses to regulatory changes implemented by the UK government, which seeks to encourage individuals to take greater responsibility in making pension-related financial decisions. The authors find positive overall consumer sentiment, stating that little regulation around access to pension savings—and the increased freedom in decision making—motivated them to take out larger pension lump sums, highlighting that the larger the lump sum, the more likely the individual is to continue saving or investing the money. In addition, other recent literature suggests that developments in digital financial technology could help overcome the generally low engagement with retirement (Brüggen et al. 2019; Dellaert 2010).

In particular, pension fund members progressively seek just-in-time information and access to retirement products and services at their convenience. Accordingly, pension funds start to invest substantial resources in the creation and implementation of online communication tools and platforms (IQ Group 2019; OECD 2017) to improve consumers' retirement awareness and engagement (Brüggen et al. 2019) and attract new members (PwC & ASFA 2014). Pension funds can leverage online technology to communicate with members in a more personalized manner, provide faster access to and a more convenient location for up-to-date financial information, encourage more account management and fee transparency, and support a more efficient management of members' personal retirement savings (Dellaert 2010; OECD 2017).

However, research on how digital technology can impact and shape consumers' retirement engagement and the retirement planning process is lacking to date. Prior research is limited to an investigation of personal finance blogs (Hoffmann and Otteby 2018), online pension planners (Brüggen et al. 2019), and interactive online decision aids (Dellaert 2010) (see overview in Table 10) but has not addressed mobile technology-enabled retirement engagement. We address this gap in the existing literature through an investigation of key adoption and engagement drivers of a mobile retirement app using data from a representative sample of 440 Australian pension fund members. Having one of the most developed pension systems globally (Mercer 2018), and given the country's high mobile app usage (Statista 2018), the Australian retirement income system ("Superannuation" or "Super") provides an ideal context for our research. Moreover, despite retirement saving being compulsory for all working Australians, there still is a need to increase their retirement engagement to improve their future well-being by ensuring these individuals meet savings goals, do not pay excess fees, have appropriate insurance cover, and avoid underperforming funds (e.g., Anderson et al. 2016; Bateman et al. 2014; Deetlefs et al. 2018). Prior studies have established the link between propensity to plan and subjective financial well-being, highlighting the need for further research (Xiao and O'Neill 2017).

Against this backdrop, the aim of our paper is to identify the drivers of mobile retirement app adoption and how it explains pension fund members' technology-enabled retirement engagement, in particular their anticipated engagement with a mobile retirement app to plan for one's retirement. We build on and extend the Technology Acceptance Model (TAM) (Davis 1989) by integrating theoretical concepts from the retirement planning involvement (Donaldson et al. 2010; Hershey et al. 2007), digital customer engagement (Brodie et al. 2011; Eigenraam et al. 2018; van Doorn et al. 2010), and mobile financial service technology adoption literature (Hershey et al. 2010; Schierz et al. 2010; Teo et al. 2015; Topa et al. 2009). Specifically, we investigate whether factors related to consumers' perceived skills (i.e., financial self-efficacy; mobile computing self-efficacy; prior finance app use), perceived relevance (i.e., consideration of future consequences; retirement planning involvement; perceived usefulness of the retirement app), and information avoidance (i.e., perceived financial security; perceived ease of use of the retirement app) affect their anticipated retirement app engagement directly as well as indirectly through the intention to adopt a retirement app. We also examine whether the relationship between adoption intentions and anticipated engagement is moderated by consumers' retirement proximity.

Our paper makes both theoretical and practical contributions to the extant literature. Theoretically, we contribute to multiple literature streams, as summarized in Table 10. Indeed, our paper is positioned at the intersection of three main research areas, as illustrated in Figure 9. In particular, we contribute to the specific topic of mobile technology-enabled retirement planning by drawing on literature from three related domains, namely (i) retirement planning involvement, (ii) mobile financial service technology adoption, and (iii) digital customer engagement. First, we contribute to the retirement planning involvement literature by answering the call for further research on how technology shapes the retirement process (Henkens et al. 2018). Following the rapid development of smartphones and apps, managing one's personal finances has become increasingly convenient, yet how these developments can support individuals with retirement planning as well as how technology can enhance the individual−business nexus has not yet been investigated in detail (Henkens et al. 2018). As adequate retirement planning is becoming increasingly important and a personal responsibility of individuals, pension funds look for potential solutions to motivate individuals to increase their engagement with and efforts to plan for retirement. We address this question by providing empirical evidence on the factors driving adoption of and engagement with mobile retirement apps.

Second, we contribute to the mobile financial service technology adoption literature by demonstrating the relevance of technology in facilitating customer engagement in a low-involvement, but high-importance context. Although prior studies have investigated the antecedents of mobile financial service adoption in general (Hsu et al. 2011; Lee et al. 2012), none have accounted for mobile app adoption drivers in the retirement planning context. This is an important omission, given that individuals are requesting mobile apps from their pension providers, yet the industry has been slow to act on this request, citing a lack of evidence in the usefulness of such apps in assisting individuals with retirement planning (IQ Group 2019). This study addresses this gap in the literature and is the first to investigate the drivers of mobile retirement app engagement, which provides useful insights for other low-involvement, but high-importance industries seeking to increase customer engagement with digital tools, such as health funds.

Third, we contribute to the digital customer engagement literature by generating insights into how mobile technology can help improve individual's interest in and engagement with retirement planning. Prior literature has focused on investigating individuals' online brand engagement (Chan et al. 2014), value co-creation (Luo et al. 2015), and social media engagement (Dolan et al. 2016). However, these types of engagement are not representative of the consequential and complex decision-making context of retirement planning. For example, providing feedback to a company via an online review is a less cognitively- and emotionally-taxing task compared to deciding on how much to save for possible future health issues in retirement. Although technology-enabled retirement planning engagement is still in its conceptual infancy, we follow the common direction of studying customer engagement with mobile apps (Kim et al. 2013).

Practically, our results provide valuable insights for policy makers and pension funds interested in the contingencies of mobile apps in facilitating retirement planning engagement. In particular, we contribute to a better understanding of the factors driving individuals' adoption of and engagement with mobile retirement apps. While existing industry and policy initiatives have focused on educational and financial literacy programs (Financial Health Network 2020), several studies suggest that education alone may not be sufficient to change individuals' financial behaviour (Lusardi and Mitchell 2007). Additionally, literacy programs have often relied on a 'one-size-fits-all' strategy, which disregards individuals' diverse saving patterns and varying degrees of financial literacy. Alsemgeest (2015) suggests that financial education can aide individuals with managing day-to-day finances, however, investment and retirement decisions require more expert knowledge. Against this backdrop, although retirement education remains a necessary tool for ensuring that individuals acquire the relevant skills needed to plan for their future financial well-being, our results suggest that individuals' perceived skills, perceived relevance, and information avoidance tendencies are key to understand the drivers of consumers' retirement engagement.

The remainder of this paper is structured as follows. First, we discuss the theoretical background. Second, we present our conceptual framework and hypotheses. Third, we report on the data and method. Fourth, we present results of our PLS-SEM analysis. Fifth, we discuss the results and their theoretical and practical implications, as well as future research opportunities.

Figure 9. Overlap of our study with related research areas

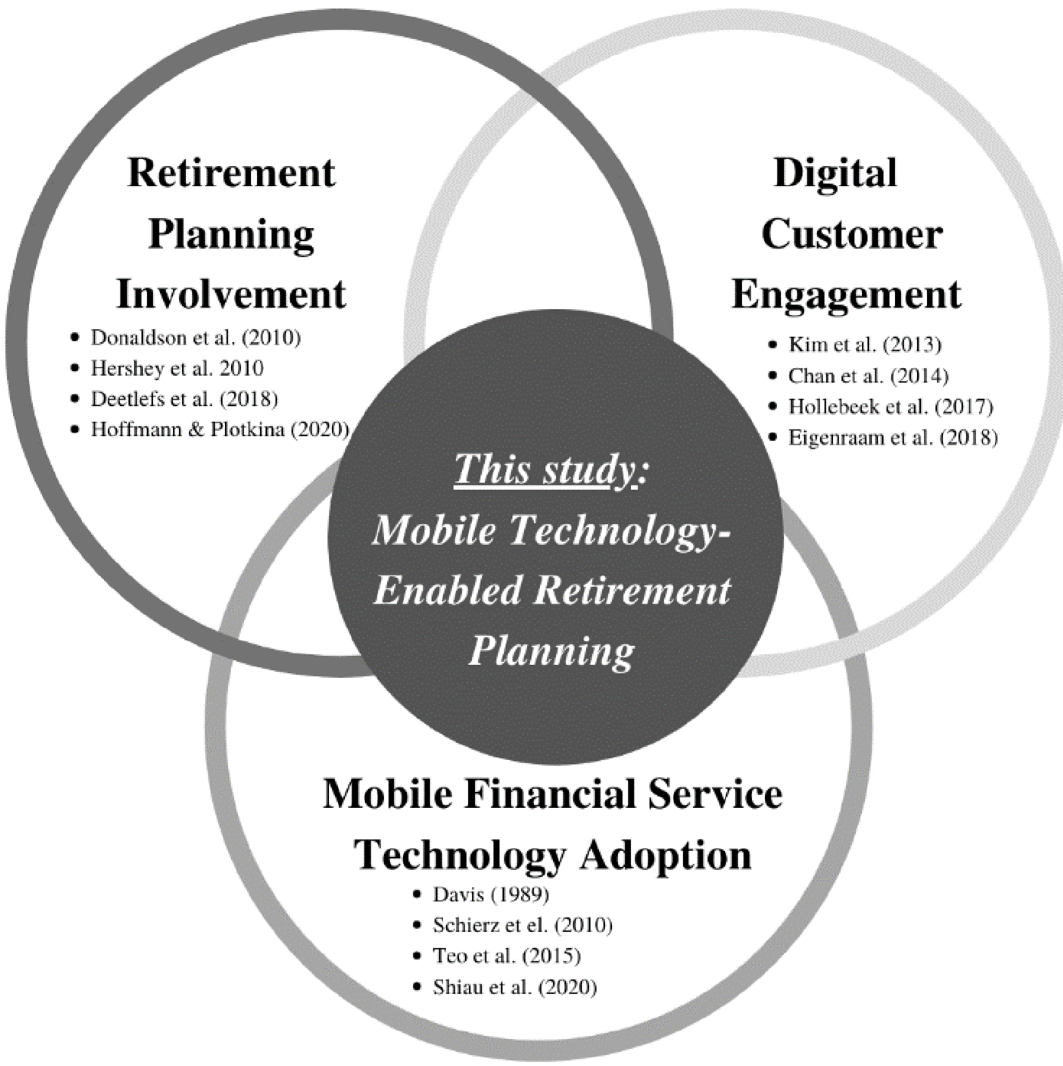


Table 10. Our study relative to related literature

			Included Variables						Estimated Models	
General Topic	**Research Focus**	**Authors**	Time Perspective	Self-Efficacy	Financial Security	Retirement Planning Involvement	Adoption Intention	(Anticipated) Engagement	Moderators	Mediators
		Current Study	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Retirement Proximity**	**Intention to Adopt**
Technology-enabled retirement planning	Role of technology on the retirement planning process	• Dellaert (2010)	No	No	No	Partial [a]	No	No	N/A	N/A
		• Breit and Salomon (2015)	No	No	No	Yes	No	No	N/A	N/A
		• Hoffmann and Otteby (2018)	No	No	Partial [b]	No	Yes	No	N/A	Perceived Helpfulness
		• Brüggen et al. (2019)	No	No	No	Moderator [c]	Yes	Yes	N/A	Involvement
Retirement planning involvement	Antecedents and consequences of retirement planning involvement	• Donaldson et al. (2010)	No	No	No	Yes	No	No	N/A	Mastery (Personal Control)
		• Deetlefs et al. (2018)	No	No	No	No	No	Partial [d]	N/A	N/A
		• Hoffmann and Plotkina (2020)	No	Utilized as moderator	Utilized as moderator	No	Partial [e]	No	Perceived Financial Security, Age, Goal Construal & Self-Control	Willingness to Learn & Retirement Self-Efficacy
Mobile financial service technology adoption	Antecedents of mobile financial service adoption	• Schierz et al. (2010)	No	No	No	No	Yes	No	N/A	N/A
		• Yang et al. (2012)	No	No	No	No	Yes	No	N/A	Relative Advantage & Perceived Risk
		• Teo et al. (2015)	No	No	No	No	Yes	No	Experience	N/A
		• Shiau et al. (2020)	No	Yes [f]	No	No	Yes	No	N/A	Expectation Confirmation
Digital customer engagement	Characteristics of online or digital customer engagement	• Chan et al. (2014)	No	No	No	No	Yes	Antecedent of intentions	N/A	N/A
		• Hollebeek et al. (2017)	No	No	No	No	No	Partial [g]	N/A	N/A
		• Eigenraam et al. (2018)	No	No	No	No	No	Partial [h]	N/A	N/A

[a] Dellaert (2010) considered involvement levels with pension products.
[b] Hoffmann and Otteby (2018) examine perceived financial uncertainty, of which perceived financial security can be used as a proxy.
[c] Brüggen et al. (2019) utilizes the concept of involvement in relation to time-bound interaction with the online service.
[d] Deetlefs et al. (2018) investigated engagement with retirement savings through non-default behavior.
[e] Hoffmann and Plotkina (2020) measured intentions in relation to retirement planning and not technology adoption.
[f] Shiau et al. (2020) examine two types of self-efficacy, namely financial self-efficacy, and technological self-efficacy.
[g,h] the authors adopted the concept of digital customer engagement.

Theoretical Background

In this study, we focus on individuals' anticipated engagement with a mobile retirement app to plan for their retirement. The topic of retirement engagement has received scant attention in previous literature, resulting in a lack of a consistent definition and conceptualization. Initial attempts to conceptualize retirement engagement commenced only recently. For example, argue that retirement engagement comprises "engagement with retirement savings through nondefault behaviour: if members make additional voluntary contributions", while Brüggen et al. (2019, p. 491) define retirement engagement as "behaviour and behavioural intentions […] [that] extend beyond transaction and examine several aspects of acquiring more information about retirement planning in general or a specific personal situation". Most recently, Eberhardt et al. (2020, p. 3) note that "beyond the purchase of a pension product, behavioural engagement implies ongoing choices about the contribution rate, risk profile, or investment portfolio." We develop our understanding of technology-enabled retirement engagement by building on prior literature from three research areas, which provide the theoretical underpinning of this study and are discussed below: (i) retirement planning involvement, (ii) mobile financial service technology adoption, and (iii) digital customer engagement (Fig. 1).

Retirement Planning Involvement

The literature stream on retirement planning involvement draws on conceptualizations of consumer involvement (Laurent and Kapferer 1985) and retirement planning (Hershey et al. 2007; Hershey and Mowen 2000). Although the concept of consumer involvement has been extensively investigated in prior consumer behaviour and marketing literature, with seminal contributions by Zaichkowsky (1985) and Laurent and Kapferer (1985), definitions of the concept vary. However, most research agrees that the focus is on personal relevance (Bienstock and Stafford 2014). Although not a theory in itself, the involvement construct has been applied to a number of research domains, including retirement planning (Hershey and Mowen 2000). In this study, we propose that delayed involvement with the topic of retirement can result in psychological distress, including increased anxiety and worry, which negatively affects the quality of retirement preparedness (planning). Specifically, involvement is considered an antecedent of customer engagement, where both are based on the needs and values of the individual, which in turn motivates them toward a specified object or behaviour (Hollebeek 2011).

Regarding retirement planning, numerous studies have investigated post-retirement decision making, but limited studies have examined *pre-retirement* financial planning (Hershey and Mowen 2000). While the factors influencing individual's preparedness are numerous, for the purpose of deciding on the key factors examined in this study we draw on two models: (i) the retirement planning model by Hershey et al. (2007) and (ii) the retirement belief model by Eberhardt et al. (2019). As retirement planning is shaped by various psychological, social, and demographic factors, mobile technology-enabled retirement planning is assumed to be influenced accordingly. The retirement planning model introduced by Hershey et al. (2007) seeks to explain individuals' actions regarding retirement planning and saving as a result of three underlying motivations, which include personality, cognitive, and motivational factors. Amongst other things, these authors suggest that future time perspective, personal self-beliefs, and knowledge affect individuals' financial planning activity levels and savings contributions. The retirement belief model (Eberhardt et al. 2019) identified several other antecedents to pension information search and retirement planning, including individuals' assessment of their current savings levels, the perceived seriousness of their financial position in relation to retirement, and their perceived capability to perform the tasks required for retirement planning.

Mobile Financial Service Technology Adoption

One of the most well-known theories stemming from the technology adoption literature is the Technology Acceptance Model (TAM) (Davis 1989). Conceptually, the TAM proposes that the perceived usefulness and ease of use of a particular technology determine an individual's intention to use, which again influences the actual use of a given technology. While the TAM has proven useful in explaining behavioural intentions, recent studies have suggested that the TAM should be extended to make it more domain-specific and thus increase its explanatory power (Kim et al. 2014; Legris et al. 2003). Accordingly, various extensions of the model have been developed to make it more relevant to specific technology domains, including mobile (financial) services (Akturan and Tezcan 2012; Baptista and Oliveira 2015; Schierz et al. 2010). By integrating variables from related theoretical perspectives, researchers can gain a better understanding of consumer adoption and use of technology (Nysveen 2005).

Digital Customer Engagement

To establish our definition of "mobile app engagement", we consider the extensive research in marketing on customer engagement (CE), including its conceptualization and operationalization. CE is defined as "a psychological state that occurs by virtue of interactive, co-creative customer experiences with a brand" (Brodie et al. 2011, p. 260). Van Doorn et al. (2010) argue that customer engagement is an iterative process that extends beyond product or service consumption. Due to rapid developments in technology and digital landscapes, some authors further conceptualize customer engagement with digital platforms and in the virtual sphere, defining digital engagement as "manifestations of consumers' motivational states of […] engagement […], namely cognitive […], emotional […], and behavioural […] engagement" (Eigenraam et al. 2018, p. 104). For the purpose of this study, we focus on mobile app engagement, a sub-category of digital customer engagement, defined as "user interaction with their devices to deliver experiences that give them value and satisfaction […] which influences their cognitive and affective user experience behaviours in real time" (Kim et al. 2013, p. 364).

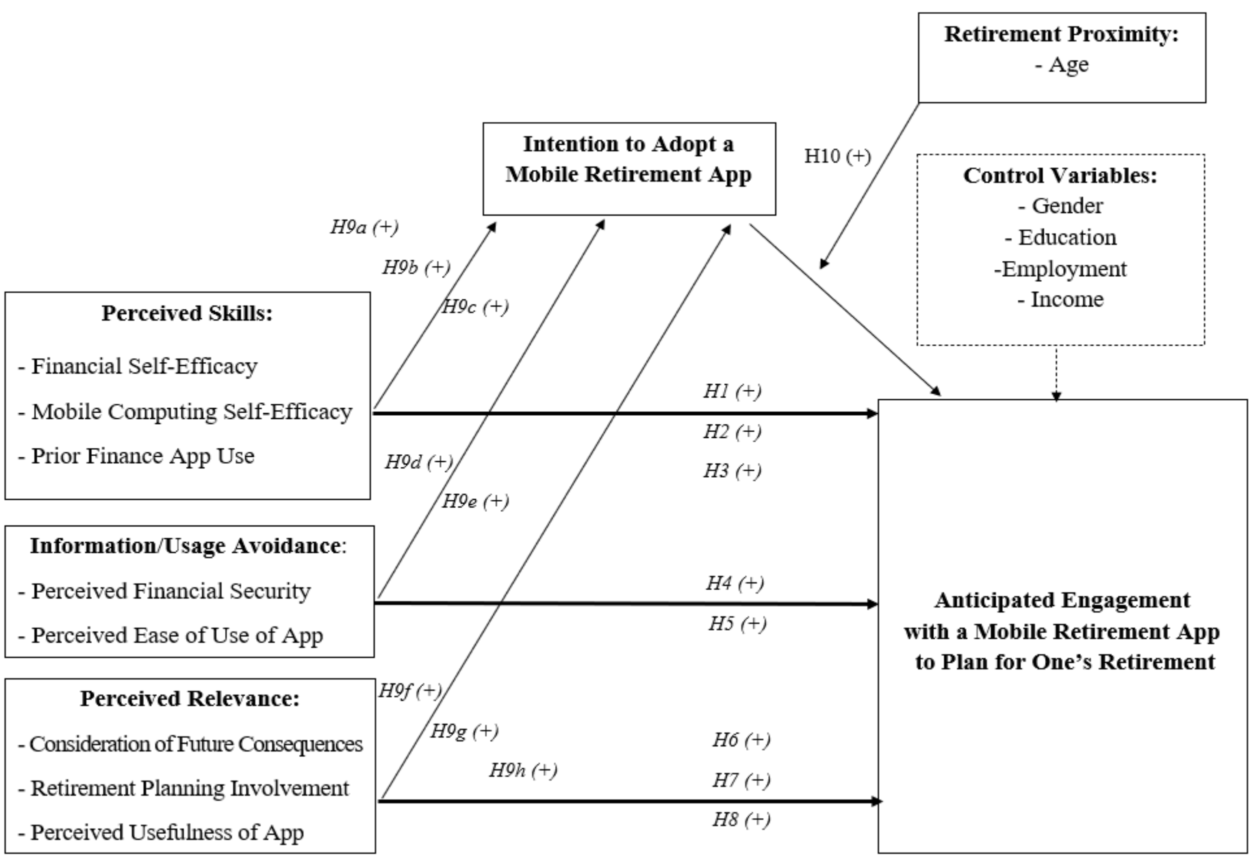
While studies on customer engagement are well-documented (Barari et al. 2020), the literature on mobile app engagement is still limited (Kim et al. 2013). In this study, we operationalize individuals' anticipated engagement with a mobile retirement app to plan for their retirement as consisting of their cognitive, emotional, and behavioural engagement with the app. That is, we explore how using a mobile retirement app could help individuals think more about, feel better about, and actively manage or plan for their retirement. We posit that mobile engagement includes initial adoption and continued/habitual usage of a mobile app (Kim et al. 2013; Wang 2020).

Conceptual Framework and Hypotheses Development

Based on the preceding theoretical background, we utilize TAM as a starting point for the development of our conceptual framework and extend it with additional constructs relevant for retirement planning involvement and (mobile) customer engagement. In doing so, we follow Bagozzi's (2007) call for additional domain-relevant research that broadens and deepens the understanding of technology adoption. In this study, we focus on individuals' anticipated engagement with a mobile retirement app to plan for their retirement, which will be operationalized through the measurement of individual's anticipated cognitive, emotional, and behavioural engagement with the app (see Table 13). We propose a conceptual framework that theorizes mobile retirement app adoption and engagement antecedents and contingencies (Figure 10). In particular, we examine the effect of a set of five psychological constructs and three technology-related constructs on consumers' adoption intentions regarding—and anticipated engagement with—a mobile retirement app. In the context of retirement planning, we extend the TAM with constructs related to an individual's perceived skills (i.e., financial self-efficacy; mobile computing self-efficacy; prior finance app use), information/usage avoidance tendencies (i.e., perceived financial security;) and perceived relevance (i.e., consideration of future consequences; retirement planning involvement). While some of these constructs have been examined within the retirement planning context, most were studied either in isolation or in a non-technology related context. The proposed conceptual framework thus seeks to combine technology adoption with financial decision-making behaviours, thereby highlighting their relational influence on one another within an integrated, overarching framework.

Additionally, our framework proposes individuals' intention to adopt the mobile app as a mediator of the relationship between aforementioned psychological and technological constructs and anticipated retirement engagement. Lastly, individuals' retirement proximity (i.e., their age) is proposed as a moderator of the relationship between their adoption intentions and anticipated retirement engagement.

Figure 10. Conceptual framework and hypotheses



Perceived Skills

Regarding the influence of perceived skills, previous studies emphasize the importance of self-efficacy in explaining human behaviour and motivation (Asebedo and Payne 2019; Hoffmann and Plotkina 2020). Recent literature suggests that different behavioural domains require different types of self-efficacy (Cassar and Friedman 2009; Shiau et al. 2020). In the context of this study, individuals are expected to evaluate their ability to manage, control, and influence retirement planning capabilities (financial self-efficacy), as well as their mobile app usage (mobile computing self-efficacy). Moreover, we examine the role of individuals' prior experience with using a finance app. Each of these factors will be discussed in detail below.

Financial self-efficacy. One of the main barriers to retirement engagement is the perceived complexity of retirement-related information and decision-making (Hoffmann and Plotkina 2020). While some individuals may have recognized the need to plan for retirement, they often fall short of executing the required behaviour. This may be due to a perceived lack of ability (both subjective and objective) and financial management skills or increased financial stress, which negatively impact long-term decision-making (Asebedo and Payne 2019). Financial self-efficacy (FSE), defined as an individual's subjective belief in their ability to successfully perform financial management behaviours is a strong indicator of their intentions and motivation to execute a financial behaviour (Netemeyer et al. 2018). A such, individuals with higher FSE have more confidence in their ability to look for and apply financial information, set higher goals, and persevere through adverse economic events (Asebedo and Payne 2019; Eberhardt et al. 2019). Similarly, we expect that the more favourable individuals perceive their financial management capabilities, the more likely they are to actively engage with retirement planning. The higher an individual's financial self-efficacy, the more capable they will feel in acquiring and applying retirement-related information and actively engage with planning for retirement. We hypothesize:

H1: FSE positively affects individuals' anticipated engagement with a mobile retirement app.

Mobile computing self-efficacy. Mobile retirement planning app engagement requires an individual to not only feel comfortable and capable about managing their finances, but also hold favourable views regarding their ability to use a mobile device. Mobile computing self-efficacy (MCSE) is defined as individuals' perceived personal ability to use mobile technology to perform a desired task and overcome technological barriers (Hong et al. 2014; Keith et al. 2015). Higher MCSE reduces technology anxiety (Fagan et al. 2004) and increases individuals' beliefs that they can effectively use wealth management apps (Hong et al. 2014; Shiau et al. 2020). Therefore, we expect individuals who hold favourable beliefs towards their ability to use mobile technology to be more likely to engage with mobile retirement apps. We thus hypothesize:

H2: MCSE positively affects individuals' anticipated engagement with a mobile retirement app.

Prior finance app use: Whereas FSE and MCSE refer to an individual's subjective knowledge or skills, we also assess individuals' objective knowledge or skills through their prior finance app use (PFAU). That is, while self-efficacy captures individuals' perceived ability, prior finance app use gauges individuals' demonstrated ability to use a financial app. As such, individuals who have used mobile finance apps are presumed to be more likely to employ their knowledge gained from previous experience to form their intentions and behaviour (Taylor and Todd 1995). Individuals' experience can be shaped in two ways: it can either stem from direct experience with a focal technology or service, or it can be formed through prior experience with several similar technologies or services (Wang et al. 2012). Hence, we hypothesize:

H3: PFAU positively affects individuals' anticipated engagement with a mobile retirement app.

Information/Usage Avoidance

According to information avoidance theory, individuals high in avoidance behaviour typically exhibit "behaviour intended to prevent or delay the acquisition of available but potentially unwanted information" (Sweeney et al. 2010, p. 341). While avoidance can be temporary, some individuals end up avoiding the information altogether, which is not without consequence. Individuals will avoid information acquisition if the information is inconsistent with their prior knowledge or beliefs and if it is likely to increase anxiety (Golman et al. 2017). While information avoidance may be a necessary part of human behaviour, it does have a negative effect on various areas, such as preventative health and financial planning (Narayan et al. 2011). For the purpose of this study, we utilize perceived financial security (PFS) as well as perceived ease of use (PEOU) as proxies for individuals' information and usage avoidance tendencies.

Perceived financial security: PFS refers to an individual's evaluation of their present and desired future financial well-being (Netemeyer et al. 2018; Strömbäck et al. 2017) and has been identified as a key determinant of retirement satisfaction (Petkoska and Earl 2009). The extent to which an individual seeks to acquire retirement related information likely depends on their perceived financial security at present and in the future. That is, we expect individuals with lower PFS to be less likely to engage with a mobile retirement app, as this behaviour would present them with potentially anxiety-inducing information (e.g., the realization that they need to save much more than they initially anticipated). In contrast, we hypothesize individuals with higher PFS to be more likely to engage with a mobile retirement app, as they will be less inclined to avoid the retirement-related information which they could access through the app:

H4: PFS positively affects individuals' anticipated engagement with a mobile retirement app.

Perceived ease of use: Perceived ease of use (PEOU) refers to "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320). In the context of this study, PEOU refers to individuals' assessment of using a mobile retirement app as not requiring a lot of time and effort. Prior studies have established PEOU's effect on behavioural intentions, but few investigate its effect on actual use (Susanto et al. 2016; Venkatesh et al. 2003;

Zhang et al. 2012). In line with prior studies, we anticipate individuals who perceive a mobile retirement app to be easy to use to exhibit less usage avoidance behaviour and thus be more likely to engage with the app (McLean 2018). As such, we hypothesize:

H5: PEOU positively affects individuals' anticipated engagement with a mobile retirement app.

Perceived Relevance

Regarding the perceived relevance of a mobile retirement app for consumers, it is important to account for how much individuals consider the future consequences of their behaviour, how involved they are with the topic of retirement planning, and their judgement of the perceived usefulness of the mobile retirement app. We discuss each of these factors in detail below.

Consideration of future consequences. One of the most noteworthy aspects of retirement engagement is the temporal separation between the present and retirement as an occurrence in the (distant) future (Dellaert 2010). Individuals face economic (i.e., recessions), physical (i.e., unexpected health issues), and social (i.e., technological advances) uncertainty regarding retirement. Additionally, a main challenge of planning for retirement is the requirement of individuals to consciously identify their future needs and preferences (e.g., what will my future family/housing situation be, will I encounter any health concerns?) (Dellaert 2010). Complex decision-making, such as financial and retirement planning, is influenced by individuals' subjective evaluation of and trade-off between short-term sacrifices and long-term benefits (Howlett et al. 2008), which depends on their consideration of future consequences (CFC).

CFC is conceptualized as a personality trait that captures "the extent to which people consider the potential distant outcomes of their current behaviours and the extent to which they are influenced by these potential outcomes" (Strathman et al. 1994, p. 743). Prior studies find that individuals with high CFC are more prone to engage in personally-beneficial behaviours (e.g., regular exercise, less impulse buying) and exhibit more self-control, as they assign more importance to future behavioural consequences (Joireman et al. 2008). Additionally, individuals with high CFC are more likely to plan for their (financial) future, including retirement (Howlett et al. 2008). Hence, we hypothesize individuals with higher levels of CFC (who are thus more future-oriented) to be more likely to exhibit stronger anticipated engagement with mobile retirement apps as these apps could help them prepare for their financial future:

H6: CFC positively affects individuals' anticipated engagement with a mobile retirement app.

Retirement planning involvement. The consumer behaviour literature has widely explored the concept of involvement (Jiang et al. 2010; Wills and Ross 2007). Zaichkowsky (1985, p. 342) defines involvement as "a person's perceived relevance of the object based on inherent needs, values, and interest". Recent empirical research supports a positive relationship between retirement planning involvement (RPI) and individuals' retirement preparedness (Topa and Valero 2017). Wills and Ross (2007) suggest that to increase an individual's retirement planning engagement, attention should be given to increasing retirement savings involvement. While related, involvement is viewed as an antecedent to engagement (Hollebeek 2011). High involvement is assumed to result in more complex cognitive activity (Bennett et al. 2005), which is important as retirement planning requires individuals to consider various issues, including investment choices, management fees, and life insurance (Deetlefs et al. 2018). We hypothesize:

H7: RPI positively affects individuals' anticipated engagement with a mobile retirement app.

Perceived usefulness. According to Davis (1989, p. 320), perceived usefulness (PU) can be described as "the degree to which a person believes that using a particular system would enhance his or her job [i.e., task] performance." Performance refers to whether mobile retirement apps can make retirement planning less boring and less daunting. Due to increasing customer expectations and technological developments, usefulness of a technology is continuously cited as one of the most important determinants of technology adoption (King and He 2006). In terms of mobile app adoption, the sheer number of apps available competing for individuals' time and attention further warrants the need for a mobile app to be useful. While PU has extensively been shown to significantly affect adoption intentions (Yang 2015), limited research has studied the effect of PU on engagement (McLean 2018). Thus, we hypothesize:

H8: PU positively affects individuals' anticipated engagement with a mobile retirement app.

Mediating Role of Adoption Intentions

Behavioral intentions capture individuals' motivation and conscious effort that they are willing to exert to perform a given behaviour (Ajzen 1991). The harder individuals are willing to try (i.e., the stronger their intention), the more likely they are to execute the desired behaviour. Contemporary theories of human behaviour and motivation (i.e., TPB, TAM, and UTAUT), as well as ample empirical studies, propose that one's behavioural intention is a proximal cause of behaviour (Cao et al. 2020; Stocchi et al. 2019). In the context of mobile app engagement, most studies have employed adoption intentions as a proxy for actual behaviour such as engagement intentions (Kim et al. 2013) or behavioural intentions to use the mobile app (Hew et al. 2015).

The current study examines adoption intentions as mediator of the relationship between financial and mobile computing self-efficacy, perceived financial security and perceived ease of use, consideration of future consequences, retirement planning involvement, perceived usefulness and anticipated engagement. Early conceptualizations of behavioural intention recognized the construct's mediating role between behaviour and its determinants (Ajzen et al. 1980; Bagozzi and Youjae 1989). Mediation occurs when a third variable (partially) accounts for the relation between the independent and dependent variable. Traditionally, for mediation to be present, the independent variable is required to have both a direct effect on the dependent and mediating variable, while the mediating variable must have a direct effect on the dependent variable (Baron and Kenny 1986). More recent approaches claim that an independent variable can also exert an indirect effect on a dependent variable through a mediator in the absence of a direct association between independent and dependent variables (Hayes 2009). We hypothesize:

H9a-h: Individuals' adoption intentions positively mediate the effect of FSE, MCSE, PFAU, PFS, PEOU, CFC, RPI, and PU on their anticipated engagement with a mobile retirement app.

Moderating Role of Retirement Proximity

The degree to which intentions explain actual behaviour can vary considerably (Ajzen and Sheikh 2013). The degree to which adoption intentions of a mobile retirement app explain anticipated engagement behaviour with the app to plan for retirement likely depends on how aware individuals are of their future retirement. Although older individuals are less inclined to adopt digital technology in general (Venkatesh et al. 2012), once they have done so we hypothesize that they are more likely to engage with this technology as the topic of retirement planning will be more on their mind due to their retirement proximity (see e.g., Hoffmann and Plotkina 2020):

H10: Age positively moderates the effect of adoption intentions on anticipated engagement.

Data and Method

Data Collection

We administered an online questionnaire using the commercial panel provider *Qualtrics*. While online data collection requires participants to possess a minimum level of digital literacy, we consider this an acceptable pre-requisite for our study, as individuals with no digital literacy and smartphone use would not be interested in or benefit from a mobile retirement app. To be eligible for our survey, participants were required to live in Australia and be between 18 – 65 years old. This study uses a broad sample in terms of age distribution, due to the nature of retirement planning. In particular, to effectively harness the benefits of compound interest and long-term capital growth, individuals are advised to start planning for retirement early on. We excluded participants aged 65+ as they were assumed to be already retired, and therefore do not need to engage with apps to plan for their future retirement. We obtained a nationally representative sample to ensure generalizability of the findings to the Australian population. We selected Australia as the target research population because of the country's high mobile app usage (Statista 2018) and its compulsory retirement system (Deetlefs et al. 2018), which ensures a minimum degree of retirement knowledge amongst participants, as most working Australians aged 18 and older are subject to participation in the so-called Superannuation scheme. We obtained a total of N=440 complete questionnaires for further statistical analysis.

Sample Description

In line with overall Australian demographics (Australian Bureau of Statistics, 2016), the sample consists of 49.3% (50.7%) males (females), aged between 18-65 years (M_{age} = 39.34; SD = 13.36). Ninety-seven percent of the sample has a high school degree or higher, 80.5% is Caucasian, and 47% is married. The modal income category is between $37,001 and $90,000 (Table 11). In line with previous industry reports (Deloitte, 2018), 32.5% of participants indicated that they spend more than 3 hours per day using mobile apps. When asked whether they use any type of financial app, most respondents answered that they did (75.7%); with 32.3% claiming they use financial apps at least once a day (Table 12). We also asked participants to share more information about their current Superannuation provider and interest in using a mobile retirement app, assuming their pension fund provider was to offer such an app. A large majority of respondents indicated their willingness to use the app (76.4%), stating that they are currently using their Superfund provider's Super app (26.6%) or that they would use such an app if available (49.8%). For those participants who stated that they would not use a Super app, the most common reason was that they did not need an app to manage their Super (13.2%).

Table 11. Descriptive statistics: socio-demographics (n = 440)

Variable	***Indicator***
Gender	Male
	Female
Age	18-22 years (Gen Z)
	23-39 years (Millennial)
	40-53 years (Gen X)
	54-65 years (Baby Boomers)
Employment	Unemployed – Looking for work
	Unemployed – Not looking for work
	Student
	Casual employment
	Part-time employment
	Full-time employment
	Self-employed/ Freelance
Education	No formal education
	Primary school
	High school diploma
	College degree
	Vocational training
	Bachelor’s degree
	Master’s degree
	Professional degree
	Doctorate degree
	Other
Relationship Status	Single
	In a relationship/ Partnered/ De-facto relationship
	Married/ Civil Union
	Separated/ Divorced
	Widowed
	Other, specify
Ethnicity	White or Caucasian
	Black or African
	Middle Eastern
	Asian
	Indigenous and Torres Strait Islanders
	Other, specify
Gross Income (Annual)	Under \$18,200
	\$18,201 – \$37,000
	\$37,001 – \$90,000
	\$90,001 – \$180,000
	\$180,001 and over

Table 12. Descriptive statistics: app usage (n = 440)

Item	*Characteristic*	*Frequency*
Time spent using Apps per day	Less than 30 minutes	60
	From 30 minutes to 1 hour	54
	From 1 to 2 hours	78
	From 2 to 3 hours	96
	More than 3 hours	143
	Other	9
Number of Apps on phone currently installed	0-5	36
	6-10	83
	11-20	119
	21-30	98
	31-50	73
	51+	31
Apps used per week	Less than 5	107
	6 - 10	181
	11 – 20	109
	21-30	29
	31-50	7
	More than 51	5
	Other	2
Use of any type of Finance App	Yes	333
	No	107
How often use Finance Apps	At least once a day	142
	Every couple of days	117
	Once a week	57
	Once a month	14
	Never	2
	Missing/ Don't Use Finance Apps	107
	Other	1
Would use Super Apps	Yes	336
	No	104
If answer: YES	I am currently using my Super provider's app	117
	I would use it if they had one	219
If answer: NO	I don't think a Super/retirement app could benefit me	25
	I don't know how a Super/ retirement app could help me manage my Super	11
	I don't need an app to manage my Super	58

Measurement Scales

All constructs use previously validated multi-item scales, which are only adapted to fit the study context (see Table 13). We used 7-point Likert scales, anchored at 1 = "strongly disagree" and 7 = "strongly agree", as well as bipolar and slider scales. To measure financial self-efficacy, we used five items from Netemeyer et al. (2018). Mobile computing self-efficacy was measured using four items from Wang and Wang (2008). Prior finance app use was measured using our own 5-item Likert scale. Consideration of future consequences was measured with six items adapted from Strathman et al. (1994), while perceived financial security was measured using three items from Strömbäck et al. (2017). Perceived ease of use and perceived usefulness were measured using three items each adapted from Lai and Li (2005). Retirement planning involvement was measured using five items adapted from Zaichkowsky (1985). Adoption intention was measured using three items adapted from Venkatesh et al. (2012). Anticipated engagement (cognitive, emotional, and behavioural) was measured with ten items from Hollebeek et al. (2014). Participants were also asked to answer a series of standard socio-demographic questions, including age, gender, employment, income and education. Before answering the survey questions, we presented participants with an infographic detailing the functions and benefits of a mobile retirement app to ensure a common knowledge base among participants and correct interpretation of our questions (Appendix F). The measurement items as well as their corresponding factor loadings (if applicable) are all displayed in Table 13.

Common Method Variance

As our data was collected using a survey methodology, we assessed the potential for common method bias (CMB) and applied a combination of procedural and post-hoc remedies to overcome CMB as recommended by Podsakoff et al. (2003). Due to the nature of the data collection, procedural remedies included variation in response format (e.g., Likert scales as well as bipolar scales and slider format) and the removal of ambiguously worded items, followed by post-hoc remedies including Harman's single factor test. In particular, we loaded all study constructs into an exploratory factor analysis and analysed unrotated factor loadings to identify the factors needed to account for the variance in constructs. The reported single factor value was 35.5% and items did not load on a single factor, alleviating CMB concerns.

Results

To test the hypotheses of the conceptual framework, we conducted a PLS-SEM analysis using SmartPLS 3.0. PLS-SEM is increasingly used as it is argued to provide a more robust estimation of the structural model compared to covariance-based techniques (Hair et al. 2014). The use of PLS-SEM is particularly appropriate to our study as it is suited for situations in which the analysis aims to: (i) test a structural model that is relatively complex and includes many constructs and relationships, and (ii) improve the understanding of theoretical extensions and complex theory development (Hair et al. 2019). A PLS path model consists of a measurement or outer model and a structural or inner model, where the measurement model focuses on the relationships between a construct and its manifest variables, and the structural model specifies the relationships between the different latent constructs (Henseler et al. 2017).

Measurement Model

We establish convergent validity based on three criteria: (i) all factor loadings for the latent constructs exceed the cut-off value of 0.70 (Hair et al. 2014); (ii) the composite reliability (CR) values for all constructs exceed the cut-off value of 0.80 (Bagozzi and Youjae 1988); and (iii) the average variance extracted (AVE) values all exceed 0.50 (Chin, 1998). Next, we investigate discriminant validity. Hair et al. (2014) suggest two measures in this regard: the Fornell-Larcker (1981) criterion and the individual cross-loadings of the constructs. As reported in Table 14, the AVE of each construct is higher than the construct's highest squared correlation with any other latent construct.

Table 13. Measurement items and factor loadings

Construct and Source	Measurement Item	Factor Loadings	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
			0.894	0.922	0.703
Financial Self-Efficacy - adapted from Netemeyer et al. (2018)	FSE1 - I know how to make complex financial decisions.	.792			
	FSE2 - When it comes to money, I know how to be disciplined.	.842			
	FSE3 - I am able to make good financial decisions that are new to me.	.903			
	FSE4 - I know how to make myself save.	.823			
	FSE5 - I am able to recognize a good financial investment.	.832			
			0.898	0.929	0.767
Mobile Computing Self-Efficacy - adapted from Wang and Wang (2008)	MCSE1 - I would be confident in using a Super app even if I had only the online instructions for reference.	.808			
	MCSE2 - I would be confident in using a Super app if I had seen someone else using it before trying it myself.	.896			
	MCSE3 - I would be confident in using a Super app if I had sufficient time to complete transactions.	.913			
	MCSE4 - I would be confident in using a Super app if someone showed me how to use it first.	.881			
			0.940	0.962	0.894
Perceived Financial Security - adapted from Strömbäck et al. (2017)	FS1 - I feel secure in my current financial situation.	.920			
	FS2 - I feel confident about my financial future.	.963			
	FS3 - I feel confident about having enough money to support myself in retirement, no matter how long I live.	.953			
			0.878	0.924	0.803
Perceived Ease of Use - adapted from Lai and Li (2005)	PEOU1 - I expect that learning to use a Super app would be easy for me.	.877			
	PEOU2 - I expect it would be easy to use a Super app to accomplish my retirement planning.	.898			
	PEOU3 - Overall, I believe a Super App would be easy to use.	.915			
			0.890	0.915	0.643
Consideration of Future Consequences – adapted from Strathman et al. (1994)	CFC1 - I act only to satisfy immediate concerns, figuring the future will take care of itself	0.814			
	CFC2 - My behavior is only influenced by the immediate (i.e. a matter of days or weeks) outcomes of my actions	0.785			
	CFC3 - I generally ignore warnings about possible future outcomes because I think the problems will be resolved before they reach crisis levels	0.785			
	CFC4 - I think that sacrificing now is usually unnecessary since future outcomes can be dealt with at a later time	0.775			
	CFC5 - I only act to satisfy immediate concerns, figuring that I will take care of future problems that may occur at a later date	0.873			

	CFC6 - Since my day-to-day work has specific outcomes, it is more important to me than behavior that has distant outcomes	0.785			
Retirement Planning Involvement - adapted from Zaichkowsky (1985)	*Retirement Planning is …*		0.909	0.932	0.734
	Unimportant – Important	.888			
	Of no concern – Of concern to me	.878			
	Irrelevant – Relevant	.883			
	Boring – Interesting	.762			
	Useless – Useful	.867			
Perceived Usefulness - Perceived Usefulness - adapted from Lai and Li (2005)			0.922	0.951	0.865
	PU1 - I think I could accomplish my retirement planning tasks more quickly using a Super app.	.943			
	PU2 - I think I could accomplish my retirement planning tasks more easily using a Super app.	.948			
	PU3 - Overall, I think I would find a Super app useful.	.899			
Adoption Intention - adapted from Lai and Li (2005); Venkatesh et al. (2012)			0.941	0.962	0.895
	I1 - I intend to use a Super app in the future once available to me.	.929			
	I2 - I would try to use a Super app in my daily life once available to me.	.953			
	I3 - I plan to use a Super app frequently once available to me.	.956			
Engagement (Cognitive Processing) – adapted from Hollebeek et al. (2014)			0.921	0.950	0.863
	CE1 - Using a Super app would get me to think about retirement.	0.939			
	CE2 - I would think about retirement a lot if I would be using a Super app.	0.937			
	CE3 - Using a Super app would stimulate my interest to learn more about retirement.	0.910			
Engagement (Emotional/Affective) – adapted from Hollebeek et al. (2014)			0.954	0.966	0.878
	AE1 - I expect to feel very positive when I would use a Super app.	0.949			
	AE2 - Using a Super app would make me happy.	0.945			
	AE3 - I expect to feel good when I would use a Super app.	0.930			
	AE4 - I would be proud to use a Super app.	0.923			
Engagement (Behavioral/Active) – adapted from Hollebeek et al. (2014)			0.912	0.945	0.850
	AEC1 - I expect to spend a lot of time using a Super app, compared to other retirement planning tools.	0.945			
	AEC2 - Whenever I would use a tool to manage my Super, I expect to use a Super app.	0.921			
	AEC3 - A Super app is one of the tools I would expect to usually use when managing my Super.	0.900			
Prior Finance App Use	*How often do you use financial apps on your mobile phone?*	N/A as prior finance app use is a formative construct			
	At least once a day				
	Every couple of days				
	Once a week				
	Once a month				
	Never				

Additionally, the factor loadings and cross-loadings assessment show that each item loads highly only on its corresponding latent construct. Internal consistency reliability is confirmed with all Cronbach alpha values above 0.7 (Table 13).

To test for multicollinearity, we assess the variance inflation factor (VIF) and tolerance values. Tolerance values for all items are well above 0.1 and VIF are all below 10 (Chin 2010). Multicollinearity is thus not an issue. Finally, to reduce the potential for our conclusions to be affected by other individual-level variables or alternative theoretical explanations, we control for gender (Faqih 2016), education and employment (Zheng 2019), and annual income (Yang 2015). We found no significant effects for any of the control variables on the anticipated engagement with the retirement app.

Table 14. Latent variable correlations (Fornell-Larcker)

	FSE	MCSE	PFAU	PFS	PEOU	CFC	RPI	PU	INT	ENG
FSE	*0.838*									
MCSE	0.247	*0.876*								
PFAU	0.238	0.290	*1.000*							
PFS	0.643	0.225	*0.227*	*0.945*						
PEOU	0.266	0.627	0.346	0.263	*0.896*					
CFC	0.053	0.090	0.0045	0.180	0.086	*0.769*				
RPI	0.240	0.268	0.175	0.229	0.335	-0.027	*0.857*			
PU	0.237	0.626	0.387	0.304	0.738	0.149	0.375	*0.930*		
INT	0.230	0.680	0.415	0.298	0.672	0.138	0.420	0.803	*0.946*	
ENG	0.331	0.610	0.405	0.396	0.678	0.184	0.439	0.871	0.819	*0.871*

Notes: The square root of the average variance extract (AVE) is displayed in *italics*. The non-italic values are the correlation of the latent constructs, of which all must be smaller than the corresponding squared root of AVE. FSE= Financial Self-Efficacy; MCSE= Mobile Computing Self-Efficacy; PFAU = Prior Finance App Use; PFS = Perceived Financial Security; PEOU = Perceived Ease of Use; CFC= Consideration of Future Consequences; RPI= Retirement Planning Involvement; PU = Perceived Usefulness; INT = Adoption Intention; ENG = Anticipated Engagement.

Structural Model

To test the structural model, we examine the model fit and structural relationships using the PLS algorithm and bootstrapping tests based on 5,000 sub-samples. We used the SRMR (standardized root mean square residual) as a criterion to assess model fit. Based on Henseler et al. (2017), the SRMR value of 0.05 indicates an acceptable model fit. Additionally, the model explains 82% of variance in anticipated engagement (R^2). This suggests that mobile retirement app engagement is well-explained by the hypothesized drivers and mediator and moderating variables.

Table 15 summarizes the results regarding the proposed direct effects. We find that financial self-efficacy (β=0.065, $p < 0.1$) is positively and significantly related to anticipated engagement, supporting H1. However, neither mobile computing self-efficacy (β=0.005, $p > 0.1$) nor prior finance app use (β=0.027, $p > 0.1$) have a significant direct effect, thus not supporting H2 and H3. In terms of information/usage avoidance, we find that perceived financial security is positively and significantly related to anticipated engagement (β=0.082, $p < 0.01$), while perceived ease of use (β=-0.000, $p > 0.1$) is not. Hence, we find support for H4, but not H5. This result demonstrates that the more financially secure an individual feels, the less likely they are to avoid retirement information and the more likely they will thus be to engage with a mobile app to plan for retirement. Concerning perceived relevance, the consideration of future consequences has a positive and significant effect on anticipated engagement (β=0.046, $p < 0.1$), supporting H6. This result highlights that the more an individual thinks about their desired future lifestyle or family situation (i.e., higher levels of CFC), the more likely they are to engage with a mobile retirement app to plan for their retirement. Finally, both retirement planning involvement (β=0.079, $p < 0.05$), and perceived usefulness (β=0.560, $p < 0.001$) have positive and significant effects on anticipated engagement, therefore supporting H7 and H8. These results indicate that those individuals who recognize the relevance of retirement planning and are personally interested in this particular activity, as well as those individuals who perceive the mobile retirement app to be more useful, are more open to use and engage with mobile technology (i.e., the retirement app) to plan for their retirement.

Table 15. Results of bootstrapping tests

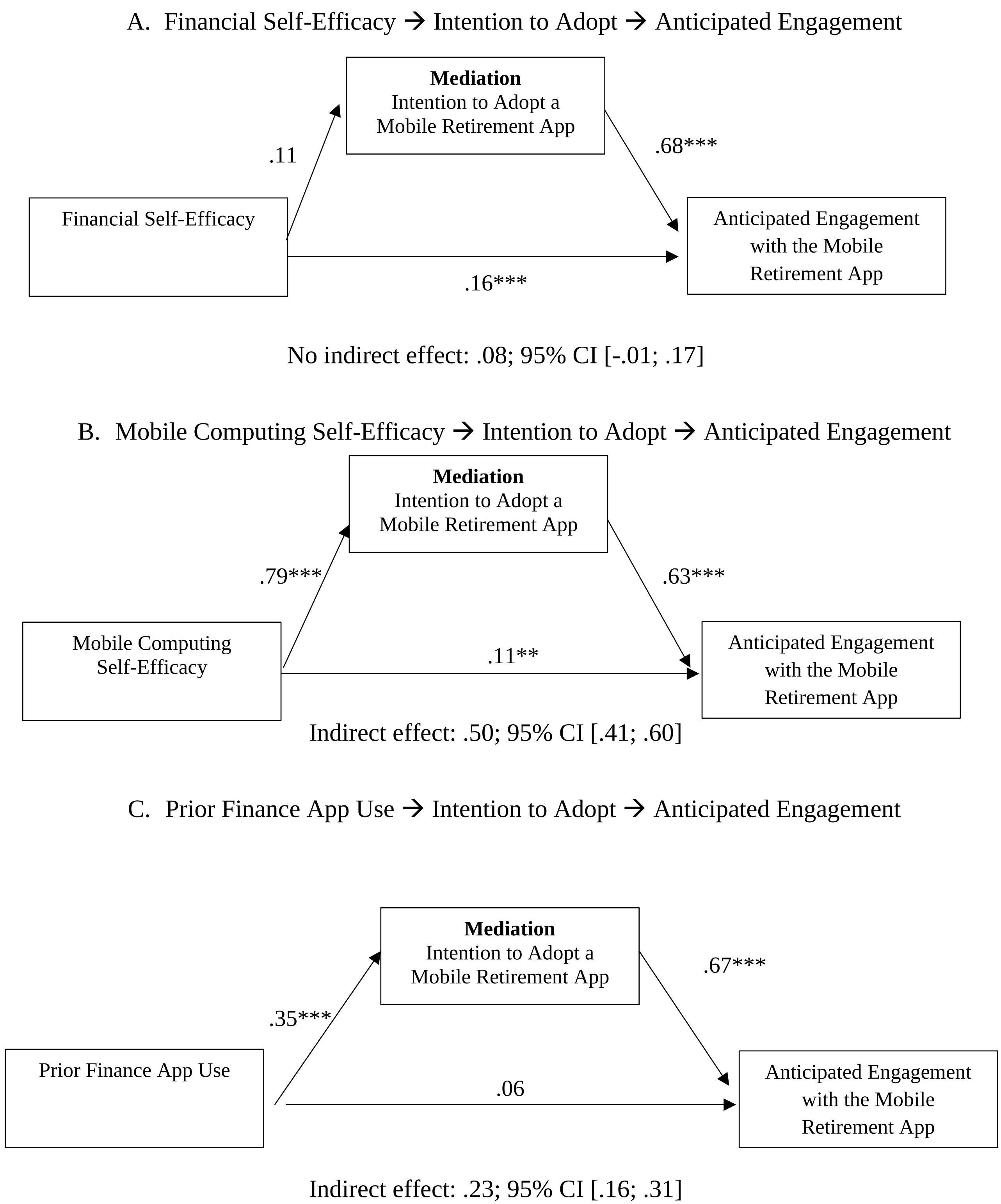
Hypothesis	Path Coefficient	*t*-value	*p*-value	Hypothesis Supported?
Direct Effects				
H1: Financial Self-Efficacy → Anticipated Engagement	0.065	1.765	0.078	Yes
H2: Mobile Computing Self-Efficacy → Anticipated Engagement	0.005	0.124	0.901	No
H3: Prior Finance App Use → Anticipated Engagement	0.027	1.034	0.301	No
H4: Perceived Financial Security → Anticipated Engagement	0.082	2.565	0.010	Yes
H5: Perceived Ease of Use → Anticipated Engagement	-0.0003	0.008	0.994	No
H6: Consideration Future Consequences → Anticipated Engagement	0.046	1.835	0.066	Yes
H7: Retirement Planning Involvement → Anticipated Engagement	0.079	2.871	0.004	Yes
H8: Perceived Usefulness → Anticipated Engagement	0.560	12.703	0.000	Yes

Mediation and Moderation Results

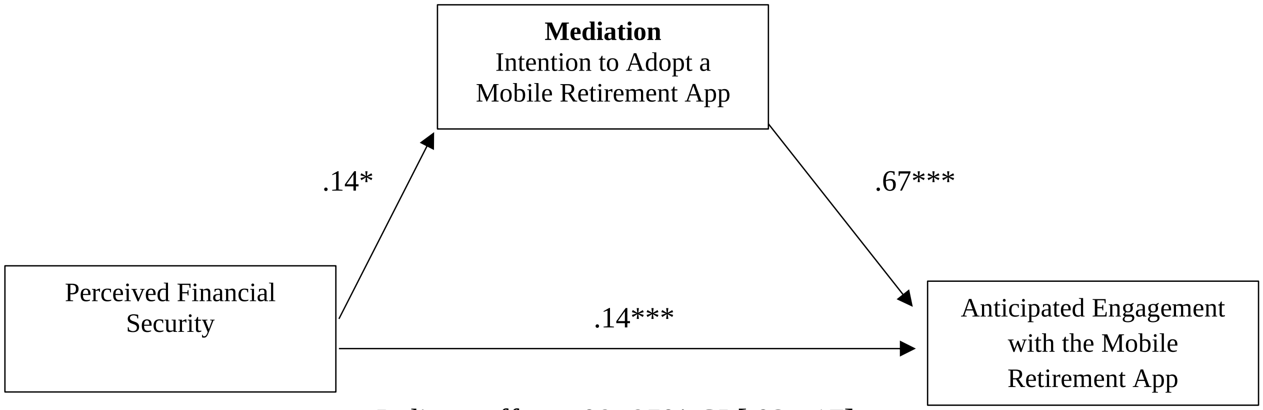
Next, we test H9a-h, which propose that the effect of aforementioned factors on anticipated engagement is mediated by individuals' intentions to adopt the retirement app. In order to perform a formal mediation analysis, we used Model 4 of the SPSS Process macro procedure (Hayes 2013; Hayes and Preacher 2014), based on 5,000 bootstrapped samples. Based on Figures 11a-h we conclude that the mediating effect of intention to adopt was positive and significant for mobile computing self-efficacy (.50; 95% CI [.41; .60])[6], perceived financial security (.09; 95% CI [.02; .17]), perceived ease of use (.44; 95% CI [.35; .53]), retirement planning involvement (.24; 95% CI [.17; .32]), and perceived usefulness (.23; 95% CI [.16; .31]), supporting H9b-e and H9g-h. Intention to adopt does not mediate the relationship between the consideration of future consequences (.04; 95% CI [-.04; .12]) and perceived financial self-efficacy (.08; 95% CI [-.01; .17]) and anticipated engagement, not supporting H9a and H9f.

[6] Please note that the PLS-SEM results indicate a non-significant direct effect of mobile computing self-efficacy and perceived ease of use on anticipated engagement (thus indicating a full mediation effect by intention to adopt), whereas the regression analysis approach in the Process macro (Hayes 2013) suggests a significant direct effect (thus indicating partial complementary mediation by intention to adopt on anticipated engagement). These differences may be attributed to the fact that, in contrast to the PLS-SEM approach, the regression analysis approach treats the elements of the effect chains as separate processes and ignores measurement error effects (Sarstedt et al. 2020).

Figure 11. Mediation analysis results

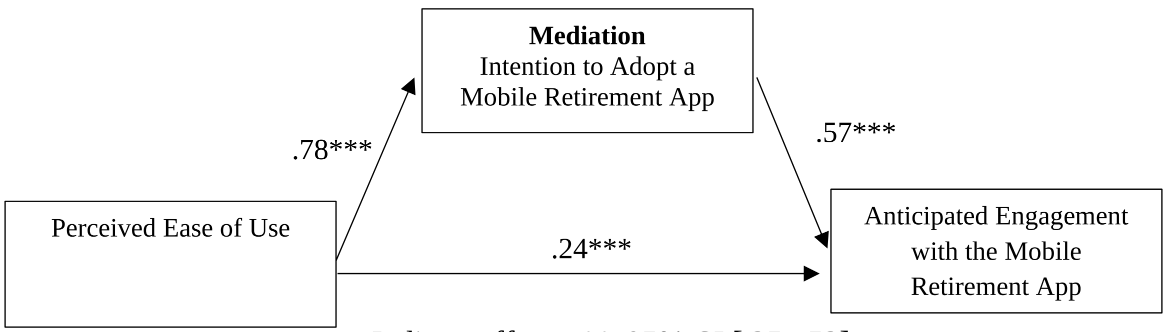


D. Perceived Financial Security → Intention to Adopt → Anticipated Engagement



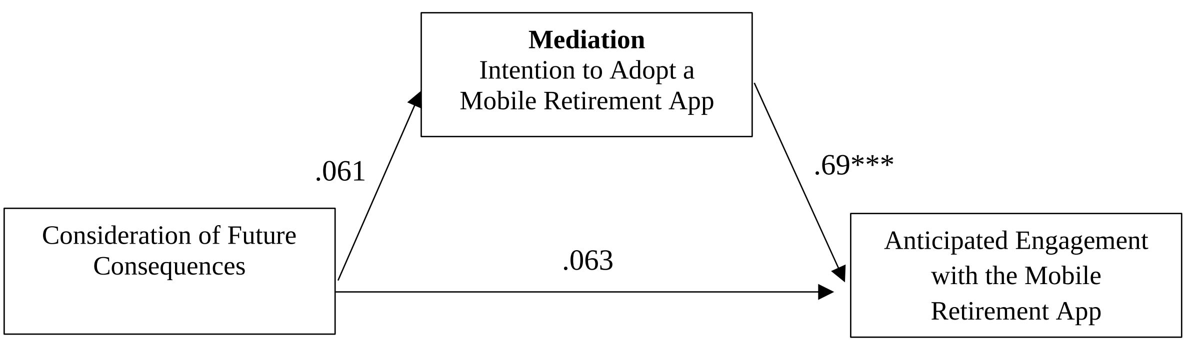
Indirect effect: .09; 95% CI [.02; .17]

E. Perceived Ease of Use → Intention to Adopt → Anticipated Engagement



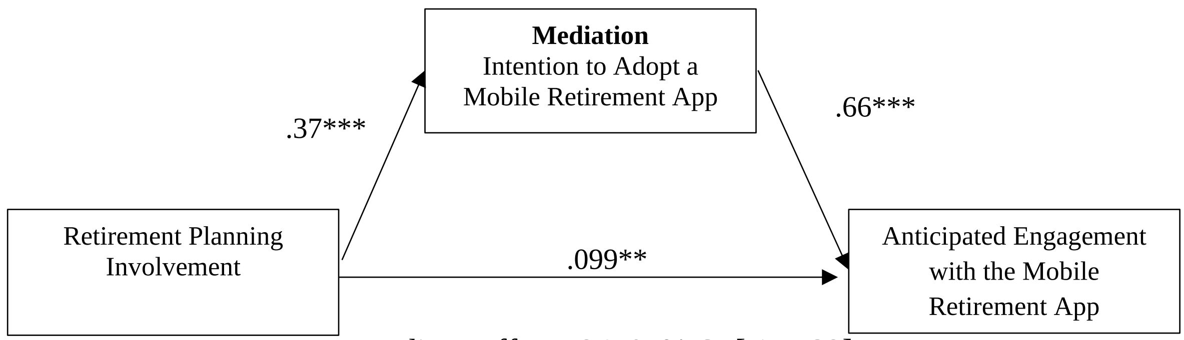
Indirect effect: .44; 95% CI [.35; .53]

F. Consideration of Future Consequences → Intention to Adopt → Anticipated Engagement



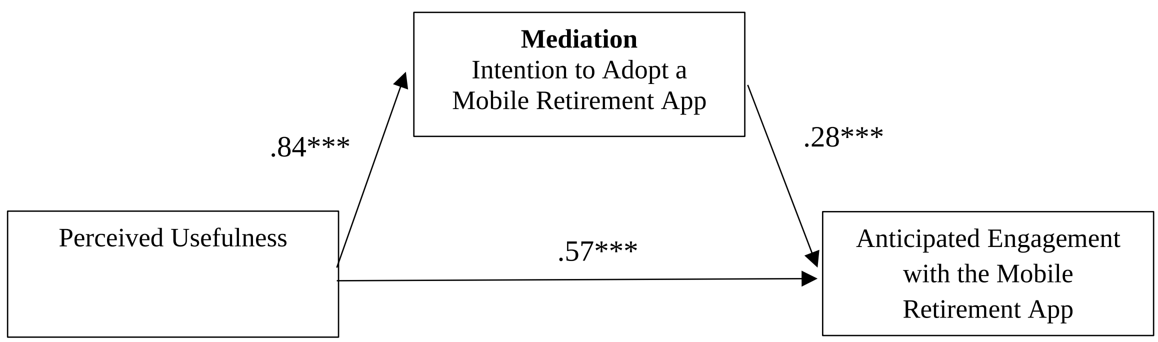
No indirect effect: .04; 95% CI [-.04; .12]

G. Retirement Planning Involvement → Intention to Adopt → Anticipated Engagement



Indirect effect: .24; 95% CI [.17; .32]

H. Perceived Usefulness → Intention to Adopt → Anticipated Engagement



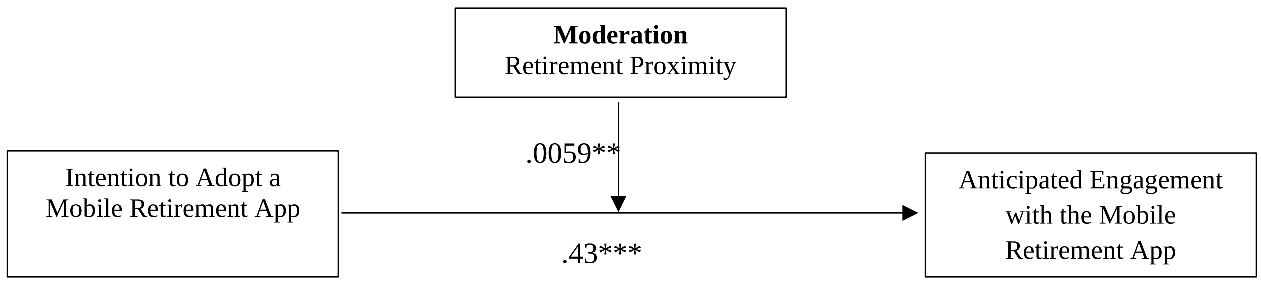
Indirect effect: .23; 95% CI [.16; .31]

Notes: *p < .10; **p < .05; ***p < .001

Finally, we test the moderating effect of retirement proximity (H10), which further clarifies the underlying process through which intention to adopt affects anticipated engagement (see Figure 12). We performed a formal moderation analysis using Model 1 of the SPSS Process Macro (Hayes 2013), using 5,000 bootstrapped samples. We find that retirement proximity, as proxied by individuals' age, positively moderates the impact of intention to adopt (moderation impact = .0059; 95% CI [.0024; .0094] on individuals' anticipated engagement. Hence, for those closer to retirement (i.e., older individuals), the intention to adopt has a stronger effect on anticipated engagement with a mobile retirement app, supporting H10.

Figure 12. Moderation analysis results

Intention to Adopt → Retirement Proximity → Anticipated Engagement



Moderation impact: .006; 95% CI [.0024; .0094]

Notes: **p < .05; ***p < .001

Discussion and Conclusion

Retirement engagement is a crucial first step in ensuring financial capability and well-being during retirement (Bateman et al. 2014; Brüggen et al. 2019; Deetlefs et al. 2018). Due to advances in digital technology tools, such as mobile apps, managing one's personal finances, including retirement savings, has become increasingly convenient (Dellaert 2010; Henkens et al. 2018). However, to date retirement awareness and engagement remains generally low (Brüggen et al. 2019), and how aforementioned technological developments can support individuals with their retirement planning has not been investigated in detail. While a few studies have started to examine the impact of digital technology on individuals' retirement planning behaviour (Brüggen et al. 2019; Hoffmann and Otteby 2018), many questions remain unanswered.

In this paper, we integrate literature on retirement planning involvement, mobile financial service technology adoption, and digital customer engagement and propose a conceptual framework that theorizes mobile retirement app adoption and engagement antecedents and contingencies. Specifically, we examine the effect of a set of psychological and technological constructs on adoption intentions and anticipated engagement with a mobile retirement app. Our study shows the importance of (i) perceived skills (i.e., financial, and mobile computing self-efficacy and prior finance app use), (ii) information/usage avoidance tendencies (i.e., perceived financial security and perceived ease of use), and (iii) perceived relevance (i.e., consideration of future consequences, retirement planning involvement, and perceived usefulness) in directly or indirectly determining individuals' anticipated engagement with a mobile retirement app. We also highlight the mediating effect of individuals' intention to adopt a retirement app in the first place. Further, we show that individuals' intention to adopt an app partially explains the relationship between aforementioned psychological and technological constructs and one's anticipated engagement with a mobile retirement app (except for consideration of future consequences and financial self-efficacy which only have direct effects). Finally, we demonstrate the moderating effect of retirement proximity in those individuals closer to retirement are more likely to transform adoption intentions into anticipated engagement with a retirement app. Our findings have theoretical and managerial implications, which we discuss next.

Implications for Theory

Our study extends the TAM with constructs relating to technology adoption and financial decision-making/retirement planning. That is, we combine constructs that have previously been studied either in different contexts or in combination with other factors. Specifically, in the context of mobile retirement planning, our study's findings add to the extant literature in several ways. First, we contribute to the emerging but still limited literature on technology-enabled retirement planning by answering the call for further investigations on how technology impacts the retirement planning process (Henkens et al. 2018). In particular, we extend recent work by Brüggen et al. (2019), who demonstrated a positive effect of interactivity on individuals' behavioural intentions and behaviour (i.e., clicked options) with an online pension planner. Our research builds on this through investigating several key psychological drivers relevant to complex future decision-making (i.e., retirement planning). That is, we broaden the scope of prior research by providing insight into how (new) technology, such as mobile apps, can impact retirement engagement.

Second, our findings offer an enhanced understanding of mobile app engagement in the low-involvement, but high-importance context of retirement planning. Prior mobile financial service adoption research has primarily focused on high-involvement contexts such as mobile payments (Alalwan et al. 2017; Lee et al. 2012; Teo et al. 2015). However, these findings are not readily applicable to the low-involvement context of retirement planning, where rewards are not immediately apparent, and consequences of low engagement are more substantial (e.g., the possibility of reduced retirement income and resulting negative effects on overall well-being). Indeed, our findings may also be applicable to other low-involvement, but high-importance industries such as the health sector. Both health and pension communication face similar challenges as both require an individual to think in the long-term, accrue immediate costs but provide only delayed rewards, and positive outcomes are not guaranteed (i.e., one might still get cancer even if one lived a healthy life, or one might die before one gets to access retirement savings) (Eberhardt et al. 2019; Gubler and Lamar 2014; Hoffmann and Risse 2020).

Research on health technology adoption, including mobile apps, has increased rapidly in the past decade, highlighting the potential of this technology in fostering positive behaviour. However, most of these studies have relied heavily on general technology acceptance theories or health behaviour (Zhao et al. 2018). Our contribution to the health and pension literature lies in the integration of the mobile app engagement literature with psychological drivers linked to complex decision-making. That is, individuals may initially adopt a health or pension app because it is easy or because they enjoy using it, but continuous engagement will depend on an individual's ability to persevere in making important decisions. The drivers identified in the present study (e.g., perceived relevance and information/usage avoidance tendencies) provide potential indicators for which individuals are likely to engage with the app in the longer term.

Finally, our research contributes to the digital customer engagement literature by highlighting the important distinction between adoption intentions and engagement. That is, we go beyond initial mobile app adoption and instead conceptualize key drivers of continuous engagement with the app regarding a complex decision-making domain (i.e., retirement planning). Most prior mobile engagement literature has applied technology-focused drivers stemming from various theories (i.e., TAM, TPB, UTAUT), leading to an abundance of evidence in the applicability of these drivers on mobile adoption intention (Alalwan et al. 2017; Faqih and Jaradat 2015). Additionally, many of these studies utilized adoption intentions as a proxy for engagement, however, several studies have shown that an individual's adoption intentions might be a poor predictor of adoption behaviour (Arts et al. 2011). By including in our study anticipated engagement as a dependent variable and demonstrating the direct impact of various psychological drivers on engagement as well as the mediating role of adoption intentions, we contribute to overcoming this limitation of prior literature. Moreover, other psychological factors not included in the standard technology adoption models (i.e., TAM, TPB, UTAUT) which are important to technology-enabled financial decision-making were glanced over by prior literature. We address this knowledge gap by combining literature on complex financial decision-making with the technology adoption and engagement literatures.

Implications for Practice

Our findings offer guidelines for pension fund managers considering how to stimulate retirement engagement through mobile apps. Practitioners should highlight mobile apps' potential to provide pension fund members with real-time insights, a condensed source of reliable information, and access to and the ability to monitor their retirement savings account (Brüggen et al. 2019; Henkens et al. 2018). In particular, we find retirement proximity to play an important role in terms of adoption intentions to convert into engagement with the app. Specifically, the closer an individual is to retirement, the more likely it is that their positive adoption intentions also translate into them engaging with the mobile retirement app. Early pension communication strategies initially sought to engage younger individuals with their retirement planning through technology because of these individuals' greater likelihood to adopt new technology and the fact that starting to prepare early is essential for achieving a financially secure retirement (Atkinson et al. 2012; BNY Mellon 2016; OECD 2017). While our findings are promising in their support for pension funds' decision to invest in mobile apps, they also highlight that these apps might fall short in stimulating the desired retirement engagement behaviour in younger individuals, as their retirement proximity is often still low.

According to Ali et al. (2014), to ensure adequate savings for retirement, one has to start planning and saving for it while still young. Therefore, pension funds could consider ways to induce retirement proximity, or the feeling of being closer to retirement, in younger individuals. One potential strategy would be to focus on including gamified elements in the mobile app (Bayuk and Altobello 2019). Through the inclusion of digital avatars or visualized planning journeys (journey mapping), individuals might be able to envision themselves being closer to retirement. In this regard, Hershfield et al. (2011) propose digital visualization techniques to reduce the distance between individuals' current and future self, which could be very helpful.

Further, our findings highlight the challenge identified by earlier studies (e.g., Hoffmann and Otteby 2018) that individuals who seem least in need of a mobile retirement app, are actually most likely to use it to engage in retirement planning. That is, we find that individuals scoring high on perceived relevance (i.e., high consideration of future consequences, high retirement planning involvement, and high perceived usefulness) and low on information avoidance tendencies (i.e., high perceived financial security) to be more likely to engage with a mobile retirement app. However, individuals scoring low on perceived financial security, and who thus fear the uncertainty of their financial well-being during retirement, may avoid using the app, although they would actually need it the most. To counter the hindering effect of fear on mobile app engagement, pension funds could clearly communicate what individuals need to do and how (i.e., outline the steps involved in retirement planning and which tasks are more complex, and indicate what support is available to help individuals with these tasks). Indeed, to minimize the perceived complexity of the task, such a message could be framed around an intuitively appealing storyline that using a mobile app to plan for retirement is 'as simple as online banking'. By referring to individuals' prior successes in managing their personal finances and using mobile technology (i.e., employing enactive mastery techniques as per Gist and Mitchell (1992)), and highlighting the benefits of using such an app, individuals' financial self-efficacy will hopefully be stimulated, which we identify as an important psychological driver of individuals' mobile retirement app adoption and anticipated engagement in our current study.

Lastly, the effect of all psychological drivers, except for financial self-efficacy and consideration of future consequences, are partially explained by their effect on individuals' intention to adopt the app. This highlights the obvious reality that individuals first need to adopt the app before they will engage with it. Nevertheless, this finding also has some implications for practice. In particular, to initiate the desired adoption behaviour, we suggest making it as easy as possible to adopt the app. That is, ensure the app is (freely) available in all app stores, is free of bugs and other technical issues, and pension fund members can easily find it (i.e., the name of the app should be the same as the name of the associated pension fund). Although these recommendations might seem obvious, to date, only half of the top 50 pension funds in Australia offer mobile retirement apps, while members of those that do, often abandon the app because of technical issues such as pages not loading fully or being shut out due to the session being timed out (IQ Group 2019). We also recommend communicating to members how useful the app can be in managing retirement planning tasks. For example, this can be done by suggesting that the app is as easy to use and useful as members' banking app, which also draws on members' prior finance app experience. Pension funds will need to address these issues if they seek to increase adoption intentions, which ultimately affects engagement with their app.

Limitations and Future Research

Despite our contributions, we acknowledge some limitations which can guide future research. First, although this study conceptualized anticipated engagement as consisting of three engagement dimensions (i.e., cognitive, emotional, and behavioural engagement), we did not investigate the effects of aforementioned psychological drivers on each dimension separately. Cognitive engagement refers to an individual's thought processing and elaboration of interaction with the focal actor/object, whereas emotional engagement is concerned with the degree to which an individual forms positively- or negatively-valenced emotions towards that focal actor/object. Finally, behavioural engagement includes the individual's effort, time spent, and energy devoted to the interaction with the focal actor/object (see Hollebeek et al. 2014).

Although a detailed analysis is beyond the scope of the present study, we did conduct an exploratory analysis of potentially differential effects on these three engagement dimensions. Interestingly, we found that each psychological driver only significantly affected two out of the three engagement dimensions. For example, financial self-efficacy and perceived financial security had significant positive effects on both emotional and behavioural engagement, but not on cognitive engagement. Meanwhile, the consideration of future consequences and mobile computing self-efficacy had no significant effect on emotional engagement, but only on cognitive and behavioural engagement. Future research could explore these findings to identify the intricacies among the three engagement dimensions and ensure that retirement engagement initiatives match the engagement dimension they are hoping to stimulate (e.g., cognitive, affective, or behavioural). For example, our exploratory analysis suggested that focusing on perceived financial security to stimulate individuals' cognitive engagement is likely to be ineffective. Areas for further study could include focusing on social media's role in increasing retirement engagement. While, traditionally, engagement research focuses primarily on the dyadic relationship between customer and organization, digital technology forces researchers to adopt a new perspective to capture the emergence of complex, interconnected actor networks (Barari et al. 2020).

Second, future research could investigate how COVID-19 has affected individual's uptake of digital technology to engage in retirement planning. As our survey data was collected pre-COVID-19, our findings may not represent the increased perceived relevance of retirement planning induced by the pandemic. Customer expectations have changed during the pandemic, driving unprecedented change and causing fundamental shifts throughout the financial services industry. According to a report by Deloitte (2020), 35% of customers increased their use of online banking during the pandemic, in part due to limited mobility related to COVID-19 lockdowns. The same report emphasizes experts' predictions that as the financial services industry is becoming more digital, industry collaboration, partnerships, and business models will change, leading to the formation of new (service) ecosystems. In addition, a recent report by KPMG (2020a) found that half of all Australian pension fund members surveyed claimed to have become more aware of their retirement savings balance as a result of the pandemic, also stating that their savings and retirement planning has been interrupted as a result of COVID-19. The same report also found that 80% of consumers are willing to be serviced through digital means, however, current satisfaction with value delivery from Superfunds is low. These findings provide numerous directions for future research. For example, the question as to how digital technology can assist individuals in their retirement planning post-COVID-19 remains unanswered but is increasingly important. Future research could also focus on identifying value (co)creation behaviour, taking a customer-centric view on the delivery of financial services.

Third, our study uses an Australian sample because of the relevance of this country's institutional setting (e.g., high mobile app usage, compulsory retirement saving). Hence, the findings might only generalize to countries with a comparable retirement scheme such as the Netherlands or Denmark (Mercer 2018). Given that Australia has one of the highest financial literacy rates globally (Klapper and Lusardi 2020), the applicability of our findings to a country with lower literacy rates and no compulsory retirement saving scheme could be investigated. As an alternative to our relatively broad sample, which included individuals aged between 18 and 64 years, future research could potentially focus on a specific age group (i.e., either older or younger individuals) when examining their intentions to adopt a mobile retirement app.

Fourth, a lack of available digital tools to support consumers in their retirement planning efforts (i.e., mobile apps, chatbots, online calculators, electronic membership cards) may be partially attributed to a paucity of research on the factors influencing individuals' adoption of said tools and their effectiveness. Future research may wish to explore the introduction and adoption of different digital tools and their impact on retirement planning engagement.

Finally, I used online data collection. As such, respondents can be assumed to possess a certain degree of familiarity with mobile technology, potentially excluding individuals who are not familiar with said technology. However, as smartphone penetration in Australia is around 90% (Deloitte 2019), identifying individuals who do not own a smartphone would have been near impossible. In addition, the researchers assume that a mobile retirement app would not be of great use to an individual not in possession of a smartphone compatible with such an app.

Despite these limitations, this research contributes to the emerging, but still limited, literature on technology-enabled retirement planning (Brüggen et al. 2019; Dellaert 2010; Hoffmann and Otteby 2018) by demonstrating the importance of various psychological and technological drivers for individuals' adoption intentions and anticipated engagement with a mobile retirement planning app.

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APPENDIX E – ETHICS APPROVAL

THE UNIVERSITY of ADELAIDE

Our reference 33740

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09 July 2019

Professor Arvid Hoffmann
Adelaide Business School

Dear Professor Hoffmann

ETHICS APPROVAL No: H-2019-117
PROJECT TITLE: Smartphone Apps and Millennials' engagement with retirement saving

The ethics application for the above project has been reviewed by the Low Risk Human Research Ethics Review Group (Faculty of Arts and Faculty of the Professions) and is deemed to meet the requirements of the *National Statement on Ethical Conduct in Human Research 2007 (Updated 2018)* involving no more than low risk for research participants.

You are authorised to commence your research on:	09/07/2019
The ethics expiry date for this project is:	31/07/2022

NAMED INVESTIGATORS:

Chief Investigator:	Professor Arvid Hoffmann
Student - Postgraduate Masters by Research:	Miss Janin Karoli Hentzen
Associate Investigator:	Dr Rebecca Marie Dolan

CONDITIONS OF APPROVAL: Thank you for your responses to the matters raised. The revised ethics application provided on the 8th of July 2019 has been approved.

Ethics approval is granted for three years and is subject to satisfactory annual reporting. The form titled Annual Report on Project Status is to be used when reporting annual progress and project completion and can be downloaded at http://www.adelaide.edu.au/research-services/oreci/human/reporting/. Prior to expiry, ethics approval may be extended for a further period.

Participants in the study are to be given a copy of the information sheet and the signed consent form to retain. It is also a condition of approval that you immediately report anything which might warrant review of ethical approval including:

- serious or unexpected adverse effects on participants,
- previously unforeseen events which might affect continued ethical acceptability of the project,
- proposed changes to the protocol or project investigators; and
- the project is discontinued before the expected date of completion.

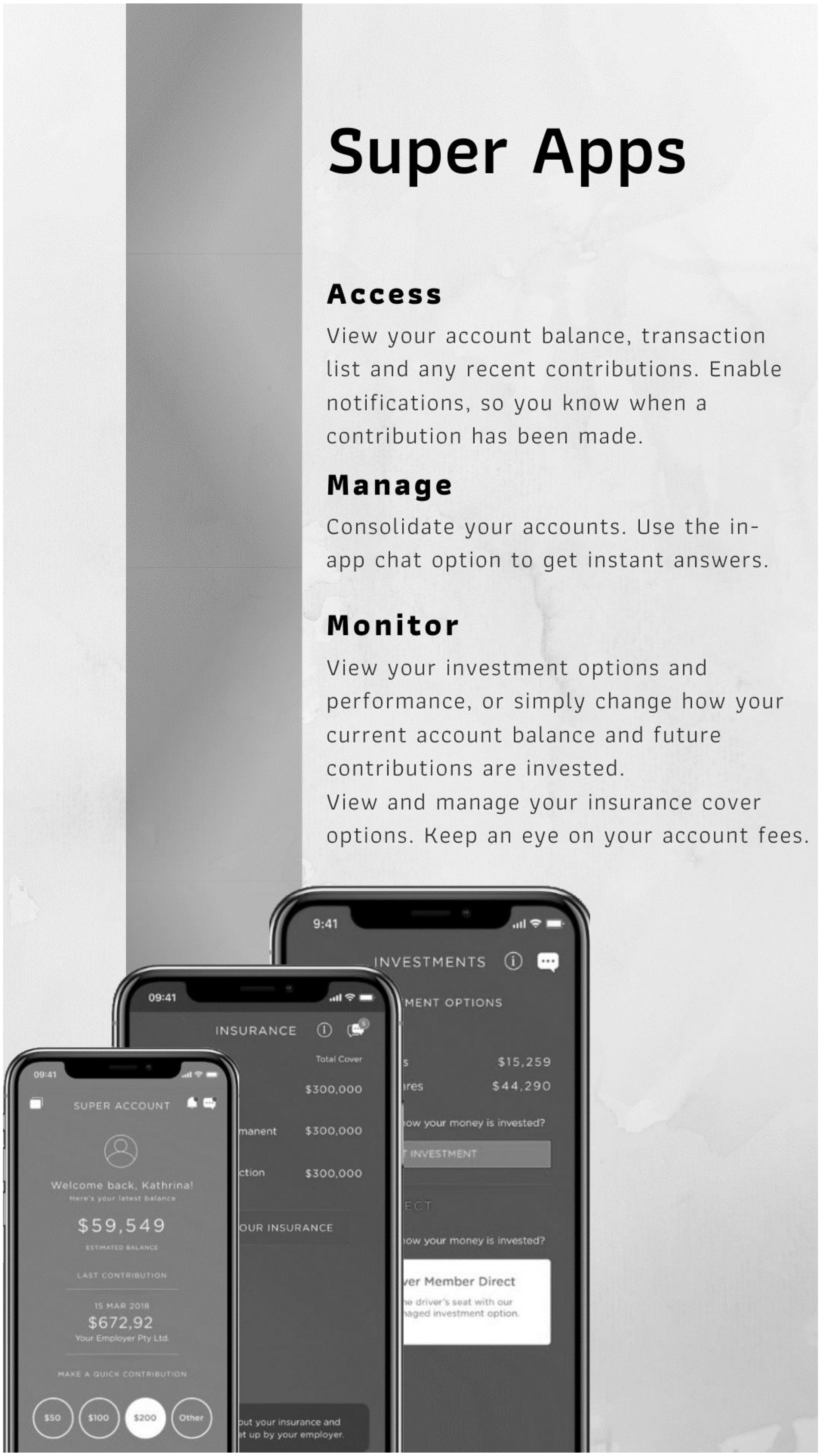
Yours sincerely,

Dr Anna Olijnyk
Convenor

Dr Jungho Suh
Convenor

The University of Adelaide

APPENDIX F – INFOGRAPHIC DISPLAYED AT START OF SURVEY



CHAPTER FIVE: CONCLUSION

Introduction

The overarching objective of this thesis was to provide research momentum and stimulate the academic discussion around the impact of digital technology on consumer financial services, and more specifically, retirement planning. Prior research has predominantly focused on identifying drivers of retirement planning (Donaldson et al. 2010; Hoffmann and Plotkina 2020), including psychological (Hershey et al. 2007; Kerry 2018; Lusardi and Mitchell 2007) and sociodemographic factors (Clark et al. 2018; Kumar et al. 2019). However, limited research has explored the implications of digital technology on retirement planning. This thesis achieved its objective, by adopting a holistic approach to study the research context. Using a macro, meso, and micro lens across three separate papers, the thesis holistically investigates the impact of digital technologies (i.e., artificial intelligence and mobile apps) on retirement ecosystem and consumer retirement planning behaviour Thus, this thesis answers the call for research on how technology can impact the retirement planning process (Bogan et al. 2020; Henkens et al. 2018).

This chapter provides an overarching conclusion to this doctoral research and thesis. The following sections provide a summary of research findings, followed by both theoretical and practical implications, as well as a discussion around the limitations and future research directions.

Summary of Research Findings

The financial services industry has undergone numerous changes in the last few decades, and while there have been multiple drivers (e.g., financial crises, regulation), technology and innovation in particular have had the biggest impact on financial service provision and consumption (Molina-Collado et al. 2021). The three studies included in this thesis confirm the growing importance of technology for the financial services sector, and more specifically, the retirement industry. While Study 1 laid the groundwork with its systematic review of the literature on artificial intelligence in consumer financial services, it also finds that select financial services' contexts have received more scholarly attention than others. That is, while banking, credit scoring and financial investment and advice have been well-addressed, the retirement or insurance industry have not received equal research interest. Additionally, more than half of all analysed studies adopted a data-driven research approach, which given the technical nature of artificial intelligence was to be expected but provides numerous challenges for academic research. Concluding with an extensive agenda for future research, Study 1 provides an overview of suggested research directions including new theoretical perspectives (e.g., service ecosystems), new research settings (e.g., retirement), new research constructs and relationships (e.g., customer engagement), and new data and methods (e.g., netnography).

Study 2 empirically validates the role of digital technology on communication and information flow amongst various actors in the Australian retirement (Superannuation) ecosystem. That is, it finds that digital technology impact both the value of communication (comprising self-servicing, ignorance, and responsibility) and ecosystem integration (comprising transparency and trust, compliance and innovation, and digital infrastructure). Overall, the findings of Study 2 emphasize that while digital technology is currently being employed in the Superannuation ecosystem to manage retirement savings and encourage consumer engagement, challenges remain. These include limited integration of processes and systems, limited resource exchanges, and information complexity.

Finally, findings from Study 3 provide a clearer indication of factors affecting consumers' intentions to adopt and engage with a mobile app to assist in their retirement planning efforts. That is, the findings indicate that consumers' financial self-efficacy, perceived financial security, consideration of future consequences, retirement planning involvement, and perceived usefulness directly impact their anticipated engagement with a mobile retirement app. Additionally, the closer an individual is to retirement, the stronger the association between mobile app adoption intention and anticipated engagement.

Research Implications

Theoretical Contributions

Despite the importance of retirement planning for consumers and society, the current retirement planning literature has yet to join the FinTech research stream and investigate the rapidly developing technological environment that consumers are being exposed to and are increasingly demanding from financial service providers. In the following sections, I emphasize the main theoretical contributions of each study.

Study 1, being a systematic literature review, provides a comprehensive overview of the current literature on Artificial Intelligence in customer-facing financial services. A systematic literature review can advance subject areas and entire research domains through a synthesis and analysis of the literature in a replicable, rigorous, and transparent manner (Paul and Criado 2020). Additionally, the main contribution of a systematic literature review is to offer new research directions (Paul et al. 2021b). As such, the main theoretical contribution of Study 1 is the extensive future research agenda, including proposed research topics and questions. These include new theoretical perspectives (i.e., service ecosystem lens or grounded theory), new research contexts (i.e., retirement or digital economy), and new characteristics and research methodologies.

The growing research interest in the application of digital technology in financial services, as evidenced in Study 1, has provided the foundation for Study 2. Despite the wide recognition of the importance and impact of technology on the financial services sector (Manser Payne et al. 2021), little is known about how digital technology can impact a complex service-ecosystem (Gruner et al. 2019; Ng et al. 2016). Thus, responding to calls for further research, Study 2 adopts a multi-actor service ecosystem perspective to investigate technology-enabled information flow and consumer information-seeking behaviours in the retirement planning industry. To the best of my knowledge, it is the first study to adopt an ecosystem perspective to investigate the impact of digital technology in the retirement planning context. Study 2 contributes to the growing literature on service ecosystems (Baccarani and Cassia 2017; Sklyar et al. 2019b) and digital information search (Dahl et al. 2021; Haluza et al. 2017) by identifying the impact of information complexity on utilization of digital technology. In line with these findings, Study 2 also demonstrates conflicting views and expectations around responsibility of information search and provision, which affect both the perceived value of communication and ecosystem integration efforts. Adding to the emerging research on digital information flow (Peltier et al. 2020), Study 2 emphasizes the need to move beyond dyadic relationships, and instead increase efforts towards ecosystem process and system integrations.

While Study 2 suggests ecosystem actors move beyond the dyadic relationship between service provider and consumer, this relationship is not to be disregarded. Instead, it needs to be further strengthened and nurtured, creating the potential need for technological assistance. As such, Study 3 develops and tests a theoretical model integrating retirement planning, mobile financial service technology adoption and customer engagement constructs. Study 3 contributes to the emerging literature on technology-enabled retirement planning, by offering an enhanced understanding of mobile app engagement in a complex service context (i.e., retirement planning). The results highlight the importance of perceived skills, information/ usage avoidance tendencies and perceived relevance in determining consumers' mobile app adoption intentions and anticipated engagement behaviours. The findings from Study 3 suggest that the closer the consumer is to retirement, the more likely their adoption intentions will transform into anticipate engagement with the retirement app. These findings beckon further research that explores how other demographic characteristics (i.e., gender) impact mobile app adoption and engagement.

Managerial Implications

The three studies included in this thesis provide numerous important considerations for practitioners and policy makers. These key managerial implications are summarized below.

First, while technologies like artificial intelligence are already employed by the financial services industry, the application of it is primarily efficiency driven. That is, AI is being used by banks and credit institutions to conduct consumer credit risk assessments and scoring, where the technology can process data at a much faster pace than an employee. Another popular use of AI is as a chatbot, which caters to consumers' demand for 24/7 accessibility of the service, however, these chatbots are still limited in their ability to fully serve the consumer beyond their initial programming. As such, the research findings suggest that practitioners seek additional applications of AI for their organizations, specifically, in increasing consumer engagement through Marketing strategies such as personalization or consumer journey mapping. Select retirement funds for example have only recently started to adopt AI to improve their consumer service offerings (Mercer 2020b). Other retirement funds may wish to follow suit, given the cost-savings and data processing capabilities of this technology, which have been a concern for many retirement service providers.

Second, the findings emphasize the critical need for service providers, regulatory bodies, and external agencies within the Australian Superannuation ecosystem to improve their collaboration and resource integration efforts. These are expected to improve not only back-office efficiency, but also consumer service experience and outcomes (Sklyar et al. 2019a). Given the complexity around retirement information, having multiple sources each providing different or conflicting information is likely to contribute to consumer information avoidance and lack of engagement. Additionally, the service providers (i.e., Superfunds) need to revaluate their communication strategies, and consider using digital technology to assist. For example, they may wish to utilize big data, data analytics and consumer journey mapping, to improve customer experiences through personalization efforts and consequently build stronger relationships with the consumer.

Third, adequate retirement planning requires early intervention. That is, consumers should start planning and saving for retirement at an early age. Digital technology thus can be used to not only educate young consumers on retirement planning, but also facilitate saving by including gamified elements (Bayuk and Altobello 2019). For example, mobile saving apps may include an avatar, that would be sent on multiple missions (saving goals) and when achieving a goal would be rewarded with points or other types of incentives. While banks and insurance companies have already implemented rewards programs, which can be accessed via their mobile apps (i.e., Commonwealth Bank rewards or Medibank's Live Better rewards), retirement funds have yet to realize the full potential of digital technology such as mobile apps to increase consumer engagement.

Lastly, while technology may appear as the solution to many problems faced by the financial services and retirement industry, practitioners must remain aware of the challenges and risks. That is, regulators will need to pay close attention to areas of consumer privacy, while simultaneously not hindering innovation unnecessarily. It is a fine line between consumer protection and stifling innovation which could be beneficial for the consumer. Other areas that both practitioners and regulators need to pay increasing attention include cyber security, as well as ethics around robo-advice and credit scoring.

Overall, the insights from the studies in this thesis emphasize the applicability and need for advanced digital technologies in increasing consumer retirement planning engagement.

Research Limitations and Future Research Directions

While this thesis contributes to the rich literature on consumer engagement and financial planning, it makes an even larger contribution to the technology-enabled retirement planning and multi-actor service ecosystem research stream, both of which have to date not received limited interest. Despite the thesis' contributions to both theory and practice, as highlighted in the section above, several overarching research limitations persist.

First, the sample for Study 1 was limited to artificial intelligence in consumer-facing financial services, which excluded back-office use and potential operationalization of AI by other financial service providers. AI is increasingly being employed by financial services providers for back-office and asset management, with numerous studies addressing this development. As such, while the sample included in the review provides a comprehensive overview on the literature, it is not complete. As for Study 2 and 3, the research was limited to the Australian context, and as such, the sample consisted of Australian retirement actors (Study 2) and Australian consumers (Study 3) only. While Australia has one of the most developed retirement systems globally (Mercer 2018), the findings may not be readily applicable to or representative of other regions or consumers. Therefore, future research can investigate the use of digital technology in facilitating retirement planning engagement in other countries with less developed pension systems such as the United States of America (Mercer 2020a). As Study 3 suggests, an alternative investigation could focus on a specific consumer group, either based off gender or age cohort.

Second, while the research studies were conducted before (study 3) and during the COVID-19 pandemic (study 1 and 2), they do not expressly account for the impact of the pandemic on consumers' retirement planning. Recent studies find that the pandemic has worsened the financial situation for many vulnerable and low-income households, as it impacted consumer income, with many consumers having to withdraw from their savings to stay afloat (Fox and Bartholomae 2020). In Australia, consumers were given the opportunity to withdraw money from their retirement (Super) savings early, because of the financial hardship faced during the pandemic. While it is too early to determine the consequences of this early release, it is evident that both financial experts and consumers are concerned about the future financial situation (Warren 2021). Additionally, the pandemic has had a positive impact on consumers' adoption of financial technology (FinTech), and as such, further research is warranted that accounts for this increase (Fu and Mishra 2022), especially in the retirement planning context, as highlighted in study 3.

Third, while Study 1 and Study 3 focused on consumer-facing technologies (AI and mobile apps), Study 2 made a first attempt at investigating the impact of digital technology on the retirement ecosystem, that is, both consumer and service provider. However, the study is limited in both sample, which excluded a few important ecosystem actors such as regulators or industry agencies, and technology. As such, future research may wish to build on these findings and take a closer look at how different technologies (i.e., AI, blockchain, big data) improve or hinder actor collaboration and the overall ecosystem. Finally, many research questions proposed in Study 1, 2, and 3 remain unanswered. This thesis aimed to encourage future research in the retirement planning field, and thus, these questions may serve as a useful guide to future researchers.

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