Netspar

Brace yourselves,
Pension is coming

Consumption, financial literacy and tailored pension communication

Milena Dinkova

NETSPAR ACADEMIC SERIES

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Brace yourselves, Pension is coming:

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Zet je schrap, je pensioen komt er aan:

Consumptie, financiële geletterdheid en maatwerk in pensioencommunicatie

(met een samenvatting in het Nederlands)

PROEFSCHRIFT

ter verkrijging van de graad van doctor

aan de Universiteit Utrecht

op gezag van de rector magnificus,

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Milena Dinkova

geboren op 11 januari 1988 te Sofia, Bulgarije

Meinen lieben Eltern

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I wish to thank so many people without whom this endeavour would be a much longer and arduous flight.

To find the appropriate words of gratitude for all those of you who have guided, taught, motivated, distracted, supported me the past years,
I first thought that writing this in rhyme could have a good ring, but it pushes the frontiers.

In order not to risk having to delay printing this dissertation and getting even more out of rhythm, let's change to prose,
Pension communication and financial literacy – does it even rhyme with Game of Thrones?

During this period of 4.5 years, I was lucky to have many supervisors whom I have so much to thank: Adriaan Kalwij, Leo Lentz, Wolter Hassink and Rob Alessie. Adriaan, you have amazing knowledge about statistics and econometrics- I count myself lucky to have learned so much from you, including many invaluable tips and tricks for writing papers, giving presentations or simply some facts about the beginnings of Pinkpop in your backyard. Also, thank you for introducing me to the Netspar research community. I am looking forward to continue to work with you the next two years on the new Netspar project. Leo, thank you for your dedication, wise advice and for keeping us economists sharp about the distinction between descriptives and results and the added value of also considering different disciplines when conducting or discussing research. You brought invaluable knowledge from a different discipline with you which made our research project a success. In line with the topic of this dissertation, you retired one and a half years ago. Yet, that did not stop you to continue your role together with Adriaan as a dedicated supervisor, thank you for this! I must admit that by working together with you, I tried to pay even more attention to writing and presenting in a way that is (hopefully) more accessible to an audience beyond economists. Wolter, thank you for your guidance and advice during the past years— in fact since the beginning of the research master. It surely must have felt a bit weird to switch our communication from English to Dutch at some point.

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Milena Dinkova,

Den Haag, September 2019

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Chapter 1: Introduction

Pensions are "our precious"— We want it and we need it to ensure a worthy living after working life, but we also do not like to think about it. Luckily, we are not likely to share the fate of poor Gollum/Smeagol[1] regarding our "precious". Yet, pensions (like the rings of power) are the subject of brain-wrecking discussions and clashes of interests. Whereas the One Ring divides and unites elvish folk, men, trees and dwarfs, pensions divide pension scholars, practitioners and political parties while having the One Goal— to ensure a decent living standard after working life for present and future generations. But let us move away from Middle Earth and delve into the no less intricate happenings of the Dutch pension world.

As in other developed countries, people in the Netherlands live longer. Therefore, the statutory pension age has been raised in order to ensure an affordable pension system. Furthermore, as pension insurers and pension funds invest in financial markets in order to ensure a large enough rate of return, pensions are sensitive to macro-economic developments of the Dutch economy and to developments in the financial markets (Ministry of Social Affairs and Employment, 2019b).

At the time this introduction has been written (beginning of 2019), the Dutch government was still debating about a suitable pension agreement (the *Pensioenakkoord*) amongst the ruling political parties. In his letter to the Dutch Parliament, minister Koolmees summarises the ongoing discussion (Ministry of Social Affairs and Employment, 2019a). People expect that pension premiums are being indexed (making sure that pension premiums are corrected for inflation). At the same time, the aim is to try to minimise discounts (*kortingen*) which lower the expected accrued pension income. A more general issue is to ensure that despite the rising statutory pension age, people can work longer healthily and still have the option to retire earlier.

Furthermore, the public debate on freedom of choice plays an important role: people would like to have more choice regarding their pension (Ministry of Social Affairs and Employment, 2016). In a recently published Netspar design paper study, researchers compare freedom of choice in the Netherlands with a selection of other (Western) countries. They conclude that regarding pension decumulation in 2nd pillar pensions, there is relatively little freedom of choice (Lever, Ponds, Dillingh, & Stevens, 2018). The question is whether freedom of choice leads to better pension decisions. It could be possible that people retire too early instead while having saved too little. The Netherlands Bureau for Economic Policy Analysis (CPB) has published a background

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[1] Smeagol (and his alter-ego Gollum) is a tragic, yet impressive character in the Lord of the Rings (fictional) trilogy of J.R.R. Tolkien, who is obsessed with a ring of power (the One Ring). He and other creatures who were under the Ring's spell refer to the Ring as the 'precious'.

document on freedom of choice regarding pension payments presenting a cost-benefit analysis. The authors stress that the pitfalls of freedom of choice can be limited by offering professional assistance, clear communication and carefully designed defaults (Folmer, Lever, Ponds, Starink, & Westerhout, 2018). This brings us to the question whether tailoring information could help to strike a balance between freedom of choice and guiding people towards (for them) better pension decisions. The Netherlands Authority for Financial Markets (AFM) has published a report on freedom of choice and tailoring in the pension system (Netherlands Authority for the Financial Markets (AFM), 2018). The AFM concluded in this literature study that choice guidance and tailoring is a hopeful possibility to limit the chance that consumers make "wrong" choices.

The pension discussion and especially the discussion about freedom of choice illustrates the relevance of two issues:

- A *clear communication* is needed about the pension scheme, reforms, concepts, the choices available and options of what one can do (from the side of the pension plan providers), which can be tailored to individual key characteristics.

- It is necessary for consumers to *understand* the choices available and to be *motivated* to make informed pension decisions. Concepts like financial literacy and need for cognition become relevant here.

Those are the main ingredients of this dissertation: effective pension communication (through tailoring) and financial literacy. This dissertation consists of four studies in which I delve into (experimentally and empirically) testing the effectiveness of tailoring pension communication and what the role of financial literacy is regarding the decision to delve into pension information and general financial decision-making (like non-durables consumption). The last study focusses on the relevance of psychological factors like need for cognition, future time perspective and attitudes towards pension information in explaining pension information decisions.

In this first chapter, I provide an overview of the context to understand the setting of the studies described in this dissertation. A short introduction into the Dutch pension system is followed by an overview of the legislation regarding pension communication in the Netherlands. Subsequently, I explain how tailoring pension communication and financial literacy come into play as tools to assist consumers to make informed financial decisions. Next, I sketch the aim and contribution of this research. At last, I provide a chapter overview of the dissertation and conclude with some final remarks.

1.1 Pensions and pension communication

1.1.1 A very short overview of the Dutch Pension System

The Dutch pension system consists of three pillars, each of them having a bundle of laws and arrangements concerning old-age, decease and disability. The first pillar provides basic income to cover basic expenses. Anyone who works and lives in the Netherlands is automatically accruing state pension (AOW). The amount of the state pension one receives is adjusted annually according to developments of the minimum wage (Ministry of Social Affairs and Employment, 2019b). The Social Insurance Bank (*Sociale Verzekeringsbank*, SVB) is responsible for paying out the state pension. The second pillar refers to arrangements between employers and employees. In most sectors, the 2nd pillar pension (or workplace pension) is quasi-mandatory resulting in about 90% of the employers offering a 2nd pillar pension scheme to their employees (Ministry of Social Affairs and Employment, 2019b). Employers usually pay two third of the total pension premium and employees the remaining one third. The third pillar encompasses all individual retirement arrangements like life insurance or life annuities that offer fiscally attractive possibilities to privately save for retirement.

This dissertation assesses the effectiveness of pension information regarding pension schemes that fall under the 2nd pillar. The focus lies on pension communication regarding second-pillar pension schemes for two reasons. First, those schemes can be relatively complex involving choices to be made by pension plan participants, hence effective pension communication regarding those schemes are crucial. Secondly, despite the legal requirements regarding information provision— which I will discuss in the next section of this chapter— there is still room (for pension plan providers in collaboration with researchers) to experiment with the way information is conveyed by offering for instance pension information tailored to individual key characteristics like age or gender.

1.1.2 Pension communication in the Netherlands: Legal and institutional setting

Before I delve deeper into the effectiveness of pension communication and financial literacy, it is wise to learn more about the legal context of pension communication in the Netherlands. In 2015, the Pension Communication Act has been passed, replacing the Pension Act from 2007. The aim of the Pension Communication Act from 2015 was to improve the effectiveness of pension communication by introducing a number of changes (Ministry of Social Affairs and Employment, 2015):

- *Formulating general requirements to pension communication*: Pension communication should be correct, clear and timely considering information needs of pension plan participants. Participants should gain insight in possible choices and the impact of life events;

- *Advocating more possibilities for digital communication*: referring to websites is not sufficient, information should be provided in a personal pension environment;
- Instead of the Introduction letter, *Pension1-2-3* was introduced providing layered pension information
- Renewing the Annual Pension Statement (UPO);
- Extending the functionalities of the existing platform *My Pension Overview* (mijnpensioenoverzicht.nl).

For a brief overview on the changes of the Pension Communication Act, please consult Chapters 1 and 2 of Louise Nell's dissertation (Nell, 2017) or, for an even shorter version, the presentation of the Ministry of Social Affairs and Employment highlighting the gist of the Pension Communication Act (Ministry of Social Affairs and Employment, 2015).

The pension communication environment in which the effectiveness of pension communication has been studied is 1) e-mail invitations to access a personal pension environment and 2) the personal digital pension environment which contains clustered digital pension information by topic, the possibility to check one's pension situation and link to layered pension information (Pension1-2-3).

1.2   Research perspectives and positioning in the literature

In this subsection, I will introduce two research perspectives that shape this dissertation. First, I will outline how tailoring pension information to key characteristics of pension plan participants can be a means to increase the effectiveness of pension information. Secondly, I will discuss the concept of financial literacy and how it can relate to financial decision making and consumption and pension decisions in particular. This subsection also positions this dissertation within existing research on effective pension communication and financial literacy.

1.2.1   Effective pension communication through tailoring pension information

As already recognised by the Netherlands Authority for the Financial Markets (Netherlands Authority for the Financial Markets (AFM), 2018), providing tailored pension information can be a means to guide pension plan participants towards making better pension decisions. In this dissertation, tailoring is regarded as a way to activate pension plan participants to look into their pension situation in the first place so that they can make informed pension decisions.

Tailoring information in other domains

Unlike in the pension domain, offering tailored information to improve health communication has been widely researched. Hawkins et al. (2008) provide a conceptual framework of tailoring health

information in order to encourage further research on tailoring. They propose a conceptual model in which tailoring depends on personalisation, feedback and content matching, arguing that tailoring will then result in larger effects of the communication. Tailoring information has already been recognised to increase the effectiveness of programs preventing binge drinking (Chiauzzi, Green, Lord, Thum, & Goldstein, 2005), promoting healthy nutrition (Brug, Steenhuis, van Assema, & de Vries, 1996; Oenema, Brug, & Lechner, 2001) and smoking cessation (Cobb, Graham, Bock, Papandonatos, & Abrams, 2005; Dijkstra, De Vries, Roijackers, & van Breukelen, 1998; Etter, 2005; Strecher, Shiffman, & West, 2005). See Chapters 3 and 4 for a more in-depth discussion of the relevant literature on tailoring information.

Three phases in pension communication

We can distinguish between three phases in which tailoring pension information can take place: the trigger phase, the navigation phase and the content phase. In the trigger phase, individuals are approached by their pension plan provider, usually by e-mail or postal mail, inviting them to log in to their personal pension environment where they can find more relevant information on their pension situation. The field experiment described in Chapter 3 is an example of tailoring in the trigger phase: There, e-mail invitations were sent to employees of an insurance company inviting them to log in to use an online tool in their personal pension environment. A relevant study related to the trigger phase is a field experiment conducted by Bauer, Eberhardt and Smeets (2017). In this field experiment, the authors investigated the impact of social norms and financial incentives in triggering pension plan participants to inform themselves about their pension situation.

The navigation phase kicks in after people have already been triggered to log in to their personal pension environment. In this phase, the focus lies on guiding pension plan participants through a myriad of information on different pension products, choices available as it comes to pension payments depending on life-events like marriage, divorce, death of a partner, etc. Tailoring in the navigation phase takes place by altering the design and presentation of choices and reorganisation of the information provided. The field experiment presented in Chapter 4 is an example of tailoring in the navigation phase: Employees of several firms were first sent a generic invitation to log in to their personal pension page and subsequently were assigned tailored versions of digital pension information.

The last phase, the content phase, refers to modifying the content of the pension information provided, based on individual preferences or characteristics. I am not aware of any empirical research on the effectiveness of tailoring pension information in the navigation phase (yet) or in the content phase.

Relevant literature

There are two dissertations that are particularly relevant for the research conducted in the present dissertation: the dissertations of Louise Nell (2017) and Wiebke Eberhardt (2018). In her research, Nell analyses the design of pension communication and how pension communication could be more effective in informing pension plan participants. She looked at the impact of regulations, the role of different types of media used in pension communication environments and also at the role of financial literacy when processing pension information. Nell concludes that as a result of the regulatory requirements of pension information provision, people are confronted with more information reducing the motivation to deal with pension issues and the findability of relevant information. Nell finds that financial literacy becomes relevant in hierarchically structured pension documents (Nell, 2017, p. 177) implying an important role of financial literacy in understanding pension communication. This dissertation picks up on the aforementioned conclusions as tailoring can be a possible solution to keep pension plan participants from being swamped by too much pension information.

In Chapter 3 of her dissertation, Eberhardt (2018) investigates how framing can help to activate pension plan participants. Eberhardt used loss vs. gain framing and assurance framing and found that the loss vs. gain frame can be an effective nudge but goes hand in hand with negative emotions and that the assurance frame, was more effective in triggering participants to click through. Furthermore, the study of Bauer et al. (2017) is related to our research in that they manipulate pension information and subsequently assess pension plan participants' online behaviour. A distinctive feature is though that Bauer et al. (2017) look at the effect of nudges and financial incentives on the decision to look up one's pension situation.

Chapters 3 and 4 test the effectiveness of tailoring digital pension information to *key characteristics* of participants like gender and age. A couple of studies provide evidence for age and gender differences in individual goals for retirement (Hershey, Jacobs-Lawson, & Neukam, 2002) and for gender differences in investment strategies (Graham, Stendardi, Myers, & Graham, 2002). Furthermore, Eberhardt et al. (2016) have incorporated demographics like age and gender to explain pension plan participants' intention to delve into their pension situation. The relevant literature is discussed more in detail in Chapters 3 and 4.

1.2.2   Financial literacy, household decision making and pension information behaviour

What is financial literacy?

Before I delve into the role of financial literacy in financial decision-making, I briefly discuss three definitions of financial literacy. A short and basic definition of financial literacy has been provided

by Huston (2010) as "measuring how well an individual can understand and use personal finance-related information" (p. 306). A more extensive definition formulated by researchers of the Organisation for Economic Co-operation and Development (OECD) incorporates the dimensions of attitude and behaviour: "Financial literacy is a combination of awareness, knowledge, skill, attitude and behaviour necessary to make sound financial decisions and ultimately achieve individual financial wellbeing." (Atkinson & Messy, 2012, p. 14). Those two definitions, while recognising the importance of understanding financial concepts (next to financial knowledge), do not explicitly mention the importance of confidence in applying the skills and knowledge to make sound financial decisions. Remund (2010) offers a broader definition incorporating more dimensions:

"Financial literacy is a measure of the degree to which one understands key financial concepts and possesses the ability and confidence to manage personal finances through appropriate, short-term decision-making and sound, long-range financial planning, while mindful of life events and changing economic conditions" (p.284).

As in this dissertation the focus lies on consumption decisions and long-term financial planning (pension decisions), I consider the definition by Huston as a starting point. Building upon this definition, I use measures of different relevant concepts to better operationalise Huston's definition of financial literacy. Operationalising the way financial literacy is defined by Atkinson and Messy (2012) or by Remund (2010) proves difficult as it involves following individuals for a longer period of time to assess their ability of long-term financial planning or when considering life events or changing economic conditions.

Measuring financial literacy and extending the concept of financial literacy

Chapter 2 of this dissertation conjectures that financially literate households can better exploit investment opportunities allowing them to enjoy a higher consumption level at a later stage in their life-cycle compared to households with a lower financial literacy level. In this chapter, financial literacy is a construct consisting of four questions testing knowledge of interest compounding, inflation, risk diversification, the relationship between bond prices and interest rates and a question on self-assessed financial knowledge.

Those questions on financial literacy have been developed and successfully implemented in numerous international surveys by Annamaria Lusardi and her co-authors such as in the Health and Retirement Study (Lusardi & Mitchell, 2007a, 2008), the RAND American Life Panel (Lusardi & Mitchell, 2007b) and the Dutch DNB Household survey (van Rooij, Lusardi, & Alessie, 2011a, 2011b). See Lusardi (2015) and Lusardi and Mitchell (2011) for an international overview of financial literacy.

Chapter 5 of this dissertation proposes to extend the way financial literacy is measured by adding a vocabulary test and questions testing topic-specific knowledge (pension knowledge). Those insights are based on academic research from linguistics and communication science (Lentz & Pander Maat, 2013; Nell, Lentz, & Pander Maat, 2016). As a result, financial literacy is considered as a construct of financial knowledge (encompassing numeracy, knowledge of financial concepts, topic-specific knowledge and perceived financial knowledge) and literacy in its original sense. Subsequently, the relationship between this financial literacy concept and log in behaviour of pension plan participants is examined.

By linking financial literacy to household consumption decisions and pension information behaviour respectively, I expect to be able to draw conclusions about the relevance of financial literacy in financial decision-making based on the analysis of representative household data (in the case of Chapter 2) and survey data and field experiments (in the case of Chapter 5).

1.3   Aim and research questions of this dissertation

The aim of this dissertation is manifold. First— to provide empirical evidence from randomised field experiments about the effectiveness of tailoring pension information. Secondly, to contribute to economic literature by zooming in on financial literacy and its relationship with a general economic variable—household consumption— that is the result of financial decisions and life circumstances. Thirdly, to advocate the use of insights from social psychology and linguistics when explaining economic outcomes. Adopting the expertise of linguists when designing the treatments in the field experiments described in this dissertation and including behavioural factors rooted in social psychology into models (especially in Chapter 5) when explaining pension information behaviour, are examples of how a multidisciplinary approach can enrich economic analyses. Fourthly, to point out several complications considering legal pension communication requirements, efforts from pension plan providers and behaviour of pension plan participants culminating in a number of policy implications. At last, this dissertation contributes to the discussion about how pension plan providers can improve the effectiveness of pension communication which, ultimately, leads to better pension outcomes for consumers.

This dissertation assesses the effect of tailoring based on objective key characteristics as age and gender. In collaboration with a leading pension plan provider, we designed different personalised pension documents, tested their effectiveness in motivating participants to delve into their pension situation and collected additional data on financial literacy, behavioural factors like need for cognition, attitudes towards pension information and time preferences.

This dissertation aims to answer the following general research questions:

1) What is the effectiveness of tailoring pension communication in motivating people to make informed pension decisions?

2) What is the role of (the components of) financial literacy in explaining people's financial decision-making (including pension planning)?

To answer those main questions, I consider a set of sub-questions that will reappear in the next chapters of this dissertation:

- To what extent is everyday household consumption related to financial literacy?
- What is the effectiveness of tailoring pension communication?
- To what extent is the effectiveness of tailored pension communication related to financial literacy?

1.4 Chapter overview

Chapter 2 stands out in that it combines economic theoretical predictions about financial literacy and its potential role in household decision-making with empirical evidence to test those predictions. It delves deeper into economic theory and at the same time uses the financial literacy concept as it has been predominantly used in economic literature. Chapter 2 examines the relationship between household consumption and financial literacy for Dutch households. The economic framework is a life-cycle model of consumption in which financial literacy affects the rate of return. The theoretical predictions are that financial literacy and consumption levels are positively correlated for plausible values of the intertemporal elasticity of substitution and that financial literacy and consumption growth are positively correlated. The theoretical predictions are empirically tested using Dutch data from the LISS household panel.

Chapters 3 and 4 describe two field experiments respectively testing the effectiveness of tailoring pension information. Chapter 3 presents the results of sending tailored e-mail invitations (tailoring in the trigger phase) to participants to log in to an online tool to learn more about their pension information. During the second experiment— described in Chapter 4— participants were assigned a digital pension document with tailoring being applied to the general structure of the pension document (the navigation phase). Both experiments were designed to analyse the participants' pension information behaviour.

Chapter 3 assesses whether offering tailored pension information based on age and gender is a way to get people interested in pension information. In a randomised field experiment, email invitations were sent to all employees of an insurance company to use an online tool, referred to as "the Pensioncheck", in order to learn more about their personal pension situation. This

experimental set-up enabled us to answer the following research question: Does tailoring induce participants to perform the Pensioncheck? The experiment provided data on (1) whether individuals clicked through from the invitation to the Pensioncheck website, (2) whether they logged in on the Pensioncheck website and (3) the amount of time they took to complete it.

Chapter 4 presents the results of a randomised control experiment (RCE) amongst employees of several firms who got enrolled into a new workplace pension scheme. Participants were sent a generic invitation email to log in to the digital pension environment (DPE) and were subsequently randomly assigned tailored versions of digital pension information based on age. Chapter 4 analysed whether tailoring the general structure of pension information based on age affected the participants' navigation behaviour. The effect of tailoring on navigation behaviour has been measured using the time spent in the DPE and clicking on relevant pension information. Tailoring of the DPE has been based on selected goals that were relevant for each age group.

Chapter 5 investigates whether financial literacy can explain the likelihood of people delving into their pension situation using the data obtained from the two experiments (from Chapters 3 and 4). In Chapter 5, a financial literacy construct is suggested that, next to the usual financial literacy questions assessing numeracy, knowledge of financial concepts and perceived financial knowledge, also includes questions on pension-specific knowledge and a vocabulary test. This chapter offers a deeper analysis of pension information behaviour by combining administrative data and survey data. A survey was distributed amongst employees and customers of a large insurance company in order to elicit participants' financial literacy level, some relevant behavioural factors and demographics. Participants' login behaviour in their respective digital pension environment (DPE) is linked to their financial literacy level and behavioural factors including attitudes towards pension information, need for cognition and future time perspective.

The concluding chapter of this dissertation, Chapter 6, summarises the findings of all studies and places them in a broader context by reflecting upon policy implications and directions for future research.

1.5   Final remarks

All studies are set up as separate journal articles and can therefore be read separately. The introductions of Chapters 3 to 5 partially overlap as they all deal with different facets of the effectiveness of pension information and the login behaviour of pension plan participants. The first three studies (Chapters 2-4) are joint work with several co-authors who provided me with valuable comments during the writing process. Chapter 2 is co-authored by Rob Alessie and Adriaan Kalwij. Chapters 3 and 4 are co-authored by Sanne Elling, Adriaan Kalwij and Leo Lentz and have been published as Netspar Design papers, a refereed industry paper series of the Network

for Studies on Pensions, Aging and Retirement. The data used in Chapter 2 is anonymised data kindly provided by CentER data. The data used in Chapters 3 through 5 has been kindly provided by a.s.r. It contained personal details but has been anonymised and will be archived using the Data Archiving and Networked Services (DANS), an institute of the Royal Netherlands Academy of Arts and Sciences (KNAW) and the Netherlands Organisation for Scientific Research (NWO). Chapters 2-5 have also been published in the TKI Discussion Papers series.

1

Chapter 2: Know more, spend more? The impact of financial literacy on household consumption[2]

Abstract

This chapter examines the relationship between household consumption and financial literacy for Dutch households. The economic framework is a simple life-cycle model of consumption in which financial literacy affects the rate of return on assets. The theoretical predictions are that financial literacy and consumption levels are positively correlated for plausible values of the intertemporal elasticity of substitution and that financial literacy and consumption growth are positively correlated. We use Dutch data from the LISS household panel to empirically test our theoretical predictions. Our results provide evidence for a strong positive association between couples' non-durable consumption and the level of the male partner's financial literacy. We did not find evidence for an association between consumption growth and financial literacy. Our results are robust to including household assets, interest in financial literacy and to examining different stages of the life-cycle.

2.1   Introduction

Saving behaviour is a means to smooth consumption and if accumulated savings are invested wisely, it increases lifetime consumption. Understanding household saving and consumption decisions is important for the current discussion on the general lack of interest in dealing with pensions and not always making wise and timely investment decisions. Procrastination may be responsible for people to postpone saving for retirement resulting in insufficient retirement income (Laibson, 1997; Laibson et al., 1998). Krijnen, Breugelmans & Zeelenberg (2014) discuss the issues around postponing retirement planning in the Netherlands and conclude that many people do not recognise why they should save now and how they should do so. The consequences of postponing planning for retirement can be that a household enters retirement with too few financial means to satisfy consumption needs. In a paper exploring whether the Dutch can meet their own retirement expenditure goals, de Bresser and Knoef (2015) find that for 20% of households the expected financial situation at age 65 falls short of minimum expenditures[3].

Thaler and Benartzi (2004) recognise that procrastinating agents do not act as predicted by standard life-cycle theory and propose a savings program called Save More Tomorrow™ in which people commit in advance to allocate a share of their future salary increases to retirement savings. A programme as designed by Thaler and Benartzi could be an effective approach but probably

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[3] To be consistent with the terminology used by CentER data (for the LISS panel), we use consumption and expenditures interchangeably.

brings along substantial implementation costs. A different and arguably less paternalistic approach could be to stimulate individuals to become more active financial planners by increasing their financial knowledge which, in turn, may as well increase their confidence in making sound financial decisions, with the aim to exploit better returns on investment. O'Donoghue and Rabin (1999a) argue that usually, if an action involves immediate costs and future benefits, people procrastinate. However, if a person is (financially) sophisticated, then "[he or she] does the activity sooner than does a naiver person with the same preferences" (p.104). Planning for retirement can undoubtedly be regarded as an action involving current costs and future benefits.

There already are several studies confirming that more sophisticated, more financially literate people are more likely to engage in financial planning (Lusardi & Mitchell, 2007c, 2011; van Rooij et al., 2011b). In its basic form, financial literacy is "measuring how well an individual can understand and use personal finance-related information" (Huston, 2010, p. 306). As discussed in Chapter 1, this will be the definition that we will use as a starting point as broader definitions are more difficult to be operationalised. Financial literacy is not only about knowledge of financial concepts but comprises also the ability to use that knowledge for financial planning. The classical approach to measure financial literacy in the economic literature has been developed by Lusardi and Mitchell (2007a) and is made up of questions essentially testing numeracy and the knowledge of (basic) financial concepts such as interest compounding, inflation, investing in stocks and the relationship between bond prices and interest rates. The questions were implemented for instance in the Health and Retirement Study (HRS) (Lusardi & Mitchell, 2007a, 2008), the RAND American Life Panel (Lusardi & Mitchell, 2007c) and the Dutch DNB Household survey (DHS) (van Rooij et al., 2011b, 2011a).

So far, the economic literature on financial literacy has often focused on the role of financial literacy in savings behaviour and stock market participation (Deuflhard, Georgarakos, & Inderst, 2018; van Rooij et al., 2011a) and in retirement planning (Bucher-Koenen & Lusardi, 2011; Lusardi & Mitchell, 2007b; van Rooij et al., 2011b). Van Rooij et al. (2011a) showed that a low level of financial literacy acts as a significant deterrent to stock ownership. Additionally, they extended their empirical model with risk aversion, cognitive ability (as a complement to financial literacy) and peer effects and still found positive and statistically significant estimates. Lusardi, Michaud and Mitchell (2017) developed a stochastic life cycle model that features endogenous financial knowledge and a sophisticated saving technology allowing for uncertainty and imperfect insurance. Their intuition is that better financial knowledge enables individuals to better allocate resources over their lifetime: financially savvy individuals can use sophisticated financial products which, in turn, raise the return on savings. Lusardi et al. (2017) found that 30-40 per cent of US wealth

inequality can be attributed to differences in financial knowledge. Also, they found the optimal financial literacy profile to be hump-shaped over the life cycle. Related work by Deuflhard et al. (2018) showed that more financially literate investors earn on average higher savings returns and that more literate households are more able to identify bank accounts yielding higher rates of return across banks. In other words, the rate of return on investments is an increasing function of financial literacy. To our knowledge, Jappelli and Padula (2017) are the only ones who link financial literacy[4] and consumption. They derived the Euler equation in a life-cycle setting linking financial sophistication and non-durable consumption growth. In their theoretical model, Jappelli and Padula (2017) allowed for individuals to invest in financial literacy. Subsequently, they tested the prediction of their model using the Italian Survey of Household Income and Wealth. As financial literacy is an endogenous variable in this setting, they used an instrumental variables (IV) approach to tackle this issue. They found that having a one point higher financial sophistication score (on a scale from 0-3) is associated with a 5.3 percent higher non-durable consumption growth.

With this analysis, we want to contribute to the discussion of the importance of financial literacy for the decision-making process of individuals and households. Similar to Jappelli and Padula (2017), we derive the Euler equation in a life-cycle setting. In contrast to Jappelli and Padula, who introduced uncertainty to their model, we first derived the Euler equation assuming full certainty. We assumed full certainty in order to elicit the total effect of an increase in the rate of return (due to a higher financial literacy level) on consumption levels. We use simulations to illustrate the theoretical predictions of our model. Subsequently, we empirically test the predictions of the model, namely a positive association between financial literacy and consumption growth and a positive association between financial literacy and consumption levels. We utilised data from the LISS panel, a representative survey of Dutch households. From the LISS panel, we obtained data on financial literacy, household consumption, and demographics.

It turns out that financial literacy has a positive effect on consumption levels (for plausible values of the intertemporal elasticity of substitution). We recognise that estimating the Euler equation using consumption data is problematic due to the availability of short panels— see Attanasio and Low (2004) for a technical discussion on the assumptions needed to consistently estimating Euler equations.

To our knowledge, we are the first to analyse the financial literacy level of a household head and his or her partner and relate this to household consumption. Moreover, we reconsidered the concept of financial literacy by adding self-assessed financial literacy to our analysis. When asked

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[4] Jappelli and Padula (2017) consistently refer to financial literacy as financial sophistication. They use three questions to measure financial literacy: interest rate compounding, portfolio diversification and understanding of mortgage contracts. The first two questions are identical to the questions included in the LISS panel.

to assess one's financial knowledge, people will provide their subjective assessment that might deviate from the objective measures that Lusardi and her colleagues have used in their work. Jappelli and Padula did not consider self-assessed financial knowledge in their theoretical and empirical models. Van Rooij et al. (2011a) have recognized in their work the importance of self-assessed financial knowledge and included this dimension in their analysis and observed a strong correlation between both measures. Furthermore, a recent study by Anderson, Baker and Robinson (2017) on precautionary savings and retirement planning found that self-perceptions of financial literacy drive decision-making, especially of low-literacy individuals.

The structure of this chapter is as follows: The second section of this chapter outlines the theoretical model and derives the Euler equation and a closed-form solution for consumption. In the third section, several descriptive statistics on financial literacy and consumption (growth) and demographic variables are presented at the individual and the household level. The fourth section describes the estimation method used and the fifth section presents the estimation results. In the sixth section, we report the results for several robustness checks. The last section discusses the results and concludes.

2.2   Theoretical framework

In order to obtain theoretical insights into the interaction between financial literacy, the rate of return and consumption patterns, we use a simple life-cycle model with full certainty. The model is based on the assumption that consumers want to smooth marginal utility over time (Hall, 1978). Following Jappelli and Padula (2017), financial literacy enters the life-cycle model through the interest rate: a higher financial literacy level is reflected in a higher rate of return on investment. Hence, financially literate households postpone current consumption in order to save now and due to a higher return on savings compared to less literate households, are able to consume more in the future.

We assume complete certainty, a constant real interest rate over time and that income is constant over the lifecycle. Both assumptions are needed in order to eliminate potential sources of uncertainty. Considering a model with full certainty allows us to mathematically derive a relatively simple closed-form solution for consumption which makes it possible to provide transparent insights into the relationship between different financial literacy levels and household consumption. Additionally, we assume that there is no bequest motive, hence $A_T = 0$, where T is the last period in the life cycle and A_T denotes wealth at the end of period T. Following Jappelli and Padula (2017) in their baseline model, we assume perfect capital markets and that there are no

liquidity constraints[5]. Furthermore, these assumptions also imply that we can assume without loss of generality that household income is constant over time.

Hence, we formulate the following value function:

$$V_0(A_0) = \max_{c_t} \sum_{t=1}^{T} (1+\rho)^{1-t} u(c_t) \tag{2.1}$$

subject to the dynamic budget constraints

$$A_t = \big(1 + r(\varphi)\big)A_{t-1} + y_t - c_t, \mathrm{t} = 1, \dots, \mathrm{T}$$

where A_t is wealth at the end of period t and A_0 is set to zero, $r(\varphi)$ is the real rate of return which is a function of the financial literacy level φ, ρ is the rate of time preference, y_t being labor income (assumed to be constant over time) and c_t being consumption at period t. Similar to Jappelli and Padula (2017), we define $r(\varphi)$ as a strictly increasing function of the financial literacy level. Whereas Jappelli and Padula allow for investment in financial literacy during one's life-time, we simplify this assumption in our theoretical setting by considering φ as exogenously given due to data availability on financial literacy. Hence, the equations we derived are conditional on the optimal financial literacy level.

We define utility to be a general constant relative risk aversion (CRRA) utility function $u(c_t) = \frac{c_t^{1-\gamma}}{1-\gamma}$ where γ is the coefficient of relative risk aversion with $\gamma \neq 1$. This utility function exhibits decreasing absolute risk aversion and has been commonly used when studying household consumption (see for instance Attanasio & Low, 2004 and Attanasio & Weber, 1989).

Formulating the Bellman equation, optimising equation (2.1) with respect to A_{t+1} (wealth at the beginning of period $t+1$) and using the Envelope Theorem, yields the following Euler equation for a broader time horizon linking consumption growth and financial literacy (Deaton, 1992):

$$u'(c_t) = \left(\frac{1 + r(\varphi)}{1 + \rho}\right)^{\tau - t} u'(c_\tau), \tau = t, \dots, T \tag{2.2}$$

Plugging in the specified form of the utility function and rewriting the Euler equation for two subsequent periods: period t and $\tau = t + 1$ gives

$$c_{t+1} = \left(\frac{1 + r(\varphi)}{1 + \rho}\right)^{\frac{1}{\gamma}} c_t \tag{2.3}$$

or, when taking the logarithm on both sides:

$$\Delta \log(c_t) = \frac{1}{\gamma} \log\left(\frac{1 + r(\varphi)}{1 + \rho}\right) = \sigma \log\left(\frac{1 + r(\varphi)}{1 + \rho}\right) \cong \sigma(r(\varphi) - \rho) \tag{2.4}$$

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[5] Jappelli and Padula found that even when they took borrowing constraints into account in their sensitivity checks by adding the logarithm of lagged disposable household income, the coefficient of financial literacy was barely affected.

where $\Delta \log(c_t) = \log(c_{t+1}) - \log(c_t)$ and $\frac{1}{\gamma} = \sigma$. σ is the intertemporal elasticity of substitution (IES) measuring the willingness to postpone current consumption. Since we assume complete certainty, risk aversion is not a relevant concept.

We can make the following observations about the change of consumption growth $\Delta \log(c_t)$: it is positive if $r(\varphi) > \rho$ and the steepness of the slope is increasing in $r(\varphi)$ for $r(\varphi) > 0$ and for $\sigma > 0$. Hence, the highly literate have a steeper consumption profile than individuals with low literacy provided they all have a positive IES: A higher level of financial literacy makes future consumption relatively less expensive compared to consumption today. In order to afford the same amount of future consumption, one needs to sacrifice less consumption today due to the higher rate of return on assets for higher literate households.

For the sake of overview, we write $r(\varphi)$ as r for the next rather lengthy equations. Rewriting the Euler equation using the preferences defined above and plugging this into the intertemporal budget constraint of the maximisation problem given by

$$\sum_{\tau=t}^{T} \frac{c_\tau}{(1+r)^{\tau-t}} = (1+r)A_{t-1} + y \sum_{\tau=t}^{T} \frac{1}{(1+r)^{\tau-t}} \tag{2.5}$$

eventually yields the following expression for household consumption:

$$c_t = \Lambda^{-1} \left((1+r)A_{t-1} + y \frac{1 + r - \left(\frac{1}{1+r}\right)^{T-t}}{r} \right) \tag{2.6}$$

where $\Lambda := \sum_{\tau=t}^{L} (1+r)^{\frac{(1-\gamma)(\tau-t)}{\gamma}} \left(\frac{1}{1+\rho}\right)^{\frac{\tau-t}{\gamma}}$.

Note that the intertemporal budget constraint only holds when $A_T = 0$ implying that there are no bequests in our model. For our analysis, we set the coefficient of time preference equal to zero, $\rho = 0$, which simplifies our computations and does not affect the mechanisms we want to study. Then, $r(\varphi) \geq \rho$ is always fulfilled as we can assume that financial literacy yields non-negative returns[6]. The closed-form solution for consumption simplifies to:

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[6] Suppose that $r(\varphi)$ is so low that $r(\varphi) < \rho$. This implies that consumers are impatient. We can show that life-time utility for households with $r(\varphi) < \rho$ is higher than life-time utility for households with $r(\varphi) = \rho$. Note that for $r(\varphi) = \rho$, consumption equals income during the entire life-cycle ($c_t = y$). To solve this issue, we can extend the model by imposing liquidity constraints like $A_t \geq 0$ which would ensure that impatient low-literacy households with $r(\varphi) < \rho$ will be bound to $c_t = y$ for the entire life-cycle.

$$c_t = \left(\sum_{\tau=t}^{T} (1+r)^{\frac{(1-\gamma)(\tau-t)}{\gamma}} \right)^{-1} \left((1+r)A_{t-1} + y\frac{1+r-\left(\frac{1}{1+r}\right)^{T-t}}{r} \right) \qquad (2.7)$$

Please refer to Appendix A for a detailed derivation of the Euler equation and the closed-form solution including a full listing of the underlying assumptions.

There are numerous studies that estimated the consumption growth equation using micro and macro data and subsequently differed in their parameter estimates of the IES: Hall (1988) estimated an IES close to zero using US non-durables consumption data (excluding services) derived from the US National Income and Product Accounts. Again, using US aggregate panel data, Beaudry and Van Wincoop (1996) estimate the IES for non-durable consumption to be "significantly different from zero and probably close to 1" (p. 509). Their estimates of the IES differ depending on how consumption is being defined (non-durable consumption excluding or including services). In a study relating intertemporal substitution, risk aversion and estimating the Euler equation using UK micro data from the Family Expenditure Survey, Attanasio and Weber (1989) estimated the coefficient of relative risk aversion to be 1.46, which corresponds to an IES of 0.68. Jappelli and Padula (2017) estimate the IES to be 0.53 for the full sample and 0.45 for a subsample of 20-65 years old. The common denominator of the cited studies using micro data is a positive IES that is between 0.5 and 0.7 for non-durable consumption excluding services derived from micro data. As will be discussed in Section 2.3, we have detailed data on household consumption allowing us to exclude expenditures on mortgage, rent and insurances. The short literature overview on the different parameter estimates of IES and the disposal of data on non-durable consumption allow us to focus on an IES between 0.4 and 0.8 (a broader range than IES estimates from the literature would suggest) when using simulations to investigate the relation between household consumption and financial literacy in Figures 2-1 and 2-2.

Figure 2-1 provides simulations of life-cycle consumption for different values of the IES and non-negative rates of return. The consumption profiles are increasing for all rates of return and are steeper for a higher rate of return. A high IES implies that a consumer is more willing to substitute present consumption for future consumption (values future consumption relatively more) than a consumer with a low IES. This results in steeper consumption profiles for consumers with a high IES (pay attention to the y-axes when examining Figure 2-1).

At young ages and high IES, consumption profiles for highly literate households appear to start at a lower level than for lower literate households. At older ages, this initial trade-off is more than compensated. See the Appendix for a derivation of the partial derivative of the closed-form

solution with respect to the rate of return: consumption is not strictly increasing in r and depends on the IES.

Figure 2-2 plots the undiscounted sum of the consumption levels for age, that is lifetime consumption, for different values of IES and rates of return. The figure shows an increase in lifetime consumption with increasing rates of return, holding IES constant. Differences in rates of return are reflected in higher levels of life-time consumption for higher IES suggesting that financial literacy— entering through the rate of return— has a larger impact on consumption levels for higher IES than for lower IES if we restrict the IES between zero and one.

The theoretical predictions that follow from this section are that financial literacy and consumption levels are positively correlated for plausible values of the IES and that financial literacy and consumption growth are positively correlated.
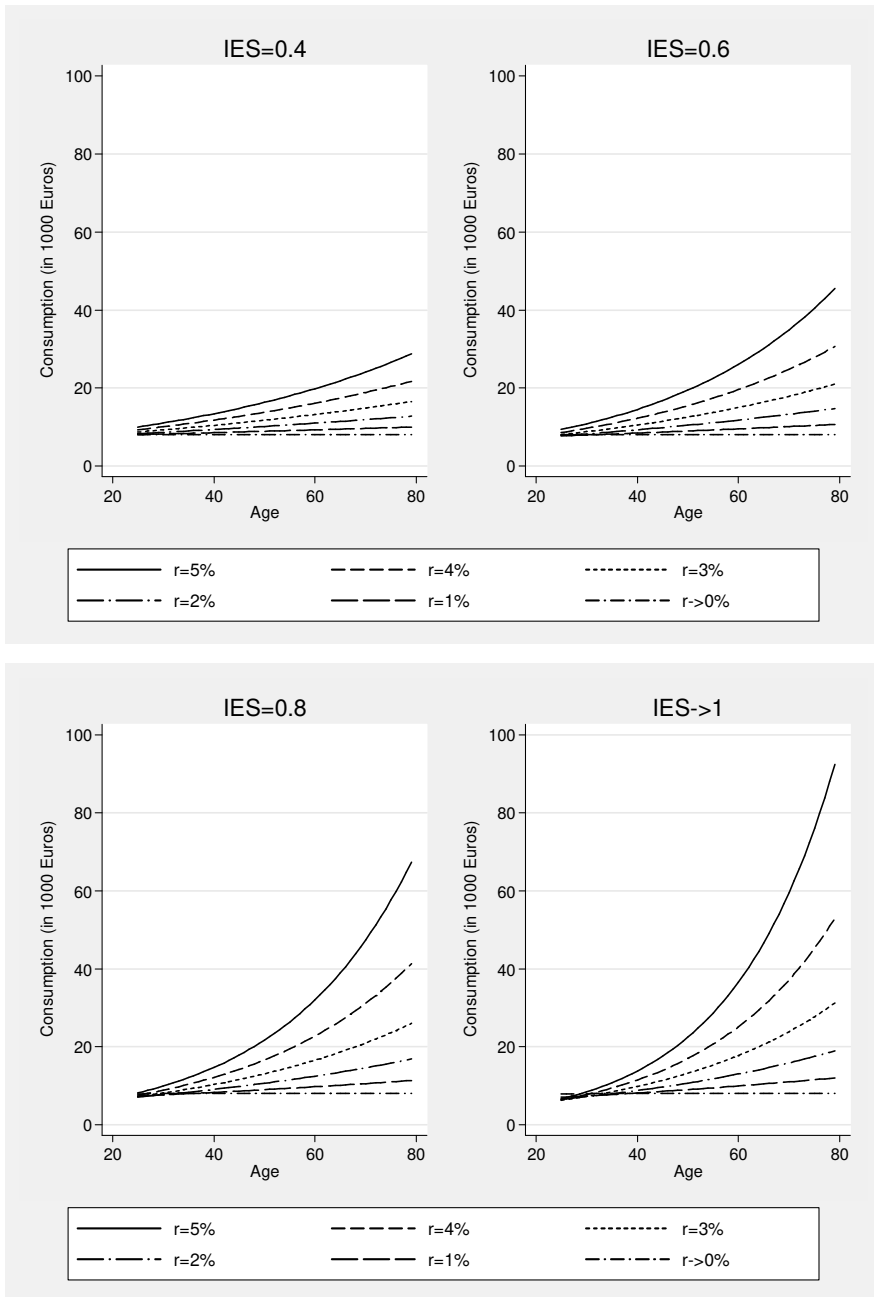
Figure 2- 1: Consumption profiles for different IES

Notes: For the simulations, we used as an approxation of r=0.0001 for $r \rightarrow 0$ and $A_0 = 0$. Furthermore, for $IES \rightarrow 1$, we used a value of 0.999.
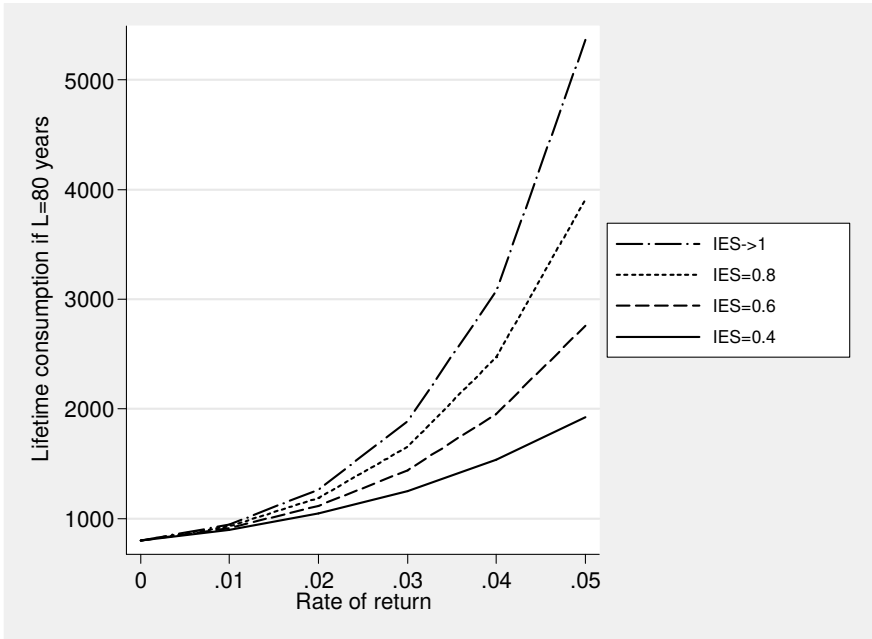
Figure 2- 2: Life-time consumption for different IES

Notes: Life-time consumption is in 1000 Euro.

2.3 Data description and summary statistics

2.3.1 Data description

Dataset composition

We used data from the LISS panel that is a part of the Measurement and Experimentation in the Social Sciences (MESS) project of CentER data in Tilburg, the Netherlands. This panel is a representative household survey and consists of 4500 Dutch households and 7000 individual respondents since 2007. Knoef and de Vos (2009) have thoroughly tested whether the LISS panel is representative of the Dutch population by comparing some key statistics with data from Statistics Netherlands (CBS) and have in general come to a positive conclusion.

Our dataset has information on demographics of the individual respondents, their financial literacy level (and their perception about their knowledge) and household consumption. The following paragraphs contain more details about the data sources of the main measures used to empirically test the theoretical predictions from Section 2.2.

Objective and subjective financial literacy measures

We used the single wave study from August 2011 on financial literacy. 4858 respondents (from 3298 households) first had to assess their financial knowledge (subjective measure of financial literacy) and subsequently, answered four questions on financial literacy (objective measures of financial literacy)[7]. For 58% of the households, more than one respondent answered the questions. The question on subjective financial knowledge was on a 7-point Likert scale which we recoded to five categories (the first and last two categories) due to the low number of observations at the tails of the distribution. The four questions on objective financial literacy tested knowledge on interest compounding, inflation, risk diversification and the relationship between bond prices and interest rates. For the exact wording of all financial literacy questions please refer to Appendix C. The first three questions tested basic financial literacy concepts and the fourth financial literacy question is testing advanced financial literacy knowledge as in Lusardi (2015). The questions are multiple choice questions and included the option for respondents to answer with "don't know" or "refuse". The financial literacy module also included data on how interesting people found the subject of financial literacy.

Consumption

The consumption data have been retrieved from the *Consumption and Time Use* longitudinal study comprising five waves collected in the years 2009, 2010, 2012, 2015 and 2017. There can be multiple respondents per household: we considered the answers of household head, partner and (if any) children. On average, there are 5200 observations per wave. The LISS panel has asked repondents to indicate (in Euro) their expenditures per month while distinguishing between consumption of assignable (including expenditures on children living in the household) and non-assignable goods. We borrowed this terminology from Bourguignon et al. (1993) who defined expenditures to be "assignable" if the "financial beneficiary of these expenditures in the family is identified" (p.147). We focussed our analysis on consumption of non-durable goods. We aggregated reported expenditures on non-assignable goods for the following subcategories: transport and means of transport, daytrips and holidays with the whole family, expenditures on cleaning the house or maintaining the garden, eating at home and other non-assignable expenditures. Expenditures on assignable goods include food and drinks outside the house, cigarettes, clothing, personal care, leisure time expenditures (film, theater, hobbies etc.). It should be noted that the wording of the questions on assignable expenditures has changed since 2015. To

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[7] Note that once respondents have answered the question about their self-assessed financial knowledge and they started answering the first question on financial literacy, they could not go back to adjust their answer to the self-assessment.

circumvent a possible questionnaire effect in our estimation results, we computed consumption growth for the periods 2009-2013 (before the change in wording) and 2015-2017 (after the change in wording) separately.

To obtain a more complete measure of non-durable consumption, we constructed the following measure: We took the answer of the household head concerning non-assignable expenditures and we added assignable expenditures of the household head together with the assignable expenditures of the partner and children (if present). To be able to compare consumption across households of different sizes, we equivalised consumption using the square root scale (OECD, 2018a).

Next to non-durable consumption, we used two alternative consumption measures in a sensitivity analysis: food consumption and total consumption. Food consumption is supposed to be relatively stable in times of crisis – note that the first waves cover the immediate post-financial-crisis period which might change people's perception on their monthly expenditures. Total consumption is an aggregate of non-durable consumption (assignable and non-assignable), expenditures on children and durable consumption (mortgages, insurances etc.). Appendix B provides more details on the exact wording of the questions used and how all consumption measures have been computed.

Other relevant characteristics

All waves have information on the age of all household members, the position in the household (e.g. household head or (un)wedded partner), number of children in the household, type of dwelling, education level of the respondent, household size, net monthly household income, occupation and marital status. Those variables are part of the *Background variables* module of the LISS panel and are available for every month between 2009 and 2017. In case that respondents have participated in modules during different months within the same year (for instance the questions on consumption and assets), we computed the average net household income within each year yielding one representative value of monthly net household income per year. The *Health Core Study* of the LISS panel contains data on objective and subjective health measures for 2009 through 2017. Appendix E provides more information about all covariates used in our empirical analysis.

Sample selection

After merging and appending all relevant modules from the LISS panel, our gross sample comprises 27640 observations (of 10741 individuals from 7290 households). The observation unit is the household. We added the children's responses to the non-assignable consumption questions

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to the answers of the parent(s) and subsequently dropped the children's observations. This way, we kept the responses of household heads and, if applicable, of their partners without losing information on the children's consumption. We also chose to drop households with children above 25 years old still living at home. We consider those households to possibly have a different life-cycle consumption: The chance is higher that, in such households, adult children financially support their parents for instance (or possibly the other way around) which can affect the dynamics of household consumption. So far, we are left with 89% of our gross sample.

As in the financial literacy module a smaller group of panel participants were sampled, the overlap with the consumption data is rather small. This leaves us with only 25% of the gross sample. Cleaning the data for missing information on (at least) one of the variables we study, including recoding the don't know answers to the consumption questions to missing, results in dropping 390 observations from 53 households. Finally, to avoid our results to be affected by outliers, we remove the top and bottom first percentiles of the total consumption distribution which makes us lose only 4 households (less than 0.5% of the households). Our final sample consists of 5508 observations across all consumption waves from 1820 households and 2620 individuals.

2.3.2. Summary statistics

Financial literacy (objective)

We first present some simple summary statistics of the objective financial literacy questions at the individual level. Table 2-1 gives the percentage shares for each financial literacy question by answer type (correct, incorrect don't know or refuse) for women and men. For both male and female respondents, there is a large difference in the percentage of correct answers for the first two questions and the last two questions (see Table 2-1). We tested for gender differences for each question using the seemingly unrelated regression model (SUR) with clustered standard errors at the individual level and found that gender differences are statistically significant.

Table 2- 1: Financial literacy scores by gender

	Interest	Inflation	Risk	Bonds
Female (n=1,223)	%	%	%	%
Correct	88.76	73.44	32.07	13.17
Incorrect	5.73	12.24	16.96	30.71
DK	4.44	12.81	49.53	54.76
Refuse	1.07	1.50	1.43	1.36
Male (n=1,397)	%	%	%	%
Correct	91.66	85.94	54.46	25.76
Incorrect	4.99	7.93	16.27	39.57
DK	2.62	5.07	27.96	33.93
Refuse	0.74	1.06	1.31	0.74

Note: Results from testing gender differences using SUR are not reported in this table.

Judging by the percentage of correct answers, the questions about interest compounding and inflation were perceived as easier than the questions on risk diversification and bond prices. The percentage of correct answers for female respondents is consistently lower than their male counterparts for all questions. Also, the share of *don't know* (DK) answers is two times larger for females. This is consistent with the findings of Bucher-Koenen et al. (2017) who pointed out that women have lower knowledge and may lack confidence about their financial knowledge.

Table 2- 2: Summary of Responses to the four financial literacy questions

Number of correct, incorrect, don't know and refuse answers (out of four questions)						
	None	1	2	3	All four	Total
	%	%	%	%	%	mean
Correct	5.04	14.20	38.13	30.04	12.60	2.31
Incorrect	48.66	37.33	12.25	1.76	0	0.67
DK	42.75	26.91	23.02	4.96	2.37	0.97
Refuse	97.94	0.72	0.61	0.19	0.53	0.05

Note: Weighted percentages of total number of respondents (2,620 individuals)

Table 2-2 provides an overview of the shares of how many financial literacy questions (out of four) were answered correctly, incorrectly or with DK or refuse. The last column returns the mean value of how many questions were answered correctly, incorrectly etc. The most important information that can be retrieved from this table is that 12.6% of the respondents answered all four questions on financial literacy correctly. On average, 2.31 out of the four questions were answered correctly. The share of correct answers is very low and there is a high share of respondents that chose the DK option providing evidence for lack of confidence regarding their knowledge of the financial concepts being tested. When glancing back at Table 2-1, the high shares of incorrect and "don't know" answers come from the questions on risk diversification and bond prices (questions 3 and 4) respectively. Those observations are consistent with van Rooij et al. (2011a), who used data from the DNB Household Survey from 2005 and found comparable shares of correct, incorrect and "don't know" answers.

Consumption

In what follows, we present summary statistics of the consumption measures (and their components) over time at the household level. In Table 2-3, we computed the (geometric) mean of equivalised consumption levels over time (in Euro). We chose for the geometric mean as the distribution of the consumption variables is skewed downward. Due to our theoretical setting and in order to be consistent with previous literature on household consumption, we focus our main analysis on non-durable consumption. For the first three waves (years 2009-2012), mean non-durable consumption has been declining. The relatively big jump between 2009 and 2010 could be explained by the financial crisis that hit in 2008: Respondents were asked to report monthly expenditures based on the previous year so that the effect of the crisis on people's perceptions becomes visible in the wave of 2010. As already discussed in Section 2.3.1, the wording of the question on assignable consumption has been changed as of 2015. This also becomes visible in Table 2-3, as mean non-durable consumption dropped considerably. This can be explained by the fact that the share of assignable consumption in total non-durable consumption is relatively large as compared to the share of assignable consumption in total household consumption. This is why we can check the robustness of our results using total consumption and food consumption.

In Table 2-4, we computed mean annualised consumption growth over time. We annualised consumption growth due to the gaps between the waves. Those computations are based on the observations from Table 2-3 and did not take into account the trend-break. Throughout the years, consumption growth appears to be zero or slightly negative with the exception of the categories miscellaneous and assignable consumption. For 2015, consumption growth declined by 14% with respect to the previous waves. Having analysed household consumption over time, we can already identify two implications for our empirical analysis: 1) we should separate the pre-change and post-change period when computing consumption growth and 2), we do not observe a clear trend in consumption (growth) over time.

Next, we tabulated consumption (growth) against some selected key variables. In Table 2-5, we computed mean non-durable consumption (in logs) by age category, education level, financial literacy level (a simple index based on the number of correctly answered four financial literacy questions) and self-assessed financial literacy (on a scale of 1-5). All variables at the individual level are observations of the household head. We present the summary statistics for singles and couples separately. Panel A of Table 2-5 reveals that mean consumption is higher for older individuals (belonging to single or couples household). Panel B shows that mean consumption is higher for more educated individuals in couples households (see F-tests at the bottom of each panel). Regarding financial literacy, we can observe in Panel C that a higher financial literacy level is

associated with a higher consumption level. The last part of Table 2-5, panel D, shows a positive association between the self-assessed financial literacy level and consumption. Note that those observations hold for singles and couples households. All differences within the groups are statistically significant save for singles in panel A. Table 2-5 provides suggestive evidence in support of the first empirical implication of our theoretical model – a positive association between household consumption level and financial literacy.

Subsequently, we looked at mean consumption growth for the same key variables as described above (see Table 2-6). We computed consumption growth by obtaining the annualised consumption growth rate (of the logarithms of equivalised household consumption). In general, we observed negative consumption growth across all key variables. This observation is in line with what we have seen already in Table 2-4. We could not observe significant differences across age categories, education levels and (self-assessed) financial literacy levels respectively suggesting no support for the theoretical prediction of a positive association between consumption growth and financial literacy.

Table 2-3: Consumption levels over time

		wave 1 (2009)		wave 2 (2010)		wave 3 (2012)		wave 4 (2015)		wave 5 (2017)	
	Consumption components	n	mean	n	mean	n	mean	n	mean	n	mean
Total Household Consumption	Non-assignable consumption	1,154	1,167.53	1,315	1,146.57	1,204	1,170.93	1,074	1,138.89	761	1,152.35
	Assignable consumption	1,154	262.06	1,315	246.37	1,204	236.07	1,074	155.58	761	164.78
	Total consumption	**1,154**	**1,438.61**	**1,315**	**1,376.18**	**1,204**	**1,394.98**	**1,074**	**1,294.87**	**761**	**1,340.91**
	Consumption components	n	mean	n	mean	n	mean	n	mean	n	mean
	Food	**1,154**	**196.06**	**1,315**	**190.34**	**1,204**	**192.01**	**1,074**	**187.38**	**761**	**196.01**
	Transport	1,154	74.19	1,315	73.50	1,204	76.67	1,074	72.42	761	71.50
	Cleaning	1,154	27.23	1,315	25.86	1,204	26.03	1,074	25.85	761	25.59
Non-durable Consumption	Holidays	1,154	93.67	1,315	89.41	1,204	95.05	1,074	91.68	761	103.86
	Misc.	1,154	99.57	1,315	73.67	1,204	69.82	1,074	69.12	761	78.03
	Assignable consumption	1,154	262.06	1,315	246.37	1,204	236.07	1,074	155.58	761	164.78
	Total Non-durables	**1,154**	**735.44**	**1,315**	**704.24**	**1,204**	**701.95**	**1,074**	**607.43**	**761**	**644.55**

Notes: All means are geometric means. The variables in bold are the three consumption measures that we use in our analysis. Deviations are due to household transitions. The trend-break due to the questionnaire effect from 2015 onwards can be detected by comparing mean assignable consumption across the waves.

Table 2-4: Annualised consumption growth over time

		wave 2 (2010)		wave 3 (2012)		wave 4 (2015)		wave 5 (2017)	
	Consumption components	n	mean	n	mean	n	mean	n	mean
Total Household Consumption	Non-assignable consumption	944	-0.015	1,088	0.006	959	-0.006	723	-0.023
	Assignable consumption	944	-0.022	1,088	-0.024	959	-0.137	723	-0.002
	Total household consumption	**944**	**-0.020**	**1,088**	**0.007**	**959**	**-0.032**	**723**	**-0.031**
	Consumption components	n	mean	n	mean	n	mean	n	mean
	Food	**944**	**-0.003**	**1,088**	**-0.004**	**959**	**-0.003**	**723**	**0.013**
	Transport	944	0.003	1,088	-0.004	959	-0.029	723	-0.023
	Cleaning	944	-0.018	1,088	0.012	959	0.005	723	0.000
Non-durable Consumption	Assignable consumption	944	-0.022	1,088	-0.024	959	-0.137	723	-0.002
	Holidays	944	-0.015	1,088	0.000	959	-0.012	723	-0.011
	Misc.	944	-0.169	1,088	-0.022	959	-0.008	723	0.008
	Total non-durables	**944**	**-0.016**	**1,088**	**-0.006**	**959**	**-0.046**	**723**	**0.006**

Notes: All means are arithmetic means of annualised growth rates of equivalised consumption. See Appendix C for more details on how consumption growth has been computed.

Table 2- 5: Non-durable consumption single households and couples

		Log(adjusted household consumption), in %			
		Singles		Couples	
		n	mean	n	mean
A.					
Age categories*	18-40 years	499	6.347	339	6.504
	40-64 years	1,488	6.395	1,197	6.688
	65+ years	1,020	6.422	965	6.728
	Total	3,007		2,501	
	F-test for equality of means (p-value)	0.072		0.000	
B.					
Education level*					
	Low education	1,126	6.265	738	6.562
	Medium education	857	6.360	819	6.595
	High education	1,024	6.570	944	6.843
	Total	3,007		2,501	
	F-test for equality of means (p-value)	0.000		0.000	
C.					
FL level (0-4)*	0	187	6.215	46	6.431
	1	508	6.222	167	6.431
	2	1,143	6.373	770	6.556
	3	845	6.466	1,004	6.750
	4	324	6.670	514	6.826
	Total	3,007		2,501	
	F-test for equality of means (p-value)	0.000		0.000	
D.					
SAFL(1-5)*	1	146	6.214	67	6.458
	2	250	6.311	152	6.537
	3	609	6.387	292	6.619
	4	1,014	6.381	815	6.619
	5	988	6.466	1,175	6.766
	Total	3,007		2,501	
	F-test for equality of means (p-value)	0.000		0.000	

Notes: * refers to age category, education level and financial literacy level of the household head.

Table 2- 6: Non-durable consumption growth for single households and couples

		Consumption growth (annual growth rate): Δlog(consumption)			
		Singles		Couples	
		n	mean	n	mean
A. Age categories*	18-40 years	228	-0.003	180	-0.008
	40-64 years	993	-0.022	809	-0.007
	65+ years	777	-0.023	727	-0.020
	Total	1,998		1,716	
	F-test for equality of means (p-value)	0.744		0.686	
B. Education level*					
	Low education	789	-0.011	489	0.005
	Medium education	534	-0.017	565	-0.027
	High education	675	-0.032	662	-0.014
	Total	1,998		1,716	
	F-test for equality of means (p-value)	0.518		0.231	
C.	0	119	-0.031	23	-0.012
FL level (0-4)*	1	340	0.002	103	0.032
	2	762	-0.029	520	-0.016
	3	559	-0.018	707	-0.017
	4	218	-0.020	363	-0.014
	Total	1,998		1,716	
	F-test for equality of means (p-value)	0.741		0.644	
D. SAFL(1-5)*	1	94	-0.057	42	-0.030
	2	164	-0.076	99	-0.009
	3	405	-0.034	192	0.007
	4	665	-0.017	547	-0.006
	5	670	0.005	836	-0.022
	Total	1,998		1,716	
	F-test for equality of means (p-value)	0.068		0.734	

Notes: * refers to age category, education level and financial literacy level of the household head.

2.4 Methodology

In this section, we propose specifications in order to test our empirical predictions formulated in the theoretical section. First, we tested the relationship between financial literacy and household consumption levels by estimating the closed-form solution derived in the theoretical section. In their work, Lusardi and Mitchell (2008) and Bucher-Koenen et al. (2017) point out the importance of the gender gap when researching financial literacy. We confirmed gender differences when exploring the financial literacy data in Table 2-1. Following this line, we decided to estimate the closed-form equation for singles and couples separately. Next, we analysed whether differences in financial literacy levels within couples were associated with different consumption levels. Subsequently, we examined the relationship between financial literacy and percentage

consumption growth. All specifications were estimated using pooled Ordinary Least Squares (OLS) with clustered standard errors at the household level.

Consumption level and financial literacy

We turn to estimating equation (2.7), the closed-form solution for consumption in terms of financial literacy. We estimated the closed-form solution for single men, women (see equation (2.8)) and couples (equation (2.9)) separately. The dependent variable is (the logarithm of) non-durable consumption. The main independent variable is the total score on each of the classic four financial literacy questions (FL) and self-assessed financial knowledge ($SAFL$). We included time dummies captured by τ and a set of individual and household characteristics summarised by the vector Z for singles and by the vector Z for couples where j denotes partner 1 or partner 2. For couples, we included the set of covariates that we observe at the individual level for both adults.

Singles:
$$\log(cons_{it})^{singles} = \alpha_1 FL_i + \alpha_2 SAFL_i + \delta' Z_{it} + \tau_t + v_{it}^{singles} \tag{2.8}$$

Couples:
$$\log(cons_{it})^{couples} = \sum_{j=1}^{2} \beta_j FL_{i,j} + \sum_{j=1}^{2} \beta_{j+2} SAFL_{i,j} + \sum_{j=1}^{2} \mu_j' Z_{it,j} + \tilde{\tau}_t + v_{it}^{couples} \tag{2.9}$$

As income and consumption are positively correlated when considering levels, we controlled for income in equations (2.8) and (2.9). By including income, we made sure that our results were not driven by income effects. Note that we are interested in eliciting the role of (self-assessed) financial literacy on household consumption for a *given* level of income.

Another important control variable when studying life-cycle behaviour is (self-reported) health. Health acts as a constraint on consumption opportunities of the elderly resulting in a declining consumption trajectory in age (see Börsch-Supan, 1992 and Börsch-Supan & Stahl, 1991 for more details). In our models, we included subjective and objective health (measured by healthy Body Mass Index). As we have shown in our theoretical model, consumption profiles are increasing in age— this is why we need to control for individual age in our models. Other important covariates are education level (due to its high correlation with financial literacy) and the gender of the household head (to see whether there are differences in consumption decisions in couples' households depending on the gender of the household head).

As life-cycle consumption patterns of households with children are different from households without children (even after using equivalised consumption), we also controlled for whether there

are children living in the household (below 25 years old). In a study on the influence of household composition on household expenditures patterns using Spanish household consumption data, Deaton, Ruiz-Castillo and Thomas (1989) found that adult goods are genuinely separable from children meaning that the effect of having children on consumption of adult goods like alcohol is essentially an income effect. For goods like baby-food or going to the movies, households reallocate their household budget to adjust to the new circumstances, implying a substitution effect (Deaton et al., 1989). Controlling for children in the household captures the changes in non-durable consumption (that includes alcohol consumption, baby-food, going to the movies) due to income or substitution effects. Furthermore, we controlled for other socio-economic factors like type of dwelling, marital status, and occupation. For a detailed description of all covariates included, see Appendix E.

Consumption level: Interactions within couples (FL and SAFL)

We observe (self-reported) financial literacy for the household head and his or her spouse, and are interested in exploring whether there are any interactions between the spouses' financial literacy levels. We expanded equation (4.2) by adding two interaction terms to the couples' equation—one interacting both individual financial literacy indices (*FL*) and one interacting both individual self-reported financial knowledge responses (*SAFL*) respectively. In order to estimate comparable individual effects of the financial literacy variables to equation (4.2), we constructed the interaction terms by expressing the financial literacy variables in deviation of their means. See equation (2.10) for the complete specification:

$$
\begin{aligned}
\log(cons_{it})^{couples} \\
= \sum_{j=1}^{2} \beta_j FL_{i,j} + \sum_{j=1}^{2} \beta_{j+2} SAFL_{i,j} + \eta_1 \prod_{j=1}^{2} \widetilde{FL}_{i,j} \\
+ \eta_2 \prod_{j=1}^{2} \widetilde{SAFL}_{i,j} + \sum_{j=1}^{2} \mu'_j Z_{it,j} + \tau_t + v_{it}^{couples}
\end{aligned}
\tag{2.10}
$$

Where $\widetilde{FL}_{i,j} = FL_{i,j} - \overline{FL}_j$ and $\widetilde{SAFL}_{i,j} = SAFL_{i,j} - \overline{SAFL}_j$.

Consumption growth and financial literacy

As we have seen in our simulations in Section 2.2, the slopes of the consumption profiles differ due to different financial literacy levels: Slopes are steeper for a higher financial literacy level. We included (self-assessed) financial literacy on the right-hand side of the consumption growth equation despite that we only observe financial literacy once. The empirical translation of the consumption growth (Euler) equation derived in Section 2.2 (equation (2.2)) is given by (2.11). We pooled singles and couples when estimating the Euler equation which relates consumption growth

and financial literacy as the estimation results did not differ when we estimated the equations separately for singles (men and women separately as well) and for couples. The dependent variable is annualised equivalised non-durable consumption growth in logs – hence we look at the variation of consumption growth in percentages. See Appendix C for the formulae used to compute consumption growth.

We included a set of time-invariant controls (in levels) and time-variant controls (in first-differences) captured by the vectors D and ΔZ respectively. D includes education of the household head (and partner) and gender of the household head. ΔZ includes health transitions, the change in whether there are children living at home, change in occupation, change in type of dwelling and change in marital status. We excluded income, as the life cycle-permanent income hypothesis posits that (lagged) income should not have any explanatory power with respect to consumption (Hall, 1978). This is also suggested by the Euler equation we derived in our theoretical model (see equation 2.2). Note that for single households, we set the characteristics of the second adult to zero by default.

$$\Delta\log(cons_{it}) = \sum_{j=1}^{2}\gamma_j FL_{i,j} + \sum_{j=1}^{2}\gamma_{j+2}SAFL_{i,j} + \sum_{j=1}^{2}\beta_j' D_{i,j} + \sum_{j=1}^{2}\mu_j'\Delta Z_{it,j} + v_{it} \qquad (2.11)$$

2.5 Results

In this section, we present three sets of results: First, the estimations of the consumption equations (2.8) and (2.9); Secondly, we tested whether (self-assessed) financial literacy of individuals who are part of a couple household influence each other and can explain some variation in consumption (growth), that is equation (2.10), and thirdly, we estimated the Euler equation (2.11). All results reported in the main text concern non-durable consumption. Estimation results involving the alternative consumption measures— total household consumption and food consumption— can be found in Appendix F.

2.5.1 Closed-form consumption equation

We estimated equation (2.8) for single households (men and women separately) and (2.9) for couples. In Table 2-7, we present the estimated coefficients for three sets of specifications: The first specification (columns 1-3) excludes self-assessed financial literacy, the second (columns 4- 6) excludes the objective financial literacy measure and the third (columns 7-9) contains both financial literacy measures. We found evidence for a strong positive association of 5.5% between financial literacy and consumption levels and self-assessed financial literacy and consumption levels (2.8%) for men if they are part of a couple household. For single women, we estimated a weaker

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association of 4% (significant at the 10%-level) between financial literacy and consumption levels. Including self-assessed financial literacy did not change the magnitude of the association between financial literacy and consumption.

We had expected that the signs of the estimates of the educational dummies would correspond with the signs of the estimates of the financial literacy variables due to the positive correlation between education and financial literacy. Interestingly, education appears not to be an important covariate. For singles, there were no statistically significant differences in consumption levels across education levels. For couples, we found that higher educated men are associated with higher household consumption relative to medium-educated men. Table 2-7 also indicates that consumption levels are sensitive to income: Households belonging to the richer part of the income distribution (last two quintiles) have a higher consumption level and household belonging to the lower part of the income distribution (first two quintiles)— a lower consumption level. Consumption levels appeared to be less sensitive to income when looking at food consumption (see Appendix F).

Please refer to Appendix F for the reported coefficients of the other covariates. Those results are in line with our first theoretical prediction. The fact that we did not find (strong) associations between financial literacy and consumption levels for singles but we did find encouraging results for couples, suggests that it is worthwhile to take a look at possible interactions of individual financial literacy levels (of the household head and his or her partner) within couples. We will come back to this in the next section.

As already discussed earlier, we used two additional measures of household consumption, next to non-durable consumption— total household consumption (the sum of assignable and non-assignable consumption) and food consumption (only in-house). We reported the estimation results for those two measures in Tables 2A-7 and 2A-8 in the Appendix. When considering total household consumption, the association between (self-assessed) financial literacy and consumption levels vanished. Regarding food consumption, the association between financial literacy both for men and women and consumption became stronger (the coefficients for singles almost double) at the expense of the role of self-assessing one's own financial knowledge (all coefficients are not statistically significant).

Table 2- 7: Closed-form non-durable consumption estimations

	(1) singles F	(2) singles M	(3) couples	(4) singles F	(5) singles M	(6) couples	(7) singles F	(8) singles M	(9) couples
	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)
FL index (0-4), women	0.041* (0.021)		-0.012 (0.016)				0.040* (0.021)		-0.009 (0.016)
Self-assessed financial knowledge (1-5), women				0.013 (0.015)		-0.011 (0.011)	0.011 (0.015)		-0.008 (0.011)
FL index (0-4), men		0.041 (0.026)	0.064*** (0.015)					0.035 (0.026)	0.056*** (0.015)
Self-assessed financial knowledge (1-5), men					0.033 (0.020)	0.039*** (0.013)		0.026 (0.021)	0.028** (0.014)
Low education dummy, women	-0.027 (0.049)		0.046 (0.033)	-0.039 (0.048)		0.047 (0.033)	-0.029 (0.049)		0.048 (0.033)
High education dummy, women	0.061 (0.045)		0.044 (0.037)	0.076 (0.046)		0.045 (0.037)	0.064 (0.046)		0.049 (0.036)
Low education dummy, men		-0.048 (0.057)	-0.011 (0.035)		-0.072 (0.053)	-0.023 (0.035)		-0.050 (0.057)	-0.004 (0.035)
High education dummy, men		0.023 (0.060)	0.078** (0.032)		0.037 (0.060)	0.085*** (0.032)		0.024 (0.060)	0.077** (0.032)
1st quintile income	-0.432*** (0.057)	-0.404*** (0.071)	0.018 (0.069)	-0.435*** (0.057)	-0.406*** (0.070)	0.009 (0.073)	-0.431*** (0.058)	-0.401*** (0.071)	0.017 (0.070)
2nd quintile income	-0.130*** (0.047)	-0.184*** (0.056)	-0.104** (0.047)	-0.124*** (0.047)	-0.187*** (0.057)	-0.105** (0.047)	-0.128*** (0.047)	-0.185*** (0.057)	-0.099** (0.047)
4th quintile income	0.186*** (0.060)	0.227*** (0.063)	0.204*** (0.034)	0.195*** (0.060)	0.220*** (0.063)	0.204*** (0.034)	0.188*** (0.060)	0.220*** (0.063)	0.204*** (0.035)
5th quintile income	0.138 (0.102)	0.286*** (0.099)	0.414*** (0.040)	0.157 (0.099)	0.280*** (0.098)	0.418*** (0.040)	0.143 (0.102)	0.272*** (0.099)	0.407*** (0.040)
Observations (Number of clusters)	1,728 (598)	1,279 (434)	2,501 (816)	1,728 (598)	1,279 (434)	2,501 (816)	1,728 (598)	1,279 (434)	2,501 (816)
R-squared	0.334	0.278	0.308	0.331	0.277	0.303	0.335	0.280	0.310
F-test equality FL and SAFL coeff. (men and women) (p-value)			0.000				0.109	0.131	0.000
F-test equality SAFL coeff. (men and women) (p-value)						0.011			0.102
F-test equality FL coeff. (men and women) (p-value)									0.001

Notes: *** p<0.01, ** p<0.05, * p<0.1. Clustered standard errors at the household level are in parentheses. Non-durable consumption has been equivalised and is in logs. FL refers to financial literacy and SAFL refers to self-assessed financial literacy. Medium education, paid employment, self-owned dwelling and the 3rd quintile of the income distributions respectively are the reference categories. Time dummies are included. For the complete set of estimated coefficients, see Appendix F. We tested for joint significance of SAFL (men and women), FL (men and women) and joint significance of all SAFL and FL respectively (Ho: no joint significance).

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As our theoretical derivation of the closed-form consumption equation included the lag of assets explicitly (see equation (2.7)), we repeated our analysis including household assets on a sub-sample of households. Data on household assets was only available for a subsample of households as household assets were asked in a different set of questionnaires causing the number of observations to drop. The coefficients are reported in Table 2A-10 in the Appendix. We found that the correlation between assets and consumption is not very strong and that the coefficients of the financial literacy measures did not change much. In our baseline specification, we controlled for the type of dwelling (self-owned house, rental dwelling etc.) which already might capture a large part of the wealth situation of a household in combination with household income.

2.5.2   Interacting (self-assessed) financial literacy within couples

The next step of our main empirical analysis is to examine for couples whether there were interactions between the partners' (self-assessed) financial literacy levels that could have an impact on consumption at the household level. Table 2-8 presents the estimated coefficients for non-durable consumption. Once we included interaction terms for self-assessed financial literacy (men and women) and for the financial literacy index (men and women) in deviations of its mean, the positive association between all financial literacy measures and consumption levels is unchanged compared to Table 2-8 (this is by construction). We found that differences between the financial literacy level of men and women do not explain any variation in total household consumption and food consumption (see Tables 2A-11 and 2A-12 in the Appendix for the reported results). Hence, we found that different combinations of financial literacy levels within couples are not responsible for different consumption levels: The financial literacy level of the man in the couple seems to be driving the results even when we control for the gender of the household head.

Table 2- 8: Closed-form consumption equation with interactions in (self-assessed) financial literacy within couples

	(1) Coeff. (S.E.)	(2) Coeff. (S.E.)	(3) Coeff. (S.E.)
$\left(\text{FL index}_w - \overline{\text{FL index}_w}\right) * \left(\text{FL index}_m - \overline{\text{FL index}_m}\right)$	-0.002 (0.013)		-0.001 (0.013)
FL (0-4), women	-0.012 (0.016)		-0.010 (0.016)
FL (0-4), men	0.058*** (0.014)		0.050*** (0.015)
$\left(\text{SAFL}_w - \overline{\text{SAFL index}_w}\right) * \left(\text{SAFL}_m - \overline{\text{SAFL}_m}\right)$		-0.007 (0.009)	-0.004 (0.010)
SAFL (1-5), women		-0.011 (0.011)	-0.008 (0.011)
SAFL (1-5), men		0.035*** (0.013)	0.026* (0.013)
Observations	2,501	2,501	2,501
R-squared	0.315	0.312	0.318
F-test equality FL coeff. women (p-value)	0.723		0.828
F-test equality FL coeff. men (p-value)	0.000		0.004
F-test equality SAFL coeff. women (p-value)		0.450	0.661
F-test equality SAFL coeff. men (p-value)		0.015	0.132

Notes: *** p<0.01, ** p<0.05, * p<0.1. Clustered standard errors in parentheses (at the household level for 816 clusters). FL refers to financial literacy and SAFL refers to self-assessed financial knowledge. The financial literacy index and self-assessed financial knowledge are in deviation of their respective mean. We used the same set of independent variables as in previous analyses. Time dummies are included.

2.5.3 Consumption growth equation

Next, we consider the estimations of the Euler equation for consumption, as specified in equation (2.11). As we did not find significant differences between the models for singles and couples, we decided to pool the data and control for the household type instead. Note that in our estimations of the Euler equation, we excluded consumption growth between 2015 and 2009, 2010, 2012 respectively due to change in the wording of the question on assignable consumption. The estimation results are presented in Table 2-9. For the estimations showing all coefficients for all three consumption measures, see Table 2A-9 in the Appendix. We did not find evidence for an association between (self-assessed) financial literacy and non-durable and total consumption growth. Those results are consistent with the raw correlations we discussed in Section 2.3.2 (Table 2-6). Note that we also tried a specification with instrumental variables (IV), using the number of books and the occupation of the mother and father of the respondents as instruments. The IV results were comparable to the OLS results, hence we decided not to report the IV estimates here and show the more efficient (still insignificant) OLS coefficients.

For food consumption (see Table 2A-9 in the Appendix), we found a negative association between female self-assessed financial literacy and consumption growth. As this is the only significant result across several specifications, we should be cautious about putting too much weight on its interpretation.

Table 2- 9: Consumption growth (Euler) estimations

	(1) Coeff. (S.E.)	(2) Coeff. (S.E.)	(3) Coeff. (S.E.)
FL index (0-4), women	-0.005 (0.007)		-0.005 (0.008)
FL index (0-4), men	0.007 (0.007)		0.004 (0.009)
SAFL (1-5), women		-0.001 (0.005)	0.001 (0.005)
SAFL (1-5), men		0.007 (0.007)	0.006 (0.008)
Low education dummy, women	0.011 (0.016)	0.012 (0.016)	0.012 (0.016)
High education dummy, women	-0.004 (0.018)	-0.006 (0.018)	-0.003 (0.018)
Low education dummy, men	0.016 (0.019)	0.014 (0.020)	0.014 (0.020)
High education dummy, men	0.025 (0.017)	0.024 (0.017)	0.024 (0.017)
Observations	2,755	2,755	2,755
R-squared	0.013	0.013	0.014
F-test equality FL coeff. (men and women) (p-value)	0.490		0.776
F-test equality SAFL coeff. (men and women) (p-value)		0.536	0.796
F-test equality FL and SAFL coeff. (men and women) (p-value)			0.715

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Clustered standard errors in parentheses (at the household level, 1426 clusters). FL refers to financial literacy and SAFL refers to self-assessed financial literacy (on a 5-point Likert scale). Medium education, paid employment, self-owned dwelling are the reference categories.

2.6   Robustness checks

2.6.1 Different stages in life cycle (age groups)

We start checking the sensitivity of our results by testing whether households belonging to different age groups have different consumption profiles. Our complete sample comprises the ages 18 until 93 suggesting that the households we examined can be at numerous stages of the life-cycle. We examined very young workers who are more likely to be financially constrained simultaneously with individuals of older age with fixed income and face no income uncertainty. We repeated our analyses for the following sub-samples: In the first sub-sample we excluded households with a household head above 65 and below 20 years old focusing on the general working population (we still include occupational dummies); the second sub-sample comprises households with a household head between 40 and 65 years old representing the age where people probably financially invest most during their life; the last sub-sample included only the households with a household head of above 65 years old, which was the statutory retirement age during the survey period.

The estimation results of the closed-form solution are presented in Table 2-10. For single women, there is no association between the financial literacy measures and consumption levels

except for women above 65 years old. For senior single women, a higher financial literacy index is associated with a 9 per cent higher consumption level. In the baseline results in Table 2-7, we estimated a positive association of 4 per cent (though only significant at the 10%-level) for single women. Hence, the latter result can be explained by the important role that financial literacy plays for senior women. Note that this also includes women who were first part of a couples' household and are divorced or widowed. As the subsample of the above 65 years old is relatively small, the association became weaker once we look at all single women.

For single men, we found weak positive associations between the financial literacy index and consumption levels (significant at the 10%-level) for the 20-65 years old and the 40-65 years old and no association for the above 65 years old. This association disappeared when considering the entire sample (cf. Table 2-7) due to the lack of precision of the estimates for the subsamples. Regarding couples, we found a strong positive association between the financial literacy level of men and consumption levels for all subsamples except for the above 65 years old. For the above 65 years old, we found a positive association between self-assessed financial literacy of men and consumption. The significant coefficients for the financial literacy measures of men in couples' households in Table 2-7 can be hence explained by two factors: The financial literacy of men is relevant for men younger than 65 years and their self-assessed knowledge is relevant for men above 65 years old. The financial literacy level of women is a relevant determinant of consumption decisions for single women above 65 years old.

2

Table 2- 10: Closed-form estimations non-durable consumption (different age groups)

	Age ∈ [20, 65]			Age ∈ [40, 65]			Age> 65		
	(1) singles F	(2) singles M	(3) couples	(4) singles F	(5) singles M	(6) couples	(7) singles F	(8) singles M	(9) couples
	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)
FL index (0-4), women	0.024 (0.025)		-0.001 (0.018)	0.005 (0.031)		-0.012 (0.021)	0.089** (0.036)		-0.033 (0.031)
SAFL (1-5), women	0.018 (0.019)		-0.003 (0.014)	0.024 (0.022)		-0.002 (0.015)	-0.002 (0.023)		-0.021 (0.017)
FL index (0-4), men		0.055* (0.031)	0.070*** (0.018)		0.061* (0.036)	0.078*** (0.021)		-0.009 (0.043)	0.016 (0.026)
SAFL (1-5), men		0.011 (0.023)	0.026 (0.016)		0.026 (0.027)	0.016 (0.018)		0.056 (0.048)	0.055** (0.022)
Low education dummy, women	-0.041 (0.064)		0.054 (0.039)	-0.053 (0.069)		0.072* (0.043)	0.035 (0.080)		0.120** (0.056)
High education dummy, women	0.096* (0.051)		0.024 (0.041)	0.130** (0.063)		-0.000 (0.048)	-0.002 (0.090)		0.224*** (0.070)
Low education dummy, men		-0.047 (0.064)	-0.026 (0.043)		-0.057 (0.072)	-0.047 (0.049)		-0.000 (0.114)	0.031 (0.054)
High education dummy, men		-0.058 (0.065)	0.049 (0.036)		-0.080 (0.077)	0.066 (0.041)		0.284** (0.115)	0.134** (0.064)
1st quintile income	-0.373*** (0.070)	-0.414*** (0.075)	-0.013 (0.077)	-0.408*** (0.082)	-0.358*** (0.091)	-0.012 (0.086)	-0.536*** (0.091)	-0.399*** (0.145)	0.193 (0.131)
2nd quintile income	-0.105* (0.053)	-0.195*** (0.059)	-0.124** (0.061)	-0.093 (0.063)	-0.188*** (0.069)	-0.130* (0.067)	-0.183** (0.086)	-0.167 (0.130)	-0.053 (0.074)
4th quintile income	0.182** (0.075)	0.292*** (0.069)	0.241*** (0.047)	0.170* (0.088)	0.294*** (0.075)	0.229*** (0.055)	0.210** (0.099)	0.051 (0.118)	0.147*** (0.054)
5th quintile income	0.090 (0.119)	0.299** (0.121)	0.427*** (0.048)	0.087 (0.123)	0.264** (0.132)	0.423*** (0.054)	0.292* (0.149)	0.173 (0.156)	0.390*** (0.067)
Observations (Number of clusters)	1,133 (441)	928 (351)	1,614 (598)	850 (319)	718 (257)	1,275 (497)	591 (215)	349 (133)	887 (345)
R-squared	0.320	0.273	0.332	0.320	0.281	0.313	0.388	0.361	0.343
F-test equality FL and SAFL coeff. (men and women) (p-value)	0.329	0.135	0.000	0.510	0.094	0.001	0.047	0.505	0.055
F-test equality SAFL coeff. (men and women) (p-value)			0.269			0.677			0.033
F-test equality FL coeff. (men and women) (p-value)			0.000			0.001			0.563

Notes: *** p<0.01, ** p<0.05, * p<0.1. Clustered standard errors in parentheses (at the household level). We used the same set of independent variables and reference categories as in previous analyses. Time dummies are included.

Table 2- 11: Annual consumption growth estimations (different age groups)

	(1) Age ϵ [20, 65]	(2) Age ϵ [40,65]	(3) Age>65
	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)
SAFL (1-5), women	-0.000 (0.006)	-0.003 (0.007)	0.003 (0.009)
FL index (0-4), women	-0.005 (0.010)	-0.012 (0.012)	0.001 (0.015)
SAFL (1-5), men	-0.002 (0.008)	-0.006 (0.010)	0.025 (0.021)
FL index (0-4), men	0.006 (0.011)	0.008 (0.013)	0.000 (0.014)
Observations	1,761	1,438	994
R-squared	0.017	0.031	0.024
F-test equality FL coeff. (men and women) (p-value)	0.780	0.547	0.999
F-test equality SAFL coeff. (men and women) (p-value)	0.967	0.749	0.468
F-test equality FL and SAFL coeff. (men and women) (p-value)	0.956	0.712	0.693

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Clustered standard errors in parentheses (at the household level for 989, 821 and 591 clusters respectively from left to right). We used the same covariates and reference categories as in previous analyses.

The above analysis encouraged us to try to explore a possible interaction between age and (self-assessed) financial literacy for couples. We wanted to check whether the association between mean (self-assessed) financial literacy and consumption levels change with the age of the household head. The estimation results of this specification are presented in Table 2A-13 in the Appendix for all three consumption measures. We did not find any evidence that the average financial literacy level has a stronger or weaker relation to consumption due to age. The association between the average financial literacy index and consumption levels is stronger (larger magnitude and higher statistical significance) which might be due to the construction of the average financial literacy index. Relying on average financial literacy as a measure would imply a joint financial decision-making process (equal weight for both partners within a couple) which is at odds with our findings from Tables 2-7 and 2-10.

We re-estimated the Euler equation for the subsamples defined above. The coefficients are reported in Table 2-11. We still did not find any evidence for a statistical relationship between financial literacy and consumption growth which is consistent with the results from Table 2-8.

2.6.2 Interest in financial literacy

The single wave study on financial literacy also contained a question on whether the respondents thought that the questions were on an interesting subject. This question could serve as a proxy for interest in financial matters. The idea behind conducting this check was that if people are not interested in financial matters in the first place, then the level of financial literacy might be irrelevant for household consumption behaviour. The estimation results of the closed-form equation for non-durable consumption including the interest variable (measured on a 5-point Likert scale) are shown in Table 2-12. We found that the coefficients of the interest variable for

men and women are not statistically significant and that the coefficients do not change compared to the baseline estimations in Table 2-7. The same holds for the estimations of the closed-form equation for total and food consumption. The estimation results for total and food consumption can be found in Tables 2A-14 and 2A-15 respectively in the Appendix.

We conducted the same check for the Euler equation. See Table 2-13 for the estimation results of the Euler equation for non-durable consumption including the interest variable. We found that the coefficients of self-assessed financial literacy for men and the interest variable for women are not statistically significant. Once we controlled for whether financial literacy is considered to be an interesting subject, self-assessed financial literacy of men is weakly negatively correlated with consumption growth. Re-estimating the Euler equation using total consumption and food consumption (see Table 2A-15 in Appendix) yielded similar results as when the interest is not included in the baseline estimations (Table 2A-9).

Table 2- 12: Closed-form estimations including interest in financial literacy

	(1) singles F	(2)	(3) singles M	(4)	(5) couples	(6)
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
SAFL (1-5), women	0.009	(0.015)			-0.012	(0.011)
FL index (0-4), women	0.037*	(0.021)			-0.014	(0.017)
SAFL (1-5), men			0.028	(0.021)	0.031**	(0.014)
FL index (0-4), men			0.037	(0.027)	0.058***	(0.015)
FL: interesting subject?, women	0.009	(0.015)			0.016	(0.012)
FL: interesting subject?, men			-0.008	(0.019)	-0.007	(0.013)
Observations	1,728		1,279		2,501	
R-squared	0.335		0.280		0.311	
Number of clusters	598		434		816	
F-test equality FL and SAFL coeff. (men and women) (p-value)	0.167		0.117		0.000	
F-test equality SAFL coeff. (men and women) (p-value)					0.058	
F-test equality FL coeff. (men and women) (p-value)					0.001	

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Clustered standard errors in parentheses (at the household level). Number of clusters from left to right: 598, 434 and 816.

Table 2- 13: Consumption growth estimations including interest in financial literacy

	(1)	(2)
	Non-durables	
	Coeff.	S.E.
SAFL (1-5), women	-0.009	(0.007)
FL index (0-4), women	-0.004	(0.010)
SAFL (1-5), men	-0.011	(0.009)
FL index (0-4), men	0.012	(0.011)
FL: interesting subject?, women	0.012	(0.008)
FL: interesting subject?, men	-0.009	(0.008)
Observations	1,252	
R-squared	0.026	
F-test equality FL coeff. (men and women) (p-value)	0.568	
F-test equality SAFL coeff. (men and women) (p-value)	0.165	
F-test equality FL and SAFL coeff. (men and women) (p-value)	0.305	

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Clustered standard errors in parentheses (at the household level, 660 clusters). The same covariates and reference categories are used as in previous analyses.

2.7 Conclusion and Discussion

Does knowing more about financial concepts imply consuming more? Based on our findings we can provide a positive answer for consumption levels. Based on our theoretical model, we predicted a positive relationship between consumption growth and financial literacy and consumption levels and financial literacy. Our findings are threefold. First, we found a strong positive association between financial literacy and non-durable consumption levels and between self-assessed financial literacy (though less strong) and non-durable consumption levels for men if they are part of a couple. Sensitivity checks showed that the financial literacy of men appears to be relevant for men younger than 65 years and their self-assessed knowledge is relevant for men above 65 years. For single women, we found a weaker association between financial literacy and non-durable consumption which is mainly driven by women above 65 years old. Secondly, we interacted (self-assessed) financial literacy of men and women within couples and found that differences between the financial literacy level of men and women did not explain any variation in non-durable (and total and food) consumption. Thirdly, after having pooled single and couples' households, we estimated the Euler equation and found no association between consumption growth and (self-assessed) financial literacy.

The consumption growth estimates computed by Jappelli and Padula (2017) were much higher than ours: Jappelli and Padula found a positive and statistically significant correlation between consumption growth and financial literacy scores (while not taking into account self-assessed financial literacy) which implies that one more correct financial literacy question is associated with 5.3 higher consumption growth. In contrast, we did not find evidence for a (negative or positive) correlation between consumption growth and financial literacy— even when taking into account self-assessed financial knowledge. A possible explanation could be that our

observation period was longer—it included five waves within eight years whereas Jappelli and Padula used two waves of consumption data observed within three years. Furthermore, although the observation periods of our study and the one of Jappelli and Padula partially overlap, household consumption in the Netherlands and Italy looked quite differently in the post-crisis period. According to OECD data (OECD, 2018b), aggregate household consumption growth in the Netherlands has been volatile between 2008 and 2014, ranging from 1% to -2% and being relatively stable around 2% from 2014 onwards. The trend for Italy actually looks similar: Between 2008 and 2010, annual consumption growth ranged from -1.6% to 1.2%. In 2012, consumption growth experienced a deep of -4% and from 2014 on, similar to the Netherlands, Italian consumption growth remained positive albeit at least 0.2 percentage points lower than the Dutch. Comparing those figures to our results makes us confident that the estimates of the Euler equation are quite plausible. It is rather surprising that the estimates of Jappelli and Padula (2017) for the period of 2008-2010 turn out so high at times with unusually low interest rates.

In the light of Deuflhard et al. (2018) who found that financial literacy is responsible for an increase of 12% (compared to the median interest rate of 2.5% in 2005) in Dutch households' individual returns on savings accounts, our estimates (which ranged from 2.8 per cent till 5.6 per cent) did not deviate much considering that the interest rates dropped significantly since the financial crisis. Naturally, we cannot translate the estimates of Deuflhard et al. directly to our estimates as the latter concern returns to savings and the former encompass returns to savings and other investments. However, the majority of investment activities concern savings accounts: Deuflhard et al. (2018) state that in the DNB Household Survey (DHS), "savings accounts are owned by 82% of all Dutch households" (p.1) and that the ownership rate for directly held stocks is merely 12%.

We would like to stress that we do not claim to estimate causal effects as we do not have suitable instruments for financial literacy to do so. Further research should pay more attention to the endogeneity problem surrounding financial literacy. However, we chose to put the focus in this chapter on the theory behind the relation between consumption (growth) and financial literacy and to carefully construct different consumption measures. As briefly mentioned in the results section of this chapter, we already conducted some analyses using several instruments (number of books in the household, occupation of mother and father of the respondent) and came to similar conclusions as when applying OLS. As with most studies using consumption data, the period we studied was relatively short, which brings along econometric issues when estimating the Euler equation (Attanasio & Low, 2004). Furthermore, as the first years of our observation period were immediately after the financial crisis and we dispose of self-reported (not observed) consumption

data, respondents might have been influenced by the unstable economic climate and under- or overreported expenditures.

Financial literacy and financial education constitute a relevant topic from a policy perspective, especially given that more financial decisions need to be borne by individuals rather than the state. We would advise to effectively financially educate women: In Section 2.6 (Table 2-10), when analysing consumption levels for different age groups, we found that for single senior women, it could pay off to have a higher financial literacy level. As we found that the financial literacy level of men is dominant for couples, the shock is arguably even higher when a man leaves the couples household (be it by choice or unfortunate circumstances) leaving the woman alone. That implies that the education should start already at the beginning of the life cycle so that women could acquire more knowledge and most of all confidence in order to make sound financial decisions jointly with their partner or on their own. It is hard to say though whether the focus should lay more on conveying knowledge or on teaching independence and confidence. We believe that accumulating knowledge also has an impact on one's confidence in itself.

Last but not least, we would like to share some directions for future research. Relaxing the assumption of full certainty as in Lusardi et al. (2017)— but applied to consumption levels rather than wealth inequality— and controlling for time preferences and risk preferences, can help to distinguish between different types of households. This, in turn, could help crystallise the effect of financial literacy on financial decision making even better. One could distinguish then between rational and myopic households, risk-averse and risk-loving households. Furthermore, observing financial literacy and its self-assessment in several waves as in Jappelli and Padula (2017) could enable us to endogenize financial literacy and analyse the returns to investing in financial literacy.

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Appendix

A. Deriving the closed-form solution for consumption using a CRRA utility function

Deriving the Euler equation

Here, we show in detail how to derive the Euler equation using stochastic dynamic programming and subsequently, how to derive the closed-form solution for consumption using a CRRA utility function.

We assume the following:

A_0: initial wealth at the end of period *t=0* is equal to zero

For the intertemporal budget constraint to hold, we need the assumption of no bequest motives: $A_T = 0$, where T denotes the last period.

c_t: consumption in period t

ρ is the rate of time preference

$u(c_t)$: utility from consumption, later specified as CRRA utility function

$r(\varphi)$: real rate of return as a strictly increasing and concave function of the financial literacy level. Financial literacy is exogenously given in this setting.

y: income level - assumed to be constant

We formulate the following value function

$$V_0(A_0) = \max_{c_t} \sum_{t=1}^{T} (1+\rho)^{1-t} u(c_t) \tag{A.1}$$

subject to the dynamic budget constraint

$$A_t = \left(1 + r(\varphi)\right) A_{t-1} + y_t - c_t, \, t=1, \dots, T \tag{A.2}$$

Which, for the purpose of the following calculations[8] can be rewritten as

$$A_{t+1} = \left(1 + r(\varphi)\right) A_t + y_t - c_t$$

Or

$$c_t = \left(1 + r(\varphi)\right) A_t + y_t - A_{t+1} \tag{A.3}$$

---

[8] Whereas equation (A.2) describes wealth at the end of period t, the following equation describes wealth at the beginning of period $t+1$.

Rewriting the maximization problem in Bellman equation form yields

$$V_t(A_t) = \max_{\{c_t\}} \{u(c_t) + (1+\rho)^{1-t}V_{t+1}(A_{t+1})\} \tag{A.4}$$

Or

$$V_t(A_t) = \max_{\{A_{t+1}|A_t\}} \{u\left((1+r(\varphi))A_t + y_t - A_{t+1}\right) + (1+\rho)^{1-t}V_{t+1}(A_{t+1})\} \tag{A.5}$$

The first-order condition for a maximum with respect to A_{t+1} is:

$$-u'(c_t) + (1+\rho)^{1-t}\frac{\partial V_{t+1}(A_{t+1})}{\partial A_{t+1}} = 0 \tag{A.6}$$

Or

$$u'(c_t) = (1+\rho)^{1-t}\frac{\partial V_{t+1}(A_{t+1})}{\partial A_{t+1}} \tag{A.7}$$

The Envelope Theorem implies:

$$\frac{\partial V_t(A_t)}{\partial A_t} = u'(c_t)\left(1+r(\varphi)\right). \tag{A.8}$$

Iterating the above equation forward one period yields:

$$\frac{\partial V_{t+1}(A_{t+1})}{\partial A_{t+1}} = u'(c_{t+1})\left(1+r(\varphi)\right) \tag{A.9}$$

Combining equations (8) and (9) results in the Euler equation:

$$u'(c_t) = \frac{\left(1+r(\varphi)\right)}{(1+\rho)}u'(c_{t+1}) \tag{A.10}$$

This is the result for two subsequent periods t and $\tau = t+1$. If we want to expand the analysis to other values of $\tau = t,..,T$, we will arrive at

$$u'(c_t) = \left(\frac{1+r}{1+\rho}\right)^{\tau-t}u'(c_\tau), \tau = t,...,T \tag{A.11}$$

In order to obtain a closed form solution for c_t, we specify utility as a general CRRA utility function $U(c_t) = \frac{c_t^{1-\gamma}}{1-\gamma}$ with $\frac{dU(c_t)}{dc_t} = c_t^{-\gamma}$ (where γ is the coefficient of relative risk aversion with $\gamma \neq 1$.

We can rewrite the Euler equation to

$$c_t^{-\gamma} = \left(\frac{1+r}{1+\rho}\right)^{\tau-t}c_\tau^{-\gamma} \tag{A.12}$$

Taking logs on both sides yields

$$\gamma \log(c_\tau) = \log\left(\left(\frac{1+r}{1+\rho}\right)^{\tau-t} c_t^\gamma\right) \tag{A.13}$$

Or

$$\log(c_\tau) = \frac{1}{\gamma}\log\left(\left(\frac{1+r}{1+\rho}\right)^{\tau-t} c_t^\gamma\right) \tag{A.14}$$

Raising both sides to the power of e:

$$c_\tau = \left(\left(\frac{1+r}{1+\rho}\right)^{\tau-t} c_t^\gamma\right)^{\frac{1}{\gamma}} \tag{A.15}$$

Or

$$c_\tau = \left(\frac{1+r}{1+\rho}\right)^{\frac{\tau-t}{\gamma}} c_t \tag{A.16}$$

Equation (16) can now be substituted into the intertemporal budget constraint.

Observations about the Euler equation for two subsequent periods

In what follows, we will comment on the properties of the Euler equation for two subsequent periods.

Note, when $\tau = t + 1$, for two subsequent periods

$$c_{t+1} = \left(\frac{1+r}{1+\rho}\right)^{\frac{1}{\gamma}} c_t \tag{A.17}$$

Dividing both sides by c_t and rewriting yields

$$\frac{c_{t+1}}{c_t} = \left(\frac{1+r}{1+\rho}\right)^{\frac{1}{\gamma}} \tag{A.18}$$

Taking logs on both sides:

$$(\log(c_{t+1}) - \log(c_t)) = \frac{1}{\gamma}\log\left(\frac{1+r}{1+\rho}\right) \tag{A.19}$$

Or

$$\Delta \log(c_t) = \frac{1}{\gamma}\log\left(\frac{1+r}{1+\rho}\right) = \sigma \log\left(\frac{1+r}{1+\rho}\right) \cong \sigma(r - \rho) \tag{A.20}$$

Where $\Delta \log(c_t) = \log(c_{t+1}) - \log(c_t)$ and $\frac{1}{\gamma} = \sigma$. σ is the intertemporal elasticity of substitution (IES). The percentage change in consumption is positive if $r > \rho$ and the marginal effect on the slope (steepness):

$$\frac{\partial \Delta \log(c_t)}{\partial r} = \sigma * \frac{1}{1+r} > 0 \ for \ r > 0 \text{ and } \sigma > 0.$$

The steepness of the slope is increasing in r for positive r and a positive intertemporal elasticity of substitution. Hence, the highly literate have a steeper consumption profile than individuals with low literacy.

Deriving the closed-form solution (substituting Euler equation into intertemporal budget constraint)

Now, let us return to the derivation of the closed-form solution. The intertemporal budget constraint is given by

$$\sum_{\tau=t}^{T} \frac{c_\tau}{(1+r)^{\tau-t}} = (1+r)A_{t-1} + y \sum_{\tau=t}^{T} \frac{1}{(1+r)^{\tau-t}} \tag{A.21}$$

It can be shown by backward induction that this constraint only holds when $A_L = 0$, hence that there are no bequest motives.

Substitute equation (16) in equation (21):

$$c_t \sum_{\tau=t}^{T} \frac{\left(\frac{1+r}{1+\rho}\right)^{\frac{\tau-t}{\gamma}}}{(1+r)^{\tau-t}} = (1+r)A_{t-1} + \sum_{\tau=t}^{T} \frac{y_\tau}{(1+r)^{\tau-t}} \tag{A.22}$$

where

$$\sum_{\tau=t}^{T} \frac{\left(\frac{1+r}{1+\rho}\right)^{\frac{\tau-t}{\gamma}}}{(1+r)^{\tau-t}} = \sum_{\tau=t}^{T} \left(\frac{1+r}{1+\rho}\right)^{\frac{\tau-t}{\gamma}} (1+r)^{-(\tau-t)} = \sum_{\tau=t}^{T} (1+r)^{\frac{\tau-t}{\gamma}-(\tau-t)} \left(\frac{1}{1+\rho}\right)^{\frac{\tau-t}{\gamma}}$$

$$= \sum_{\tau=t}^{T} (1+r)^{\frac{(1-\gamma)(\tau-t)}{\gamma}} \left(\frac{1}{1+\rho}\right)^{\frac{\tau-t}{\gamma}}$$

In order to elicit the pure impact of financial literacy on consumption, we can assume that household income is constant over time. Rewriting equation (22) yields

$$c_t \sum_{\tau=t}^{T} (1+r)^{\frac{(1-\gamma)(\tau-t)}{\gamma}} \left(\frac{1}{1+\rho}\right)^{\frac{\tau-t}{\gamma}} = (1+r)A_{t-1} + y \sum_{\tau=t}^{T} \left(\frac{1}{1+r}\right)^{\tau-t} \tag{A.23}$$

Dividing both sides by $\sum_{\tau=t}^{T}(1+r)^{\frac{(1-\gamma)(\tau-t)}{\gamma}}\left(\frac{1}{1+\rho}\right)^{\frac{\tau-t}{\gamma}}$ yields

$$c_t = \Lambda^{-1}\left((1+r)A_{t-1} + y\frac{1+r-(\frac{1}{1+r})^{T-t}}{r}\right) \tag{A.24}$$

Where $\Lambda := \sum_{\tau=t}^{T}(1+r)^{\frac{(1-\gamma)(\tau-t)}{\gamma}}\left(\frac{1}{1+\rho}\right)^{\frac{\tau-t}{\gamma}}$

For our analysis, we assume that $\rho = 0$, so that the closed form solution for consumption simplifies to:

$$c_t = \left(\sum_{\tau=t}^{T}(1+r)^{\frac{(1-\gamma)(\tau-t)}{\gamma}}\right)^{-1}\left((1+r)A_{t-1} + y\frac{1+r-(1+r)^{t-T}}{r}\right) \tag{A.25}$$

To check whether the closed-form solution is increasing in r implying no intersection points for consumption profiles across different levels of r, we compute the first-order partial derivative with respect to r. For simplicity, we compute the partial derivative for $t = 1$ (see equation (A.26)):

$$\frac{\partial c_1}{\partial r} = -\frac{y(-\left(\frac{1}{1+r}\right)^{T-1}+r+1)(\sqrt[\gamma]{1+r}-r-1)}{r^2(1+r)((1+r)^{\left(\frac{(1-\gamma)T}{\gamma}\right)}-1)}$$
$$-\frac{(1-\gamma)Ty\left(-\left(\frac{1}{1+r}\right)^{T-1}+r+1\right)(\sqrt[\gamma]{1+r}-r-1)(1+r)^{\frac{(1-\gamma)T}{\gamma}-2}}{\gamma r\left((1+r)^{\left(\frac{(1-\gamma)T}{\gamma}\right)}-1\right)^2}$$
$$+\frac{y\left((T-1)\left(\frac{1}{1+r}\right)^{T}+1\right)(\sqrt[\gamma]{1+r}-r-1)}{r(1+r)((1+r)^{\left(\frac{(1-\gamma)T}{\gamma}\right)}-1)} \tag{A.26}$$
$$+\frac{y\left(-\left(\frac{1}{1+r}\right)^{T-1}+r+1\right)\left(\frac{(1+r)^{\frac{1}{\gamma}-1}}{\gamma}-1\right)}{r(1+r)((1+r)^{\left(\frac{(1-\gamma)T}{\gamma}\right)}-1)}$$
$$-\frac{y\left(-\left(\frac{1}{1+r}\right)^{T-1}+r+1\right)(\sqrt[\gamma]{1+r}-r-1)}{r(1+r)^2((1+r)^{\left(\frac{(1-\gamma)T}{\gamma}\right)}-1)}$$

B. Household consumption and consumption growth

Household consumption (levels)

Table 2A- 1: Wording of questions in LISS panel (Consumption and time use module)

How many euros does your household spend on average each month on:	Couples or singles with children living at home	Singles
mortgage: interest plus amortization (what matters is the gross amount, so before tax deduction)	bf09a66; bf10b66; bf12c66; bf15d66; bf17e66	bf09a79; bf10b79; bf12c79; bf15d79; bf17e79
rent (NOT including costs of gas and electricity)	bf09a67; bf10b67; bf12c67; bf15d67; bf17e67	bf09a80; bf10b80; bf12c80; bf15d80; bf17e80
general utilities (heating, electricity, water, telephone, Internet, etc; but NO insurances)	bf09a68; bf10b68; bf12c68; bf15d68; bf17e68	bf09a81; bf10b81; bf12c81; bf15d81; bf17e81
transport and means of transport *(public transport; own car: gasoline/ diesel and maintenance, but NOT insurances or the purchase of e.g. a car or [motor] bike)* *	*bf09a69; bf10b69; bf12c69; bf15d69; bf17e69*	*bf09a82; bf10b82; bf12c82; bf15d82; bf17e82*
insurances (home insurance, car insurance, health insurance, etc.)	bf09a70; bf10b70; bf12c70; bf15d70; bf17e70	bf09a83; bf10b83; bf12c83; bf15d83; bf17e83
children's daycare (day care center, out-of-school supervision, guest parents, homework guidance, etc.)	bf09a71; bf10b71; bf12c71; bf15d71; bf17e71	
alimony and financial support for children not (or no longer) living at home	bf09a72; bf10b72; bf12c72; bf15d72; bf17e72	bf09a85; bf10b85; bf12c85; bf15d85; bf17e85
debts and loans (but NOT the mortgage)	bf09a73; bf10b73; bf12c73; bf15d73; bf17e73	bf09a86; bf10b86; bf12c86; bf15d86; bf17e86
daytrips and holidays with the whole family or part of the family *(flight tickets, hotel, restaurant bills for the family, etc.)* *	*bf09a74; bf10b74; bf12c74; bf15d74; bf17e74*	
expenditures on cleaning the house or maintaining the garden *	*bf09a75; bf10b75; bf12c75; bf15d75; bf17e75*	*bf09a87; bf10b87; bf12c87; bf15d87; bf17e87*
eating at home *(food, drinks, candy, etc.)* *	*bf09a76; bf10b76; bf12c76; bf15d76; bf17e76*	*bf09a88; bf10b88; bf12c88; bf15d88; bf17e88*
other household expenditures *(but no expenditures meant only for yourself or another specific person in your household)* *	*bf09a77; bf10b77; bf12c77; bf15d77; bf17e77*	*bf09a89; bf10b89; bf12c89; bf15d89; bf17e89*
Personal expenditures: Indicate how many Euro you (personally) spent per month on average on other personal expenditures for yourself in the past 12 months? For example, you can think of food and drinks outside the house, cigarettes and other tobacco products, clothing, personal care products and services, leisure time expenditures (film, theatre, hobbies, sports activities, photography, books, etc.), further schooling and donation or gifts *	*bf09a104; bf10b104; bf12c104; bf15d131+bf15d134; bf17e131+bf17e134*	*bf09a104; bf10b104; bf12c104; bf15d131+bf15d134; bf17e131+bf17e134*

* indicates that item has been used to compute household consumption

Non-durable consumption

$$
\begin{aligned}
Non &- durable\ consumption \\
&= \frac{1}{\sqrt{household\ size}} [non - assignable \\
&+ \sum assignable\ consumption]
\end{aligned}
\tag{B.1}
$$

Non-durable consumption is an aggregate of the following components:

- eating at home (food, drinks, candy, etc.),
- transport and means of transport (public transport; own car: gasoline/diesel and maintenance, but not insurances or purchase of a car or (motor)bike),
- daytrips and holidays with the entire family or part of the family (flight tickets, hotel, restaurant bills for the family, etc.)
- expenditures on cleaning the house or maintaining the garden
- other household expenditures (but not expenditures meant only for yourself or another specific person in your household)
- assignable consumption for every household member

For the first three waves (years 2009, 2010 and 2012), assignable consumption was an aggregate of the following components: food and drinks outside the house, cigarettes and other tobacco products, clothing, medical expenses (not covered by health insurance), personal care products and services, leisure time expenditures (film, theatre, hobbies, sports activities, photography, books, etc.), further schooling and donation or gifts. Respondents were asked to indicate how much, on average, they spend per month on each of the aforementioned categories. From 2015 on (the last two waves), however, total assignable expenditures are being asked without splitting the categories. Furthermore, medical expenditures are asked in a separate question from 2015 on. We had to take this into account when computing consumption growth to prevent our results to be driven by a questionnaire effect.

Total consumption

Total consumption is an aggregate of non-durable and durable consumption of all household members (including children < 25 who filled in the questionnaires). The categories of total household consumption partially overlap with the categories used to compute non-durable consumption. Total household consumption consists of the following categories:

- mortgage (interest plus amortisation)
- rent (not including costs of gas and electricity)
- general utilities
- insurances
- children's day care
- alimony and financial support for children not living at home
- debts and loans (but not mortgage)
- eating at home (food, drinks, candy, etc.),
- transport and means of transport (public transport; own car: gasoline/diesel and maintenance, but not insurances or purchase of a car or (motor)bike),
- daytrips and holidays with the entire family or part of the family (flight tickets, hotel, restaurant bills for the family, etc.)
- expenditures on cleaning the house or maintaining the garden
- other household expenditures (but not expenditures meant only for yourself or another specific person in your household)
- assignable consumption for every household member

Consumption growth

Consumption growth has been computed using the following commonly used formula as a starting point where n denotes the number of years elapsed since year t:

$$total\ consumption_{t+n} = total\ consumption_t (1 + growth\ rate)^n \tag{B.2}$$

Taking logs on both sides and using the approximation $\ln(1 + growth\ rate) \approx growth\ rate$ gives the following simple expression for annualised consumption growth

$$growth\ rate = \frac{1}{n}(\ln(total\ consumption_{t+n}) - \ln(total\ consumption_t)) \tag{B.3}$$

As the consumption data we analysed was not available for subsequent years but for 2009, 2010, 2012, 2015 and 2017, we had to compute consumption growth rates using this method. To circumvent the questionnaire effect concerning assigned consumption as described earlier, we excluded consumption growth for the year 2015 and for the year 2017, we only considered the difference between 2015 and 2017.

C. Questions on financial literacy

Question on self-assessed financial literacy
How would you score your understanding of financial matters (on a scale of 1 to 7, where 1 means 'very poor' and 7 means 'very good')?
The 'Go back' button was not offered with the following question, so that the respondent was not able to return to previous questions in the questionnaire. Respondents can still use the browser to go back in the questionnaire.
Question on interest compounding (Q1)
Suppose you have 100 euros on a savings account and the interest is 2% per year.
How much do you think you will have on the savings account after five years, assuming that you leave all your money on this savings account: more than 102 euros, exactly 102 euros, less than 102 euros?

1 more than 102 euros
2 exactly 102 euros
3 less than 102 euros
4 I don't know
5 I would rather not say

2

Question on inflation (Q2)
Suppose that the interest on your savings account is 1% per year and that inflation amounts to 2% per year. After 1 year, would you be able to buy more, exactly the same, or less than you could today with the money on that account?

1 more than today
2 exactly the same as today
3 less than today
4 I don't know
5 I would rather not say

Question on risk diversification (Q3)
A share in a company usually offers a more certain return than an investment fund that only invests in shares.

1 true
2 not true
3 I don't know
4 I would rather not say

Question on relation between bond prices and interest rate (Q4)
If the interest rate goes up, what should happen to bond prices?

1 they should increase
2 they should decrease
3 they should stay the same
4 none of the above
5 I don't know
6 I would rather not say

The first question tests the knowledge on interest compounding – a simple setting that does not require computing skills but is concerned with understanding the concept of earning interest on interest. The second question is a question on inflation and does not require computation skills either but understanding the difference between real and nominal interest rate. The third question tests the knowledge on risk diversification – a more advanced financial concept and the fourth question tests knowledge on the relationship between bond prices and interest rates.

D. More descriptive statistics on financial literacy

Table 2A- 2: Percentage shares of correct answers for each FL question by age group (n=2,620)

	Q1 Interest	Q2 Inflation	Q3 Risk	Q1 Bonds
<40 years (n=579)	%	%	%	%
Correct	88.26	76.86	43.87	19.86
Incorrect	5.35	8.46	13.47	26.08
DK	4.49	12.09	40.07	51.64
Refuse	1.90	2.59	2.59	2.42
40-64 years (n=1282)	%	%	%	%
Correct	91.19	79.10	45.48	19.11
Incorrect	5.23	11.23	16.22	36.66
DK	2.96	8.58	37.05	43.21
Refuse	0.62	1.09	1.25	1.01
65+ years (n=759)	%	%	%	%
Correct	89.72	81.42	36.50	18.31
Incorrect	5.67	9.88	19.76	38.47
DK	3.95	8.04	43.08	43.08
Refuse	0.66	0.66	0.66	0.13

Notes: We test for age differences for each question using the seemingly unrelated regression model (SUR) with clustered standard errors at the individual level. For the first question, the differences between men and women are not statistically significant and for the remaining questions— at the 0.1%-level. The test results are available upon request by the corresponding author.

Table 2A-2 summarizes the share of answering type (correct, incorrect, DK or refuse) by age group. For every age group, the share of correct answers was the highest for the first question, followed by the second, third and fourth. The share of "don't knows" is lowest for the first question and highest for the last question – with the exception of the old age group. For seniors, the share of "don't know" answers was similar for the third and the fourth question. The largest difference across age categories can be observed for the third financial literacy question.

We also examined the share of correct (incorrect etc.) answers by question by education categories – see Table 2A-3. We can observe that financial literacy is increasing in education level and that the share of "don't knows" is becoming smaller for individuals with a higher education level.

Table 2A- 3: Cell percentages by education level and answer type (n=2,620)

	Q1 Interest	Q2 Inflation	Q3 Risk	Q4 Bonds
Low (n=963)	%	%	%	%
Correct	84.01	69.47	27.10	10.49
Incorrect	8.31	14.95	19.63	34.89
DK	6.33	13.50	51.40	53.37
Refuse	1.35	2.08	1.87	1.25
Medium (n=843)	%	%	%	%
Correct	91.22	81.02	44.60	20.17
Incorrect	5.34	8.54	15.54	33.10
DK	2.49	9.25	38.32	45.31
Refuse	0.95	1.19	1.54	1.42
High (n=812)	%	%	%	%
Correct	96.31	89.16	58.62	28.08
Incorrect	1.97	6.40	14.29	36.70
DK	1.35	3.94	26.48	34.73
Refuse	0.37	0.49	0.62	0.49

Notes: We test for differences between education levels for each question using the seemingly unrelated regression model (SUR) with clustered standard errors at the individual level. For all questions, the differences between men and women are significant at the 0.1%-level. The test results are available upon request by the corresponding author.

E. Descriptive statistics of all variables included in the regressions (final pooled sample)

Table 2A- 4: Variable definitions

Variable	Description
Food consumption (in Euro)	Self-reported monthly in-house food expenditures at the household level (in Euro)
Nondurable consumption (in Euro)*	Self-reported monthly non-durable expenditures at the household level (in Euro)
Total consumption (in Euro)*	Self-reported monthly total expenditures at the household level (in Euro)
Equivalised food consumption (in logs)	Logarithm of equivalised food consumption at the household level
Equivalised nondurable consumption (in logs)	Logarithm of equivalised nondurable consumption at the household level
Equivalised total consumption (in logs)	Logarithm of equivalised total consumption at the household level
$\Delta\log$(food consumption)	Consumption growth (differencing the logarithm of equivalised food consumption)
$\Delta\log$(nondurable consumption)	Consumption growth adjusted for the trend-break (differencing the logarithm of equivalised nondurable consumption)
$\Delta\log$(total consumption)	Consumption growth adjusted for the trend-break (differencing the logarithm of equivalised total consumption)
FL index	Simple financial literacy index based on the number of questions answered correctly (out of 4) at the individual level.
SAFL	Self-assessed financial literacy on a 5-point Likert scale (very poor - very good) at the individual level.
Subjective health	Self-reported health based on one question on a 5-point Likert scale (poor-excellent) at the individual level
Healthy BMI	Measure for objective health. =1 if body mass index (BMI) of respondent is healthy (18<BMI<30); =0 if BMI is unhealthy (<19 or >29) at the individual level.
Low education	Primary school/intermediate secondary education, binary
Medium education	Higher secondary education/ intermediate vocational education, binary (reference category)
High education	Higher vocational education/ university, binary
Married	Respondent is married, binary (reference category)
Divorced/Separated	Respondent is divorced or separated, binary
Widow/Widower	Respondent is widowed, binary
Never been married	Respondent never has been married, binary
Income quintiles	Five dummies for each quintile of the total income distribution (based on net household income). Reference category is the third income quintile.
# of (Self-)Employed (0-2)	Occupation: Number of (Self-)Employed adults in household
# of Job-seekers (0-2)	Occupation: Number of Job-seekers adults in household
# of Students (0-2)	Occupation: Number of Students in household
# of Volunteers/Homemakers (0-2)	Occupation: Number of Volunteers/Homemakers in household
# of Retirees (0-2)	Occupation: Number of Retirees in household

Table 2A-4 (*continued*)

Variable	Description
# of Members with (partial) work disability (0-2)	Occupation: Number of adults with (partial) work disability in household
Something else (0-2)	Occupation: Number of (Self-)Employed adults in household
Self-owned dwelling	Self-owned dwelling, binary (reference category)
Rental dwelling	Rental dwelling, binary
Cost-free dwelling	Cost-free dwelling, binary
Household head is male	Household head is male, binary
Children living at home	Children (<25 years) are living at home, binary
Assets quintiles	Assets are savings and the balance on the current account that are on the name of either of the household head and/or his or her partner. Five dummies for each quintile of the total assets distribution. Reference category is the third assets quintile.
Interest in FL	Question from the Single wave study about whether the respondent found the questions on FL interesting (individual level) at a 5-point Likert scale.

Notes: * for more details on the composition of those variables, see Appendix B.

Table 2A- 5: Summary statistics

	Variable	Obs.	Mean	Sd	Min	Max
Consumption	Food consumption (in Euro)	5,508	303.052	206.959	1	4500
	Non-durable consumption (in Euro)	5,508	1048.844	714.378	38	7445
	Total consumption (in Euro)	5,508	1968.288	1001.154	20	8360
	Equivalised food consumption (in logs)	5,508	5.258	0.670	0	7.719
	Equivalised non-durable consumption (in logs)	5,508	6.524	0.583	3.638	8.294
	Equivalised total consumption (in logs)	5,508	7.224	0.554	2.446	8.639
	Delta log food consumption	2,755	0.001	0.484	-4.200	2.708
	Delta log total consumption	2,755	-0.012	0.417	-4.271	3.367
	Delta log non-durable consumption	2,755	-0.006	0.370	-4.192	2.325
Financial literacy	SAFL (1-5), women	4,229	3.633	1.211	1	5
	SAFL (1-5), men	3,780	4.086	1.040	1	5
	FL index (0-4), women	4,229	2.106	0.960	0	4
	FL index (0-4), men	3,780	2.641	0.982	0	4
Health	subjective health, women	4,229	2.974	0.735	1	5
	subjective health, men	3,780	3.047	0.743	1	5
	Healthy BMI (=1), women	4,229	0.834	0.372	0	1
	Healthy BMI (=1), men	3,780	0.868	0.339	0	1
Demographics (individual level)	Age, women	4,229	56.104	15.190	19	92
	Age, men	3,780	57.040	14.778	18	93
	Low education (=1), women	4,229	0.424	0.494	0	1
	Low education (=1), men	3,780	0.322	0.467	0	1
	Medium education (=1), women	4,229	0.289	0.453	0	1
	Medium education (=1), men	3,780	0.324	0.468	0	1
	High education (=1), women	4,229	0.287	0.452	0	1
	High education (=1), men	3,780	0.354	0.478	0	1
	Married (=1), women	4,229	0.526	0.499	0	1
	Married (=1), men	3,780	0.591	0.492	0	1
	Divorced/Separated (=1), women	4,229	0.148	0.355	0	1
	Divorced/Separated (=1), men	3,780	0.135	0.342	0	1
	Widow	4,229	0.109	0.312	0	1
	Widower	3,780	0.056	0.230	0	1
	Never been married, women	4,229	0.216	0.412	0	1
	Never been married, men	3,780	0.218	0.413	0	1
Demographics (household level)	Household head is male	5,508	0.645	0.479	0	1
	1st Income quintile	1,202	803.079	432.459	0	1250
	2nd Income quintile	1,071	1545.044	152.086	1252	1750
	3rd Income quintile	1,095	2055.465	172.574	1751	2380
	4th Income quintile	1,091	2753.125	222.690	2385	3171
	5th Income quintile	1,049	4776.128	12201.618	3173	285759
	# of (Self-)Employed (0-2)	5,508	0.665	0.730	0	2

2

Table 2A-5 (*continued*)

	Variable	Obs.	Mean	Sd	Min	Max
	# of Job-seekers (0-2)	5,508	0.050	0.223	0	2
	# of Students (0-2)	5,508	0.021	0.149	0	2
	# of Volunteers/Homemakers (0-2)	5,508	0.162	0.384	0	2
	# of Retirees (0-2)	5,508	0.465	0.670	0	2
	# of Members with (partial) work disability (0-2)	5,508	0.079	0.273	0	2
	Something else (0-2)	5,508	0.012	0.115	0	1
	Self-owned dwelling (=1)	5,508	0.624	0.484	0	1
	Rental dwelling (=1)	5,508	0.367	0.482	0	1
	Cost-free dwelling (=1)	5,508	0.009	0.094	0	1
	Children living at home (=1)	5,508	0.176	0.381	0	1
	1st Assets quintile	735	-1,094.834	5,428.213	-80,000	50
	2nd Assets quintile	751	2,124.075	1,536.845	54	5,000
Controls (additional analyses)	3rd Assets quintile	674	10,893.880	3,762.140	5,005	18,826
	4th Assets quintile	728	31,920.113	9,625.092	18,956	50,000
	5th Assets quintile	714	165,112.356	445,884.086	50,086	8,135,049
	FL: interesting subject?, women	4,229	3.105	1.269	1	5
	FL: interesting subject?, men	3,780	3.501	1.113	1	5

F. Estimation results

Table 2A- 6: Closed form consumption estimations (non-durable consumption)

	(1) singles F	(2) se	(3) singles M	(4) se	(5) couples	(6) se
FL index (0-4), w	0.040*	(0.021)			-0.009	(0.016)
FL index (0-4), m			0.035	(0.026)	0.056***	(0.015)
SAFL (1-5), w	0.011	(0.015)			-0.008	(0.011)
SAFL (1-5), m			0.026	(0.021)	0.028**	(0.014)
Low education dummy, w	-0.029	(0.049)			0.048	(0.033)
High education dummy, w	0.064	(0.046)			0.049	(0.036)
Low education dummy, m			-0.050	(0.057)	-0.004	(0.035)
High education dummy, m			0.024	(0.060)	0.077**	(0.032)
subjective health, w	-0.006	(0.023)			0.005	(0.016)
Healthy BMI (=1), w	0.037	(0.042)			0.014	(0.036)
subjective health, m			-0.006	(0.033)	0.036**	(0.016)
Healthy BMI (=1), m			-0.034	(0.052)	0.033	(0.045)
Married (=1), w	0.453**	(0.210)			-0.061	(0.048)
Divorced/Separated (=1), w	-0.040	(0.052)			0.064	(0.113)
Widow	0.050	(0.063)			0.347**	(0.153)
Married (=1), m			-0.278**	(0.130)		
Divorced/Separated (=1), m			-0.028	(0.053)	-0.090	(0.112)
Widower			0.009	(0.083)	-0.367	(0.290)
wave 1	0.230***	(0.044)	0.220***	(0.048)	0.134***	(0.034)
wave 2	0.190***	(0.043)	0.155***	(0.044)	0.107***	(0.032)
wave 3	0.152***	(0.044)	0.161***	(0.045)	0.112***	(0.032)
wave 4	0.013	(0.042)	-0.033	(0.042)	-0.041	(0.033)
1st quintile income	-0.431***	(0.058)	-0.401***	(0.071)	0.017	(0.070)
2nd quintile income	-0.128***	(0.047)	-0.185***	(0.057)	-0.099**	(0.047)
4th quintile income	0.188***	(0.060)	0.220***	(0.063)	0.204***	(0.035)
5th quintile income	0.143	(0.102)	0.272***	(0.099)	0.407***	(0.040)
# of Job-seekers (0-2)	-0.019	(0.078)	0.042	(0.097)	0.111**	(0.050)
# of Students (0-2)	-0.265**	(0.131)	0.146	(0.151)	-0.062	(0.088)
# of Volunteers/Homemakers (0-2)	-0.121	(0.080)	0.152	(0.136)	-0.025	(0.036)
# of Retirees (0-2)	-0.083	(0.081)	-0.033	(0.113)	0.023	(0.034)
# of Members with (partial) work disability (0-2)	-0.103	(0.082)	0.102	(0.085)	-0.104**	(0.050)
Something else (0-2)	-0.070	(0.222)	0.237	(0.187)	-0.040	(0.079)
Rental dwelling (=1)	-0.156***	(0.042)	-0.104**	(0.048)	-0.063*	(0.036)
Cost-free dwelling (=1)	-0.180	(0.144)	0.208	(0.160)	-0.372*	(0.226)
Children living at home (=1)	-0.136**	(0.062)	-0.297***	(0.093)	-0.213***	(0.039)
Household head is male					-0.006	(0.045)
Observations	1,728		1,279		2,501	
R-squared	0.335		0.280		0.310	
Number of clusters	598		434		816	
F-test SAFL=FL=0 index (p-value)	0.109		0.131		0.000	
F-test SAFL (p-value)					0.102	
F-test FL index (p-value)					0.001	

Notes: *** p<0.01, ** p<0.05, * p<0.1. Clustered standard errors in parentheses (at the household level). The same covariates and reference categories are used as in previous analyses.

Table 2A- 7: Closed-form consumption estimations (total consumption)

	(1) singles F	(2) se	(3) singles M	(4) se	(5) couples	(6) se
FL index (0-4), w	0.029**	(0.013)			0.028	(0.022)
FL index (0-4), m			0.013	(0.016)	0.025	(0.018)
SAFL (1-5), w	-0.010	(0.010)			-0.014	(0.014)
SAFL (1-5), m			-0.001	(0.012)	0.032*	(0.017)
Low education dummy, w	-0.019	(0.032)			0.040	(0.041)
High education dummy, w	0.046	(0.031)			0.009	(0.052)
Low education dummy, m			-0.048	(0.038)	0.063	(0.043)
High education dummy, m			-0.009	(0.035)	0.057	(0.042)
subjective health, w	-0.000	(0.016)			0.010	(0.021)
Healthy BMI (=1), w	0.010	(0.028)			-0.003	(0.047)
subjective health, m			0.020	(0.018)	-0.004	(0.024)
Healthy BMI (=1), m			-0.068*	(0.036)	0.067	(0.053)
Married (=1), w	0.174	(0.257)			0.001	(0.070)
Divorced/Separated (=1), w	0.005	(0.032)			-0.022	(0.222)
Widow	-0.006	(0.040)			0.276	(0.252)
Married (=1), m			-0.071	(0.121)		
Divorced/Separated (=1), m			0.099***	(0.034)	-0.025	(0.217)
Widower			0.111**	(0.051)	-0.362	(0.291)
wave 1	0.066**	(0.026)	0.090***	(0.032)	0.114**	(0.048)
wave 2	0.054**	(0.025)	0.052*	(0.029)	0.056	(0.051)
wave 3	0.040	(0.025)	0.073***	(0.026)	0.096*	(0.049)
wave 4	0.001	(0.026)	-0.003	(0.026)	-0.012	(0.049)
1st quintile income	-0.333***	(0.038)	-0.325***	(0.040)	0.040	(0.079)
2nd quintile income	-0.118***	(0.032)	-0.142***	(0.032)	-0.060	(0.064)
4th quintile income	0.193***	(0.045)	0.177***	(0.040)	0.197***	(0.045)
5th quintile income	0.248***	(0.088)	0.223***	(0.076)	0.407***	(0.049)
# of Job-seekers (0-2)	-0.071	(0.061)	0.012	(0.063)	0.133*	(0.069)
# of Students (0-2)	-0.120	(0.099)	-0.077	(0.093)	-0.144	(0.163)
# of Volunteers/Homemakers (0-2)	-0.107**	(0.052)	0.082	(0.085)	0.047	(0.040)
# of Retirees (0-2)	-0.140**	(0.055)	-0.003	(0.066)	0.090**	(0.037)
# of Members with (partial) work disability (0-2)	-0.033	(0.043)	0.024	(0.047)	-0.110	(0.078)
Something else (0-2)	0.018	(0.084)	-0.016	(0.130)	0.068	(0.072)
Rental dwelling (=1)	0.012	(0.028)	0.020	(0.030)	0.076*	(0.040)
Cost-free dwelling (=1)	-0.173	(0.137)	0.045	(0.160)	-0.193	(0.414)
Children living at home (=1)	-0.227***	(0.044)	-0.265***	(0.050)	-0.242***	(0.057)
Household head is male					-0.125**	(0.054)
Observations	1,728		1,279		2,501	
R-squared	0.378		0.349		0.147	
Number of clusters	598		434		816	
F-test SAFL=FL=0 index (p-value)	0.085		0.708		0.024	
F-test SAFL (p-value)					0.148	
F-test FL index (p-value)					0.083	

Notes: *** p<0.01, ** p<0.05, * p<0.1. Clustered standard errors in parentheses (at the household level). The same covariates and reference categories are used as in previous analyses.

Table 2A- 8: Closed-form consumption estimations (food consumption)

	(1) singles F	(2) se	(3) singles M	(4) se	(5) couples	(6) se
FL index (0-4), w	0.064***	(0.023)			-0.041*	(0.021)
FL index (0-4), m			0.085***	(0.029)	0.059***	(0.021)
SAFL (1-5), w	0.008	(0.019)			-0.010	(0.014)
SAFL (1-5), m			0.016	(0.024)	0.018	(0.019)
Low education dummy, w	-0.016	(0.059)			-0.025	(0.043)
High education dummy, w	-0.024	(0.052)			0.001	(0.043)
Low education dummy, m			-0.118*	(0.071)	-0.032	(0.045)
High education dummy, m			0.029	(0.065)	0.085**	(0.041)
subjective health, w	0.007	(0.026)			0.008	(0.020)
Healthy BMI (=1), w	0.003	(0.053)			-0.006	(0.045)
subjective health, m			-0.033	(0.037)	0.025	(0.021)
Healthy BMI (=1), m			0.016	(0.067)	0.057	(0.056)
Married (=1), w	0.347***	(0.127)			-0.020	(0.061)
Divorced/Separated (=1), w	0.012	(0.059)			-0.031	(0.129)
Widow	0.108	(0.076)			0.357*	(0.194)
Married (=1), m			-0.009	(0.230)		
Divorced/Separated (=1), m			0.004	(0.065)	0.112	(0.119)
Widower			-0.017	(0.104)	-0.142	(0.450)
wave 1	0.074	(0.049)	-0.040	(0.068)	0.069	(0.043)
wave 2	0.005	(0.049)	-0.017	(0.060)	0.053	(0.040)
wave 3	0.010	(0.049)	-0.057	(0.059)	0.072*	(0.039)
wave 4	0.033	(0.046)	-0.115*	(0.061)	-0.004	(0.040)
1st quintile income	-0.326***	(0.064)	-0.317***	(0.087)	-0.055	(0.080)
2nd quintile income	-0.084	(0.055)	-0.127*	(0.072)	-0.133**	(0.064)
4th quintile income	0.153**	(0.067)	0.170**	(0.074)	0.124***	(0.046)
5th quintile income	-0.037	(0.108)	0.132	(0.116)	0.232***	(0.052)
# of Job-seekers (0-2)	0.067	(0.090)	0.042	(0.104)	0.093*	(0.056)
# of Students (0-2)	0.008	(0.119)	0.192	(0.186)	0.068	(0.109)
# of Volunteers/Homemakers (0-2)	-0.054	(0.107)	0.289*	(0.150)	-0.005	(0.044)
# of Retirees (0-2)	0.064	(0.102)	0.091	(0.103)	0.032	(0.041)
# of Members with (partial) work disability (0-2)	-0.021	(0.079)	0.092	(0.110)	-0.025	(0.062)
Something else (0-2)	-0.189	(0.214)	0.459	(0.328)	-0.020	(0.064)
Rental dwelling (=1)	-0.095*	(0.049)	0.008	(0.061)	-0.012	(0.051)
Cost-free dwelling (=1)	-0.035	(0.154)	0.168	(0.184)	-0.358**	(0.179)
Children living at home (=1)	0.029	(0.070)	-0.065	(0.080)	-0.164***	(0.050)
Household head is male					-0.034	(0.049)
Observations (Number of clusters)	1,728 (598)		1,279 (434)		2,501 (816)	
R-squared	0.175		0.170		0.172	
F-test SAFL=FL=0 index (p-value)	0.011		0.006		0.007	
F-test SAFL (p-value)					0.544	
F-test FL index (p-value)					0.007	

Notes: *** p<0.01, ** p<0.05, * p<0.1. Clustered standard errors in parentheses (at the household level). The same covariates and reference categories are used as in previous analyses.

Table 2A- 9: Consumption growth estimations (all consumption measures)

	(1) Non-durables	(2) se	(3) Total	(4) se	(5) Food	(6) se
FL index (0-4), w	-0.005	(0.008)	-0.010	(0.009)	0.012	(0.009)
FL index (0-4), m	0.004	(0.009)	-0.009	(0.010)	-0.015	(0.012)
SAFL (1-5), w	0.001	(0.005)	-0.005	(0.007)	-0.014**	(0.007)
SAFL (1-5), m	0.006	(0.008)	0.006	(0.009)	0.012	(0.011)
Change in subjective health, w	-0.032	(0.024)	-0.013	(0.031)	-0.018	(0.029)
Change in objective health, w	-0.030	(0.052)	0.053	(0.052)	0.046	(0.073)
Change in subjective health, m	0.010	(0.021)	0.022	(0.027)	0.056*	(0.030)
Change in objective health, m	-0.087	(0.073)	0.001	(0.138)	-0.061	(0.092)
Low education dummy, w	0.012	(0.016)	0.003	(0.019)	-0.037*	(0.021)
High education dummy, w	-0.003	(0.018)	-0.016	(0.024)	-0.031	(0.023)
Low education dummy, m	0.014	(0.020)	0.025	(0.022)	0.005	(0.027)
High education dummy, m	0.024	(0.017)	0.027	(0.024)	0.019	(0.022)
Change in whether married, m	-0.187	(0.161)	-0.122*	(0.066)	-0.272***	(0.090)
Change in whether widower	0.448***	(0.130)	0.004	(0.047)	0.874***	(0.057)
Change in whether never married, m	-1.046**	(0.433)	-0.202	(0.297)	-0.499*	(0.257)
Change in whether married, w	0.368*	(0.201)	0.342***	(0.130)	-0.497	(0.362)
Change in whether widow	0.950***	(0.323)	0.811***	(0.133)	-0.090	(0.378)
Change in whether never married, w	1.197***	(0.431)	0.764***	(0.134)	-0.483	(0.392)
Household head is male	-0.042	(0.027)	-0.061**	(0.029)	-0.010	(0.036)
Household type	0.005	(0.010)	0.018	(0.012)	0.007	(0.012)
Change in whether kids live at home or not	-0.357***	(0.138)	-0.254**	(0.100)	0.020	(0.161)
Change in # of Job seekers	-0.107	(0.077)	-0.132	(0.081)	-0.122*	(0.067)
Change in # of Students	-0.199	(0.168)	-0.137	(0.124)	-0.470**	(0.201)
Change in # of Adults with unpaid work	0.037	(0.078)	-0.043	(0.121)	-0.066	(0.091)
Change in # of Retirees	0.105	(0.064)	0.042	(0.072)	0.071	(0.078)
Change in # of adults with (Partial) Work disability	0.005	(0.120)	-0.040	(0.080)	-0.004	(0.115)
Change in # of adults doing Something else	0.106	(0.140)	0.005	(0.097)	-0.073	(0.178)
Change in whether rental dwelling	0.019	(0.153)	0.077	(0.115)	0.188	(0.204)
Change in whether cost-free dwelling	0.353	(0.290)	0.088	(0.160)	0.007	(0.337)
Observations	2,755		2,755		2,755	
R-squared	0.014		0.008		0.016	
F-test FL(m)=FL(w)=0 (p-value)	0.776		0.390		0.264	
F-test SAFL(m)=SAFL(w)=0 (p-value)	0.796		0.598		0.053	
F-test SAFL=FL=0 (p-value)	0.715		0.401		0.193	

Notes: *** p<0.01, ** p<0.05, * p<0.1. Clustered standard errors in parentheses (at the household level for 1426 clusters). The same covariates and reference categories are used as in previous analyses.

Table 2A- 10: Closed-form estimations (all consumption measures) including assets

	Non-durable consumption			Total household consumption			Food consumption		
	(1) singles F	(2) singles M	(3) couples	(4) singles F	(5) singles M	(6) couples	(7) singles F	(8) singles M	(9) couples
SAFL (1-5), w	0.032*		0.002	0.003		-0.005	0.029		0.000
	(0.019)		(0.012)	(0.012)		(0.017)	(0.024)		(0.016)
FL index (0-4), w	0.022		-0.031*	0.027		0.025	0.059*		-0.058**
	(0.029)		(0.018)	(0.017)		(0.025)	(0.033)		(0.024)
SAFL (1-5), m		0.008	0.031**		0.019	0.033		-0.002	0.027
		(0.026)	(0.015)		(0.016)	(0.021)		(0.030)	(0.020)
FL index (0-4), m		-0.000	0.067***		0.006	0.035		0.065*	0.070***
		(0.031)	(0.018)		(0.018)	(0.022)		(0.037)	(0.025)
1st quintile assets	-0.173***	-0.165**	0.008	-0.084**	0.029	0.020	-0.185**	-0.250***	-0.025
	(0.062)	(0.072)	(0.042)	(0.039)	(0.039)	(0.061)	(0.094)	(0.095)	(0.061)
2nd quintile assets	-0.119**	-0.003	0.004	-0.080**	0.054	0.001	-0.134*	-0.035	-0.012
	(0.057)	(0.069)	(0.039)	(0.031)	(0.037)	(0.062)	(0.075)	(0.075)	(0.052)
4th quintile assets	-0.049	0.020	0.070*	-0.056	-0.073**	0.072	-0.135	-0.065	0.001
	(0.059)	(0.060)	(0.036)	(0.038)	(0.037)	(0.056)	(0.082)	(0.076)	(0.049)
5th quintile assets	0.089	0.194**	0.002	0.002	-0.019	-0.029	-0.098	-0.071	-0.031
	(0.075)	(0.088)	(0.037)	(0.048)	(0.059)	(0.054)	(0.094)	(0.120)	(0.047)
Observations (Number of clusters)	969 (428)	811 (337)	1,822 (690)	969 (428)	811 (337)	1,822 (690)	969 (428)	811 (337)	1,822 (690)
R-squared	0.405	0.362	0.339	0.453	0.449	0.185	0.223	0.231	0.207
F-test SAFL=FL, index=0 (p-value)	0.168	0.959	0.000	0.238	0.451	0.045	0.055	0.199	0.001
F-test SAFL (p-value)			0.121			0.286			0.402
F-test FL index (p-value)			0.001			0.092			0.002

Notes: *** p<0.01, ** p<0.05, * p<0.1. Clustered standard errors in parentheses (at the household level). The same covariates and reference categories are used as in previous analyses.

Table 2A- 11: Closed-form estimations (total consumption) with interactions of (self-assessed) financial literacy within couples

	(1)	(2)	(3)
$\left(\text{FL index}_w - \overline{\text{FL index}_w}\right) * \left(\text{FL index}_m - \overline{\text{FL index}_m}\right)$	0.023		0.022
	(0.015)		(0.015)
FL index (0-4), w	0.021		0.025
	(0.023)		(0.022)
FL index (0-4), m	0.033*		0.025
	(0.018)		(0.018)
$(\text{SAFL}_w - \overline{\text{SAFL}_w}) * (\text{SAFL}_m - \overline{\text{SAFL}_m})$		0.008	0.008
		(0.012)	(0.013)
SAFL (1-5), w		-0.012	-0.014
		(0.014)	(0.014)
SAFL (1-5), m		0.037**	0.032*
		(0.017)	(0.018)
Observations	2,501	2,501	2,501
R-squared	0.147	0.147	0.150
F-test FL index w (p-value)	0.174		0.147
F-test FL index m (p-value)	0.058		0.138
F-test SAFL w (p-value)		0.629	0.546
F-test SAFL m (p-value)		0.109	0.190

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Clustered standard errors in parentheses (at the household level, 816 clusters). The financial literacy index is in deviation of its mean. We report the estimated coefficients, not marginal effects. We use the same set of independent variables as in previous analyses.

Table 2A- 12: Closed-form estimations (food consumption) with interactions of (self-assessed) financial literacy within couples

	(1)	(2)	(3)
$\left(\text{FL index}_w - \overline{\text{FL index}_w}\right) * \left(\text{FL index}_m - \overline{\text{FL index}_m}\right)$	-0.022		-0.024
	(0.017)		(0.017)
FL index (0-4), w	-0.042**		-0.039*
	(0.021)		(0.021)
FL index (0-4), m	0.059***		0.055***
	(0.020)		(0.021)
$(\text{SAFL}_w - \overline{\text{SAFL}_w}) * (\text{SAFL}_m - \overline{\text{SAFL}_m})$		0.009	0.013
		(0.013)	(0.014)
SAFL (1-5), w		-0.018	-0.012
		(0.014)	(0.014)
SAFL (1-5), m		0.029	0.019
		(0.018)	(0.019)
Observations	2,501	2,501	2,501
R-squared	0.175	0.169	0.177
F-test FL index w (p-value)	0.049		0.064
F-test FL index m (p-value)	0.004		0.007
F-test SAFL w (p-value)		0.361	0.501
F-test SAFL m (p-value)		0.285	0.468

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Clustered standard errors in parentheses (at the household level, 816 clusters). The financial literacy index is in deviation of its mean. We report the estimated coefficients, not marginal effects. We use the same set of independent variables as in previous analyses.

Table 2A-13: Interactions mean FL and mean SAFL and age of the household head within couples

	Non-durable consumption			Total household consumption			Food consumption		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$(\text{FL index}_w + \text{FL index}_m)/2$	0.045**		0.044**	0.054**		0.052**	0.024		0.025
	(0.018)		(0.019)	(0.023)		(0.023)	(0.027)		(0.027)
$(\text{age}_{hhead} - \overline{\text{age}_{hhead}})$	0.005*	0.009*	0.008	-0.003	0.004	0.002	0.002	0.007	0.005
	(0.003)	(0.005)	(0.005)	(0.004)	(0.006)	(0.006)	(0.004)	(0.006)	(0.007)
$\dfrac{\text{FL index}_w + \text{FL index}_m}{2} * (\text{age}_{hhead} - \overline{\text{age}_{hhead}})$	-0.000		0.000	0.000		0.001	0.001		0.001
	(0.001)		(0.001)	(0.001)		(0.001)	(0.002)		(0.002)
$(\text{SAFL}_w + \text{SAFL}_m)/2$		0.012	0.005		0.012	0.005		-0.003	-0.006
		(0.016)	(0.016)		(0.020)	(0.019)		(0.020)	(0.020)
$\dfrac{\text{SAFL}_w + \text{SAFL}_m}{2} * (\text{age}_{hhead} - \overline{\text{age}_{hhead}})$		-0.001	-0.001		-0.001	-0.001		-0.000	-0.001
		(0.001)	(0.001)		(0.001)	(0.001)		(0.001)	(0.001)
Observations	2,501	2,501	2,501	2,501	2,501	2,501	2,501	2,501	2,501
R-squared	0.262	0.259	0.262	0.101	0.099	0.101	0.104	0.103	0.104
F-test mean FL index (p-value)	0.014		0.020	0.021		0.023	0.366		0.357
F-test mean SAFL (p-value)		0.439	0.738		0.537	0.815		0.880	0.779

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Clustered standard errors in parentheses (at the household level, 816 clusters). Age of the household head is in deviation from its mean. We report the estimated coefficients, not marginal effects. We use the same set of independent variables as in previous analyses. When constructing the interaction terms, we adjust the age of the household head by the overall average age.

Table 2A- 14: Closed-form estimations including interest in FL: total household consumption

	(1) singles F	(2) se	(3) singles M	(4) se	(5) couples	(6) se
SAFL (1-5), w	-0.010	(0.010)			-0.018	(0.014)
FL index (0-4), w	0.028**	(0.014)			0.021	(0.022)
SAFL (1-5), m			0.000	(0.012)	0.028	(0.019)
FL index (0-4), m			0.014	(0.016)	0.022	(0.018)
FL: interesting subject?, w	0.002	(0.009)			0.016	(0.015)
FL: interesting subject?, m			-0.007	(0.012)	0.023	(0.018)
Observations (Number of clusters)	1,728 (598)		1,279 (434)		2,501 (816)	
R-squared	0.378		0.350		0.149	
F-test SAFL=FL=0 index (p-value)	0.097		0.670		0.075	
F-test SAFL (p-value)					0.208	
F-test FL index (p-value)					0.189	

Notes: *** p<0.01, ** p<0.05, * p<0.1. Clustered standard errors in parentheses (at the household level). The same covariates and reference categories are used as in previous analyses.

Table 2A- 15: Closed-form estimations including interest in FL: food consumption

	(1) singles F	(2) se	(3) singles M	(4) se	(5) couples	(6) se
SAFL (1-5), w	0.012	(0.020)			-0.016	(0.015)
FL index (0-4), w	0.070***	(0.023)			-0.049**	(0.022)
SAFL (1-5), m			0.020	(0.023)	0.020	(0.019)
FL index (0-4), m			0.090***	(0.030)	0.059***	(0.021)
FL: interesting subject?, w	-0.019	(0.018)			0.024	(0.015)
FL: interesting subject?, m			-0.024	(0.023)	0.003	(0.017)
Observations (Number of clusters)	1,728 (598)		1,279 (434)		2,501 (816)	
R-squared	0.177		0.171		0.174	
F-test SAFL=FL=0 index (p-value)	0.006		0.003		0.003	
F-test SAFL (p-value)					0.384	
F-test FL index (p-value)					0.004	

Notes: *** p<0.01, ** p<0.05, * p<0.1. Clustered standard errors in parentheses (at the household level). The same covariates and reference categories are used as in previous analyses.

Table 2A- 16: Consumption growth estimations including interest in FL: total household and food consumption

	(1) Total	(2) se	(3) Food	(4) se
SAFL (1-5), w	-0.016	(0.011)	-0.026***	(0.010)
FL index (0-4), w	-0.012	(0.017)	0.014	(0.015)
SAFL (1-5), m	-0.002	(0.015)	-0.011	(0.012)
FL index (0-4), m	-0.019	(0.017)	-0.020	(0.017)
FL: interesting subject?, w	0.014	(0.011)	0.006	(0.011)
FL: interesting subject?, m	-0.001	(0.014)	-0.003	(0.011)
Observations	1,252		1,252	
R-squared	0.011		0.017	
F-test FL(m)=FL(w)=0 (p-value)	0.215		0.405	
F-test SAFL(m)=SAFL(w)=0 (p-value)	0.318		0.015	
F-test SAFL=FL=0 (p-value)	0.171		0.051	

Notes: *** p<0.01, ** p<0.05, * p<0.1. Clustered standard errors in parentheses (at the household level, 660 clusters). The same covariates and reference categories are used as in previous analyses.

Chapter 3: You're invited – RSVP! The role of tailoring in incentivising people to delve into their pension situation[9]

3

Abstract

Many people lack motivation to process pension information, as they do not feel the urgency to delve into their pension situation. This attitude may prevent them from taking informed pension decisions. This study assesses whether offering tailored pension information based on age and gender is a way to get people interested in pension information. We conducted a randomised field experiment in which we sent email invitations to all employees of an insurance company to use an online tool, referred to as "the Pensioncheck", in order to learn more about their personal pension situation. This experimental set-up enabled us to answer the following research question: Does tailoring induce participants to perform the Pensioncheck? The experiment provided data on (1) whether individuals clicked through from the invitation to the Pensioncheck website, (2) whether they logged in on the Pensioncheck website and (3) the amount of time they took to complete it. There was evidence suggesting a negative gender-tailoring effect and a negative gender- *and* age-tailoring effect for young females and middle-aged males concerning clicking and login behaviour. Additionally, we found a large positive age- *and* gender-tailoring effect for young participants regarding the time spent in the Pensioncheck. These may suggest that tailoring in the trigger phase can work in two opposite directions.

3.1   Introduction

The consequences of the latest financial crisis have caused (future) pensions of Dutch people to become less generous. Financial risks have increasingly shifted from pension providers to individuals (Krijnen, Breugelmans and Zeelenberg, 2014). Policymakers reacted to the recent changes by passing the Pension Information Act in 2015, which requires clear and effective pension communication from the side of pension providers. This act introduced mandatory disclosure by pension providers in order to guarantee an environment that enables people to appropriately plan for retirement (Autoriteit Financiële Markten (AFM), 2018). While pension funds and insurers are thus mandated to provide accurate information, their clients are under no obligation to delve into their own pension situation. People do not seem to feel the urgency to read pension documents and they postpone planning for retirement (Krijnen et al., 2014, 2016). One of the main trends in the discussion surrounding the pension system is freedom of choice. In a *Netspar Brief* on freedom of choice in pensions, Harry van Dalen and Kène Henkens (2016) conclude that people actually prefer to outsource the majority of choices regarding their pensions to a pension fund. Nevertheless, individuals find it important to retain a certain degree of freedom of choice[10]. More choice also means that it becomes essential to delve into information

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[10] For an overview of what types of choices pension plan participants can typically make, see Lentz, Nell and Pander Maat (2017).

surrounding those choices. People do not seem to be so keen on diving into the ocean of information, however: They are routinely swamped with information on a myriad of financial products and they find that making a well-thought-out financial decision can be more challenging than expected. Lee and Lee (2004) show in their work that information overload results in "less satisfied, less confident, and more confused consumers" (p.159) who make poorer decisions.

Pension providers have followed the call for more transparency. At the same time, they assist their clients in the process of making (complex) choices concerning their retirement benefits. Several pension funds and insurers are already experimenting with providing layered information or creating individual profiles for their clients. Nell, Lentz and Pander Maat (2016) conducted a study on the effectiveness of providing layered pension information. They tested whether participants who were subjected to a layered pension document showed a better understanding of the situation than those who had to read a pension document without layers. The study found no evidence for an overall effect of layering. Another relevant study on the topic of pension communication is that of Eberhardt, Brüggen, Post and Hoet (2016). They develop a conceptual model (the *retirement belief model*) and identify different segments of pension plan participants with certain characteristics. Our study builds upon their findings, following their call to research "how different target groups react to different types of framing information" (Eberhardt et al., 2016, p. 44).

In economic terms, individuals aim at smoothing consumption over their lifetime. During their working life, they accumulate wealth and make investment decisions using the information available to them so that they can maintain their desired consumption level after retirement. This is the basic idea behind life-cycle models, which are used to explain lifetime consumption patterns of individuals and households (for more background, see Deaton, 1992, Chapter 2 and Deaton and Muellbauer, 1980, Chapter 12). In the ideal case, individuals have access to full information, which they may use in order to make optimal financial decisions. However, individuals are not always well-informed about complicated financial matters such as pension systems. This might be due to a lack of intrinsic motivation or simply an inability to grasp financial concepts. Due to compulsory pension plan participation, pension premiums are deducted automatically. Pension benefits are received in the future. This creates a setting in which time preference plays a crucial role in how individuals make investment decisions concerning their pension. Inconsistent time preferences are typically modelled by a hyperbolic discount function— with "high discount rates over short horizons and relatively low discount rates over long horizons" (Laibson, 1997, p. 445). Individuals keep on postponing their decision to invest, as the expected returns (the pension payments) lie relatively far in the future. Though not explicitly modelled in our study, the concept

of time preferences helps us to understand the mechanisms behind making financial decisions with benefits that can be reaped in the future. Naturally, the time horizon of the expected benefits varies with the individual's age.

The general question that arises is whether we can induce people to acquire information about their pension such that they are able to make (financially) wise decisions. In order to grapple with the problem of incentivising people to delve into their pension situation, this chapter combines insights from economics on the nature of financial decision making with insights from the fields of communication science and social psychology on tailoring information pieces. We contribute to the literature by conducting a randomized controlled experiment on the effectiveness of tailoring pension communication. The effectiveness is measured by monitoring pension information behaviour (PIB hereafter), which includes clicking on a link to a (personal) pension information website, logging in to this website (which requires a username and password) and spending time on this website.

Hawkins et al. (2008) define tailoring as "a number of methods for creating communications individualized for their receivers […]" (p. 454). In their discussion on communication strategies for enhancing information relevance, Kreuter and Wray (2003) conclude that programs that "succeed in making information relevant to their intended audience will be more effective" than non-tailored information materials (p.227). In their systematic review on (computer-) tailored behavioural interventions, Lustria et al. (2009) suggest several tailoring criteria, such as demographic information (age and gender), individual characteristics or health information needs. Examples of research on tailoring information (in smoking cessation programs) based on demographics are Etter (2005) and Cobb (2005). Etter (2005) compared the efficacy of two internet-based, computer-tailored smoking-cessation programs. Both programs were tailored based on personal characteristics, attitudes towards smoking and other variables. Etter found that for the original program, smoking abstinence rates were higher than for the modified program, which contained a counselling letter as an intervention. Cobb (2005) conducted a study in which he evaluates a well-known smoking-cessation website (QuitNet) that provided targeted and tailored information to each user based on personal characteristics such as age, gender, quitting history and prior usage patterns within the site. This study found that sustained use of the website was associated with higher abstinence. Both studies analysed programs that did not tailor information on the basis of demographics alone but were also based on individual preferences. Putting this into practice concerning pension information is far from straightforward. A start can be made by focussing on a few easily observable characteristics: Tailoring on demographic

information rather than on individual preferences allows a relatively clear-cut segmentation that does not require a great deal of effort from the relevant information providers.

Tailoring information according to personal characteristics has received attention in health communication as a way to get people interested in health information (Hawkins et al., 2008; Kiesler & Auerbach, 2006). Binge drinking (Chiauzzi et al., 2005), nutrition (Brug et al., 1996; Oenema et al., 2001) and smoking (Dijkstra et al., 1998; Etter, 2005; Strecher et al., 2005) are some examples within the domain of health communication where tailoring has been found effective to induce awareness and promote healthier behaviour. As we have seen, the effectiveness of tailoring in achieving socially desirable behaviour has been documented in several research domains. To offer a complete picture, we should consider a strand of literature from social psychology that questions the effectiveness of communication with a persuasive intent. Several studies discuss a phenomenon known as the forewarning effect (see Kamalski, Lentz, Sanders and Zwaan, 2008; McGuire and Papageorgis, 1962; Petty and Cacioppo, 1979), which could counteract the desired effects from offering information with a persuasive intent. With forewarning, recipients of a message would be "motivated to counterargue the message in order to reassert their freedom" (Petty and Cacioppo, 1979, p. 173). Kamalski et al. (2008) provide experimental evidence in favour of a forewarning effect when processing an informative text. Tailored communication has a persuasive intent— people should get involved with their pension situation. When recipients recognise that they are being persuaded to act upon the tailored invitation, their intrinsic motivation to do so might be crowded out: They develop resistance and it becomes harder, or even impossible, to persuade them.

In this study, we investigate whether we can induce individuals to acquire information about their pension situation. This is a crucial first step toward informed pension decision making; people need to be motivated to abandon their state of inertia and to become more involved pension planners. We distinguish between three different phases that are at the heart of acquiring information about one's pension situation. The first phase is the trigger phase, followed by the navigation phase and, subsequently, the content phase. In the trigger phase, individuals are stimulated to access a particular website by either following a link or logging into their individual customer page of their pension plan provider. Usually, individuals receive an invitation by (e-)mail or in the digital environment of their pension plan provider. The second phase is when people have already been triggered to seek more information about their pension situation and they need guidance to take them through the myriad of information pieces that are available. This phase refers to the design and presentation of choices, that, according to Prast and Van Soest (2016), is "a complementary way [to financial education and pension knowledge] to improve decisions on

pension preparation" (p. 113). The third phase concerns the content of the information provided. Regarding the content of an information piece, possible approaches for research include analysing whether information is provided in layers and discerning which information is considered relevant for a particular customer group.

This chapter focuses on the triggering phase: We manipulated the invitation (or the trigger) for individuals to delve into their pension situation. Our aim is to explore the effect that the intervention had on the subsequent behaviour of the participants in our field experiment.

The main goal of our study is to assess whether tailoring invitations to individuals in order to trigger them to delve into their pension information results in a higher probability to do so. For this assessment, we conducted a field experiment in which email invitations were sent to all employees of an insurance company to use an online tool, referred to as the *Pensioncheck*, to learn more about their personal pension situation. Half of the employees were randomly assigned to receive tailored invitations; the other half received non-tailored invitations. We tailored the invitations based on age and gender. The non-tailored (or generic) invitations were gender- and age neutral. Age and gender are characteristics of customers that are a priori known by their pension plan provider. Conceptually, the main dependent variable is the behaviour of individuals after they received different invitation versions— in short, their pension information behaviour (PIB). We identify three traceable dimensions of PIB: 1) clicking behaviour 2) login behaviour and 3) the time spent in the Pensioncheck.

The remainder of this chapter is structured as follows: Section 3.2 outlines the experimental design. Section 3.3 describes the data collected, followed by two sections describing, respectively, the estimation procedure and the empirical results. The last section provides a discussion of our findings and an outlook towards future research.

3.2   Experimental design

The experiment was carried out in collaboration with a pension insurance company. The participants in our study are insurance company employees— all of whom automatically participate in the pension scheme provided by their employer and have access to the Pensioncheck. Note that because of the nature of our research population, we are restricted in generalizing our results beyond employees of the financial sector.

The Pensioncheck is an online tool that enables participants to check whether they have accrued enough pension income for their old age. When logging into the Pensioncheck, participants must use their digital identity code (DigiD). This identity code, provided by the Dutch government to access personal online information, is needed, among other things, for filing income tax. In the Pensioncheck, users are asked to upload their salary and pension-specific details

from a website administered by the Dutch pension sector. The idea behind the Pensioncheck is not only to check what to expect, but also to consider what is needed in order to accrue enough pension entitlements. We sent the tailored email invitations to perform the Pensioncheck to all employees (*N=3,298*). One week later, we sent a reminder for the invitation (using the same wording as the initial email) to those who had not taken any action.

We tailored the invitation to participate in the Pensioncheck on two variables: age and gender. We based our choice on the findings of Hershey, Jacobs-Lawson and Neukam (2002), who found that there were age and gender differences in goals individuals hold for retirement. We defined three age categories: 18-34 years, 35-54 years and 55 years and older. The youngest age group encompasses the part of the population that is at the beginning of their working career. They are typically more concerned with saving for their first car, their first house or the next vacation rather than for retirement. The middle-aged group typically has more working experience and starts accumulating savings to buy a larger house or car and to settle down. Financially, middle-aged individuals are expected to have a buffer to start saving for retirement. The 55+ group is a heterogeneous group of individuals ranging from those who still have some working years left (and can still make important financial decisions concerning their future pension entitlements) to those who are about to retire (and who cannot do much to change their pension entitlements). The idea was that the sense of urgency and possible actions differ for the three age groups. For the young group, although retirement is still far away, it would still pay off to have an overview of the pension situation, although the benefits might not be immediate. The earlier that people are confronted with the fact that they need to be aware of their pension situation, the more time they have to digest any practical information on this topic. This could save them some time and stress in the future when the urgency increases. For the middle group, respondents should be aware that their retirement is approaching and that they should take action well in advance. For the senior group, it is crucial to be aware of their pension situation; in some cases, it may still not be too late to improve matters. The motivation to tailor on gender is provided by Graham et al. (2002), which investigated gender differences in investment strategies from an information-processing perspective. The study concluded that there are gender-based information-processing differences, as men and women select different "cues from the environment when processing information" (idem, p.19). Females tend to process information more comprehensively, considering also subtle bits; males typically do not process all available information. Furthermore, Graham et al. point out several important implications regarding "the marketing of financial services to male versus female customers" (idem, p. 9). We acknowledged those conclusions in our decision to tailor the e-mail invitation also on gender.

Having defined three age groups and two gender groups, we ended up with six separate groups for a tailored approach. We randomly assigned each individual to one out of four conditions. In the first condition, participants received an invitation tailored on age and gender. In the second condition, participants received a version tailored on gender; in the third condition, they received a version tailored on age. The fourth condition entailed receiving a generic version that contained no tailoring. The four conditions we designed enabled us to trace back whether the causal effect of tailoring on participant behaviour is due to the tailoring solely on age *or* gender, or due to the tailoring simultaneously on both variables.

3

We tailored the mail invitation as follows: 1) we included a quote by a fictional persona in the preamble of the email, indicating also the gender and age of the persona and 2) we included a couple of tailoring sentences that differed in their content (urgency and possible action), depending on the age group. We developed four different quotes, depending on which version the participant would receive, with the content of the quote differing for each age category. Additionally, we provided a different quote for the version that did not contain tailoring based on age. The quote contains a reflection made by a fictional persona after performing the Pensioncheck. Underneath every quote, we added a name that is typical for that specific age group and gender with a fictional age between brackets (this is how we tailored on gender). Note that for the versions in which we did not tailor on gender, we chose the name Robin, a gender-neutral name in the Netherlands. See figure 1 for an overview of the quotes and Appendix A for an overview of the names and ages used for the personas appearing below every quote. Our approach is comparable to the work of Bauer, Eberhardt and Smeets (2017). In a controlled field experiment, they sent invitation letters conveying a social norm as a nudge to pension plan participants to look into their personal pension planner. Whereas our design of the quotes aimed at motivating participants directly to look into their pension situation, Bauer et al. (2017) went a step further with their intervention and formulated the social norms in terms of (in)sufficient pension income. They found that the control letter was actually more effective than the social norm letters— a result we can confirm in our study.

Apart from the quotes, we also developed two types of tailoring sentences in the invitation letter: One group of sentences that referred to the urgency for people of a particular age group to inform themselves about their pension situation and a second group of sentences that focussed on encouraging participants to take action. Figure 2 shows the exact wording of the tailored sentences (in Dutch) and their English translation. For a detailed overview of the complete mailings, please refer to Appendix B. Generally, the formulation of the tailored passages in the

email invitation was designed to have an encouraging tone, accompanied by a hint of admonishment.

Young age group

"Ik vroeg me af of het wel nodig is om op mijn leeftijd al met mijn pensioensituatie bezig te zijn. Toch ben ik blij dat ik de Pensioencheck gedaan heb. Wat fijn om nu overzicht te hebben! Ik heb nu een idee waar ik aan toe ben…"

"I wasn't at all sure whether—at my age— it would be necessary to look into my pension situation. And yet, I am glad that I did the Pensioncheck. How nice to have an overview! Now, I have a sense of where I am at…"

Middle-aged group

"Ik was al een paar jaar aan het denken dat het tijd werd om me te verdiepen in mijn pensioensituatie. Ik ben blij dat ik nu de Pensioencheck gedaan heb. Wat fijn om overzicht te hebben! Ik heb nu een idee waar ik aan toe ben…"

"For several years now, I have been thinking about delving into my pension situation. Now, I am glad that I did the Pensioncheck. How nice to have an overview! Now, I have a sense of where I am at…"

Senior age group

"Ik denk de laatste tijd regelmatig na over mijn pensioensituatie en twijfelde in hoeverre ik er goed genoeg voor sta. Ik ben blij dat ik nu de Pensioencheck gedaan heb. Wat fijn om overzicht te hebben! Ik heb nu een idee waar ik aan toe ben…"

"For some time now my thoughts have turned regularly to my pension situation, wondering about whether I am doing well enough. Now, I am glad that I did the Pensioncheck. How nice to have an overview! Now, I have a sense of where I am at…"

Generic

"Ik ben blij dat ik de Pensioencheck gedaan heb. Wat fijn om nu overzicht te hebben! Ik heb nu een idee waar ik aan toe ben…"

"I am glad that I did the Pensioncheck. How nice to have an overview! Now, I have a sense of where I am at…"

Figure 3- 1: Overview of the quotes at the beginning of the email invitations

I.   Urgency

Young group:

Je pensioen voelt waarschijnlijk nog erg ver weg, maar kijk toch alvast eens hoe je ervoor staat. Het is prettig om overzicht te hebben!
It probably still feels like your retirement is really far away. And yet, why not already take a look at how you are faring? It is nice to have an overview!

Middle-aged group:

Je pensioen voelt misschien nog ver weg, maar kijk toch eens hoe je ervoor staat. Stel het niet langer uit!
Perhaps your retirement still feels far away. And yet, why not take a look at how you are faring? Don't postpone it any longer!

Old group:

Je pensioen komt dichterbij, dus kijk hoe je ervoor staat. Weet wat je kunt verwachten!
Your retirement is getting closer, so have a look at how you are faring. Know what you can expect!

II.   Possible action

Young group:

Als je maatregelen neemt nu je nog jong bent, leveren ze het meeste op.
If you take action now while you are still young, you will have the most benefit.

Middle-aged group:

Als je ruim vóór het pensioen maatregelen neemt, kun je gemakkelijker een goed effect bereiken.
If you take action well in advance of retirement, you can more easily achieve a beneficial effect.

Old group:

Je kunt nu misschien nog voorbereidingen treffen om je pensioensituatie te verbeteren.
You may still be able to take measures now to improve your pension situation.

Figure 3- 2: Overview of tailored sentences

3.3   Data description

The invitations to perform the Pensioncheck were sent out to all employees of the insurance company. Twelve employees did not receive the email invitation, due to technical reasons, which left us with a sample of 3,286 individuals. We collected data not only about the mailing version each participant received (as a double check), but also pertaining to who clicked on the link in the email invitation and who actually logged in the Pensioncheck environment (and how often). Also known are: The amount of time each participant spent per session (converted to seconds) and at

which page of the Pensioncheck the participants aborted the session. We also have information on who completed the Pensioncheck.

The average age of the participants is 45 years and the share of female employees is 33%. Figure 3 provides an overview of (sub-)sample sizes at the different stages of the experiment. 42% of the individuals who received the email invitation clicked on the link in the invitation. Of those who clicked through, 25% logged in on the Pensioncheck. This is equivalent to 11% of all participants in this experiment. Once logged in, more than half of the participants completed the Pensioncheck. This is an indication that the login stage is the largest hurdle relative to clicking through and completing the Pensioncheck.

Received invitation		Clicked through		Logged in		Completed Pensioncheck
N=3,286	⇨	n=1,392	⇨	n=346	⇨	n=186
		42%*		11%*		6%*
				25%°		54%°
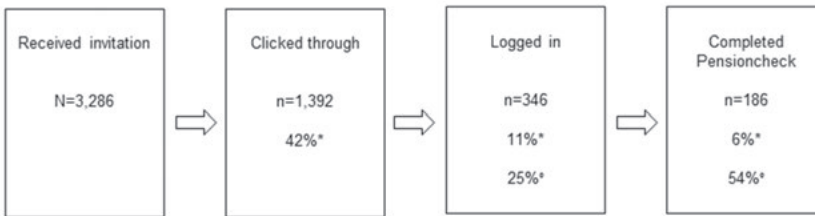
Figure 3- 3: Structure of dataset

Notes: *Denotes a percentage of the total sample and ° denotes a percentage of the subsample of the previous stage.

The majority of the respondents logged in on the Pensioncheck once, and about 10% of respondents logged in twice or more. The maximum of login attempts was six. Per individual, we took the longest attempt into consideration when analyzing the time spent on the Pensioncheck. The average time spent on the Pensioncheck was 800 seconds (roughly 13 minutes). The largest hurdle (responsible for 60% of the respondents quitting the Pensioncheck) was the page about the composition of the accrued pension amount.

Table 3- 1: Number of participants by segment and tailoring type. In parentheses is the number of participants who spent time on the Pensioncheck

Age group	18-34 years		35-54 years		>55 years		**All**	
Gender								
Male	GA	A	GA	A	GA	A	*GA*	*A*
	69 (9)	63 (5)	327 (32)	295 (39)	105 (18)	142 (22)	*501 (59)*	*500 (66)*
	G	none	G	none	G	none	*G*	*none*
	74 (8)	82 (14)	312 (33)	273 (46)	145 (19)	125 (13)	*531 (60)*	*480 (73)*
Female	GA	A	GA	A	GA	A	*GA*	*A*
	71 (9)	64 (3)	218 (13)	210 (11)	37 (5)	48 (2)	*326 (27)*	*322 (16)*
	G	none	G	none	G	none	*G*	*none*
	81 (7)	62 (4)	197 (14)	206 (15)	36 (4)	44 (1)	*314 (25)*	*312 (20)*
All	*GA*	*A*	*GA*	*A*	*GA*	*A*	**GA**	**A**
	140 (18)	*127 (8)*	*545 (45)*	*505 (50)*	*142 (23)*	*190 (24)*	**827 (86)**	**822 (82)**
	G	*none*	*G*	*none*	*G*	*none*	**G**	**none**
	155 (15)	*144(18)*	*509 (47)*	*479 (61)*	*181 (23)*	*169 (14)*	**845 (85)**	**792 (93)**

Notes: *GA*=tailoring on gender and age, *A*=tailoring on age, *G*=tailoring on gender, *none*=no-tailoring. Column and row totals are in *italics*. Regarding young males, for instance, 69 received an invitation tailored on age and gender, and nine out of these spent some time in the Pensioncheck.

For an overview of the distribution of the number of participants per segment and condition for our dependent variables, see table 3-1. The largest segments are middle-aged men and women and senior men. As only a small fraction of the total sample did the Pensioncheck, the number of observations of the time spent in the Pensioncheck is very low. The sum of the four numbers in bold in the right bottom corner is equal to 3286 (i.e. the total number of participants); and 346 (11%) of them spent time on the Pensioncheck.

3.4   The models

Restricted models

First of all, we are interested in the effect of tailoring on pension information behaviour without taking into account any interaction between tailoring types, age categories or gender. In other words, we separately estimate three restricted models with three different dependent variables: clicking behaviour, login behaviour and the time spent in the Pensioncheck. Those three dependent variables fall under pension information behaviour (PIB). For brevity, equation (3.1) summarizes the three restricted models with PIB_i referring to clicking behaviour in the first, login behaviour in the second and the time spent (in logs) in the third model. Clicking (and login) behaviour is measured by a dichotomous variable set equal to 1 if the participant clicked through (logged into the Pensioncheck) and 0 (zero) if otherwise. We also estimated the model explaining login behaviour for a sub-sample of participants who clicked through. The aforementioned

estimations make use of the linear probability model[11]. Finally, we estimate equation (3.1) using ordinary least squares with the logarithm of time as a dependent variable. t_{age_i}, t_{g_i} and t_{ageg_i} are dummy variables and refer to the tailoring type (age, gender, age and gender, respectively); no-tailoring is the reference category. $young_i$ and $senior_i$ are dummy variables that refer to the age categories (the middle aged-category is the reference) and ξ_i is an error term.

$$PIB_i = \alpha_0 + \alpha_1 t_{age_i} + \alpha_2 t_{g_i} + \alpha_3 t_{ageg_i} + \alpha_4 young_i + \alpha_5 senior_i + \alpha_6 male_i + \xi_i \quad (3.1)$$

We continue our analysis by estimating models that take into account differences in the effect of tailoring on pension information behaviour within and across age groups and gender.

First model: clicking behaviour

We use a linear probability model to estimate the effects of tailoring on the probability to click (see equation (3.2)). $clicked_i$ is a binary dependent variable which is set to 1 if someone clicked through and 0 if otherwise.

$$clicked_i = \sum_{j=1}^{24} \beta_j \, I(AGT_i = j) + \varepsilon_i \quad (3.2)$$

Let I($\cdot$) be an indicator function equal to 1 if individual i is in group j, and 0 otherwise. For consistency with the experimental setup, we distinguish between six segments (based on the three age categories and gender) in our empirical models. We constructed interactions between segments and tailoring dummies in line with the cells presented in table 3-1. The groups are based on the six segments (i.e. age $A \in$ {*young, middle, old*} in combination with gender $G \in$ {*male, female*}, and the four tailoring types $T \in$ {*none, age, gender, age and gender*}), which allows us to distinguish 24 groups. β_j is the probability to click through for individuals of a group j. In total, we estimate 24 probabilities— one for each group. ε_i is an error term. Random assignment of the tailored invitations across all age and gender segments enables us to eliminate selection bias (Angrist and Pischke, 2008). This allows us to interpret the difference for each segment between the estimated coefficient on any tailored invitation and the coefficient on the generic invitation as the causal effect of tailoring on pension information behaviour.

Second model: entering the Pensioncheck

We continued our analysis to investigate whether the participant actually logged in and started the Pensioncheck. We estimated the effects of tailoring on the probability to log in to the

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[11] Please note that for all models with a binary dependent variable, we estimated alternative non-linear specifications (probit and logit). The average marginal effects and standard errors are very similar, which explains our choice to present only the estimations of the linear probability model.

Pensioncheck using equation (3.3). The binary dependent variable is $login_i$, which is set to 1 if someone logged into the Pensioncheck and 0 if otherwise.

$$login_i = \sum_{j=1}^{24} \gamma_j \, I(AGT_i = j) + \nu_i \tag{3.3}$$

The 24 groups are based on age (young, middle, old), gender (male, female) and tailoring condition (none, age, gender, age and gender). γ_j is the probability to log in for individuals belonging to group j and ν_i is an error term. We also estimated a specification using conditional probabilities (conditional on having clicked through). That is, we estimated equation (3.3) on a subsample of participants who clicked through (42% of the sample).

Third model: time spent in the Pensioncheck

The final model we estimated is the time (measured in seconds) needed to perform the Pensioncheck. We estimated equation (3.4) using ordinary least squares, with the dependent variable being the logarithm of time. We distinguish between the same age categories and tailoring conditions as in the other models. Due to the small variation for women, we pooled the data across gender, which left us with 12 sub-groups (including the base category). δ_j is the estimated percentage change in the time spent on the Pensioncheck relative to the reference category of middle-aged employees who received the generic email invitation. We included a direct gender effect denoted by α_1.

$$\log(time_i) = \delta_0 + \sum_{j=1}^{11} \delta_j \, I(AT_i = j) + \alpha_1 male_i + \mu_i \tag{3.4}$$

3.5   Results

3.5.1 Tailoring effects

General effects (restricted models). We start our analysis by estimating the restricted models summarised by equation (3.1). Table 3-2 shows the estimated differences in clicking probabilities, login-probabilities and the time spent (in %, due to logarithmic transformation) in the Pensioncheck for the type of tailoring relative to the no-tailoring condition. The first three columns in table 3-2 show the estimated probabilities to click through and to log in to the Pensioncheck relative to the reference category of no-tailoring. The probability to click (column 1) is 4.9 percentage points lower for respondents who received the invitation tailored on age and gender than for respondents who received the generic invitation. Regarding logging in (conditional and not conditional on having clicked) and time spent, we found no differences between the tailored

and non-tailored (generic) versions. We continue our analysis by inspecting tailoring effects within each segment.

Table 3- 2: Estimated tailoring effect on clicking and logging in, and estimated percentage difference in time spent on the Pensioncheck

	Probability of clicking	Probability of logging in	Conditional probability of logging in	Log(time spent logged in)
	Coeff. (SE)	Coeff. (SE)	Coeff. (SE)	Coeff. (SE)
Tailoring: age and gender	-0.049**	-0.013	0.009	0.052
	(0.024)	(0.016)	(0.034)	(0.126)
Tailoring: age	-0.011	-0.018	-0.034	0.049
	(0.024)	(0.015)	(0.032)	(0.112)
Tailoring: gender	-0.029	-0.018	-0.028	-0.121
	(0.024)	(0.015)	(0.033)	(0.128)
Observations	3,286	3,286	1,392	346
R-squared	0.030	0.010	0.013	0.018

Notes: Heteroskedasticity-consistent standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$
Reference category: no-tailoring. Log(time) refers to the logarithm of time (measured in seconds) and the coefficients are percentage shares. We controlled for gender and age in all specifications. In column three, the results were obtained for a subsample of respondents who logged in.

Tailoring effects by segments. Table 3-3 presents the estimated probabilities to click through from the email invitation for each of the six segments based on equation (3.2). Within each segment, we distinguished between the tailoring type that was accorded to each respondent. We also tested for significant differences between the estimated probabilities within each segment. We computed the size of the tailoring effect for the segments for which we detected significant differences. See tables 3A-2 to 3A-6 in the appendix for a detailed overview of the pairwise comparisons within particular segments. The results of the F-tests in table 3-3 show that there are significant differences between the estimated probabilities to click for the segments of young women and middle-aged men. In other words, at least one probability within that particular segment is significantly different from the other probabilities.

Perhaps the greatest hurdle to delving into one's pension information was, for the participants in this experiment, logging into the Pensioncheck environment using the digital identity code. The estimation of equation (3.3) is shown in table 3-4. The segment of middle-aged males is the only segment where at least one estimated probability to log in is significantly different from the other estimated probabilities to log in (*p*-value of the corresponding F-test is 0.080). To be able to compare the results for clicking and login behaviour, we repeated the analysis of login behaviour and estimated probabilities to log in, conditional on having clicked through. That is, we estimate

equation (3.3) on a subsample of participants who clicked through. See table 3-5 for the conditional probabilities. We found significant differences between the probabilities to log in for the senior women segment due to tailoring.

Finally, we look at the effort exerted in the Pensioncheck, measured as time spent in seconds during the longest session in the Pensioncheck. The estimation results of equation (3.4) are presented in table 3-6. As discussed in Section 3.4, due to low numbers of observations for this analysis, we aggregated the segments of men and women. Middle-aged participants who received a generic invitation are the base category who, on average, spent 13 minutes per session in the Pensioncheck. Only within the young age category were there significant differences between the time spent on the Pensioncheck between respondents who received the invitation tailored on age and gender and respondents who received the generic version and the tailored version on gender, respectively. We discuss the findings for every tailoring type separately.

3

Table 3- 3: Estimated probabilities of clicking (n=3,286)

Age group	18-34 years		35-54 years		>55 years	
Gender						
	GA	A	GA	A	GA	A
Male	0.420	0.460	0.321	0.444	0.590	0.599
	(0.059)	(0.063)	(0.026)	(0.029)	(0.048)	(0.041)
	G	None	G	None	G	None
	0.540	0.450	0.439	0.458	0.510	0.632
	(0.058)	(0.055)	(0.028)	(0.030)	(0.042)	(0.043)
$F - stat$ [a)]	0.77		5.52		1.38	
$[p - value]$	[0.512]		[0.001]		[0.246]	
	GA	A	GA	A	GA	A
Female	0.493	0.281	0.335	0.338	0.514	0.541
	(0.059)	(0.056)	(0.032)	(0.033)	(0.082)	(0.073)
	G	None	G	None	G	None
	0.247	0.387	0.345	0.320	0.444	0.523
	(0.048)	(0.062)	(0.034)	(0.032)	(0.0831)	(0.075)
$F - stat$ [a)]	4.00		0.11		0.34	
$[p - value]$	[0.008]		[0.952]		[0.795]	

Notes: Heteroskedasticity-consistent standard errors in parentheses. GA=tailoring on gender and age, A=tailoring on age, G=tailoring on gender, None=no-tailoring.

a) H_0: all estimated probabilities within a segment are equal to each other; analogous H_0 for the remaining segments.

Table 3- 4: Estimated probabilities of logging in (n=3,286)

Age group	18-34 years		35-54 years		>55 years	
Gender						
	GA	A	GA	A	GA	A
Male	0.130	0.079	0.098	0.132	0.171	0.155
	(0.041)	(0.034)	(0.016)	(0.019)	(0.037)	(0.031)
	G	None	G	None	G	None
	0.108	0.171	0.106	0.168	0.131	0.104
	(0.036)	(0.042)	(0.018)	(0.023)	(0.028)	(0.027)
$F-stat$ a)	1.01		2.25		0.78	
[p − value]	[0.385]		[0.080]		[0.505]	
	GA	A	GA	A	GA	A
Female	0.127	0.047	0.059	0.052	0.135	0.042
	(0.039)	(0.027)	(0.016)	(0.015)	(0.056)	(0.029)
	G	None	G	None	G	None
	0.086	0.065	0.071	0.073	0.111	0.023
	(0.031)	(0.031)	(0.018)	(0.018)	(0.053)	(0.023)
$F-stat$ a)	1.02		0.41		1.68	
[p − value]	[0.382]		[0.745]		[0.170]	

Notes: Heteroskedasticity-consistent standard errors in parentheses. Probabilities here are not conditioned on having clicked.
GA=tailoring on gender and age, A=tailoring on age, G=tailoring on gender, None=no-tailoring.
a) H_0: all estimated probabilities within a segment are equal to each other; analogous H_0 for the remaining segments.

Table 3- 5: Estimated probabilities of logging in (conditional on having clicked, n=1,392)

Age group	18-34 years		35-54 years		>55 years	
Gender						
	GA	A	GA	A	GA	A
Male	0.310	0.172	0.305	0.297	0.290	0.259
	(0.086)	(0.071)	(0.045)	(0.040)	(0.058)	(0.048)
	G	None	G	None	G	None
	0.200	0.378	0.241	0.368	0.257	0.165
	(0.064)	(0.080)	(0.037)	(0.044)	(0.051)	(0.042)
$F-stat$ a)	1.62		1.67		1.37	
[p − value]	[0.184]		[0.172]		[0.249]	
	GA	A	GA	A	GA	A
Female	0.257	0.167	0.178	0.155	0.263	0.077
	(0.075)	(0.088)	(0.045)	(0.043)	(0.102)	(0.053)
	G	None	G	None	G	None
	0.350	0.167	0.206	0.227	0.250	0.043
	(0.108)	(0.077)	(0.049)	(0.052)	(0.109)	(0.043)
$F-stat$ a)	0.85		0.44		2.09	
[p − value]	[0.467]		[0.722]		[0.099]	

Notes: Heteroskedasticity-consistent standard errors in parentheses. Probabilities here are conditioned on having clicked.
GA=tailoring on gender and age, A=tailoring on age, G=tailoring on gender, None=no-tailoring.
a) H_0: all estimated probabilities within a segment are equal to each other; analogous H_0 for the remaining segments.

Table 3- 6: Estimated percentage difference in time spent (relative to the base middle generic) on the Pensioncheck (n=346)

Age group	18-34		35-54		55+	
	GA 0.292 (0.169)	A -0.08 (0.267)	GA -0.135 (0.158)	A 0.012 (0.128)	GA -0.287 (0.236)	A -0.271 (0.188)
	G -0.425** (0.215)	None -0.597*** (0.211)	G -0.209 (0.165)	**None (base)**	G -0.237 (0.210)	None -0.034 (0.248)
$F-stat$ [a) $[p-value]$	5.82 [0.0007]		1.05 [0.349]		0.28 [0.837]	

Notes: Heteroskedasticity-corrected standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1 GA=tailoring on gender and age, A=tailoring on age, G=tailoring on gender, none=no-tailoring. We controlled for gender in our model. We obtained the effects presented below by using the logarithmic transformation formula $100\%(exp^{\beta_j}-1))$ where β_j is the estimated coefficient and $exp(\cdot)$ is a general exponential function.

a) H_0: all estimated probabilities within a segment are equal to each other; analogous H_0 for the remaining segments.

Age-tailoring

Concerning the condition of tailoring based on age alone, we found no evidence of a tailoring effect. This implies that there were no differences in clicking and login behaviour or in the time spent in the Pensioncheck between participants who received the invitation tailored on age and participants who received the generic invitation.

Gender-tailoring

We found a negative tailoring effect of tailoring based on gender amounting to 14 percentage points for young females on the probability to click. Furthermore, we found a negative tailoring effect for middle-aged males of 6 (13) percentage points on the probability to log in (conditional on clicking). For senior women, we obtained a positive gender-tailoring effect of 20 percentage points on the conditional probability to login. We did not find a gender-tailoring effect regarding the time spent in the Pensioncheck.

Age- and gender-tailoring

As to the third tailoring type, tailoring on age and gender, we obtained the following results. We found a negative tailoring effect amounting to 13 percentage points on the probability to click for middle-aged males. Considering login behaviour, we found a negative tailoring effect of 7 percentage points for middle-aged males. For senior women, we found a positive tailoring effect of 26 percentage points regarding login behaviour conditional on having clicked through. Lastly, when looking at the time spent in the Pensioncheck, we found a large positive tailoring effect for young respondents: Those with a tailored version spent about 79 percent more time on the Pensioncheck than those who did not receive a tailored invitation.

3.5.2 Gender and age effects

Our results enabled us to compare clicking, login behaviour and the time spent in the Pensioncheck between men and women per age category and across age groups. For this, we compared the estimated coefficients for the generic invitation; that is, we only look at those who did not receive a tailored invitation, across age categories and gender. See tables 3A-7 and 3A-8 for pairwise comparisons across age categories and gender.

Gender effects

For the youngest age group, we found no evidence of a significant difference between men and women regarding the probabilities to click. The same holds for the oldest age group. For the middle-age group, we found a statistically significant difference between men and women: Middle-aged men were more likely to click through than their female counterparts were, by 13 percentage points. Regarding login behaviour (conditional and unconditional on having clicked through), men were consistently more likely to log in than women were— for every age category. The differences amount to around 10 percentage points (15 percentage points, if the probabilities are conditioned on having clicked through). As we pooled our observations for men and women, we cannot make any observations about gender differences in the time spent.

Age effects

Across age groups, older men are more likely to click through than young or middle-aged men. The differences amount to 18 percentage points for young versus old and 17 percentage points for middle-aged versus old. Similarly, women from the 55+ category clicked through (on average) more often than women from the younger and middle-age categories. The percentage-point difference is 13 and 20, respectively.

Regarding login behaviour, middle-aged men were more likely (by 7 percentage points) to log in than men belonging to the senior category. The difference in estimated login probabilities between middle-aged women and 55+ women is around 7 percentage points. Repeating this analysis for login behaviour conditional on having clicked, we find results that are similar— although not in magnitude— to the case with absolute probabilities: Middle-aged women had a 23 percentage-point higher probability to log in than did senior women. Senior men were significantly less likely to log in than were young (21 percentage points) or middle-aged men (20 percentage points). Respondents from the young category who received a generic invitation spent, on average, 45% less time in the Pensioncheck than respondents from the middle category with a generic invitation. There were no significant differences in the time spent in the Pensioncheck between middle-aged and older participants.

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3.6   Conclusion and Discussion

We conducted an experiment amongst employees of an insurance company in order to test whether tailoring affects their decision to gain more information about their pension situation. Employees were sent randomly assigned tailored email invitations encouraging them to perform an online check of their individual pension situation, the Pensioncheck. The invitations were tailored based on age and gender, which resulted in three different tailoring types.

We found no evidence of an age-tailoring effect and predominantly mixed evidence of a gender-tailoring effect and a gender- *and* age-tailoring effect: There was evidence for a negative gender-tailoring effect and a gender- and age-tailoring effect for young females and middle-aged males concerning clicking and login behaviour. Additionally, we found a large positive age- and gender-tailoring effect for young participants regarding the time spent in the Pensioncheck: Young respondents with a tailored invitation spent about 79% more time on it than did young respondents with a generic invitation. In general, we found results in line with Bauer et al. (2017): The control letter proved to be more effective than the tailored invitation letters. On the one hand, by having obtained negative tailoring effects, we can posit that there is some support for a forewarning effect (Kamalski et al., 2008; Petty and Cacioppo, 1979). The participants' intrinsic motivation may have been crowded out by the persuasive intent of the tailored invitations. On the other hand, we also found evidence that tailoring can have a positive effect on the time spent in delving into one's pension situation. We should keep in mind, however, that only one out of four participants logged in to the Pensioncheck after clicking through and that merely a small fraction of the entire sample (6%) completed the Pensioncheck.

We also found interesting results on age- and gender effects on pension information behaviour. Older men and women were most likely to click through, compared to their middle-aged and young counterparts. Those results may indicate that the older generation recognises the urgency of looking into one's pension situation more than the young and middle-aged groups do. This signals the importance of considering carefully how best to reach the young and middle-aged (as they are still facing many important financial decisions) in order to help them realise that, also for them, there is some urgency to act. Another finding was that women consistently logged in less often than men did. This result could be explained by the fact that women might use their digital identification code less often in their daily life than men do— an indication of a certain task division within couples. In a classic scenario, men are more likely to be the household member who usually takes care of financial matters in the household.

We can conclude that tailoring may work in two opposite directions. More experimental evidence— preferably with a different research population and various tailoring approaches— is

needed in order to identify which mechanisms push people away and which pull them towards engaging in their pension situation.

It is up for discussion whether the tailoring approach we applied is strong enough and occurs in the right phase of the pension communication process. Perhaps tailoring in the navigation phase or in the content phase of pension information documents might be more effective. Caution is advisable in bringing across a particular message, for too much persuasion can also have a deterrent effect. Approaching various age groups in a different manner is a step in the right direction, as it provides a clear-cut division that also requires a minimum effort by pension plan providers. Taking life-events into account could be one possible approach— as was done by Blakstad, Brüggen and Post (2017). Differentiation according to gender proved to be more difficult to put into practice, as it was hard to determine how to approach men and women differently and to incorporate gender-based differentiation in the design of the materials. We recognise that alternative ways to implement tailoring into a pension information document could have yielded different results.

It should also be kept in mind that the population we analysed in this study has a higher affinity with financial planning (due to their employment in the insurance sector). Hence, we refrain from generalising our findings to the Dutch population. As already noted, it is crucial to collect experimental evidence for different (and more representative) populations. As well, we should mention that the generic invitation is shorter than the tailored invitations. A valid concern is whether we measured the impact of tailoring or rather the phrasing of the benchmark. It is an utterly challenging task to keep the length of the invitations identical and at the same time to tailor to personal characteristics. We chose to add information in the shape of quotes or certain key sentences in the tailored documents, necessarily increasing their length a bit. Despite the aforementioned shortcomings, we are confident to be the first to have devised and conducted an experiment on tailoring pension communication— an experiment that enables us to identify causal effects, be they restricted to our research population. Segmenting into groups, as was done in Eberhardt et al. (2016), was a first crucial step in finding ways to activate pension plan participants. We set a second step by actually intervening in the information provided and testing those effects.

The challenge for future research is to identify per segment what the optimal approach is to get people to master the technical barriers of obtaining pension information (e.g. to log in) and to spark their interest in the content of the information provided. The importance of the trigger phase in the analysis of pension information behaviour should not be underestimated. Identifying which groups one would like to reach and finding key characteristics in order to define those groups is a good start. The next step should include formulating more specific aims per group rather than pursuing the goal of informing everyone uniformly about their pension situation. When trying to

realize those aims in the development of, for instance, the navigation structure of a website, or the content of information materials, insights gleaned from other sectors and fields (think of the tourism sector and marketing strategies) can be of tremendous value. Taking account of other personal and behavioural characteristics than age and gender can enrich the understanding of what drives people toward or deters them from deepening their knowledge of their own pension situation. Future research could, for instance, be directed at eliciting attitudes and preferences about (pension) information and saving behaviour. The extent to which people value future consumption relative to present consumption, or the extent to which people appreciate complete or concise information, could be alternative key variables that go beyond common key characteristics. If we can identify individuals who prefer the short term over the long term, we may be able to target them in such a way that their long-term mind-set is activated.

Recent developments that can be observed around the use of Big Data may also be pertinent for future research on tailoring pension communication. Discovering patterns in browsing behaviour and social media activity of customers creates opportunities for companies to offer products that they deem to be more suitable for their customers. This development may also have (as yet undiscovered) benefits for non-commercial research on consumer behaviour. A paper that has been the main output of the Netspar Pension Innovation Programme 2015-2016 (Bode, Gijsen, van Ewijk, & van de Grootevheen, 2016) calls for pension plan providers to reap the benefits of the rise of Big Data (a recommendation that is accompanied by a word of caution). The authors, observing that insights from Big Data are already being used in the insurance sector, envisage opportunities for the pension sector to benefit from the availability of Big Data. Pension plan providers could then collect data on risk attitudes and the financial situation of their clients and use these to tailor pension information to the needs of their clients while complying with their duty of care.

Acknowledgements

Appendices

A. Tailoring based on age and gender (quotes)

The table below provides the names and corresponding ages that were displayed underneath each quote as a means of tailoring based on gender.

Table 3A- 1: Name and age beneath every quote, per version

Version		Name and age beneath quote
version 1	tailoring man	Peter Mulder
version 2	tailoring woman	Iris Mulder
version 3	no-tailoring	Robin Mulder
version 4	tailoring gender and age: young M	Mark Mulder (27 yrs)
version 5	tailoring gender and age: young F	Sanne Mulder (27 yrs)
version 6	tailoring age: young	Robin Mulder (27 yrs)
version 7	tailoring gender and age: middle M	Peter Mulder (43 yrs)
version 8	tailoring gender and age: middle F	Sandra Mulder (43 yrs)
version 9	tailoring age: middle	Robin Mulder (43 yrs)
version 10	tailoring gender and age: old M	Jan Mulder (58 yrs)
version 11	tailoring gender and age: old F	Yvonne Mulder (58 yrs)
version 12	tailoring age: old	Robin Mulder (58 yrs)

B. Examples mailing versions – tailored content is underlined

Version tailoring on gender and age: young age group, female

[Quote: Bovenin het bericht staat een quote:]

"Ik vroeg me af of het wel nodig is om op mijn leeftijd al met mijn pensioensituatie bezig te zijn. Toch ben ik blij dat ik de PensioenCheck gedaan heb. Wat fijn om nu overzicht te hebben! Ik heb nu een idee waar ik aan toe ben…"

Sanne Mulder (27 jaar)

Beste <VOORNAAM>,

Steeds meer mensen willen weten of ze op schema liggen met hun pensioen. Dat kun jij nu ook. Je pensioen voelt waarschijnlijk nog erg ver weg, maar kijk toch alvast eens hoe je ervoor staat. Het is prettig om overzicht te hebben! Sinds kort heeft xxx de PensioenCheck, een handige tool die snel een beeld geeft van je persoonlijke pensioensituatie.

De PensioenCheck geeft je in een paar eenvoudige stappen antwoord op drie vragen: hoeveel inkomen heb je nodig om later prettig te kunnen leven op de manier die jij wilt? Lig je nu goed op koers om dat gewenste inkomen te bereiken? En wat zijn jouw mogelijkheden wanneer dat niet zo is? Als je maatregelen neemt nu je nog jong bent, leveren ze het meeste op.

Neem even tien minuten de tijd om je situatie te bekijken. Je logt in met je DigiD, zodat je in een veilige omgeving je persoonlijke situatie kunt bekijken. Houd je DigiD inloggegevens dus bij de hand.

<Ga naar de PensioenCheck van xxx>

Met vriendelijke groet,

XYZ

directeur Pensioenen

[*Pay off*

Onderaan de mailing staat een generieke pay off zin:]

Pensioen, we werken er gemiddeld een dag per week voor!

Version no-tailoring

[*Quote*:]

"Ik ben blij dat ik de PensioenCheck gedaan heb. Wat fijn om nu overzicht te hebben! Ik heb nu een idee waar ik aan toe ben…"

Robin Mulder

Beste <VOORNAAM>,

Steeds meer mensen willen weten of ze op schema liggen met hun pensioen. Dat kun jij nu ook. Sinds kort heeft xxx de PensioenCheck, een handige tool die snel een beeld geeft van je persoonlijke pensioensituatie.

De PensioenCheck geeft je in een paar eenvoudige stappen antwoord op drie vragen: hoeveel inkomen heb je nodig om later prettig te kunnen leven op de manier die jij wilt? Lig je nu goed op koers om dat gewenste inkomen te bereiken? En wat zijn jouw mogelijkheden wanneer dat niet zo is?

Neem even tien minuten de tijd om je situatie te bekijken. Je logt in met je DigiD, zodat je in een veilige omgeving je persoonlijke situatie kunt bekijken. Houd je DigiD inloggegevens dus bij de hand.

> <Ga naar de PensioenCheck van xxx>

Met vriendelijke groet,

XYZ

directeur Pensioenen

[*Pay off*

Onderaan de mailing staat een generieke pay off zin:]

Pensioen, we werken er gemiddeld een dag per week voor!

C. Pairwise comparisons supplementing the estimation results

Table 3A- 2: Pairwise comparisons of the probabilities to click within the young females segment (F-statistic and p-value between brackets)

	tailoring gender and age	tailoring age	tailoring gender	no-tailoring
tailoring gender and age	--	6.662 (0.010)	10.333 (0.001)	1.514 (0.219)
tailoring age		--	0.215 (0.643)	1.592 (0.207)
tailoring gender			--	3.186 (0.074)
no-tailoring				--

Table 3A- 3: Pairwise comparisons of the probabilities to click within the middle-aged males segment (F-statistic and p-value between brackets)

	tailoring gender and age	tailoring age	tailoring gender	no-tailoring
tailoring gender and age	--	9.984 (0.002)	9.493 (0.002)	11.784 (0.001)
tailoring age		--	0.902 (0.643)	1.592 (0.742)
tailoring gender			--	0.206 (0.650)
no-tailoring				--

Table 3A- 4: Pairwise comparisons of the probabilities to log in within the middle-aged males segment (F-statistic and p-value between brackets)

	tailoring gender and age	tailoring age	tailoring gender	no-tailoring
tailoring gender and age	--	1.777 (0.183)	0.108 (0.742)	6.325 (0.012)
tailoring age		--	1.002 (0.317)	1.450 (0.230)
tailoring gender			--	4.785 (0.029)
no-tailoring				--

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Table 3A- 5: Pairwise comparisons of the probabilities to log in (conditional on clicking through) within the senior females segment (F-statistic and p-value between brackets)

	tailoring gender and age	tailoring age	tailoring gender	no-tailoring
tailoring gender and age	--	2.635 (0.105)	0.008 (0.930)	3.948 (0.047)
tailoring age		--	0.154 (0.317)	0.242 (0.623)
tailoring gender			--	3.099 (0.079)
no-tailoring				--

Table 3A- 6: Pairwise comparisons of the percentage time spent in the Pensioncheck within the young segment (F-statistic and p-value between brackets)

	tailoring gender and age	tailoring age	tailoring gender	no-tailoring
tailoring gender and age	--	1.656 (0.199)	9.000 (0.003)	14.230 (0.0002)
tailoring age		--	1.168 (0.281)	2.710 (0.101)
tailoring gender			--	0.404 (0.525)
no-tailoring				--

Table 3A- 7: Pairwise comparisons across age categories (F-statistic and p-value between brackets) by gender

		men			women		
		young	middle	senior	young	middle	senior
Panel A	young	--	0.011 (0.916)	6.648 (0.010)	--	0.905 (0.342)	1.923 (0.166)
	middle		--	10.866 (0.001)		--	6.042 (0.014)
Panel B	young	--	0.002 (0.963)	1.788 (0.181)	--	0.053 (0.819)	1.173 (0.279)
	middle		--	3.281 (0.070)		--	2.992 (0.084)
Panel C	young	--	0.013 (0.910)	5.549 (0.019)	--	0.427 (0.513)	1.964 (0.161)
	middle		--	11.296 (0.001)		--	7.428 (0.010)

Note: Panel A: clicking behaviour; Panel B: login behaviour (unconditional); Panel C: login behaviour (conditional on clicking)

Table 3A- 8: Pairwise comparisons across gender by age categories (F-statistic and p-value between brackets)

		young	middle	senior
Panel A: clicking	F-test	0.596	9.543	1.574
	p-value	(0.440)	(0.002)	(0.210)
Panel B: login	F-test	4.148	10.807	5.245
	p-value	(0.042)	(0.001)	(0.022)
Panel C: login (conditional)	F-test	3.627	4.304	4.060
	p-value	(0.057)	(0.038)	(0.044)

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Chapter 4: The effect of tailoring pension information on navigation behaviour[12]

4

Abstract

In this study, we analysed whether tailoring the general structure of pension information on the basis of age affects the navigation behaviour of participants. We conducted a randomized control experiment (RCE) among 8,563 employees of several firms, who were enrolled in a new company pension scheme. Participants were sent a generic invitation email to log into the digital pension environment (DPE) and were subsequently randomly assigned tailored versions of digital pension information, based on their age. The effect of tailoring on the participants' navigation behaviour was analysed on the time spent in the DPE and clicking on relevant pension information. Tailoring of the DPE was based on selected goals that were relevant for the separate age groups. Five percent of the participants logged into the DPE. We found no tailoring effect for young participants regarding the goal of knowing how their pension is arranged. Concerning the goal of knowing whether one is on track, tailoring the structure of the pension document was effective in distracting young participants from clicking on information not relevant to them and in motivating senior participants to click on relevant information. As for the goal of awareness of the choices available, we found that tailoring worked for senior participants as they clicked more on relevant pension information.

4.1   Introduction

During the past several decades, the ease of access to any type of information through computers, but also through tablets and mobile phones, has increased tremendously. Organizations that provide financial services face the challenge of providing accurate information to their customers and at the same time limiting the costs that arise with it. These organizations also need to comply with legal requirements regarding the transparency and intelligibility of the information transmitted to their customers. These obligations are set out in the Pension Communications Act (Wet pensioencommunicatie) that was enacted by the Dutch parliament in 2015. An unintended consequence of the disclosure that was mandated by this law is information overload, which hampers consumers in making optimal financial decisions (Iselin, 1988; Lee & Lee, 2004)[13]. A side effect of being confronted with a large volume of information is that consumers feel swamped and less motivated to process all this pension information in their minds.

An additional problem caused by information overload is that of accumulation (Ben-Shahar & Schneider, 2011). In their rather extensive critique on mandated disclosure[14], Ben-Shahar and

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[12] A slightly modified version of this chapter has been published as a TKI Discussion Paper (No. 19-15) and a Netspar Design Paper No. 118 with the title "The effect of tailoring pension information on navigation behaviour" (joint with Adriaan Kalwij and Rob Alessie).

[13] See Eppler and Mengis (2004) for an overview of the literature on information overload from various domains, including organization science, marketing, and accounting.

[14] According to Ben-Shahar and Schneider (2010), mandated disclosure is a regulatory technique that requires "the discloser" to provide "the disclosee" with information, which the latter can use to make informed decisions.

Schneider argue that "in disclosees' lives, each disclosure competes for their time and attention with other disclosures […] and with everything they do besides collecting information and making decisions" (p. 689). This causes disclosees to give up and not read (or not proficiently) all the disclosures. Consequently, the challenge for researchers and ultimately policymakers and pension organizations is to figure out how to rescue these drowning consumers and to motivate them to find their way through the ocean of pension information. In a review of the communication activities of pension organizations in a changed regulatory environment, Nell (2017) concludes that "the functions the [Dutch] government has established for pension communication are inaccurately formulated", which in turn results in information overload by communication designers (chapter 6, p. 133). According to Nell (2017), communication designers generally prefer to "play it safe" (p. 168) and to provide more information than mandatory in order to ensure that they comply with the pension communication requirements of the Dutch government. Hence, the pension sector creates information overload, which makes it necessary to examine how pension communication can be made more effective.

In their study on comprehension of pension communication, Lentz, Nell, and Pander Maat (2017) found that pension organizations considered the obligations imposed by the Pension Communications Act an impediment to effective pension communication. In the second chapter of her dissertation on how organizations deal with communication regulations, Nell (2017) identified three strategies that pension organizations apply in response to the Pension Communications Act[15]. First, pension organizations comply with legislation without any additional actions. Second, they focus on optimizing the legally required media. Third, they optimize additional media. Such additional media include online pension information that can be accessed on the website of the pension provider, often in combination with audio and/or video elements. The majority of financial institutions and organizations find that mandatory information such as the Annual Pension Statement and the website Pensioen 1-2-3[16] are not sufficient to inform their clients. Consequently, pension organizations look for alternative ways to convey information to them. This leads to the circulation of information through many different channels: postal mail, emails, website texts, and videos that can be accessed on any smart device. In this study, we tested the effectiveness of digital pension documents that fall in the category of additional media.

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[15] For an overview of the Dutch pension system and especially the institutional context of pension information, we recommend the introductory chapter of Nell (2017).

[16] Pensioen 1-2-3 is a website that provides layered information on the most important elements of a personal pension scheme.

We sought answers to the following research question: What is the effect on navigation behaviour of tailoring the structure of pension information? Together with an insurance company, we changed the structure of a digital pension document that introduces new pension plan participants to their employees' pension fund, one that belongs to the second pillar of the Dutch pension system. Being a new pension fund participant can mean of two things: Either an individual has started in a new job and is automatically enrolled in the new pension fund, or an individual was already working at a company which has entered into a new agreement with a pension plan provider (i.e. the insurance company that collaborated with us for this study).

We differentiated consumers on the basis of their age and manipulated the general structure of the pension document accordingly. We defined goals that should receive the highest prominence per age group and then designed different versions of pension documents that reflect those goals, plus a generic version of the pension document containing basic information. Within each age group, we randomly assigned a pension document with either a tailored or a generic structure. Hershey, Jacobs-Lawson, and Neukam (2002) found that there were age and gender differences in workers' goals for retirement. This is partially explained by differences in time preference, depending on which stage of the life-cycle people find themselves in. The propensity to plan is assumedly low for young people and increases with age. Eberhardt et al. (2016) integrated demographics such as age and gender into the conceptual model that they developed, in order to explain the participants' intention to learn more about their pension situation. Age as a key variable has been used before in research on tailoring information: See Lustria et al. (2009) for tailoring on the basis of health information needs or Etter (2005) and Cobb et al. (2005) on programs to stop smoking. To measure whether participants delved into the information that was relevant to them, we focused on who logged into the pension environment, how much time they spent going through the pension document, and, most importantly, whether participants clicked on content that was related to the age-specific goals.

The importance of effective pension communication has also been motivated from a behavioural economics perspective. Individuals appear to have time-inconsistent preferences when it comes to retirement planning (O'Donoghue & Rabin, 1999b) as they are faced with costs now and benefits in the future. Consequently, they procrastinate and postpone saving for retirement. Offering them effective pension communication can act as a commitment device in order to motivate them to start or continue planning for retirement, regardless of the life phase that they are in.

To understand the path to effective digital pension communication, we distinguish three phases that are at the heart of providing pension information: the trigger phase, the navigation phase, and the content phase[17].

This study is directed at the effect of manipulating pension information in the navigation phase, with particular focus on the general structure of pension information and on the design and presentation of choices. In a review article on financial literacy and preparing for retirement, Prast and Van Soest (2016) recognize that choice architecture plays a crucial role in improving the decision-making by consumers regarding their pension. Manipulation in the navigation phase may concern the restructuring of content in order to give prominence to particular topics by changing the order and rank (main or subordinate position within the information document) of the information provided.

With this study, we provide several contributions to research on the effectiveness of pension communication. First, we contribute to the scarce literature on tailoring of pension communication by designing and conducting an experiment that measures real behaviour. Second, we provide a framework of three communication phases that we embedded our study in. Third, we combine methods adapted from communication science and linguistics to answer a question that is relevant for researchers from multiple disciplines – economists, psychologists, and communication scientists who are interested in investigating how people can be motivated to actively engage in financial planning.

This chapter is organized as follows: In Section 4.2, we describe the experimental design. Sections 4.3 and 4.4 deal with the descriptive statistics and the estimation strategy respectively. Section 4.5 presents the estimation results. Section 4.6 contains the conclusion and a discussion of the results.

4.2 Experimental Design

The experiment

The research population consisted of employees of companies that entered into a new employees' pension plan with an insurance company between January and May 2017. Employees who enrolled

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[17] In the trigger phase, the pension plan provider contacts customers by mail or email, providing information about the different tools and websites available to become better informed about one's pension situation. Alternative triggers can be brochures, short videos, or even postcards. In a previous study (Dinkova, Elling, Kalwij, & Lentz, 2018a, see also Chapter 3), we analysed the effect of tailoring in the trigger phase on pension information behaviour and found that a generic email invitation to be more effective than a tailored invitation. Another relevant study about pension communication in the trigger phase was conducted by Bauer, Eberhardt, and Smeets (2017). They investigated the impact of using social norms and financial incentives to trigger pension plan participants to seek information about their pension situation. The effect of tailoring pension information in the content phase has not been subjected to empirical research as yet.

into this pension plan during this period received an email invitation to log into the online environment of the insurer and to explore pension information that provided them with useful information about their pension situation. Following Dinkova et al. (2018), we defined three age categories that differ in terms of urgency to save for retirement: young participants (18-34 years old), middle-aged participants (35-54 years), and senior participants (55 years and older). Employees belonging to the youngest age group are in the early phase of their working career and are typically concerned with other personal investments than their pension. The middle group has more working experience and has already accumulated savings to settle down and to start saving for retirement more actively. The senior age category is a heterogeneous group comprised of individuals who still have a number of working years left – and also opportunities to save for retirement – and individuals who are close to retirement.

We developed four different versions of the pension information document (three for each age category plus a generic version). Each version consisted of several pages. Each page contained dropdown menus with short titles on each page that, when clicked on, revealed more detailed information on selected subjects. For instance, the version for young participants included, for example, a page with the title *Pension in five minutes*, containing information on how their pension is arranged, when action must be taken, and which choices are available. On the other hand, the generic version included a page with the title *Good to know*, including the above information plus information on whether a participant is on track for retirement, which the pension plan provider communicates online. A more detailed overview of the structure of the pension documents is presented in the Appendix (boxes A1 and A2). We randomly assigned half of the employees to tailored pension information and the other half to the generic information.

Goals per age category

We identified different goals for each age category. We formulated the goals together with pension communication experts of the insurance company. See Table 4-1 for an overview of the goals per age group. The goals reflect what the insurer deemed most important for each age group. We do not claim that these goals would apply to the entire pension sector. Note that there is not necessarily just one goal per age group.

Young participants should especially realize that their pension scheme is an important employee benefit and know how their pension is organized. The goals for the middle-age category are threefold: First, to be aware of their pension situation and especially to know whether they are on track relative to people of the same age; Second, to be aware of the possibilities for enriching their portfolio if necessary; And third, to know what to do considering different life events such as divorce, occupational disability, or death. Senior participants, in turn, should know how much

future pension income they have accrued. Furthermore, it is important for them to be aware of the choices that could still be made, especially with regard to the partner's pension and survivor's pension.

Table 4- 1: Goals per type of pension information document

Age category			
Young	Middle	Senior	Generic
Know how their pension is arranged	Be aware of their pension situation and to know whether they are on track (relative to people in a similar situation)	Know how much future pension income they (and possibly their partner) have accrued	Receive basic information on pension situation
Realize that pension plan membership is an important fringe benefit	Be aware of the possibilities to enrich their portfolio if needed	Be aware of the choices that can still be made and to be able to decide	To be informed about the possible choices and when action is required
	Know what to do considering different life events (e.g. divorce, working disability)	Convey the feeling of support by the insurer*	

Note that we did not specify goals for the generic version. The goal for the senior category marked * is an implicit goal that we did not explicitly measure.

Operationalization of the goals

Having outlined the goals of pension information for each age group, we move on to creating a hierarchy for the goals across age groups. This hierarchy identifies which goals are measured and how and then helps in constructing measures to evaluate the effectiveness of tailoring the navigation structure of the pension documents. We limited the number of goals to three since not all goals could be applied when tailoring the structure of the pension documents. This left us with the following goals for pension plan participants: 1) knowing how their pension is structured, 2) knowing whether they are on track with saving for retirement, and 3) their awareness of the choices available within their pension arrangement. Table 4-2 provides an overview of the three main goals per pension document and their operationalization in the related pension information document. The most prominent goal for the age group consisting of younger people is to know how their pension is arranged. For the middle age group, the most prominent goal is knowing whether participants are on track with saving for retirement, plus the goal of being aware of the choices available within the pension arrangement. For the senior age group, the above goals are very important. For the middle age group, we changed the navigation structure in a subtler way than for the senior age group regarding the goals of *being aware of the choices available* and whether *one is on*

track. This results in different levels of prominence of the goals for the middle age group (*medium*) and the senior age group (*high*).

We tailored at three levels, with level 1 corresponding to a high prominence of the goals and level 3 to low prominence. Tailoring at level 1 implies that the goal is displayed as a page title, which stays visible during the entire time while the participant goes through the pension document. In this way, the goal received high prominence since the entire document page contains information that is dedicated to this goal. Tailoring at level 2 implies that the goal is addressed in the title of the dropdown menus on each page of the pension document. This information is only visible when the participant views the respective page of the pension document. Lastly, tailoring at level 3 implies that the goal receives relatively low prominence on the final page of the pension document. Here, participants are redirected to online content with more specific information or other pension tools such as Pensioncheck and Pensioen 1-2-3. The Pensioncheck is an online tool that enables participants to check whether they have accrued enough pension income for their old age. As mentioned in the introduction, Pensioen 1-2-3 is a legally mandated document that includes layered pension information.

Consider, for instance, the group of young participants, whose most important goal is knowing how their pension is structured. The pension document has an entire page dedicated to how their pension is arranged, with additional information at level 1. Consider now the tailored version for the middle and senior age groups. Information about how the pension is structured can be found on the final page of the pension document (level 3). For the generic version, knowing one's pension arrangement is of medium importance at level 2, by dedicating a part of a page (title and content of dropdown menu) to this goal. See Figure 1 for a schematic illustration of the operationalization of the various levels.

Table 4- 2: Prominence of goals per type of pension information (scale: high, medium, low)

	Prominence (by age category)			
Goal	Young	Middle	Senior	Generic
Know how the pension is structured	high	low	low	medium
Operationalization	*Level 1*	*Level 3*	*Level 3*	*Level 2*
Know whether on track with saving for retirement	low	medium	high	medium
Operationalization	*Level 3*	*Level 2*	*Level 1*	*Level 2*
Be aware of the choices available within pension arrangement	medium	medium	high	medium
Operationalization	*Level 2*	*Level 2*	*Level 1*	*Level 2*

Notes: Level 1 refers to page title (visible all the time to participants), level 2 refers to title of dropdown menus (only visible if at respective page), and level 3 refers to the final page, where participants are redirected to content with more specific information and other pension tools.
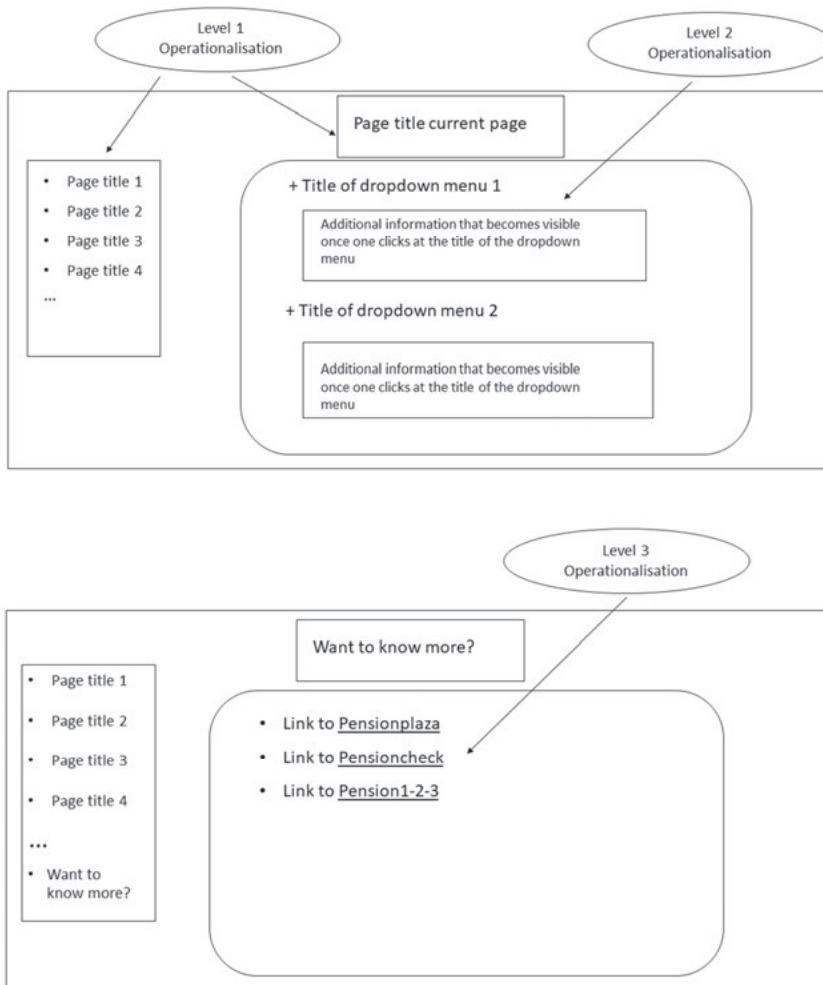
Figure 4- 1: Schematic overview of the operationalization of the goals

Note: The bottom of the figure describes the operationalization at the third level on the very last page of the pension document, which carries the title "Want to know more?" in each version.

4.3   Data description

In total, 8,563 participants from 345 companies received an invitation to log into the digital environment of their pension plan provider and to explore the information about their pension situation. All of these participants were employees who were recently enrolled in the employees' pension plan of the insurer. We collected data on gender, age, marital status, and employer for

every participant. About 5% (447 participants from 133 companies) logged into the digital pension environment (DPE). This is the group of participants whose navigation behaviour we analysed. In Table 4-3 the login behaviour to the DPE is presented for each of the six segments. The distribution of participants who logged in is roughly the same across all segments. This does not come as a surprise as we did not tailor the invitation to log into the DPE. Furthermore, we observed that the middle segments are better represented in our sample relative to the young and senior segments. Comparing the subsamples of who logged in and who did not across other known key characteristics, such as gender and marital status, can give us more information on whether the individuals who logged in are a representative subsample.

Table 4- 3: Behaviour of login to the Digital Pension Environment (DPE) across segments (percentages in parentheses)

4

Segment	Obs.	Logged in to DPE
Young generic	1,068	48 (4.49)
Young tailored	1,118	60 (5.37)
Middle generic	2,420	127 (5.25)
Middle tailored	2,566	132 (5.14)
Old generic	682	43 (6.30)
Old tailored	709	37 (5.22)
Total	8,563	447 (5.22)

Demographics and time spent during the login

In Table 4-4, we present the means for the demographics (gender, age, marital status) and several indicators of overall activity in the DPE. The average age of participants was 43 years. Of the participants who had logged in to the DPE, 75% were male, while of individuals who did not log in, 72% were male. Typically, participants who logged in were married or lived with a registered partner (55%). Participants spent an average of 15 minutes in the DPE during their longest session.

The means for age and gender did not differ significantly between the participants who logged in and the participants who did not. Nevertheless, we should be careful when interpreting the results from the experiment. As Table 4-4 shows, we do not have convincing evidence that the subsample of participants who logged into the DPE is representative of the entire research population since unobserved heterogeneity (the motivation that drove people to log in) cannot be accounted for.

Table 4- 4: Mean values of demographics and time spent for subsamples of participants who logged into the Digital Pension Environment and participants who did not log in

	Logged in?		
Variable	Yes	No	$\Pr(|T|>|t|)^a$
Male (%)	75.17	72.20	0.172
Age of participants (in years)	43.30	43.02	0.593
Singles (%)	36.91	44.44	0.002
Married/registered partners (%)	54.59	50.25	0.074
Cohabiting (%)	8.50	4.99	0.001
Unknown (%)	0.00	0.32	0.231
Total time (in minutes, all sessions)	24.45		
Time spent behind login (in minutes, longest session)	15.00		
Total number of actions in pension document	14.16		
Ratio number of actions per minute	1.59		
Number of observations	447	8,116	

Note: [a] $\Pr(|T| > |t|)$ returns the p-value of a two-sided t-test comparing means testing the zero hypothesis H_0: $\mu_{Yes} = \mu_{No}$ where μ_{Yes} and μ_{No} are the population means of the group that logged into the DPE and of the group that did not log in, respectively.

We were able to track the total time spent (in seconds) each time that participants visited the pension information. This includes the time they spent going through the pension information, but also the time to follow the links to additional information and tools that were provided in the pension information document. To better understand the overall activity of participants during the experiment, we considered the longest session. The majority of participants who logged in had a maximum of four sessions (90%), with an average of two sessions. Note that even with multiple logins, participants were assigned the same version of the pension document. We can only speculate about the reasons for multiple logins: It might be that respondents were distracted during the first session and wanted to take their time looking at the pension information provided.

We furthermore tracked which pages the participants visited, and also which dropdown menus they clicked on. We have added up this information as the total number of actions. To create a proxy for the intensity of activity, we calculated the ratio of number of events per minute by dividing the total number of actions behind the login by the total time (in minutes) spent behind the login: The higher the ratio, the higher the intensity of activity while logged in.

4.4   Estimation procedure

Logging in

First, we looked at the determinants of logging into the online environment of the pension insurer using the personal DigiD code. With the DigiD, Dutch residents gain access to Dutch government websites. This enables them, for instance, to complete and file their income tax return, to apply

for benefits and allowances, and to check their accrued pension on an online basis. Analysis of login behaviour serves mainly as a check since we did not tailor the trigger (the invitation) but the pension document that could be accessed after being logged in. We used a linear probability model to estimate the probability of login – see equation (4.1), where $login_i$ is a binary dependent variable equal to 1 if an individual has logged into the digital environment and 0 if otherwise. Let $I(\cdot)$ be an indicator function equal to 1 if individual i belonged to group j and 0 if otherwise. We have three age categories, age $A \in \{young,\ middle,\ senior\}$, and two types of versions $T \in \{tailored,\ generic\}$ resulting in six groups.

$$login_i = \beta_0 + \sum_{j=1}^{5} \beta_j\, I(AT_i = j) + \delta' Z_i + \varepsilon_i\,, \tag{4.1}$$

4

β_j is the difference in the probability of login between individuals i of a group j and those in the reference group (or base), which we set at middle-aged individuals who received a tailored pension document, once controlled for gender and marital status (included in Z).

Explorative analysis and navigation behaviour

The remainder of our empirical analysis focused on the subsample of participants who logged in. To measure online activity of the participants and their navigation behaviour, we selected three dependent variables, namely the time spent in the digital pension environment (DPE), the intensity of the overall activity in the DPE (clicks per minute), and the clicking activity relating to navigation behaviour, in other words, whether participants clicked at goal-related content. The models that we estimated are summarized by equation (4.2) with NB_i being a catch-all term for the above dependent variables. Table 4-5 provides a detailed overview of how the three dependent variables that measure navigation behaviour are constructed.

$$NB_i = \beta_0 + \sum_{j=1}^{5} \beta_j\, I(AT_i = j) + \delta' Z_i + \varepsilon_i\,, \tag{4.2}$$

For the first two specifications, β_j is the difference in the effect of tailoring on the time spent (or on activity) in the DPE relative to the reference group of middle-aged participants, who were assigned a tailored version of the pension document. For the three dependent variables referring to navigation behaviour, β_j is the difference in the probability of clicking on goal-related content for individuals i of a group j and those in the reference group. Z includes gender and marital status.

Table 4- 5: Construction of the variables that measure navigation behaviour

Dependent variable*	Measures what?	Constructed how?
Arrangement	Whether participant clicked on content related to goal 1 from Table 4-1 (most relevant for young group)	Binary: = 1 if participant clicked on "How is your pension arranged" or on the link to Pensioen 1-2-3; = 0 if otherwise
On track	Whether participant clicked on content related to goal 3 from Table 4-1 (most relevant for middle and senior groups)	Binary: = 1 if participant clicked on "Are you on track for retirement?" or on the link to the Pensioncheck; = 0 if otherwise
Choices	Whether participant clicked on content related to goal 2 from Table 4-1 (most relevant for middle and senior groups)	Binary: = 1 if participant clicked on "Which choices do you have?" or "Choices to make when you retire" or "Which additional choices do you have?"; = 0 if otherwise

Note: * NB is a placeholder for all dependent variables in equation (4.2). The text between the quotation marks is clickable content (page headings and titles of dropdown menus) in the different versions of the pension documents. For more details, refer to boxes A1 and A2 in the Appendix.

4.5   Empirical Results

4.5.1 Explorative analysis: navigation behaviour

Table 4-6 provides an overview of navigation behaviour measured by the three dependent variables, as described in the methodology section. The percentage of young participants who clicked on goal-related content about their pension arrangement is the highest of the three age groups. As expected, young participants were the most active group when it comes to learning more about their pension arrangement. However, we could not detect significant differences in clicking behaviour between young participants regarding the generic and tailored versions. Additionally, we observed that on average, the percentage of middle-aged participants with a generic version of the pension document in clicking on content about their pension arrangement was higher than the percentage of these participants with a tailored version.

As to the second goal, that of being on track, we found significant differences in navigation behaviour between participants with a generic version and those with a tailored version for the young and senior age groups. For the young group, the percentage of goal-related clicks was significantly higher for participants with a generic version. For the senior group, the percentage of goal-related clicks was significantly higher for participants with a tailored version. These observations are in line with our intentions for designing the pension documents.

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Table 4- 6: Navigation behaviour: percentage clicking on goal-related content per goal by age category

Goals		How arranged (%)	On track (%)	Choices (%)
Age category	Version pension document			
Young (18-34 years)				
	generic	64.58	**54.17**	45.83
	tailored	66.67	**20.00**	35.00
	H₀: $\mu_G = \mu_T$ (p-values)[a]	0.823	**0.000**	0.257
Middle (35-54 years)				
	generic	**59.06**	52.76	**33.86**
	tailored	**47.73**	55.30	**18.94**
	H₀: $\mu_G = \mu_T$ (p-values)	**0.068**	0.682	**0.006**
Senior (55+ years)				
	generic	53.49	**62.79**	**34.88**
	tailored	45.95	**91.89**	**89.19**
	H₀: $\mu_G = \mu_T$ (p-values)	0.507	**0.002**	**0.000**
Total				
	generic	59.17	36.70	55.05
	tailored	52.40	34.50	51.97
	H₀: $\mu_G = \mu_T$ (p-values)	0.150	0.515	0.628

Note: G and T refer to generic and tailored versions of the pension document respectively.
[a] The reported p-values correspond to testing this null hypothesis against a two-sided alternative, where μ_G and μ_T are the population means of the group with generic and tailored versions respectively. Statistically significant differences are in bold

For the third goal— being aware of the choices available— we detected differences in navigation behaviour for the middle-aged and senior participants. Middle-aged participants with a generic version clicked more often at goal-related content than middle-aged participants with a tailored one— an activity we did not expect. As expected, the share of senior participants with a tailored version who clicked on goal-related content was significantly higher than the share of senior participants with a generic one.

4.5.2 Estimation results of login, intensity, and navigation behaviour

Estimation results are reported in Table 4-7. The tailoring effects obtained in Table 4-7 are summarized in Table 4-8. Note that all results on time spent and navigation behaviour in the DPE are conditional on having logged in. Essentially, the regression results confirm the correlation analysis conducted in Table 4-6 about navigation behaviour.

Logging in

The first column of Table 4-7 presents the estimates of the probability of logging in; this is the only specification that takes the gross sample into account. We did not find differences in login

behaviour between participants of all age groups, no matter which pension document version they were assigned. This is as expected, for the invitation to log in to access the insurer's online environment was identical for all age groups. Married and cohabiting participants were more likely to log in than single participants.

Time spent and ratio events/time

Table 4-7 shows no evidence of a tailoring effect for the total time (in minutes) spent going through the assigned pension information. Married and cohabiting participants spent significantly more time (but less intensively) in the DPE than their single counterparts. Middle-aged participants with a tailored version were less active (0.45 events/minute) than middle-aged participants with a generic version. Being less active implies that the navigation structure was more efficient in the tailored version and that participants could go through the pension information with less effort.

Navigation behaviour

Table 4-8 shows that, as to the first goal of knowing how their pension is arranged, middle-aged participants with a generic version clicked more often on goal-related content than those with a tailored version. We estimated a negative coefficient of 12 percentage points. This result is in line with our expectations, as the pension document with the tailored structure was intended to induce young participants to focus on how their pension is arranged and to induce middle-aged and senior participants to explore the choices available and whether they were on track. Contrary to what we expected, we did not find significant differences in clicking on information about pension arrangements for young participants with a generic or tailored version. One explanation could be that young people do not realize the importance of having a pension and therefore do not examine how their pension is arranged.

For the second goal, that of knowing whether one is on track with saving for retirement, we estimated a negative coefficient of 35 percentage points for young participants. This was as intended by our design of the pension document, as we wanted to induce young participants to focus on how their pension was arranged rather than on whether they were on track. For senior participants, we found a positive coefficient, implying that they were 38 percentage points more likely to click on pension information about being on track when receiving the pension document with the tailored structure relative to the generic version. This result was also in line with our design intentions, as being on track was considered a primary goal for the senior group.

As for the third goal, being aware of choices regarding the pension plan, we found that middle-aged participants with a generic version clicked more often (14 percentage points) on goal-related

Table 4- 7: Estimation results for logging in and navigation behaviour concerning goal-related content

	(1)	(2)	(3)	(4)	(5)	(6)
	Probability of logging in	Log(time)	Events per minute	Probability of clicking on goal 1 information	Probability of clicking on goal 2 information	Probability of clicking on goal 3 information
Young generic	-0.002	0.069	0.065	0.076	0.027	0.119
	(0.009)	(0.209)	(0.341)	(0.076)	(0.090)	(0.078)
Young tailored	0.006	-0.144	0.099	0.104	-0.322***	0.017
	(0.009)	(0.229)	(0.339)	(0.084)	(0.071)	(0.071)
Middle tailored	-0.001	0.211	-0.452**	-0.116*	0.030	-0.142***
	(0.005)	(0.164)	(0.196)	(0.062)	(0.066)	(0.046)
Senior generic	0.009	0.302	-0.395	-0.055	0.096	0.007
	(0.012)	(0.190)	(0.298)	(0.086)	(0.095)	(0.077)
Senior tailored	-0.001	0.287	-0.351	-0.134	0.380***	0.558***
	(0.010)	(0.245)	(0.336)	(0.091)	(0.066)	(0.064)
Share of men (%)	0.006	0.027	0.024	-0.011	0.025	-0.068
	(0.006)	(0.131)	(0.190)	(0.052)	(0.050)	(0.047)
Married/registered partner (=1)	0.012*	0.442***	-0.501***	0.087	0.015	0.025
	(0.006)	(0.125)	(0.184)	(0.057)	(0.046)	(0.045)
Cohabiting (=1)	0.042**	0.701***	-0.897***	0.111	-0.093	-0.009
	(0.019)	(0.227)	(0.255)	(0.078)	(0.077)	(0.086)
Unknown marital status (=1)	-0.045***					
	(0.005)					
Observations	8,563	447	447	447	447	447
R-squared	0.003	0.059	0.054	0.030	0.117	0.149
Number of clusters	345	133	133	133	133	133
p-value F-test (married=cohabiting=unknown)	0.000	0.001	0.002	0.173	0.369	0.810
p-value F-test (young generic=young tailored)	0.327	0.382	0.930	0.744	0.000	0.226
p-value F-test (middle generic=middle tailored)	0.850	0.202	0.022	0.063	0.645	0.003
p-value F-test (senior generic=senior tailored)	0.435	0.956	0.877	0.473	0.003	0.000

Table 4- 7 *(continued)*

Notes: Clustered standard errors in parentheses (at employer level). *** p<0.01, ** p<0.05, * p<0.1. Goals 1, 2, and 3 refer to Arrangement, On track, and Choices, respectively. Reference categories: middle age generic; single (marital status). The first F-test tests whether the marital status dummies are jointly significant. The next F-tests test for each age category whether the coefficients of the tailored version are equal to the coefficients of the generic version (thus whether there is a tailoring effect). Effects are in percentage points when multiplied by 100, except for columns (2) and (3), which are measured in percentages (times 100) and clicks/minute respectively. In an additional specification, we tested whether age (in years) could mediate the effect of tailoring on navigation behaviour by interacting each segment with age. We did not find empirical evidence for such a mediating effect. A more flexible specification using age dummies instead of age in years leads to many empty cells, which is due to our sample size. Hence, we are not in the position to test whether the effects we found are sensitive around the margins of the age categories we defined. Results are available upon request from the corresponding author.

Table 4- 8: Tailoring effects per goal by age category

Age category	Goal: arrangement	According to expectations?	Goal: on track	According to expectations?	Goal: choices	According to expectations?
Young (18-34 years)	0.028	*No*	**-0.350***	*Yes*	-0.103	*Yes*
	0.084		0.086		0.084	
Middle (35-54 years)	**-0.116***	*Yes*	0.03	*No*	**-0.142***	*No*
	0.062		0.066		0.047	
Senior (55+ years)	-0.078	*Yes*	**0.284***	*Yes*	**0.551***	*Yes*
	0.109		0.092		0.086	

Notes: Standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1; Tailoring effects are computed by taking the difference between the estimated coefficients for the tailored and generic version for each age group using the *lincom* command with STATA. Effects are in percentage points when multiplied by 100. In the columns after the computed tailoring effects, we indicated whether the effects are in line with our expectations when designing the structure of the pension information.

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content than those with a tailored version. This result is reason for concern (together with the results for the young participants) as tailoring did not have the desired effect on navigation behaviour. For senior participants, we found a large positive and significant tailoring effect as intended: The difference of clicking on information on pension choices by seniors with a tailored version compared to seniors with a generic version was 50 percentage points.

In the light of Table 4-2, which presents the operationalization of the goals in the navigation structure, we can explain the results regarding the second and third goals (being on track and choices available) by comparing the prominence of the tailored and generic versions. For the second and third goals, tailoring did not achieve the desired effect for the middle-aged participants, as the prominence of information regarding knowing whether one is on track was *medium* for the tailored and the generic versions[18]. For senior participants, we did achieve the desired tailoring effect, as the prominence differed between the generic version (*medium*) and the tailored version (*high*). This explanation does not appear to apply to the results regarding the first goal (knowing how one's pension is arranged).

Sample selection and representativeness

We conclude this section by discussing the issue of sample selection in our study. By randomly assigning a generic or a tailored version to participants, we did not eliminate the selection bias from logging into the DPE. We compared the distributions of the key variables between the subsample of the participants who logged in and the overall sample (Table 4-4). Regarding gender and age, we did not find significant differences between the subsample and the overall sample. At the bottom of Table 4-7, we presented an F-test on all coefficients of the marital status variables: We found significant differences between the subsample and the overall sample. Given those tests, we cannot establish with certainty whether the subsample of participants who logged into the DPE is representative of all participants in the experiment. Hence, it is more accurate to interpret the effects as being causal *conditional* on having logged into the DPE, referring to the conditional independence assumption (CIA), which, according to Angrist and Pischke (2008), eliminates selection bias. A related issue is that only 5% of the research population participated in the experiment, which means that we estimate a treatment effect on the basis of a small select group of pension participants. We would thus advise caution as to the results applying to the entire research population.

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[18] The prominence of information regarding a specific goal being the same for the generic and tailored versions does not imply that the navigation structures for the two versions was identical. There are subtle differences within each operationalization level, for instance in the order or the number of the dropdown texts. Readers who are interested can obtain the screenshots of all versions of the original digital pension documents (in Dutch) by requesting these from the corresponding author.

4.6 Conclusions

We conducted an experiment among employees who enrolled recently in a new employees' pension scheme. We analysed whether tailoring the general structure of pension information based on age affected the participants' navigation behaviour through the digital pension setting. Participants were sent a generic invitation email to log into the digital pension environment of their pension provider and were subsequently randomly assigned tailored versions of the pension information document. To obtain the effect of tailoring on navigation behaviour, we analysed clicking behaviour that involved selected goals that were relevant for different age groups. Participants should know 1) how their pension is arranged, 2) whether they are on track with saving for retirement, and 3) the choices available within the pension plan.

Concerning the first goal (knowing how one's pension is arranged), we found that tailoring distracted middle-aged participants away from the goal that was not deemed relevant for them. For young participants, however, tailoring was not effective in inducing them to click on goal-related pension information. For the second goal (being on track), tailoring the structure of the pension documents was effective in distracting young participants from clicking on information that was not relevant to them and in motivating senior participants to click on relevant information. These results were in line with our expectations: Since being on track was not a prominent goal for the young age group, we did not expect young participants to be more active in the tailored version as we did not show information about being on track very prominently. Tailoring was effective for senior participants as they clicked on information that was considered relevant to them. The middle group however, contrary to our expectations, was not more active in the tailored pension document. We had expected participants from the middle-aged group to be triggered by the tailored navigation structure to click on information regarding whether they were on track with saving for their pension. The lack of evidence for a tailoring effect might suggest otherwise. As for the third goal (being aware of the choices available), we found that tailoring worked for senior participants as they clicked on relevant pension information. Similar to our findings about the second goal (being on track), we had to conclude that tailoring was more effective in the generic version in motivating the middle-aged group to click on relevant pension information.

The resistance of the middle group to tailoring pension information is in line with findings from tailoring in the trigger phase (Dinkova et al., 2018), where we found the generic invitation letter to be more effective than the tailored letter in inducing young and middle-aged participants to click through and log into a DPE. If a tailored invitation letter did not trigger young and middle-aged participants

to click through and log into the DPE (Dinkova et al., 2018), and if according to the present experiment, a tailored digital pension document did not succeed in motivating participants to click on relevant information, then what drove those participants and how can they be motivated to delve into their pension situation in the future?

From within a behavioural economics framework of individuals with time-inconsistent preferences about retirement planning (O'Donoghue & Rabin, 1999b), we could argue that young and middle-aged participants have time-inconsistent preferences. They postpone their planning for retirement by not looking at relevant pension information which could provide them with more guidance on making informed pension decisions. Similarly, senior participants, for whom the horizon of future benefits is shorter, appear to realize that they cannot postpone planning for retirement any longer, as the urgency of what may be their final steps to prepare for retirement is apparent.

A less theoretical explanation concerning the results for the middle group is that this group is heterogeneous and that, depending on the life phase that middle-aged individuals are in, there could be an overlap in preferences across age groups. Although we tried to address this issue when estimating our results, we could not draw any conclusions about a possible overlap across age categories due to the small number of observations. Field experiments on effective pension communication in the navigation phase with a higher number of active participants (thus a more representative subsample of active participants) would enable researchers to estimate causal treatment effects and identify clearer interval borders of the age categories. Table 4-9 summarizes the lessons learned from our study by age category.

Table 4- 9: Lessons learned by age category

	Lessons learned
Age category	
Young (18-34 years)	Tailoring succeeds in distracting young participants from clicking on information that is not (or not yet) relevant to them. Tailoring does not succeed in motivating young participants to click on relevant information.
Middle (35-54 years)	Similar as with young participants, tailoring works in distracting from irrelevant information but does not succeed in motivating middle-aged participants to click on relevant information.
Senior (55+ years)	Tailoring is successful in distracting senior participants from clicking on information that is not relevant to them and successful in motivating them to click on relevant information
General lesson	Young and middle-aged participants are still a tough nut to crack. More experimental evidence is needed to figure out how to motivate them to click on relevant information.

As already touched upon in previous sections, the results should be treated with caution since the tailoring effects we found are based on a subsample of assumedly intrinsically motivated people, who took the first hurdle of logging in (5% of our sample). The effects are causal but only if they are conditioned on having logged in. To gain a clearer view on who logged in in the first place and who clicked more actively on relevant information than others, it may be necessary to analyse personal characteristics that go beyond simple demographics. Empirical evidence about attitudes to pension information, the need for cognition (in general and related to the pension domain), financial literacy, and future time perspective (how individuals value present versus future benefits and present costs) can complete the picture of profiling individuals who typically are more likely to be actively interested in their pension situation. Directing future research at the role of future time perspective and financial literacy in improving the effectiveness of pension communication can be an example of how concepts that are rooted in economics can contribute to overcoming challenges of societal relevance jointly with insights from communication science, linguistics, and psychology.

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From a policy perspective, there are two implications that come forward. First, especially young and middle-aged pension plan participants need to be aware of the importance of pensions and the choices available within their pension scheme. Our study shows that these age groups are more difficult to reach. Future reforms and policy measures will impact the future retirement income of these age groups. Therefore, it is crucial for policymakers to facilitate research and sharing of expertise on how to motivate people to delve into their pension situation. A second point, one that is related to the previous paragraph, pension plan providers should take the preferences of different age groups into account. Formulating goals per age group, similar to what we did in this study, could serve as a point of departure. We suggest that pension plan providers spend more effort to find out the needs and expectations of people of different age groups. Conducting informal interviews or polls via social media could help to calibrate the desired goals of informing pension plan participants of different ages effectively about their pension situation.

Acknowledgements

Appendices

A. Overview of structure of each version of the pension information document

Box A1: Structure for each version of the pension information document. Arabic numbers refer to pages (higher level), bullets represent titles of the drop-down menus (lower level)

Generiek
0. Welkomscherm: plaatje met een groep relatief jonge mensen; Button: Ga verder
1. Welkom bij het Werknemers Pensioen
2. Goed om te weten
   - Hoe is je pensioen geregeld?
   - Lig je op koers met je pensioen?
   - Welke keuzes heb je?
   - Wanneer moet je in actie komen?
   - Wij communiceren digitaal
3. Meer weten? (Verwijs naar Pensioenplein, pensioen 1-2-3 en Pensioencheck en verwijs naar een adviseur en de helpdesk)

Jong

0. Welkomscherm: plaatje met relatief jonge groep; Button: Check het hier
1. Welkom bij het Werknemers Pensioen
2. Pensioen in vijf minuten
   - Hoe is je pensioen geregeld?
   - Wanneer moet je in actie komen?
   - Welke keuzes heb je?
3. Wil je meer weten? (Verwijs naar Pensioenplein, pensioen 1-2-3 en Pensioencheck en verwijs naar een adviseur en de helpdesk)

Midden

0. Welkomscherm: plaatje met een stel (middengroep) in de keuken; Button: Check het hier
1. Welkom bij het Werknemers Pensioen
   - Lig je op koers met je pensioen?
   - Wat kun je doen om extra pensioen op te bouwen?
   - Wanneer moet je in actie komen?
   - Welke keuzes heb je?
2. Meer weten? (Verwijs naar Pensioenplein, pensioen 1-2-3 en Pensioencheck en verwijs naar een adviseur en de helpdesk)

Senior
0. Welkomscherm: plaatje met een oudere man die aan het strand voetbalt; Button: Ga verder
1. Welkom bij het Werknemers Pensioen
2. Lig je op koers met je pensioen?
3. Keuzes als je met pensioen gaat
   - Wanneer wil je met pensioen?
   - Wil je eerst met deeltijdpensioen?
   - Wil je eerst een hoger pensioen en daarna een lager pensioen?
   - Wil je partnerpensioen ruilen voor extra ouderdomspensioen?
4. Welke keuzes heb je nog meer?
5. Meer weten? (Verwijs naar Pensioenplein, pensioen 1-2-3 en Pensioencheck en verwijs naar een adviseur en de helpdesk)

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Box A2: Structure for each version of the pension information document (English translation). Arabic numbers refer to pages (higher level) and bullets represent titles of the drop-down menus (lower level)

Generic

0. Homescreen: image of a group of relatively young people; Button: <Continue>
1. Welcome to the Employees' Pension
2. Good to know
    - How is your pension arranged?
    - Are you on track for retirement?
    - Which choices do you have?
    - When do you have to take action?
    - We communicate digitally
3. Know more? (Refer to Pension plaza, pensioen 1-2-3 and Pensioncheck and refer to an advisor and the helpdesk)

Young

0. Homescreen: image of a relatively young group; Button: <Check it here>
1. Welcome to the Employees' Pension
2. Pension in five minutes
    - How is your pension arranged?
    - When do you have to take action?
    - Which choices do you have?
3. Would you like to know more? (Refer to Pensionplaza, pensioen 1-2-3 and Pensioncheck and refer to an advisor and the helpdesk)

Middle

0. Homescreen: image of a middle-aged couple in the kitchen; Button: <Check it here>
1. Welcome to the Employees' Pension
    - Are you on track for retirement?
    - What can you do to accrue more pension?
    - When do you have to take action?
    - Which choices do you have?
2. Know more? (Refer to Pension plaza, pensioen 1-2-3 and Pensioncheck and refer to an advisor and the helpdesk)

Senior

0. Homescreen: image of a senior man playing football; Button: <Continue>
1. Welcome to the Employees' Pension
2. Are you on track for retirement?
3. Choices to make when you retire
    - When do you want to retire?
    - Do you first want to retire partially?
    - Do you first want to be paid out a higher pension amount and afterwards a lower pension amount?
    - Do you want to exchange partner's pension for additional retirement pension?
4. Which additional choices do you have?
5. Know more? (Refer to Pension plaza, Pensioen 1-2-3 and Pensioncheck and refer to an advisor and the helpdesk)

Additional notes:

Pensionplaza is a personal internet environment for customers of the insurer that allows access to pension information. Until the summer of 2017 it consisted of several documents that relate to pensions.

Pensioen 1-2-3 is a website, administered by the Federation of the Dutch Pension Funds (Nederlandse Pensioenfederatie) and the Dutch Association of Insurers (Verbond van Verzekeraars), that provides information on the most important elements of your pension plan. The information is organized in three layers. The first layer provides a quick overview of your pension scheme, the second layer builds on the information in the previous layer, and the third layer presents more detailed information and may include official documents about your specific pension scheme. The Pensioncheck is an online tool that enables participants to check whether they have accrued enough pension income for their old age.

B. Screenshots of front pages of all four versions of the pension document

Version 1 (young)

Version 2 (middle group)

Version 3 (senior)

Version 4 (generic)

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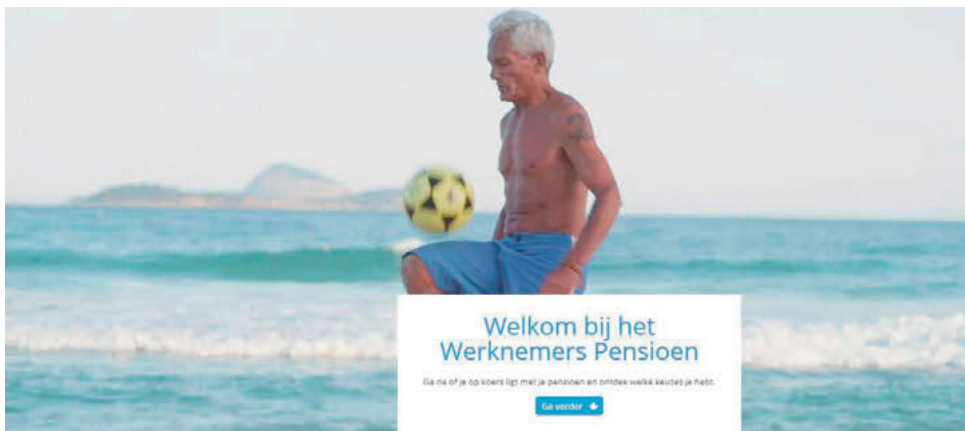
Chapter 5: I know (and) I can and I do? The role of Multi-dimensional financial literacy in explaining pension information behaviour[19]

Abstract

This chapter assesses whether financial literacy can explain the likelihood of people delving into their pension situation. We suggest to use a financial literacy construct that, next to the usual financial literacy questions assessing numeracy and knowledge of financial concepts, also includes perceived financial knowledge, questions on pension-specific knowledge and a vocabulary test. A survey was distributed amongst employees and customers of a large insurance company in order to elicit participants' financial literacy level, some relevant behavioural factors and demographics. We linked participants' login behaviour in their respective digital pension environment (DPE) to their financial literacy level and behavioural factors including attitudes towards pension information, need for cognition and future time perspective. People with higher pension knowledge and knowledge about the concept of interest compounding were more likely to log in to the DPE. Attitudes, need for cognition and future time perspective are directly related with login behaviour. The relationship between financial literacy and login behaviour is not affected by behavioural factors.

5

5.1 Introduction

In the Netherlands, there is a discussion going on about providing more freedom of choice to pension plan participants. More freedom of choice implies that the responsibility for making optimal pension decisions shifts to the participants. Many efforts have been made in the pension industry to provide transparent and user-friendly pension information that can help individuals to ensure a careless (at least moneywise) old age. The main challenge in the pension communication sector is how to get people to log in to their digital pension environment (DPE) in the first place. What are the underlying factors that drive people to or deter people from looking into their pension situation? Financial literacy is a factor that has been mentioned often in relation to optimal financial planning. For instance, Lusardi and Mitchell (2011) and Van Rooij et al. (2011b) confirm that more sophisticated and financially literate people are more likely to engage in financial planning. Arguably, financially literate individuals are aware of the importance and urgency to start planning for retirement if they have not done so already. Is being financially literate enough for people to motivate themselves to sit down, switch on their (smart) device and log in to their DPE?

In this study, we investigate the role of financial literacy in explaining the likelihood to look into one's personal pension situation (pension information behaviour) and the extent to which the effect

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[19] A slightly modified version of this chapter has been published as a TKI Discussion Paper (No. 19-06) with the title "I know (and) I can and I do? The role of multi-dimensional financial literacy in explaining pension information behaviour".

of financial literacy is influenced by behavioural factors such as attitudes, need for cognition and future time perspective. To study this issue, we use data containing login information of 1) employees and 2) new customers of a large insurance company who were asked by means of an invitation letter to log in to their digital pension environment in order to take a closer look at their pension situation. See Dinkova et al. (2018a, 2018b) for more details on how the login data has been obtained. Every participant was invited to fill in a survey including questions measuring the financial literacy level of the participants and the behavioural factors mentioned further up in the paragraph.

To the best of our knowledge, the only study that provides experimental evidence on real login behaviour of pension participants in the Netherlands is a study by Bauer, Eberhardt and Smeets (2017). They conducted a field experiment on retirement information search amongst pension fund participants. They observe, amongst others, that participants who logged in are more likely to be male, older, earn more and have a partner.

Many studies on financial literacy focus on the impact of financial literacy on savings behaviour and stock market participation (Deuflhard et al., 2018; van Rooij et al., 2011a) and on retirement planning (Bucher-Koenen & Lusardi, 2011; Lusardi & Mitchell, 2007b; van Rooij et al., 2011b). Those studies predominantly used a basic concept of financial literacy comprising numeracy and knowledge of basic financial concepts like interest compounding, inflation and risk diversification.

However, financial literacy has more facets, especially when we want to study retirement planning. Retirement planning undoubtedly requires financial knowledge and skills. Sound retirement planning though also requires confidence in one's knowledge, the ability to read complex texts (pension documents are not written in the easiest language) and a fair share of basic knowledge about pensions. Financial literacy has been defined by Huston (2010) as "measuring how well an individual can understand and use personal finance-related information" (p.306) – a clear and simple definition. Remund (2010) presents a more multi-dimensional approach of financial literacy as a construct that does not only comprise knowledge of financial concepts but also the skill to use that knowledge for financial planning. When examining the complete definition of Remund (see Chapter 1), it turned out that operationalizing the different concepts relating to long-term planning, confidence and the impact of life events can be difficult. Hence the choice to still follow Huston's definition of financial literacy (2010) while taking a different approach towards measuring the financial literacy concept.

Using insights from linguistics and communication science (Lentz & Pander Maat, 2013; Nell et al., 2016), we propose a comprehensive financial literacy construct that consists of numeracy, knowledge of financial concepts, topic-specific knowledge (pensions in this case), literacy in its original sense and one's self-assessment regarding financial knowledge. Furthermore, this study contributes to the

literature on retirement planning by linking financial literacy and other relevant behavioural factors to real behaviour[20] rather than behavioural intention as had been done by recent relevant studies (such as Eberhardt, Brüggen, Post, & Hoet, 2016). By following Eberhardt et al. (2016) and including behavioural factors like attitudes towards pension information, need for cognition and time preferences, the importance of intrinsic motivation in explaining people's pension information behaviour is addressed.

Next to financial literacy, it is important to consider several factors that might capture heterogeneity in (time) preferences[21]: People value current consumption more than future consumption, or people do not like to think about serious issues in general (or related to their pension) and consider everything related with pensions to be dull and difficult to digest. Future time perspective refers to how important the future is to people and to what degree they like to engage in (long-term) planning rather than valuing present consumption. Carstensen et al. (1999) suggest that assessment of time is crucial "in the ranking and execution of social goals" (p.175). Although Zimbardo and Boyd (2015) are entirely correct about the need to consider a multi-dimensional time perspective (considering past, future and even perception about the beyond) when explaining present behaviour for most people, this study focusses on the future. After all, pension lies in the near or far future. We posit that future time perspective has an influence on the motivation of people to delve into their pension information. If for instance people tend to procrastinate, as they might value present benefits more than spending time on future benefits, the likelihood that they would delve into their pension information is smaller. Possibly this is even the case for people with a high financial literacy level, hence future time perspective may have a moderating effect on the relationship between financial literacy and login behaviour.

Finally, we believe that two additional factors that influence the motivation to look into one's pension information are attitudes towards pension information and need for cognition. With attitudes we mean attitudes that are "expressed by evaluating a particular entity [pension information] with some degree of favour or disfavour" (Eagly & Chaiken, 1993, p. 1). When measuring attitudes towards pension information, particular adjectives are used enabling respondents to clearly state their (dis)liking of pension information. The last element in this conceptual framework is need for cognition. The oldest definition of need for cognition is provided by Cohen, Stotland and Wolfe (1955): "[the] need to structure relevant situations in meaningful, integrated ways [and] the need to

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[20] With the notable exception of Bauer et al. (2017)

[21] As including attitudes, need for cognition and future time perspective are not typical concepts used in economic literature, we chose to provide a more detailed background of those concepts in the main text.

understand and make reasonable the experiential world" (p.291). Cacioppo et al. (1986) extend this concept by emphasising that the dominant factor of this construct is that individuals "engage in and enjoy effortful cognitive endeavors" (p.1033). Using the latter view, one can set up the link to the pension context. General need for cognition should still be seen separately from the need to be informed about one's pension. There are individuals after all who dearly like to solve puzzles but yet, they prefer not to focus their cognitive efforts towards pension information.

With this study we want to advocate the use of behavioural variables, next to the usual economic variables (wealth, income, household assets) and demographics, in enriching economic models. This way, insights from other disciplines (communication science, linguistics and social psychology) can complement already established findings in economics and help to answer the economic question of how consumers can be incentivised in optimal financial planning. More knowledge about people's attitudes and need to be informed can help policy makers and financial institutions to assist people in making the right financial decision at the right time.

This chapter is organised as follows: Section 5.2 describes the methodology used to elicit login behaviour, the constructs measured in the survey and a schematic overview of how the constructs relate to each other. The third section of this chapter (5.3) describes the data, the fourth section (5.4) contains estimation procedure and Section 5.5— the estimation results. The sixth and final section of this chapter (5.6) concludes and briefly discusses the results.

5.2   Methodology

In this section we first briefly describe how the dependent variable— login behaviour into one's digital pension environment— is constructed. Then, we provide more information on the survey methodology and which constructs were measured. Lastly, we outline how financial literacy is defined and which relations are examined in particular.

5.2.1 Constructing the dependent variable – login behaviour

The data on login behaviour to a digital pension environment has been obtained during a field experiment - see Dinkova et al. (2018a, 2018b) for more details. There were two different research populations: The first research population comprised employees of a large insurance company (data collection in winter 2016) and the second research population— customers who enrolled into a new workplace pension scheme with the aforementioned insurance company (data collection in the first half of 2017). From here onwards, we will refer to the first group as the employee subsample and to the second group as the customer subsample. All participants had to log in to their digital pension

environment using the Digital Identification (DigID). Two weeks after having received the invitation to login to their digital pension environment, the participants received a survey eliciting financial literacy and several psychometric concepts[22].

5.2.2 Survey Methodology

The survey contained questions on financial literacy (comprising self-assessed financial literacy, questions testing numeracy and knowledge of financial concepts, a vocabulary test and a pension knowledge test), need for cognition (general and pension-related), attitudes related to pension information and relevant demographics. Please refer to Appendix C for the exact wording of all survey questions.

Financial literacy

Nell, Lentz and Pander Maat (2016) and Nell (2017) used a financial knowledge test of 11 questions based on Lusardi (2015) and Lusardi and Mitchell (2011) and found that topic-specific knowledge is an important predictor (after language skill) for readers' performance in understanding financial documents. Combining those insights with Remund's view on financial literacy, we end up with the following constituent parts of financial literacy: Numeracy and knowledge of financial concepts (the classical approach in economic literature so far), topic knowledge (in this case pension knowledge), self-assessed financial knowledge and literacy in its original sense.

Numeracy and knowledge of financial concepts. The survey also takes into account the classical approach adopted in financial literacy literature which essentially measures numeracy and knowledge of financial concepts. Lusardi and her colleagues implemented a set of financial literacy questions in various (inter)national surveys such as the RAND American Life Panel (Lusardi & Mitchell, 2007b b), the Survey of Health Ageing and Retirement in Europe (SHARE) (Christelis, Jappelli, & Padula, 2010), the Dutch DNB Household survey (DHS) (van Rooij et al., 2011b) and the LISS panel. This classical approach uses four multiple-choice questions that test the following financial concepts: interest compounding, inflation, risk diversification and the relationship between bond prices and interest rate. Here, the "don't know" option is included as well. See Lusardi and Mitchell (2011) for more details on those questions.

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[22] Note that the data for the employee subsample has been collected during one wave. Regarding the second subsample, data has been collected in multiple waves for a total duration of six months. The timing of the waves depended on how many new customers got enrolled into the workplace scheme. The invitation to fill in the survey always succeeded the invitation to log in by two weeks.

Topic knowledge. Based on Lentz and Pander Maat (2013) and Nell et al. (2016), we asked the respondents four questions in order to test their pension knowledge. The topics covered are workplace pension schemes (*werkgeverspensioen* in Dutch), basic state pension (*AOW*), life events that can impact one's pension and the investment behaviour of pension funds. When assessing topic knowledge, two alternative grading systems are applied— a strict and a lenient one. Concerning the strict grading, it is assessed how many out of the four pension knowledge questions were answered completely correct implying that for a question with multiple correct answers, *all* correct answers had to be ticked. This resulted in a scale from 0-4. The lenient grading applied a different scale (0-7) and counted the total number of correct responses for all questions— hence 7 correct answers in total for 4 questions. With the lenient grading scheme, scoring 0 or 1 becomes less likely compared to the strict grading scheme. For the main analysis of this study, the strict grading scheme applies. The lenient scheme is used to check the sensitivity of the estimation results.

Self-assessed financial knowledge. As people's behaviour is not only driven by one's skills and knowledge but also by the own perception of one's knowledge, respondents were asked to indicate on a 7-point Likert scale how they would assess their own financial knowledge. Van Rooij, Lusardi and Alessie (2011a) also included self-assessed financial knowledge in their analysis in order to capture people's confidence in dealing with financial matters.

Vocabulary. Nell and her colleagues (2016) found that language skill was the most important predictor for readers' performance in finding and understanding information in financial documents. A shortened version of the vocabulary test that they used in their study has been included in the present survey. Respondents were asked to identify the correct meaning of a complex word embedded in a specific context in a multiple-choice setting (four possibilities). The words were general words that could be encountered in newspapers, books or discussions: demagogue, segregation, philanthropist or megalomaniac. Additionally, to avoid gambling (van Rooij et al., 2011a; van Rooij, Lusardi, & Alessie, 2012), the "don't know" option has been added to every question (see for instance van Rooij, Lusardi & Alessie (2012) and van Rooij et al. (2011a)).

Need for cognition

Need for cognition (NFC) also appears in two variations in the survey: general NFC and topic NFC. General NFC consists of four items that aim at identifying the extent to which the respondent enjoys being confronted with situations that require some cognitive effort. For the purpose of this study, a shortened version has been constructed based on Cacioppo et al. (1986) and Pieters et al. (1987).

Three additional items were included in the survey to measure topic NFC. In particular, respondents were asked to indicate the extent to which they wished to be informed about their pension and in how far they liked to look into it themselves. NFC is different from behavioural intention in that it relates to affection/aversion towards a certain topic and behavioural intention refers to a stated intention to look into one's pension situation within a given timeframe.

Future time perspective

As the goal of saving for pension lies in the near or far future, time preferences can be an important factor in explaining pension information behaviour. Zimbardo (2015) proposed three statements measuring future time perspective that should be evaluated on a 5-point Likert scale. Those three statements have been included in this survey as well. For instance, one statement was about to what extent respondents agree that they prefer to spend money now on nice things rather than saving for later.

Attitudes towards pension information

Another construct that is needed to explain behaviour, are attitudes towards this particular behaviour (see Ajzen, 1991; Eagly & Chaiken, 1993; Yzer, 2012). In this context, it is more sensible to measure attitudes towards pension information (rather than attitudes towards login behaviour) as people know that the goal of logging in is to eventually look into their *pension information*. Respondents were asked to assess their attitudes regarding pension information by ranking six characteristics respectively on a 5-point Likert scale. In particular, respondents had to indicate how unimportant/important, interesting/uninteresting, difficult/easy, reliable/unreliable, unclear/clear and useful/not useful they considered pension information to be. To avoid mechanical answers, the scales were alternating from positive to negative and vice versa.

Socio-economic variables

The survey also contained questions on socio-economic variables: date of birth, gender, and household composition, number of children, monthly net household income and education level. Respondents could choose from dropdown income categories as suggested by Statistics Netherlands (CBS).

5.2.3 The financial literacy construct in relation to behavioural factors

Figure 5-1 presents the composition of the financial literacy construct we propose to use. Financial literacy can be dissected in two parts: the concept of financial knowledge which consists of numeracy

and knowledge of financial concepts, topic-specific knowledge and perceived financial knowledge on the one hand, and the concept of literacy which refers to literacy in its original sense on the other hand. Note that this does not imply that the constituent parts should be aggregated to one single financial literacy construct as it is the multi-dimensionality of financial literacy that makes it an interesting subject.

Having visualised what financial literacy is, we move on to setting the links between login behaviour and specifying the role of the behavioural factors. First, we are interested in examining the relationship between financial literacy and login behaviour— this is the main research question of this study. Secondly, we will examine whether the behavioural factors need for cognition, attitudes towards pension information and future time perspective affect the relationship between financial literacy and login behaviour. In other words, we will investigate whether there are interaction effects between the behavioural factors and financial literacy. A schematic visualisation of the associations that are examined in this study can be found in the Appendix (Figure 5A-1).
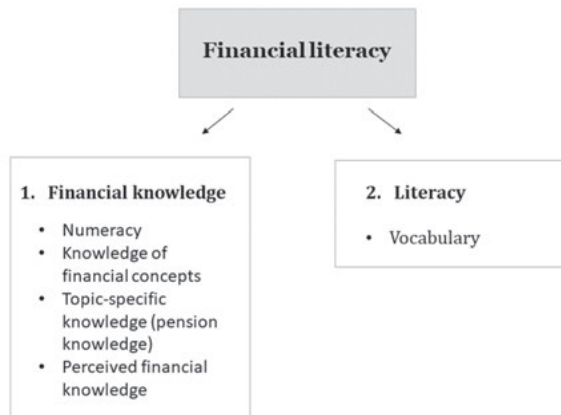
Figure 5- 1: Composition of financial literacy construct

5.3   Data description

5.3.1 Summary statistics

The research populations from both subsamples summed up to 11,797 (3,159 for the first experiment and 8,638 for the second experiment embodying the gross employee and customer sub-sample respectively). Login behaviour could only be linked to the participants' financial literacy level and the

other factors provided that they also answered the survey. The overlap between the survey responses and the behaviour measured is 980 participants for the first (employee) sub-group and 613 participants for the second (customer) sub-group. Additionally, 10% of the observations had to be dropped as they did not agree for their survey responses to be linked to their online behaviour. This leaves us with a final sample of 1,351 participants (where 62% belong to the first sub-sample and the remaining share— to the second sub-sample). See Table 5A-1 in the Appendix for summary statistics of all variables included in this analysis.

The share of participants who logged in is quite high: On average, 19% of the participants who received an invitation to login have logged in at least once. Table 5-1 breaks down the login share and other key variables into the subsamples. For the employee subsample, the login share (conditional on having filled in the survey) was 23% and for the customers subsample, the share was 12%. An attentive reader might think that the research questions have been already answered with Table 5-1. It is true that the employee subsample is comprised of intrinsically more motivated individuals who self-selected into filling in the survey. However, we will confirm later in this study (in the Appendix), that when the results for both subsamples are estimated separately, there is still heterogeneity in login behaviour related to attitudes towards pension information and future time perspective. In the next subsection, we will discuss the graveness of self-selection and its implications for the interpretation of our results.

Table 5-2 displays the mean values for all financial literacy variables for participants who logged in and did not log in respectively. Considering the total sample, participants who logged in are, on average, more confident about their financial knowledge (higher mean of self-assessed financial knowledge), they score higher on the classic financial literacy questions and know more about their pension. The average score in the vocabulary test did not differ for participants who logged in to their DPE and those who did not log in. The general score in the vocabulary test was quite high: The average participants answered at least 6 out of 9 questions correctly.

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Table 5- 1: Mean values of some key variables by subsample

Variable	Employee subsample	Customer subsample	Pr($\|T\|>\|t\|$)*
Logged in	0.23	0.12	0.000
Self-assessed financial knowledge (1-7)	5.39	4.62	0.000
Score on classic financial literacy questions (0-4)	3.31	2.95	0.000
Score Vocabulary test (0-9)	6.99	5.95	0.000
Score Pension knowledge (0-4)	2.55	2.24	0.000
Attitudes PIB - negative to positive	3.43	3.19	0.000
NFC General	3.68	3.59	0.008
NFC Pension information	3.47	3.37	0.012
Future time perspective	3.45	3.39	0.087
Age (in years)	46.73	43.69	0.000
Low education dummy	0.09	0.12	0.129
High education dummy	0.60	0.52	0.004
Male (=1)	0.67	0.70	0.180
Number of observations	840	511	

Notes: *Pr($\|T\| > \|t\|$) returns the p-value of a two-sided t-test comparing means testing the zero hypothesis H_0: $\mu_{Employee} = \mu_{Customer}$ where $\mu_{Employee}$ and $\mu_{Customer}$ are the population means of the employee subsample and of the customer subsample respectively. SAFL is self-assessed financial literacy measured on a 7-point scale.

Table 5- 2: Mean values for all measured financial literacy concepts for participants who have logged in to the Digital Pension Environment and participants who did not log in (n=1,351)

	Logged in?		
	Yes	No	Pr($\|T\|>\|t\|$)*
Variable			
Self-assessed financial knowledge (1-7)	5.35	5.04	0.00
Score on classic financial literacy questions (0-4)	3.30	3.14	0.00
Score Pension knowledge (0-4)	2.58	2.40	0.00
Score Vocabulary test (0-9)	6.80	6.55	0.14

Notes: *Pr($\|T\| > \|t\|$) returns the p-value of a two-sided t-test comparing means testing the zero hypothesis H_0: $\mu_{Yes} = \mu_{No}$ where μ_{Yes} and μ_{No} are the population means of the group that has logged in to the DPE and of the group that has not logged in respectively.

Table 5-3: Percentage share per type of answer for the Numeracy and financial knowledge questions, Pension knowledge and Vocabulary questions (n=1,351)

A. Classical FL questions		Q1: Interest	Q2: Inflation	Q3: Risk	Q4: Bonds
	Correct	96.52	92.30	87.70	40.67
	Incorrect	2.52	4.22	2.37	26.59
	DK	0.96	3.48	9.93	32.74

B. Pension knowledge (strict)		Q1: Workplace pension	Q2: State pension	Q3: Life changes and pension	Q4: Pension funds
	Correct	71.13	77.65	2.59	91.86
	Incorrect	28.87	8.22	97.41	1.78
	DK	N/A	14.14	N/A	6.37

C. Vocabulary		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
	Correct	75.35	86.01	49.26	78.67	84.96	87.18	61.87	69.99	67.56
	Incorrect	13.92	8.59	12.15	5.63	12.52	9.12	4.97	9.51	5.27
	DK	10.73	5.40	38.59	15.70	2.52	3.71	33.16	20.51	27.17

Notes: For the precise wording of the questions refer to the Appendix. Note also the following about the pension knowledge questions: Question 1 contained two correct answers (referred to as Q1.1 and Q1.2), question 2 and 4 had only one possible correct answer and question 3 had three correct answers (referred to as Q3.1, Q3.2 and Q3.3 respectively in panel C). Questions 2 and 4 contained the don't know option.

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In Table 5-3, we computed the percentage share of correct, incorrect and don't know answers for every question for the classical financial literacy questions (panel A), the pension knowledge questions (panel B) and the vocabulary test (panel C). Regarding the classical financial literacy questions, the share of correct answers for the first three questions is extremely high. A possible explanation is that the majority of the respondents (who are part of the employee sample) have an affinity towards financial issues due to their work.

The questions on pension knowledge with multiple correct answers (questions 1 and 3), were considered more difficult than questions 2 and 4. The share of correct answers for the question of life-events is strikingly low: To answer this question entirely correctly, participants had to get all three correct sub-answers correct. The share of correct answers for the vocabulary test is quite high – for every question, the share is not lower than 60% with the single exception of question 3 (the question on what a demagogue is) that had the lowest share of correct answers. As in Table 5-3 we could detect differences in the difficulty of questions, we should take this into account when conducting our empirical analysis. Including dummy variables for every question separately rather than the scores of the respective knowledge tests accounts for the differences in difficulty of the questions.

5.3.2 Sample selection and representativeness

To assess how far we can go in the inference of the estimation results, we compared the sub-sample of individuals who filled in the survey— and hence became part of our final sample— with the remainder of the gross sample consisting of individuals who did not fill in the survey. Next to login behaviour for the gross sample, there is also information available about age and gender of the research population. The mean values of login behaviour, age and gender who filled in the survey (and who did not) are presented in Table 5-4. The most concerning statistics of Table 5-4 are the means for login behaviour: 18.8 percent of the individuals who filled in the survey logged in to the DPE compared to 5.2 percent who did not fill in the survey. When digesting the estimation results in Section 5.5, we should keep in mind that we are analysing a selective sub-sample and that the results we find are correlations.

Table 5- 4: Mean values of login behaviour, age and gender of participants who filled in the survey and participants who did not fill it in

	Filled in survey?		
	Yes	No	$Pr(|T|>|t|)$*
Variable			
Logged in (=1)	0.188	0.052	0.000
Age (in years)	45.580	43.317	0.000
Male (=1)	0.679	0.697	0.179
Nr. of observations	1,351	10,401	

Notes: *$Pr(|T| > |t|)$ returns the p-value of a two-sided t-test comparing means testing the zero hypothesis H_0: $\mu_{Survey} = \mu_{No\ Survey}$ where μ_{Survey} and $\mu_{No\ Survey}$ are the population means of the group that has filled in the survey and of the group that has not filled in the survey respectively.

5.4   Estimation procedure

5.4.1   Financial literacy and login behaviour

In order to investigate the answer to the first research question, we use a linear probability model[23] to estimate the probability to log in to the digital pension environment with clustered standard errors at the employer level. We estimated models for the total sample— employee and customer subsamples altogether[24]. The estimation equation is given by (5.1) with $login_i$ being a binary dependent variable equal to 1 if an individual has logged in and 0 if otherwise, $NumFin_i, PK_i, Vocabulary_i$ and $SAFL_i$ denoting numeracy and knowledge of financial concepts (the questions developed by Lusardi and Mitchell), pension knowledge, vocabulary and self-assessed financial literacy respectively. Vocabulary is measured on a scale from 0-9, based on the number of correct answers given regarding the nine questions testing the participants' literacy. Self-assessed financial literacy is measured by one question on a 7-point Likert scale.

$$login_i = \beta_0 + \beta_1 NumFin_i + \beta_2 PK_i + \beta_3 Vocabulary_i + \beta_4 SAFL_i + \sum_{j=1}^{4} \gamma_j B_{ji} + \delta' Z_i + \epsilon_i \qquad (5.1)$$

We implement $NumFin_i$ and PK_i by 1) using a simple scale consisting of the number of correct answers respectively, where for pension knowledge we use the strict grading scale (as described in

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[23] Please note that we also estimated alternative non-linear specifications (probit and logit). The average marginal effects and standard errors are very similar to the estimations of the linear probability model, hence the choice to present the estimations of the linear probability model.

[24] The Chow-statistic of 45.26 is fairly high suggesting that the model could be estimated separately for the employee and customers subsample. Those results are reported in the Appendix. However, it is still more sensible to focus on the results of the total sample as reported in the main text for the sample size is still too small for examining the separate cells of the interaction terms in the unrestricted model.

Section 5.2) and 2) by including dummies for every question in a different specification. We also conducted sensitivity checks using the lenient grading scale of the pension knowledge questions. The decision to use two approaches to measure numeracy and knowledge of financial concepts on the one hand and pension knowledge on the other hand is based on the rationale that those concepts are already multi-dimensional by nature. The first two questions by Lusardi and Mitchell arguably test numeracy, the last two questions test general financial knowledge and pension knowledge is about knowing what someone is entitled to and which choices are available depending on life events. B_{ji} in equation (5.1) captures the behavioural constructs of interest: attitudes towards pension information (we aggregated the answers to the six questions on attitudes by computing the mean), general (aggregated four questions) and pension-related need for cognition (aggregated three questions) and future time perspective (aggregated three questions). At last, Z is a vector including the following control variables: gender, age, education level, household situation, children in the household (dummy).

For all constructs that involved more than one question, we computed the coefficient alpha— an indicator that has been widely used (and admittedly overused) in the psychology literature — to get an idea about the interim correlations between the items supposed to measure one concept. See Cronbach (1951) for more details on the coefficient alpha and Cortina (1993), Rodriguez and Maeda (2006) for a discussion of the coefficient and Raykov (2001), Schmitt (1996) and Sijtsma (2008) for a more critical discussion. Appendix D contains a short discussion of the literature surrounding the coefficient alpha and the computations for the financial literacy and behavioural constructs. We loosely based the decision how to implement the respective concepts into our empirical strategy on those results. For instance, regarding vocabulary, need for cognition (general and pension-related) and attitudes towards pension information, the alpha was 0.82, 0.68, 0.713 and 0.73 respectively. Following a rule of thumb that an alpha of 0.7 is an acceptable value, this is an indication that we could aggregate the questions without claiming uni-dimensionality. Note that for the numeracy, general financial knowledge and pension knowledge questions, the coefficient alpha was substantially lower and therefore encouraging the reporting of several specifications.

5.4.2 Financial literacy, behavioural factors and login behaviour

Next, we turn to the specification testing whether there are interactions between the financial literacy constituent variables and the behavioural concept. The estimation equation is given by (5.2) where again the linear probability model with clustered standard errors is used to obtain the estimates. The dependent variable and the set of covariates is unchanged with respect to equation (5.1). Fl_{ji} captures

all financial literacy variables (still estimated separately) and B_{ji} refers to the behavioural variables which are now a set of the following dummy variables in order to facilitate the interpretation of the interactions: positive attitude towards pension information (equal to 1 if the aggregated attitudes are above the median), high need for cognition (all seven questions pooled and equal to 1 if the aggregated need for cognition is above the median) and high future time perspective implying that the individual is forward-looking (rather than being short-sighted).

$$login_i = \alpha_0 + \sum_{j=1}^{4} \alpha_j Fl_{ji} + \sum_{j=1}^{3} \theta_j B_{ji} + \sum_{j=1}^{3} \mu_j Fl_{ji} * B_{ji} + \tau' Z_i + \epsilon_i \tag{5.2}$$

$Fl_{ji} * B_{ji}$ refers to the set of interaction terms where each financial literacy concept (aggregated to a score) is multiplied with each behavioural dummy. Consequently, μ_j is the difference in the probability to login between individuals with a positive attitude (high need for cognition, high future time perspective) relative to individuals with a negative attitude (low need for cognition, low future time perspective) for a given level of the financial literacy variables. Z includes the same control variables as equation (5.1).

5.5 Empirical results

In this section, two sets of results are presented: First, we investigate the role of financial literacy in predicting participants' probability to log in (see equation 5.1) and secondly, we explore whether behavioural factors (attitudes, need for cognition and future time perspective) affect the relationship between financial literacy and the probability to log in (see equation 5.2). Additionally, we also present a set of sensitivity checks.

5.5.1 Financial literacy and login behaviour

Table 5-5 displays the estimation results when including the scores based on the number of correct answers respondents provided for each of the financial literacy concepts (and self-assessed financial literacy being a scale variable): the score on the numeracy and financial knowledge questions, the score in the Vocabulary test and the score on the Pension knowledge test. The coefficients of the pension knowledge variables were estimated using strict grading— a question was either entirely correct or not at all.

Participants who scored one point higher on the pension knowledge test, have a predicted probability of 2.7 percentage points to log in to their DPE. Regarding the other financial literacy concepts, there were no differences in login behaviour for different scores on the vocabulary test,

numeracy and financial knowledge questions or for differences in self-assessed financial literacy. All financial literacy constructs are jointly significant at the 1%-level. Regarding the behavioural factors, a more positive attitude towards pension information and higher pension-related need for cognition was associated with an estimated login probability of 4.7 percentage points and 2.3 percentage points respectively. Surprisingly, participants who are more forward-looking, were 3.3 percentage points less likely to log in. Re-estimating the model for different age groups might shed more light on the negative coefficient of future time perspective. Considering demographic factors, the estimated login probability differed only marginally for different age. Furthermore, participants with a low education level were less likely to log in (8.2 percentage points) than participants with a medium education level. We did not find any differences in login probabilities between participants with medium and high education levels. As the summary statistics in Section 5.3 already have suggested, men were more likely to log in than women (6.2 percentage points). Additionally, there is evidence that younger participants were more likely to login than older participants[25]. The findings regarding the demographics are in line with Bauer et al. (2017).

Table 5-6 presents the estimated coefficients when including each numeracy, financial knowledge and pension knowledge question rather than counting the number of correct answers. Participants who answered the question on interest rates correctly (the first in the set of questions of Lusardi and Mitchell), were 9.7 percentage points more likely to log in than participants who did not know the answer or gave an incorrect answer. Furthermore, participants who answered the first and fourth pension knowledge question correctly (factors influencing the workplace pension scheme and why pension funds invest money in shares) were more likely to log in than participants who did not answer those questions correctly. The numeracy and financial knowledge questions, the pension knowledge questions and all variables measuring financial literacy are jointly significant (see F-tests at the bottom of Table 5-6).

The coefficients of the behavioural factors and demographic variables have a similar magnitude and standard errors as in Table 5-3— coefficients are reported in Appendix B. So far, we have seen that from the financial literacy variables, pension knowledge and to a certain extent numeracy can be important determinants—next to behavioural characteristics like attitudes towards pension

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[25] Note that the coefficient of the square is only statistically significant at the 10% level, suggesting that the probability of logging in is (linearly) decreasing in age. See Figure 5A-5 in the Appendix for a density plot of the age distribution of participants by login behaviour.

information— of characterising the individuals who are more likely to log in and to take a look at their pension information.

Table 5- 5: Estimation results of login behaviour (total sample)

	(1) Probability of logging in	(2) se
Self-assessed financial knowledge (1-7)	0.001	(0.010)
Score on Numeracy and financial knowledge questions (0-4)	0.005	(0.014)
Score Vocabulary test (0-9)	-0.004	(0.003)
Score Pension knowledge, strict grading (0-4)	**0.027***	(0.009)
Attitudes PIB - negative to positive	**0.047***	(0.013)
NFC General- low to high	0.014	(0.011)
NFC Pension information - low to high	**0.023**	(0.010)
Future time perspective - low to high	**-0.033**	(0.015)
Age (in years)	**-0.011**	(0.005)
Age (squared)	0.000*	(0.000)
Low education dummy	**-0.082***	(0.020)
High education dummy	-0.009	(0.020)
Male (=1)	**0.062***	(0.018)
Observations	1,351	
R-squared	0.052	
F-test FL variables (p-value)	0.004	
F-test NFC variables (p-value)	0.033	
F-test all beh. vars (p-value)	0.001	
F-test age variables (p-value)	0.006	

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Those are the estimates for the total sample. Estimates for the employee and customers subsamples can be found in the Appendix. Clustered standard errors in parentheses (at the level of the employer of the participants). FL index is a simple measure of the number of the classic financial literacy questions answered correctly (0-4). Additional covariates are: attitudes towards pension information, need for cognition (NFC general and pension-related), and future time perspective (FTP). Furthermore, I controlled for gender, age and its square, education level, household net income level, household type, whether there are children living at home and whether the respondent is part of the customer subsample. Medium education level and median income level (between 3,001 and 3,500 EUR) are the reference group. Note also that pooling NFC general and pension-related NFC does not change our estimates. Ho of the F-tests is respectively whether al coefficients of the mentioned group are equal to zero.

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Table 5- 6: Estimation results of login behaviour (total sample), numeracy and financial and pension knowledge questions included separately

	(1) Probability of logging in	(2) se
Self-assessed financial knowlegde (1-7)	0.002	(0.010)
Interest question correct (=1)	**0.097*****	(0.029)
Inflation question correct (=1)	-0.018	(0.040)
Risk div. question correct (=1)	0.019	(0.022)
Bond pricing question correct (=1)	-0.017	(0.023)
PK Q1 correct (strict)	**0.032****	(0.015)
PK Q2 correct (strict)	0.011	(0.023)
PK Q3 correct (strict)	-0.038	(0.033)
PK Q4 correct (strict)	**0.055*****	(0.020)
Score Vocabulary test (0-9)	**-0.004***	(0.003)
Age (in years)	**-0.010****	(0.005)
Age (squared)	**0.000***	(0.000)
Low education dummy	**-0.081*****	(0.019)
High education dummy	-0.008	(0.019)
Male (=1)	**0.062*****	(0.019)
Observations	1,351	
R-squared	0.055	
F-test Numeracy and fin. knowledge questions (p-value)	0.000	
F-test Pension knowledge questions (p-value)	0.001	
F-test FL variables (p-value)	0.000	
F-test NFC variables (p-value)	0.004	
F-test all beh. vars (p-value)	0.000	
F-test age variables (p-value)	0.003	

Notes: *** p<0.01, ** p<0.05, * p<0.1. Those are the estimates for the total sample. Estimates for the employee and customers subsamples can be found in the Appendix. Clustered standard errors in parentheses (at the level of the employer of the participants). Interest, inflation, risk diversification and bond prices refer to the questions developed by Lusardi and Mitchell. The same covariates and reference categories are used as in previous analyses. Ho of the F-tests is respectively whether al coefficients of the mentioned group are equal to zero.

5.5.2 Interacting financial literacy with behavioural factors

In order to explore whether attitudes towards pension information, need for cognition and future time perspective have an impact on the relationship between financial literacy and login behaviour, equation (4.2) has been estimated. Table 5-7 presents the estimation results with the first three columns including interaction terms of each financial literacy concept with attitudes, need for cognition and future time perspective respectively. The last column contains a model including all three sets of interactions. As already noted in Section 5.4, we multiplied the financial literacy variable with a binary behavioural variable in order to facilitate an easy to grasp interpretation. For the first three models, all interaction terms (with a single exception) are not statistically significant (neither marginally nor jointly), implying that there is no evidence that attitudes, need for cognition and future time perspective have an impact on the association between financial literacy and log in. The same holds for the specification with interactions with all three behavioural factors.

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Table 5- 7: Estimation results with interactions between financial literacy variables and behavioural factors

	(1) Probability of logging in - attitudes IT	(2) Probability of logging in - NFC IT	(3) Probability of logging in - FTP IT	(4) Probability of logging in - All IT
SAFL*attitude	0.003			-0.000
	(0.016)			(0.019)
NumFin*attitude	0.015			0.016
	(0.024)			(0.031)
Vocabulary*attitude	0.004			-0.002
	(0.007)			(0.007)
PK*attitude	-0.013			-0.012
	(0.016)			(0.022)
SAFL*NFC		0.009		0.013
		(0.013)		(0.014)
NumFin*NFC		-0.004		-0.012
		(0.017)		(0.020)
Vocabulary*NFC		**0.015**		**0.014***
		(0.007)		(0.008)
PK*NFC		-0.012		-0.017
		(0.030)		(0.040)
SAFL*FTP			-0.011	-0.015
			(0.010)	(0.010)
NumFin*FTP			0.008	0.009
			(0.019)	(0.018)
Vocabulary*FTP			0.006	0.002
			(0.007)	(0.008)
PK*FTP			0.027	0.032
			(0.028)	(0.034)
Observations	1,351	1,351	1,351	1,351
R-squared	0.049	0.051	0.050	0.052
F-test all beh. vars (p-value)	0.629	0.000	0.000	0.463
F-test all attitudes IT (p-value)	0.575			0.945
F-test all FL (p-value)	0.005	0.000	0.000	0.000
F-test all NFC IT (p-value)		0.126		0.218
F-test all FTP IT (p-value)			0.149	0.290

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. SAFL, NFC, PK, FTP and IT refer to self-assessed financial knowledge, need for cognition, pension knowledge, future time perspective and interaction term respectively. Clustered standard errors in parentheses (at the employer level). The covariates are identical to previous analyses. See Appendix B for all estimated coefficients.

5.6 Sensitivity checks

Lenient scale pension knowledge

As a first sensitivity check of the estimation results, the results from Section 5.1 were re-estimated using an alternative scale to measure pension knowledge. See Table 5-8 for the estimation results. We broke down how many of the possible correct answers have been chosen: There were four questions testing pension knowledge with some questions having multiple correct answers resulting in a total of

seven possible correct answers. This resulted in a scale from 0-7. The coefficients of this specification are reported in column 1 of Table 5-8.

Regarding the specification with dummies for each numeracy/financial knowledge and pension knowledge question (column 3 in Table 5-8), a strong association can be found between knowing how interest compounding works and the probability to log in to the DPE. Regarding pension knowledge, participants who knew that the amount of years they have worked until retirement influence the workplace pension (Q1.2) and participants who knew that pension funds invest in shares in order to obtain a larger return in the long run (Q.4) were more likely to log in by 10.4 and 5.1 percentage points respectively. Additionally, participants who knew that if their partner stopped with working, their future pension could be affected, had a lower estimated probability (3.7 percentage points) to log in than participants who did not know this.

Differences in login behaviour by age categories

5

As people's preferences to the extent to which they wish to be informed about their pension and people's time preference can differ by age, estimating the probability to log in separately for different age groups can give more sensible results which also might explain the estimation results from the previous sub-sections. The estimation results are shown in Table 5-9. The division of the age categories correspond with the age categories used in the field experiments that generated the data of this study (see Dinkova et al., 2018a, 2018b). The sample is divided in three age categories: young (18-34 years), middle (35-54 years) and senior (55-65 years).

For young participants, there were no differences in login behaviour due to differences in financial literacy levels. From the behavioural factors, only the coefficient of future time perspective is statistically significant. As in Section 5.1, the association between the estimated probability to log in and future time perspective is negative, implying that young participants with stronger preferences for present benefits rather than future benefits logged in more often.

Zooming in on the middle-aged participants gives a different picture: Participants with higher self-assessed financial knowledge, higher pension knowledge and a lower vocabulary score (though the coefficient is close to zero) were more likely to log in. Regarding the behavioural factors, middle-aged participants who had a higher need to be informed about pensions (pension-related NFC) and who valued present benefits more than future benefits logged in more often.

Table 5- 8: Estimation results using lenient grading (pension knowledge)

	(1) Probability of logging in	(2) se	(3) Probability of logging in	(4) se
Self-assessed financial knowledge (1-7)	0.003	(0.010)	0.002	(0.010)
Score on classic financial literacy questions (0-4)	0.009	(0.014)		
Interest question correct (=1)			**0.094***	(0.034)
Inflation question correct (=1)			-0.023	(0.040)
Risk div. question correct (=1)			0.027	(0.022)
Bond pricing question correct (=1)			-0.018	(0.024)
Score Pension knowledge, lenient grading (0-7)	0.008	(0.005)		
PK Q1.1 correct (lenient)			-0.021	(0.017)
PK Q1.2 correct (lenient)			**0.104***	(0.025)
PK Q2 correct (lenient)			0.009	(0.021)
PK Q3.1 correct (lenient)			**-0.037***	(0.013)
PK Q3.2 correct (lenient)			-0.000	(0.015)
PK Q3.3 correct (lenient)			0.028	(0.036)
PK Q4 correct (lenient)			**0.051**	(0.022)
Score Vocabulary test (0-9)	-0.004	(0.003)	**-0.006**	(0.003)
Attitudes PIB - negative to positive	**0.048***	(0.013)	**0.047***	(0.013)
NFC General	0.014	(0.011)	0.012	(0.013)
NFC Pension information	**0.024**	(0.010)	**0.026***	(0.008)
Future time perspective	**-0.032**	(0.015)	**-0.032**	(0.015)
Age (in years)	**-0.010***	(0.005)	**-0.008***	(0.005)
Age (squared)	0.000	(0.000)	0.000	(0.000)
Low education dummy	**-0.081***	(0.020)	**-0.086***	(0.019)
High education dummy	-0.010	(0.020)	-0.001	(0.018)
Male (=1)	**0.062***	(0.018)	**0.062***	(0.019)
Observations	1,351		1,351	
R-squared	0.050		0.059	
F-test FL variables (p-value)	0.121		0.000	
F-test NFC variables (p-value)	0.023		0.004	
F-test all beh. vars (p-value)	0.002		0.000	
F-test age variables (p-value)	0.016		0.001	
F-test Numeracy and fin. knowledge questions (p-value)			0.000	
F-test Pension knowledge questions (p-value)			0.000	

Notes: *** p<0.01, ** p<0.05, * p<0.1. Estimates are for the total sample. Clustered standard errors in parentheses (at the level of the employer of the participants). The first two columns are the estimation results for the specification including the scores of the financial literacy constructs and the corresponding standard errors respectively. The last two columns are the estimation results for the specification including dummies per numeracy/financial knowledge and pension knowledge question. The same set of covariates has been included as in previous analyses (with the same reference categories). Estimation results per sub-sample and including all covariates are in the Appendix.

Concerning the senior age group, participants with a higher self-assessed financial knowledge were less likely to log in. At the same time, senior participants with more positive attitudes towards pension information and who had a stated preference for future benefits rather than present benefits were more likely to log in. Note that the standard errors of all coefficients for the model for the middle-aged group are smaller than the model for the young and senior group as 57% of the total sample belong to the middle-aged group. Summing up, we can observe that financial literacy appears to be more relevant for middle-aged and senior participants. Furthermore, future time perspective is

relevant for all three age groups implying that young and middle-aged participants who log in are typically more impatient compared to young and middle-aged participants who did not log in; senior participants who logged in were, on average, more patient.

Table 5- 9: Estimation results by age category

	Age ∈ [18, 34]		Age ∈ [35, 54]		Age ∈ [55, 65]	
	(1) Probability of logging in	(2) se	(3) Probability of logging in	(4) se	(5) Probability of logging in	(6) se
Self-assessed financial knowledge (1-7)	0.001	(0.028)	**0.021*****	(0.007)	**-0.048*****	(0.012)
Score on classic financial literacy questions (0-4)	-0.012	(0.017)	0.013	(0.018)	-0.006	(0.015)
Score Pension knowledge, strict grading (0-4)	**0.039***	(0.020)	**0.023****	(0.011)	0.006	(0.015)
Score Vocabulary test (0-9)	0.009	(0.009)	**-0.007****	(0.003)	-0.001	(0.006)
Attitudes PIB - negative to positive	**0.106***	(0.059)	0.017	(0.012)	**0.080*****	(0.017)
NFC General	0.013	(0.054)	0.002	(0.011)	**0.054***	(0.028)
NFC Pension information	0.048	(0.032)	**0.026****	(0.011)	-0.012	(0.023)
Future time perspective	**-0.113*****	(0.041)	**-0.051****	(0.021)	**0.091*****	(0.025)
Age (in years)	0.134	(0.101)	-0.035	(0.023)	0.161	(0.147)
Age (squared)	-0.002	(0.002)	0.000	(0.000)	-0.001	(0.001)
Low education dummy	-0.087	(0.097)	**-0.111*****	(0.032)	**-0.042***	(0.023)
High education dummy	0.043	(0.044)	-0.033	(0.022)	-0.029	(0.031)
Male (=1)	0.024	(0.043)	**0.076*****	(0.015)	0.036	(0.028)
Observations	239		779		333	
R-squared	0.105		0.068		0.115	
F-test FL variables (p-value)	0.335		0.000		0.004	
F-test NFC variables (p-value)	0.293		0.007		0.164	
F-test all beh. vars (p-value)	0.017		0.003		0.000	
F-test age variables (p-value)	0.417		0.215		0.544	

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Clustered standard errors in parentheses (at the level of the employer of the participants). The same set of covariates has been included as in previous analyses (with the same reference categories). Estimation results per sub-sample and including all covariates are in the Appendix.

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5.7 Discussion and conclusion

With this study we sought to investigate whether multi-dimensional financial literacy (extended by a pension knowledge and vocabulary test) can explain the login behaviour of people to their digital pension environment, next to behavioural factors like attitudes towards pension information, need for cognition and future time perspective. We combined data on login behaviour of participants into a digital environment with survey data measuring financial literacy constructs, behavioural constructs and demographics. A financial literacy construct has been proposed consisting of numeracy and financial knowledge, pension knowledge, literacy in its original sense and perceived financial knowledge. People with higher pension knowledge and knowledge about the concept of interest compounding were more likely to log in to the DPE. Attitudes, need for cognition and future time perspective are directly related with login behaviour. The relationship between financial literacy and login behaviour is not affected by behavioural factors.

There are several limitations that should be considered. First, as only the behaviour of participants who completed the survey could be analysed, the sample is not representative (not even for the population of pension plan participants). Hence, the estimated results are associations[26]. Secondly, the employee sub-sample, which is larger than the customers sub-sample, is a selection of people who already have a higher affinity with the financial sector than the average Dutch individual. This implies that the variation of the individual characteristics within the sample might not be large enough in order to explain differences in login behaviour. The customer sub-sample, although being more representative as those participants worked for many different companies, is considerably smaller than the employee sample. By pooling the employee and customer subsample, the mass and variation has been increased.

Nonetheless, there are two main contributions that crystallise: First, this study linked real behaviour (login behaviour) with financial literacy and other behavioural characteristics and secondly, a concept of financial literacy has been proposed using insights from other disciplines. The value added of including psychological factors when explaining economic decision making has been demonstrated in this study: Attitudes towards pension information and need for cognition are directly related to login behaviour. Taking the aforementioned psychological factors into account when analysing pension information behaviour can (at least partially) capture unobserved heterogeneity due

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[26] Even if the sample was representative, the results would not have a causal interpretation due to the endogeneity of financial literacy.

to the (lack of) motivation of people to delve into their pension information. More empirical work with larger (representative) samples linking real behaviour and eliciting knowledge, attitudes and preferences towards pensions and pension information is needed to understand what pushes and pulls people to delve into their pension situation. Lab experiments can also be very useful in this area, as then researchers could get more insights into what goes through the participants' head when they are confronted with a set of questions or a digital portal they are asked to enter. Furthermore, lab experiments can help to understand why behavioural factors are directly related to login behaviour but do not affect the relationship between financial literacy and login behaviour. This would be particularly useful when understanding the rationale of participants regarding time preferences, attitudes or need for cognition.

Going one step further, one could argue that providing only financial education in the classical sense is not enough, but it should be designed to create an affinity with the topic. Although not exactly in the pension context, an example of how one can increase people's knowledge about a topic on the one hand and motivation to deal with it at the other is the Money Week organised by the Money Wise Platform in the Netherlands. During this week, many financial institutions are involved in for instance visiting schools and teaching children in game-like situations how to deal with money. A game developed especially for the Money Week, the Cash quiz, is a good example of a tool that conveys knowledge and at the same time— as it is a game— tickles the competitive nature of (very young) individuals to increase their motivation to deal with money. Developing a pension game is probably not an easy task, but a first step could be for pension plan providers to offer a short quiz testing one's pension knowledge before one logs in to the digital pension environment. Alternatively, employers could take responsibility and offer once in a while a question on pensions before people log in to their workplace and subsequently provide the correct answer.

Acknowledgements

Appendices

A. A schematic overview of the tested hypotheses and Additional descriptive statistics
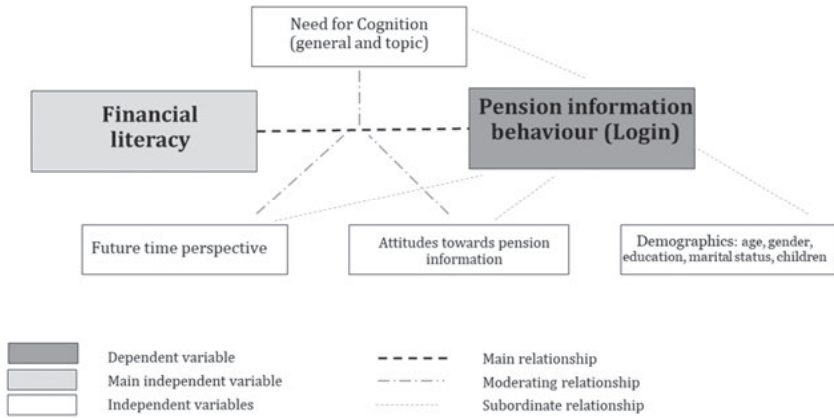
Figure 5A- 1: Schematic visualisation of the relation between constructs
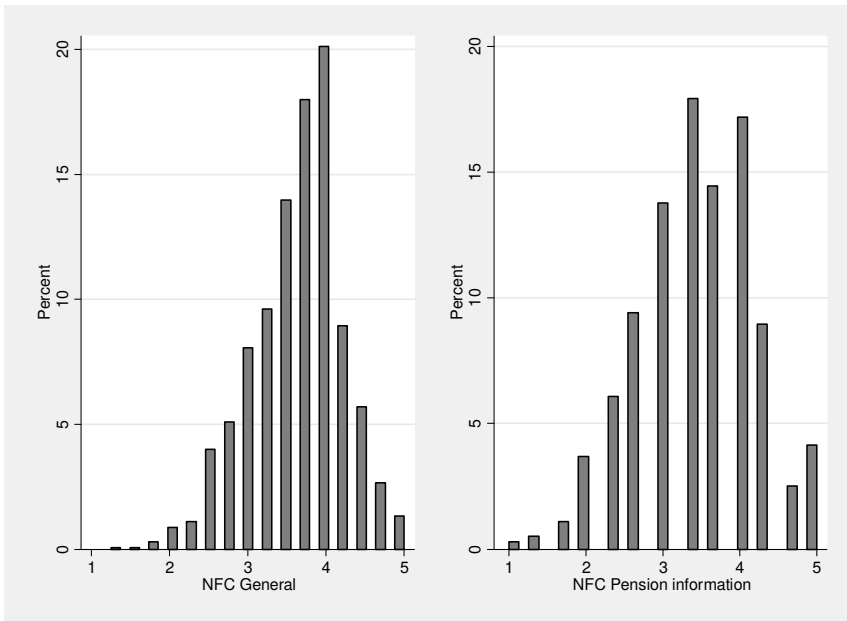
Figure 5A- 2: Histogram for general and pension-related need for cognition
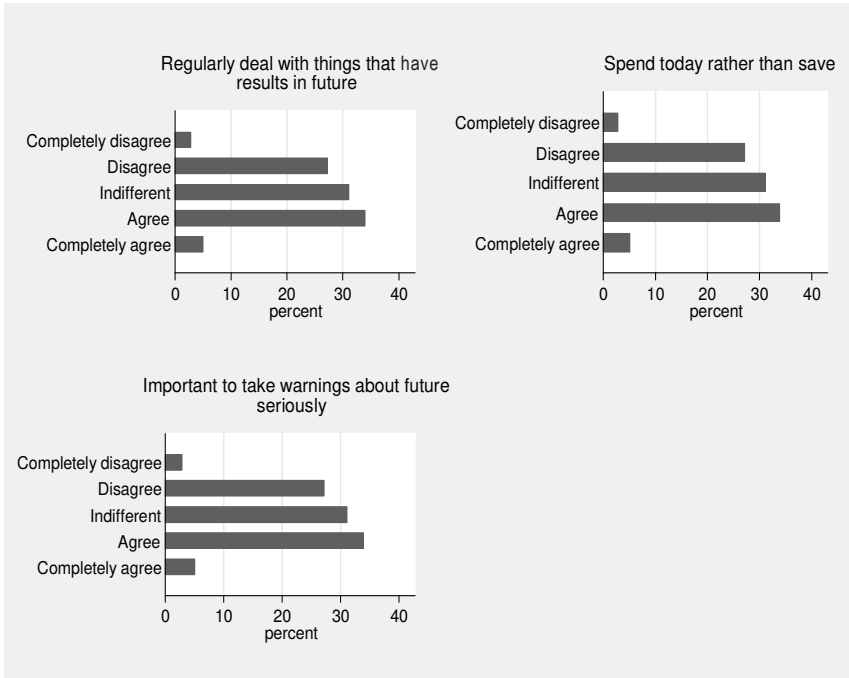
Figure 5A- 3: Distribution of answers to questions on future time perspective (in percentages)
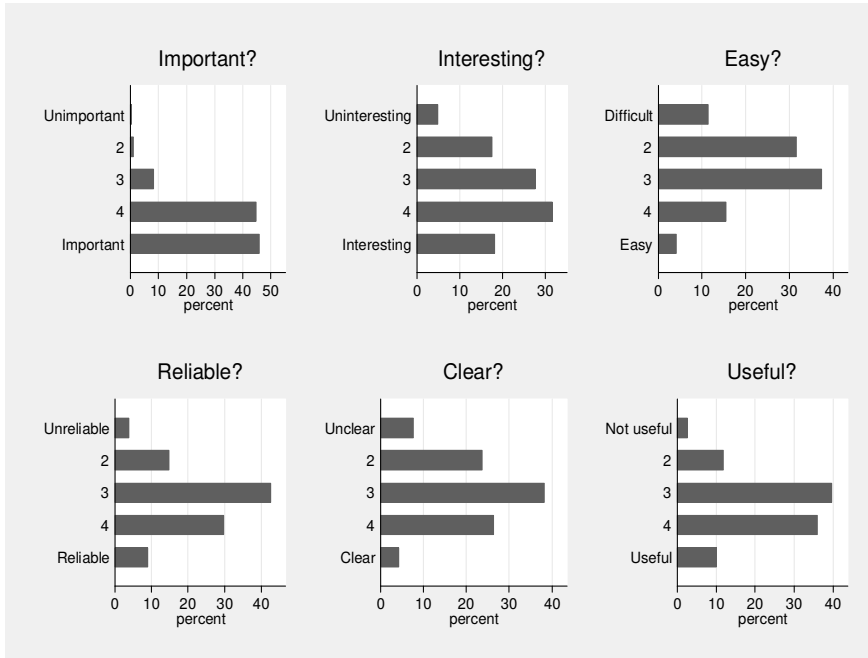
Figure 5A- 4: Distribution of answers to questions about attitudes towards pension information (in percentages)
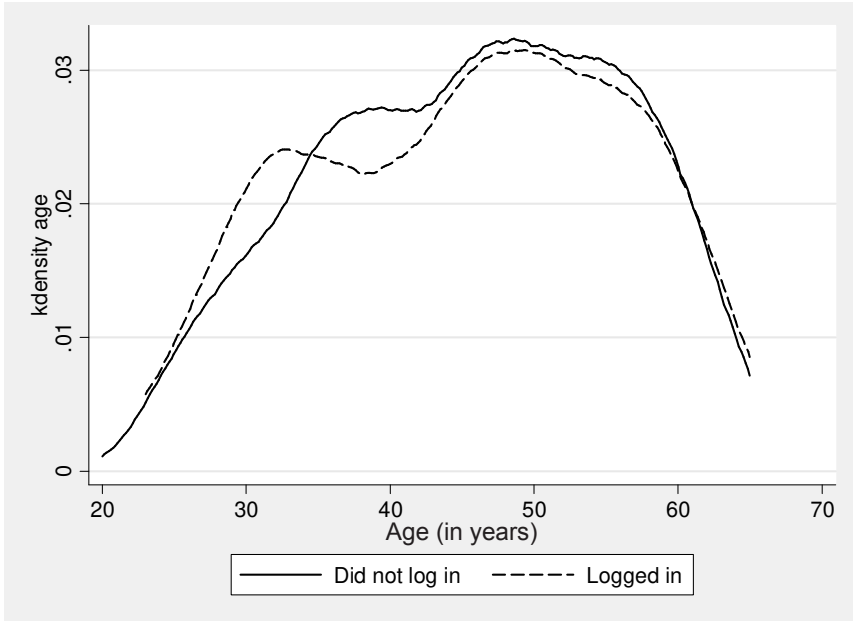
Figure 5A- 5: Density plot of age (in years) by login behaviour

Table 5A- 1: Summary statistics of all covariates (dummies per Numeracy and Financial knowledge questions and Pension knowledge)

Variable	Observations	Mean	Sd	Min	Max
Logged in (dummy)	1,351	0.19	0.39	0	1
Self-assessed financial knowledge (1-7)	1,351	5.09	1.18	1	7
Score on classic financial literacy questions (0-4)	1,351	3.17	0.80	0	4
Score Vocabulary test (0-9)	1,351	6.60	2.39	0	9
Score Pension knowledge, strict grading (0-4)	1,351	2.43	0.81	0	4
Score Pension knowledge, lenient grading (0-7)	1,351	5.50	1.24	0	7
Attitudes PIB - negative to positive	1,351	3.34	0.62	1.33	5
NFC General	1,351	3.64	0.61	1.25	5
NFC Pension information	1,351	3.43	0.76	1	5
Future time perspective	1,351	3.43	0.58	1.33	5
Age (in years)	1,351	45.58	10.48	20	65
Low education dummy (=1)	1,351	0.10	0.30	0	1
High education dummy (=1)	1,351	0.57	0.49	0	1
Male (=1)	1,351	0.68	0.47	0	1
Income category: <2,000	1,351	0.13	0.33	0	1
Income category: EUR 2,001 - EUR 2,500	1,351	0.11	0.32	0	1
Income category: EUR 2,501 - EUR 3,000	1,351	0.12	0.33	0	1
Income category: EUR 3,501 - EUR 4,000	1,351	0.12	0.33	0	1
Income category: EUR 4,001 - EUR 4,500	1,351	0.12	0.32	0	1
Income category: EUR 4,501 - EUR 5,000	1,351	0.12	0.32	0	1
Income category: > EUR 7,500	1,351	0.02	0.14	0	1
Single household (=1)	1,351	0.20	0.40	0	1
Other household (=1)	1,351	0.00	0.05	0	1
Children living at home (=1)	1,351	0.55	0.50	0	1
Part of customer subsample (=1)	1,351	0.38	0.49	0	1

Table 5A- 2: Percentage share per type of answer for the pension knowledge questions (lenient grading scheme)

Pension knowledge (lenient)		Q1: Workplace pension		Q2: State pension	Q3: Life changes and pension			Q4: Pension funds
		Q1.1	Q1.2	Q2	Q3.1	Q3.2	Q3.3	Q4
	Correct	81.87	94.23	77.65	33.60	75.50	95.34	91.86
	Incorrect	18.13	5.77	8.22	66.40	24.50	4.66	1.78
	DK	N/A	N/A	14.14	N/A	N/A	N/A	6.37

Notes: There were seven possible correct answers in four questions. The means are computed whether the respective answer has been given (=correct) or not given (=incorrect) or, for questions 2 and 4, the don't know option has been chosen.

B. Empirical results

Table 5A- 3: Complete estimation results (total sample, scores of FL variables)

	(1) Total	(2) se	(3) Total	(4) se
SAFL (1-7)	0.001	(0.010)	0.003	(0.010)
Score on classic financial literacy questions (0-4)	0.005	(0.014)	0.009	(0.014)
Score Vocabulary test (0-9)	-0.004	(0.003)	-0.004	(0.003)
Score Pension knowledge, strict grading (0-4)	0.027***	(0.009)		
Score Pension knowledge, lenient grading (0-7)			0.008	(0.005)
Attitudes PIB - negative to positive	0.047***	(0.013)	0.048***	(0.013)
NFC General	0.014	(0.011)	0.014	(0.011)
NFC Pension information	0.023**	(0.010)	0.024**	(0.010)
Future time perspective	-0.033**	(0.015)	-0.032**	(0.015)
Age (in years)	-0.011**	(0.005)	-0.010*	(0.005)
Age (squared)	0.000*	(0.000)	0.000	(0.000)
Low education dummy	-0.082***	(0.020)	-0.081***	(0.020)
High education dummy	-0.009	(0.020)	-0.010	(0.020)
Male (=1)	0.062***	(0.018)	0.062***	(0.018)
Income category: <2,000	0.053*	(0.031)	0.049	(0.031)
Income category: EUR 2,001 - EUR 2,500	0.086***	(0.027)	0.084***	(0.027)
Income category: EUR 2,501 - EUR 3,000	0.009	(0.018)	0.007	(0.018)
Income category: EUR 3,501 - EUR 4,000	0.031*	(0.017)	0.031*	(0.017)
Income category: EUR 4,001 - EUR 4,500	0.059**	(0.022)	0.058**	(0.022)
Income category: EUR 4,501 - EUR 5,000	0.057***	(0.018)	0.055***	(0.018)
Income category: > EUR 7,500	-0.031***	(0.008)	-0.034***	(0.008)
Single household (=1)	-0.046**	(0.020)	-0.045**	(0.020)
Other household (=1)	-0.021	(0.156)	-0.022	(0.144)
Children living at home (=1)	-0.007	(0.013)	-0.006	(0.014)
Participated in experiment 2(=1)	-0.107***	(0.021)	-0.107***	(0.021)
Observations	1,351		1,351	
R-squared	0.052		0.050	
F-test FL variables (p-value)	0.004		0.121	
F-test NFC variables (p-value)	0.033		0.023	
F-test all beh. vars (p-value)	0.001		0.002	
F-test age variables (p-value)	0.006		0.016	

Notes: *** p<0.01, ** p<0.05, * p<0.1. Clustered standard errors in parentheses (at the level of the employer of the participants). Medium education level and median income level (between 3,001 and 3,500 EUR) are the reference group. Note also that pooling NFC general and pension-related NFC does not change our estimates.

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Table 5A- 4: Estimation results by subsample

	(1) Employee subsample	(2) se	(3) Customer subsample	(4) se	(5) Employee subsample	(6) se	(7) Customer subsample	(8) se
SAFL (1-7)	-0.012	(0.016)	0.019	(0.014)	-0.011	(0.016)	0.021	(0.013)
Score on classic financial literacy questions (0-4)	0.022	(0.021)	-0.019	(0.020)	0.026	(0.021)	-0.016	(0.019)
Score Vocabulary test (0-9)	-0.004	(0.008)	-0.005	(0.006)	-0.004	(0.008)	-0.005	(0.006)
Score Pension knowledge, strict grading (0-4)	0.031	(0.019)	0.023	(0.019)				
Score Pension knowledge, lenient grading (0-7)					0.006	(0.013)	0.009	(0.010)
Attitudes PIB - negative to positive	0.057*	(0.030)	0.025	(0.032)	0.059**	(0.030)	0.024	(0.032)
NFC General	0.023	(0.028)	-0.003	(0.023)	0.022	(0.028)	-0.001	(0.023)
NFC Pension information	0.030	(0.025)	0.012	(0.025)	0.030	(0.025)	0.013	(0.025)
Future time perspective	-0.048*	(0.028)	0.001	(0.026)	-0.047*	(0.028)	0.003	(0.026)
Age (in years)	-0.009	(0.014)	-0.012	(0.012)	-0.008	(0.014)	-0.012	(0.012)
Age (squared)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Low education dummy	-0.075	(0.051)	-0.080*	(0.045)	-0.077	(0.051)	-0.076*	(0.046)
High education dummy	0.017	(0.035)	-0.039	(0.036)	0.017	(0.035)	-0.041	(0.036)
Male (=1)	0.082**	(0.034)	0.023	(0.028)	0.083**	(0.034)	0.022	(0.028)
Income category: <2,000	0.045	(0.078)	0.055	(0.059)	0.042	(0.078)	0.052	(0.058)
Income category: EUR 2,001 - EUR 2,500	0.069	(0.059)	0.108*	(0.056)	0.066	(0.059)	0.106*	(0.057)
Income category: EUR 2,501 - EUR 3,000	-0.000	(0.050)	0.015	(0.051)	-0.004	(0.050)	0.014	(0.050)
Income category: EUR 3,501 - EUR 4,000	0.040	(0.047)	0.036	(0.055)	0.041	(0.048)	0.034	(0.056)
Income category: EUR 4,001 - EUR 4,500	0.078	(0.050)	0.040	(0.066)	0.076	(0.050)	0.042	(0.067)
Income category: EUR 4,501 - EUR 5,000	0.071	(0.051)	0.049	(0.054)	0.069	(0.051)	0.047	(0.054)
Income category: > EUR 7,500	-0.033	(0.077)			-0.036	(0.077)		
Single household (=1)	-0.026	(0.045)	-0.058	(0.045)	-0.025	(0.045)	-0.057	(0.045)
Other household (=1)	0.202	(0.365)	-0.287***	(0.062)	0.175	(0.358)	-0.276***	(0.060)
Children living at home (=1)	-0.009	(0.034)	0.003	(0.038)	-0.009	(0.034)	0.005	(0.038)
Observations	840		511		840		511	
R-squared	0.044		0.044		0.042		0.042	
F-test FL variables (p-value)	0.245		0.252		0.635		0.304	
F-test NFC variables (p-value)	0.306		0.892		0.315		0.871	
F-test all beh. vars (p-value)	0.022		0.808		0.019		0.793	
F-test age variables (p-value)	0.527		0.112		0.656		0.136	

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. For the specification for the employee subsample, we computed heteroskedasticity-robust standard errors and for the specification for the customer subsample, we clustered the standard errors at the employer level. Medium education level and median income level (between 3,001 and 3,500 EUR) are the reference group. Note also that pooling NFC general and pension-related NFC does not change our estimates.

Table 5A- 5: Estimation results (all covariates) when including dummy per numeracy, financial and pension knowledge questions – total sample

	(1) Probability of logging in	(2) se	(3) Probability of logging in	(4) se
SAFL (1-7)	0.002	(0.010)	0.002	(0.010)
Interest question correct (=1)	0.097***	(0.029)	0.094***	(0.034)
Inflation question correct (=1)	-0.018	(0.040)	-0.023	(0.040)
Risk div. question correct (=1)	0.019	(0.022)	0.027	(0.022)
Bond pricing question correct (=1)	-0.017	(0.023)	-0.018	(0.024)
PK Q1 correct (strict)	0.032**	(0.015)		
PK Q2 correct (strict)	0.011	(0.023)		
PK Q3 correct (strict)	-0.038	(0.033)		
PK Q4 correct (strict)	0.055***	(0.020)		
PK Q1.1 correct (lenient)			-0.021	(0.017)
PK Q1.2 correct (lenient)			0.104***	(0.025)
PK Q2 correct (lenient)			0.009	(0.021)
PK Q3.1 correct (lenient)			-0.037***	(0.013)
PK Q3.2 correct (lenient)			-0.000	(0.015)
PK Q3.3 correct (lenient)			0.028	(0.036)
PK Q4 correct (lenient)			0.051**	(0.022)
Score Vocabulary test (0-9)	-0.004*	(0.003)	-0.006**	(0.003)
Attitudes PIB - negative to positive	0.047***	(0.014)	0.047***	(0.013)
NFC General	0.010	(0.012)	0.012	(0.013)
NFC Pension information	0.026***	(0.008)	0.026***	(0.008)
Future time perspective	-0.033**	(0.015)	-0.032**	(0.015)
Age (in years)	-0.010**	(0.005)	-0.008*	(0.005)
Age (squared)	0.000*	(0.000)	0.000	(0.000)
Low education dummy	-0.081***	(0.019)	-0.086***	(0.019)
High education dummy	-0.008	(0.019)	-0.001	(0.018)
Male (=1)	0.062***	(0.019)	0.062***	(0.019)
Income category: <2,000	0.063*	(0.032)	0.066**	(0.032)
Income category: EUR 2,001 - EUR 2,500	0.085***	(0.026)	0.084***	(0.026)
Income category: EUR 2,501 - EUR 3,000	0.008	(0.018)	0.008	(0.018)
Income category: EUR 3,501 - EUR 4,000	0.030	(0.018)	0.035**	(0.017)
Income category: EUR 4,001 - EUR 4,500	0.062***	(0.022)	0.066***	(0.020)
Income category: EUR 4,501 - EUR 5,000	0.057***	(0.017)	0.057***	(0.017)
Income category: > EUR 7,500	-0.026***	(0.009)	-0.028***	(0.009)
Single household (=1)	-0.044**	(0.020)	-0.045**	(0.019)
Other household (=1)	-0.006	(0.146)	0.005	(0.131)
Children living at home (=1)	-0.011	(0.014)	-0.013	(0.014)
Participated in experiment 2(=1)	-0.110***	(0.021)	-0.108***	(0.022)
Observations	1,351		1,351	
R-squared	0.055		0.059	
F-test Numeracy and fin. knowledge questions (p-value)	0.000		0.000	
F-test Pension knowledge questions (p-value)	0.001		0.000	
F-test FL variables (p-value)	0.000		0.000	
F-test NFC variables (p-value)	0.004		0.004	
F-test all beh. vars (p-value)	0.000		0.000	
F-test age variables (p-value)	0.003		0.001	

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Those are the estimates for the total sample. Clustered standard errors in parentheses (at the level of the employer of the participants). Interest, inflation, risk diversification and bond prices refer to the questions developed by Lusardi and Mitchell. SAFL refers to self-assessed financial literacy (on a 7-point Likert scale). PK refer to the pension knowledge questions. I controlled for attitudes towards pension information, need for cognition (NFC general and pension-related), and future time perspective (FTP). Note also that pooling NFC general and pension-related NFC does not change the estimates.

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Table 5A- 6: Estimation results (all covariates) when including dummy per numeracy, financial and pension knowledge questions – per subsample

	(1) Employee subsample	(2) se	(3) Customer subsample	(4) se	(5) Employee subsample	(6) se	(7) Customer subsample	(8) se
SAFL (1-7)	-0.012	(0.016)	0.020	(0.013)	-0.012	(0.016)	0.021	(0.014)
Interest question correct (=1)	0.035	(0.078)	0.128***	(0.032)	0.014	(0.080)	0.134***	(0.032)
Inflation question correct (=1)	0.051	(0.050)	-0.067	(0.052)	0.049	(0.050)	-0.070	(0.051)
Risk div. question correct (=1)	0.006	(0.049)	0.027	(0.045)	0.017	(0.050)	0.037	(0.045)
Bond pricing question correct (=1)	0.011	(0.030)	-0.082**	(0.032)	0.013	(0.030)	-0.085***	(0.031)
Score Vocabulary test (0-9)	-0.004	(0.008)	-0.005	(0.006)	-0.006	(0.008)	-0.006	(0.006)
PK Q1 correct (strict)	0.020	(0.035)	0.038	(0.033)				
PK Q2 correct (strict)	0.048	(0.040)	-0.019	(0.037)				
PK Q3 correct (strict)	-0.047	(0.093)	-0.045	(0.061)				
PK Q4 correct (strict)	0.045	(0.058)	0.070*	(0.037)				
PK Q1.1 correct (lenient)					-0.035	(0.045)	-0.025	(0.040)
PK Q1.2 correct (lenient)					0.115	(0.074)	0.094**	(0.038)
PK Q2 correct (lenient)					0.040	(0.039)	-0.015	(0.037)
PK Q3.1 correct (lenient)					-0.040	(0.032)	-0.019	(0.028)
PK Q3.2 correct (lenient)					-0.009	(0.042)	-0.002	(0.032)
PK Q3.3 correct (lenient)					0.073	(0.063)	0.003	(0.051)
PK Q4 correct (lenient)					0.034	(0.060)	0.073*	(0.040)
Attitudes PIB - negative to positive	0.058*	(0.030)	0.017	(0.032)	0.057*	(0.030)	0.019	(0.030)
NFC General	0.022	(0.029)	-0.008	(0.024)	0.026	(0.029)	-0.009	(0.026)
NFC Pension information	0.030	(0.025)	0.026	(0.021)	0.028	(0.025)	0.027	(0.022)
Future time perspective	-0.047*	(0.028)	0.006	(0.026)	-0.045*	(0.027)	0.005	(0.027)
Age (in years)	-0.008	(0.014)	-0.011	(0.012)	-0.007	(0.014)	-0.009	(0.012)
Age (squared)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Low education dummy	-0.072	(0.051)	-0.074*	(0.042)	-0.082	(0.052)	-0.080*	(0.043)
High education dummy	0.016	(0.036)	-0.038	(0.036)	0.021	(0.036)	-0.028	(0.036)
Male (=1)	0.083**	(0.034)	0.021	(0.028)	0.084**	(0.034)	0.020	(0.028)
Income category: <2,000	0.048	(0.082)	0.073	(0.058)	0.041	(0.082)	0.083	(0.056)
Income category: EUR 2,001 - EUR 2,500	0.068	(0.059)	0.107**	(0.053)	0.067	(0.059)	0.117**	(0.053)
Income category: EUR 2,501 - EUR 3,000	0.043	(0.048)	0.024	(0.057)	0.046	(0.048)	0.035	(0.054)
Income category: EUR 3,501 - EUR 4,000	0.082	(0.050)	0.054	(0.066)	0.081	(0.050)	0.067	(0.066)
Income category: EUR 4,001 - EUR 4,500	0.069	(0.051)	0.058	(0.053)	0.070	(0.051)	0.061	(0.051)
Income category: EUR 4,501 - EUR 5,000	-0.032	(0.077)			-0.038	(0.078)		
Single household (=1)	-0.023	(0.045)	-0.057	(0.045)	-0.026	(0.045)	-0.056	(0.045)
Other household (=1)	0.225	(0.368)	-0.228***	(0.056)	0.211	(0.370)	-0.186***	(0.058)
Children living at home (=1)	-0.013	(0.035)	-0.007	(0.039)	-0.015	(0.035)	-0.007	(0.040)

I know (and) I can and I do?

Table 5.A-6 (continued)

Observations	840	511	840	511
R-squared	0.046	0.067	0.050	0.072
F-test Numeracy and fin. knowledge questions (p-value)	0.827	0.002	0.857	0.001
F-test Pension knowledge questions (p-value)	0.518	0.160	0.364	0.065
F-test FL variables (p-value)	0.561	0.001	0.316	0.000
F-test NFC variables (p-value)	0.331	0.476	0.303	0.461
F-test all beh. vars (p-value)	0.023	0.535	0.024	0.513
F-test age variables (p-value)	0.488	0.120	0.400	0.093

Notes: *** p<0.01, ** p<0.05, * p<0.1. For the specification for the employee subsample, I computed heteroskedasticity-robust standard errors and for the specification for the customer subsample, I clustered the standard errors at the employer level. Medium education level and median income level (between 3,001 and 3,500 EUR) are the reference group. Note also that pooling NFC general and pension-related NFC does not change our estimates.

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Table 5A- 7: Estimation results (all covariates)- interaction terms, total sample

	(1) Probability of logging in - attitudes IT	(2) Probability of logging in - NFC IT	(3) Probability of logging in - FTP IT	(4) Probability of logging in - All IT
SAFL (1-7)	0.003	-0.000	0.008	0.005
	(0.013)	(0.009)	(0.008)	(0.010)
Score on classic financial literacy questions (0-4)	-0.002	0.006	0.001	-0.001
	(0.020)	(0.013)	(0.013)	(0.017)
Score Vocabulary test (0-9)	-0.006*	-0.010***	-0.006	-0.010**
	(0.003)	(0.004)	(0.004)	(0.004)
Score Pension knowledge, strict grading (0-4)	0.032***	0.033**	0.018	0.027**
	(0.010)	(0.015)	(0.014)	(0.013)
Positive attitude (=1)	0.008	0.062***	0.062***	0.051
	(0.088)	(0.013)	(0.013)	(0.083)
High NFC (=1)	0.009	-0.095	0.008	-0.076
	(0.011)	(0.062)	(0.011)	(0.060)
High FTP (=1)	-0.012	-0.013	-0.088	-0.055
	(0.010)	(0.010)	(0.074)	(0.071)
SAFL*attitude	0.003			-0.000
	(0.016)			(0.019)
NumFin*attitude	0.015			0.016
	(0.024)			(0.031)
Vocabulary*attitude	0.004			-0.002
	(0.007)			(0.007)
PK*attitude	-0.013			-0.012
	(0.016)			(0.022)
SAFL*NFC		0.009		0.013
		(0.013)		(0.014)
NumFin*NFC		-0.004		-0.012
		(0.017)		(0.020)
Vocabulary*NFC		0.015**		0.014*
		(0.007)		(0.008)
PK*NFC		-0.012		-0.017
		(0.030)		(0.040)
SAFL*FTP			-0.011	-0.015
			(0.010)	(0.010)
NumFin*FTP			0.008	0.009
			(0.019)	(0.018)
Vocabulary*FTP			0.006	0.002
			(0.007)	(0.008)
PK*FTP			0.027	0.032
			(0.028)	(0.034)
Observations	1,351	1,351	1,351	1,351
R-squared	0.049	0.051	0.050	0.052
F-test all beh. vars (p-value)	0.629	0.000	0.000	0.463
F-test all attitudes IT (p-value)	0.575			0.945
F-test all FL (p-value)	0.005	0.000	0.000	0.000
F-test all NFC IT (p-value)		0.126		0.218
F-test all FTP IT (p-value)			0.149	0.290

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Clustered standard errors in parentheses (at the employer level). The covariates are identical to previous analyses.

C. Survey questions

All questions were in Dutch. The complete questionnaire in Dutch is available upon request by the corresponding author.

i.   Demographics

What is your date of birth? (DD/MM/YYYY)

What is your gender?

[] Male
[] Female

You live in the following household composition:

[] single
[] single with children living at home
[] (un)married cohabiting, without children living at home
[] (un)married cohabiting, with children living at home
[] other, namely […]

How many children do you have? (Living at home or living separately)

[0-12]

What is roughly your monthly total net household income?

[] no income
[] EUR 500 or less
[] EUR 501 to EUR 1,000
[] EUR 1,001 to EUR 1,500
[] EUR 1,501 to EUR 2,000
[] EUR 2,001 to EUR 2,500
[] EUR 2,501 to EUR 3,000
[] EUR 3,001 to EUR 3,500
[] EUR 3,501 to EUR 4,000
[] EUR 4,001 to EUR 4,500
[] EUR 4,501 to EUR 5,000
[] EUR 5,001 to EUR 7,500
[] More than EUR 7,500
[] I really don't know
[] I don't want to say

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What is your highest obtained diploma? (or educational level)

[] Elementary school
[] Lower secondary vocational education, Domestic science school [LBO, huishoudschool]
[] Pre-vocational education (middle management-oriented learning path) [VMBO]
[] Pre-vocational education (theoretical learning path) [VMBO-T or MAVO]
[] Senior secondary vocational education and training level 1 [MBO niveau 1]
[] Senior secondary vocational education and training level 2 [MBO niveau 2]
[] Senior secondary vocational education and training level 3 [MBO niveau 3]
[] Senior secondary vocational education and training level 4 [MBO niveau 4]
[] Further extended primary education [MULO/MMS]
[] Higher civic school [HBS]
[] Senior general secondary education [HAVO]
[] University preparatory education [VWO]
[] University of applied science (college) [HBO]
[] University
[] Other

If the respondent crossed "other", the following question is being displayed:

You have indicated that your education falls under the category "other". Here you have the opportunity to provide more details about it: [text box]

The original Dutch abbreviations are in square brackets.

ii.   *Need for cognition*

People differ in the extent to which they like to delve into things. Hereunder there are several questions about how much you like to think about and would like to be informed about things.

To what extent do you agree with the following statements? [general NFC]

I like to be in a situation where I need to think a lot.

[] Completely disagree [] Disagree [] Don't disagree, don't agree [] Agree [] Completely agree

Thinking about things is not really my idea of having fun.

[] Completely disagree [] Disagree [] Don't disagree, don't agree [] Agree [] Completely agree

To consider something long-term and precisely gives me satisfaction.

[] Completely disagree [] Disagree [] Don't disagree, don't agree [] Agree [] Completely agree

I like to think about new solutions to problems.

[] Completely disagree [] Disagree [] Don't disagree, don't agree [] Agree [] Completely agree

To what extent do you agree with the following statements? [pension-related NFC]

I would like to be extensively informed about everything related to my pension.

[] Completely disagree [] Disagree [] Don't disagree, don't agree [] Agree [] Completely agree

I like to delve into information regarding the amount of my pension.

[] Completely disagree [] Disagree [] Don't disagree, don't agree [] Agree [] Completely agree

I feel aversion when I need to deal with my pension.

[] Completely disagree [] Disagree [] Don't disagree, don't agree [] Agree [] Completely agree

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iii.   *Future time perspective*

Below there are several questions on how important it is to you to deal with the future.

I am regularly occupied with issues that will have a result in many years.

[] Completely disagree [] Disagree [] Don't disagree, don't agree [] Agree [] Completely agree

I'd rather spend money on nice things today than saving money for later.

[] Completely disagree [] Disagree [] Don't disagree, don't agree [] Agree [] Completely agree

I think that it is important to take warnings seriously, even though they become relevant a long time from now.

[] Completely disagree [] Disagree [] Don't disagree, don't agree [] Agree [] Completely agree

iv.   Attitudes regarding pension information

What is your attitude on information regarding your pension?

I find information regarding my pension: [horizontal 5-point scale]

Unimportant	[] [] [] [] []	Important
Interesting	[] [] [] [] []	Uninteresting
Difficult	[] [] [] [] []	Easy
Reliable	[] [] [] [] []	Unreliable
Unclear	[] [] [] [] []	Clear
Useful	[] [] [] [] []	Not useful

v.   Financial literacy

[Note that the correct answers are marked in italics]

Vocabulary test

Pension information should be understandable for everyone, both for people who are used to reading a lot and for people who are less language-skilled. Which language use are you used to? Hereafter you will find several questions about words that are more or less familiar. Don't think about the answers for too long, this is not an exam. Don't you know the answer? Don't gamble but fill in "I don't know" instead.

She is known to be a **philanthropist**.
What does this word mean?
[] Someone who is very rich
[] Someone who adjusts her opinion according to changing circumstances
[] Someone who is a victim of fraud
[] *Someone who gives a lot to the poor*
[] I don't know

His contribution to this work is **marginal**.
What does this word mean?
[] Large
[] *Small*
[] Positive
[] Negative
[] I don't know

He is a **demagogue**.

What does this word mean?

[] Someone who does a lot for the common people
[] Someone who lets the people co-decide
[] Someone who represents the people in Parliament
[] *Someone who misleads the people*
[] I don't know

She has no **scruples**.

What does this word mean?

[] Setbacks
[] *Guilty conscience*
[] Stress
[] Responsibilities
[] I don't know

His statements were **unambiguous**.

What does this word mean?

[] *Clear*
[] Unclear
[] Friendly
[] Unfriendly
[] I don't know

It is **equitable** for him to pay back.

What does this word mean?

[] Probable
[] Necessary
[] *Reasonable*
[] Unjust
[] I don't know

He is an **erudite** man.

What does this word mean?

[] Attractive
[] *Learned*
[] Unreasonable
[] Thick
[] I don't know

The **segregation** in the Amsterdam suburb Bijlmer has increased.

What does this word mean?

[] Crime
[] Nuisance due to vandalism
[] Cooperation between groups
[] *Separated living of groups*
[] I don't know

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She is being **megalomaniac**.

What does this word mean?
[] *Has delusions of grandeur*
[] Is insecure
[] Is sombre
[] Is hyperactive
[] I don't know

Self-assessed financial literacy

How would you assess your knowledge about money issues?

Very bad [] [] [] [] [] [] [] Very good

Financial literacy questions developed by Lusardi and Mitchell

Question on interest compounding (Q1)
Suppose you have 100 euros on a savings account and the interest is 2% per year.
How much do you think you will have on the savings account after five years, assuming that you leave all your money on this savings account?

[] *More than 102 euros*
[] Exactly 102 euros
[] Less than 102 euros
[] I don't know

Question on inflation (Q2)
Suppose that the interest on your savings account is 1% per year and that inflation amounts to 2% per year. After 1 year, would you be able to buy more, exactly the same, or less than you could today with the money on that account?

[] More than today
[] Exactly the same as today
[] *Less than today*
[] I don't know

Question on risk diversification (Q3)
A share from one company usually offers a more certain return than a fund that invests in shares from different company.*

[] True
[] *Not true*
[] I don't know

*We changed the wording of this question slightly compared to Lusardi and Mitchell (2011) in order to make the question less ambiguous.

Question on relation between bond prices and interest rate (Q4)

If the interest rate goes up, what should happen to bond prices?

[] They should increase
[] *They should decrease*
[] They should stay the same
[] None of the above
[] I don't know

Pension knowledge

Which factors influence the pension that you receive through your employer? Cross what you

think has an influence (several answers are possible):

[] *The hourly wage that you earn*
[] Whether or not you receive state pension [AOW in Dutch]
[] *The amount of years you have worked until your retirement*
[] None of the above
Does someone with a higher pension receive less state pension?

[] *No, the amount of the state pension is not related to the amount of the pension.*
[] No, the state pension is a fixed percentage of the pension: someone with a high pension receives a higher state pension than someone with a lower pension.
[] Yes, those who have a pension above 100.000 Euro per year receives less state pension as of the beginning of 2016.
[] I don't know

Which life changes can influence your personal future pension? Cross the factors that you think

have an influence (several answers are possible):

[] *Your partner stops with working*
[] You get children
[] *You receive a promotion*
[] You get a divorce
[] *You are going to work less*
[] None of the above changes

Why do pension funds invest money in shares?

[] *Pension funds invest in shares in order to obtain a larger return in the long run rather than putting the money in a savings account.*
[] Pension funds invest in shares in order to be able to pay for their employees and to cover other expenses.
[] Pension funds invest in shares as they trust firms more than the government.
[] I don't know

D. About indicative construct validity

Cronbach's alpha is a measure widely used in academic literature to assess the reliability of a set of items intended to measure a specific concept. This metric has been outlined by Cronbach more than half a century ago (1951). In fact, it had been defined by earlier researchers credited by Cronbach: Guttman (1945) and Hoyt (1941). It is given by the following formula:

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$$\alpha = \frac{n}{n-1}\left(1 - \frac{\sum_i V_i}{V_t}\right) \qquad\qquad (\text{D.1})$$

where n is the number of components (or items), V_t is the variance of the observed total test scores, and V_i is the variance of item scores after weighing (p.299). As our items are not binomial, there was no need to compute the standardised score.

Cronbach's alpha depends on 1) the number of items included (the more items, the higher the alpha), 2) the average of all covariances between items (the higher the average covariance, the higher the alpha) and 3) the average variance of each item (the higher the average variance, the lower the alpha). A rule of thumb of an alpha above 0.7 is regarded as acceptable.

Coefficient alpha (as it is called in academic literature) has been widely discussed in academic literature. See for instance Cortina (1993) and Rodriguez and Maeda (2006) for an overview of coefficient alpha and Raykov (2001), Schmitt (1996) and Sijtsma (2008) for a more critical discussion. For instance, Sijtsma (2008) and Schmitt (1996) argue that alpha is not a measure of internal consistency or uni-dimensionality of the data. Despite this, presenting the inter-item test and rest correlations and the corresponding alphas can be of interest to readers who are involved in developing surveys in the area of financial literacy and pension communication. The only conclusions drawn are whether a set of items can be pooled into a test scale or whether the questions need to be included separately into the statistical analyses.

The first row of each table in this subsection returns the alpha when the respective item has been excluded. The second row presents the item-test correlation coefficients – the correlation of each item with the summed index and the third row displays the computed item-rest correlation coefficients – the correlation of each item with the summed index if this item was excluded. The final row shows the alpha for the entire test scale.

Table 5A- 8: Classical FL questions

	Q1	Q2	Q3	Q4
Alpha	0.429	0.319	0.294	0.520
Item-test correlation	0.428	0.610	0.691	0.753
Item-rest correlation	0.270	0.375	0.341	0.225
Test scale	0.454			

Note that if I group Q1 and Q2 on the one hand and Q3 and Q4 on the other hand, I obtain an alpha of 0.5 and 0.32 respectively suggesting that the scores on questions 1 and 2 could possibly be analysed separately from questions 3 and 4.

Table 5A- 9: Vocabulary test

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
Alpha	0.801	0.813	0.802	0.804	0.817	0.821	0.796	0.803	0.798
Item-test correlation	0.683	0.573	0.714	0.666	0.547	0.487	0.743	0.684	0.726
Item-rest correlation	0.585	0.483	0.576	0.551	0.468	0.398	0.616	0.559	0.601
Test scale	0.824								

Table 5A- 10: Pension knowledge: strict and lenient scales

Strict scale	Q1	Q2	Q3	Q4
Alpha	0.284	0.234	0.411	0.215
Item-test correlation	0.716	0.695	0.229	0.589
Item-rest correlation	0.220	0.245	0.034	0.298
Test scale	0.363			

Lenient scale	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Alpha	0.361	0.446	0.472	0.580	0.359	0.408	0.420
Item-test correlation	0.628	0.403	0.486	0.373	0.648	0.524	0.488
Item-rest correlation	0.377	0.228	0.168	-0.009	0.366	0.383	0.292
Test scale	0.478						

Table 5A- 11: Attitudes towards pension information

	Q1	Q2	Q3	Q4	Q5	Q6
Alpha	0.720	0.715	0.707	0.694	0.664	0.667
Item-test correlation	0.531	0.650	0.635	0.657	0.733	0.723
Item-rest correlation	0.375	0.418	0.429	0.474	0.568	0.570
Test scale	0.733					

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Table 5A- 12: Need for cognition (general and pension-related)

General	Q1	Q2	Q3	Q4			
Alpha	0.552	0.592	0.697	0.626			
Item-test correlation	0.776	0.755	0.657	0.686			
Item-rest correlation	0.571	0.507	0.351	0.460			
Test scale	0.684						
Pension-related	Q5	Q6	Q7				
Alpha	0.644	0.489	0.724				
Item-test correlation	0.772	0.852	0.772				
Item-rest correlation	0.517	0.637	0.456				
Test scale	0.713						
All together	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Alpha	0.675	0.685	0.694	0.698	0.685	0.668	0.686
Item-test correlation	0.631	0.610	0.581	0.533	0.606	0.669	0.632
Item-rest correlation	0.473	0.427	0.389	0.370	0.425	0.489	0.426
Test scale	0.717						

Table 5A- 13: Future time perspective

	Q1	Q2	Q3
Alpha	0.266	0.384	0.399
Item-test correlation	0.770	0.701	0.597
Item-rest correlation	0.329	0.267	0.264
Test scale	0.456		

Chapter 6: Discussion and Conclusion

People generally do not like to think a lot about intricate financial decisions— be it consumption or savings and in particular, saving for retirement. It comes naturally to postpone those decisions and think about the next movie visit or festival instead of bracing yourself for a winter that might seem far away. The excessive information provision via numerous communication channels causing information overload does not help consumers either in dealing with pension planning. With the quest to offer a way out of the information overload and activate people to become more involved pension planners, this dissertation investigated the role of tailoring pension information to personal characteristics in effective pension communication and how financial literacy can contribute to preparing for retirement. I presented four studies that are joint work with researchers with expertise in economics, statistics, linguistics and communication science: An empirical study with a theoretical heart on financial literacy and household consumption (Chapter 2), two field experiments testing the effect of tailoring pension information in the trigger and navigation phase respectively (Chapters 3 and 4) and a final study linking survey data on financial literacy and behavioural factors with online pension information behaviour collected during the aforementioned experimental studies (Chapter 5).

In the remainder of this final chapter, I will provide a short summary and discuss the main findings of the studies that were presented in Chapters 2 through 5. Then, I will put the results in a broader perspective by reflecting upon policy implications that follow from this dissertation. In the third subsection, I will discuss the boundaries of this dissertation and offer some ideas on future research in the research domain of effective pension communication and financial literacy. At last, I will wrap up this dissertation with an overall conclusion.

6.1   Summary of the main findings and discussion

To be consistent with the set-up of the introductory chapter of this dissertation, I will consider the results on tailoring pension information and on the role of financial literacy separately.

6.1.1 Testing the effectiveness of tailoring pension information

Chapters 3 and 4 examined the effectiveness of tailoring pension communication in an experimental setting. Chapter 3 assessed whether offering tailored pension information based on age and gender is a way to get people interested in pension information. Email invitations were sent to employees of an insurance company encouraging them to use an online tool, the Pensioncheck, to learn more about their pension situation. The effectiveness of tailoring was measured by monitoring 1) clicking behaviour on a link to the digital pension environment 2) login behaviour to the digital pension environment (granting access to the Pensioncheck) with the Dutch

digital identity and 3) the time spent in the Pensioncheck. The invitations were tailored based on age and gender, resulting in three different tailoring types: age-tailoring, gender-tailoring *and* gender- and age-tailoring. There was no evidence of an age-tailoring effect and mixed evidence of a gender-tailoring and a gender- *and* age-tailoring effect.

There were tailoring effects for young women and middle-aged men: For those participants, the generic invitations were more effective in inducing them to click through or log in than the tailored versions suggesting crowding-out of motivation by the persuasive intent of the tailored invitation. This crowding-out has been known in the socio-linguistic literature as the forewarning effect (Kamalski et al., 2008; Petty & Cacioppo, 1979). Regarding the time spent in the Pensioncheck, young respondents with a tailored invitation spent 79% more time in it than did young respondents with a generic invitation. Next to tailoring effects, there were also age- and gender-effects which are interesting from a policy perspective. Senior men and women were more likely to click through relative to their young and middle-aged counterparts. However, senior men were less likely to log in than younger participants. Furthermore, women (for all age groups) were less likely to log in than men.

Chapter 4, which dealt with tailoring the general structure of a pension document, presents more encouraging results. The research population in this field experiment were employees of 346 firms who got enrolled into a new workplace pension scheme. In collaboration with pension experts, we had defined goals for each age category that should receive the highest prominence in the pension documents. For the young participants, the goal of the pension document was to make them realise how their pension is arranged. Pension information for middle-aged and senior participants had the primary goal to inform them whether they are on track with saving for retirement and to present the choices available within their pension arrangement[27]. After having received a generic invitation to log in to their personal digital pension environment, participants were randomly assigned to tailored versions of digital pension information based on age. The effect of tailoring has been analysed by looking at the time spent in the digital pension environment and clicking on relevant pension information for each goal separately.

For young participants, tailoring the navigation structure of the pension document succeeded in distracting from clicking on information that is not (yet) relevant to them. However, tailoring did not succeed in motivating them to click on relevant information. The same holds for middle-aged participants. For senior participants, tailoring had the intended effect: Participants clicked on relevant information and did not click on information that was less relevant for them. Regarding

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[27] As described in Chapter 4, those goals were more prominent for the senior group (high prominence) than for the middle-aged group (medium prominence).

the time spent in the pension environment, there were no significant differences between participants with tailored or generic pension documents.

There are three conclusions that can be drawn from the field experiments described above. First, the young and middle-group appeared not to be responsive to tailoring both in the email invitation to log in and when relevant information for these age group is being put forward. A possible explanation could be that the middle-aged group, comprising of individuals between 35 and 54 years old, is too heterogenous in its preferences and attitudes towards pensions and pension information and a finer segmentation is needed. Furthermore, young and middle-aged individuals could have time-inconsistent preferences (O'Donoghue & Rabin, 1999a) resulting in postponing planning for retirement. Secondly— and more positively—, senior participants appear to be more responsive to tailoring, especially by clicking on relevant information. In general, this group is characterised by clicking through more often from the email invitation than their younger counterparts. It is not surprising though that as it comes to logging in with the digital identity, senior participants are less likely to log in as they might struggle more with the increasing digitalisation. Thirdly, based on the results from Chapter 3, women had mixed responses to tailoring (negative tailoring effect on clicking behaviour for young women and positive tailoring effect on login behaviour for senior women) and they were less likely to log in than men for all age groups.

The main take-away from studying tailoring pension information is that young participants are not interested (yet) in delving into their pension situation, middle-aged participants are also not really looking for relevant information yet and that senior people are interested, but face the technical barriers of logging in. Additionally, women appear to be less involved in pension planning with mixed evidence on the effect of tailoring.

6.1.2 Financial literacy, consumption and pension information decisions

Chapters 2 and 5 focus on unravelling the relationship between financial literacy and household consumption (Chapter 2) and pension information behaviour (Chapter 5). Chapter 2 studied the relationship between household consumption (growth) of non-durable goods and financial literacy. A simple life-cycle model in which financial literacy affects the rate of return on assets served to understand how financial literacy can impact consumption decisions. The theoretical part of Chapter 2 continues with the derivation of the Euler equation, which describes the relationship between consumption growth and financial literacy, and subsequently, the derivation of a closed-form solution for consumption assuming full certainty. The theoretical predictions were that financial literacy and consumption levels are positively correlated (for plausible values of the intertemporal elasticity of substitution) and that consumption growth and financial literacy are

positively correlated. Those predictions were empirically tested using Dutch data from the LISS household panel. The LISS panel contained, amongst others, five waves on household consumption spread throughout 2009-2017, a single-wave study on financial literacy and socio-economic variables. Financial literacy was regarded as a construct of questions testing the knowledge on interest rate, inflation, risk diversification and bond prices (measured by a financial literacy score between 0 and 4) and a question asking to self-assess one's financial knowledge.

There was evidence for a strong positive association between couples' non-durable consumption levels and the level of the male partner's financial literacy. As the financial literacy level has been measured at the individual level, it was possible to examine whether there were interactions between the financial literacy levels of partners within a household. There were no significant differences in consumption levels due to differences in financial literacy levels of partners in couples' households. Furthermore, there was no evidence for an association between consumption growth and financial literacy. All results were robust to including household assets, examining different stages of the life-cycle and interest in financial literacy. An interesting result that came forward from analysing different age groups, is that the financial literacy level of men younger than 65 is relevant for household consumption decisions, and for men older than 65, self-assessed financial literacy (which has not been relevant when looking at the entire sample) became relevant for explaining differences in consumption levels. The coefficients of the financial literacy level of men (in couples' households) dominated the results of this study. Zooming in on the subsample of the retired (above 65), the financial literacy level of single women turned out to be a relevant determinant of household consumption levels.

Chapter 5 extended the financial literacy concept used in Chapter 2 by including questions on pension-specific knowledge and vocabulary. Chapter 5 assessed whether financial literacy can explain the likelihood of people delving into their pension situation. A financial literacy construct has been proposed, consisting of a financial knowledge and a literacy component. The financial knowledge component consisted of numeracy and knowledge of financial concepts— measured by the questions developed by Lusardi and Mitchell (2011) which have been used in Chapter 2— and topic knowledge (in this case, pension-specific knowledge). The literacy component was measured by including a vocabulary test of nine questions, which has been adapted from a 25 question vocabulary test developed by Nell, Lentz and Pander Maat (2016) and Nell (2017). A survey was distributed amongst employees and customers of a large insurance company in order to elicit participants' financial literacy level, some relevant behavioural factors (like attitudes towards pension information, need for cognition and future time perspective) and some socio-economic variables. The participants' login behaviour to their digital pension environment was

linked to their survey responses on financial literacy and behavioural factors— in fact, the login data stems from the field experiments described in Chapters 3 and 4.

People with higher pension knowledge and knowledge about the concept of interest compounding were more likely to log in to the digital pension environment. The score on the numeracy/financial knowledge questions was not correlated with login behaviour. Moreover, attitudes towards pension information, need for cognition and future time perspective were directly related with login behaviour. The relationship between financial literacy and login behaviour was not affected by other behavioural factors.

To be able to build a bridge across all studies in this dissertation, Chapter 5 examined whether there were differences in the relationship between financial literacy and pension information behaviour by age categories. The same cut-off points of the age groups have been used as in the field experiments described in Chapters 3 and 4. In this sensitivity analysis, financial literacy was more relevant for middle-aged and senior participants in predicting login behaviour. In the light of the discussion about explanations of the lack of active pension planning that followed from Chapters 3 and 4 in the previous sub-section, a sign switch in time-preferences came forward when analysing login behaviour in Chapter 5. Time-preferences were measured by questions on whether participants value consuming now more than saving now and consuming later. Young and middle-aged participants value present consumption more than future benefits and that senior participants value future benefits more. Hence, there is support across all studies that young and middle-aged consumers are less concerned with pension planning as it may be too far in the future, explaining why they were also less receptive to tailoring pension information.

Concerning financial literacy, I can conclude the following: Although a causal relationship between financial literacy and consumption decisions and pension planning decisions could not be identified, there was evidence for a positive association (corrected for education and income). The level of financial literacy of men who are part of a couples' household is associated with a higher consumption level. It is for single senior women (above 65), that financial literacy becomes relevant for household consumption. Pertaining to pension information behaviour, general knowledge of financial concepts (with the exception of interest compounding) is less relevant. Pension knowledge and behavioural factors like need for cognition, future time perspective and attitudes towards pension information are more relevant in explaining the decision to look up one's pension situation.

Linking the results of Chapter 2 and Chapter 5 is rather complicated as in the former, consumption decisions are made at the household level (when considering couples' households) and in the latter, pension information behaviour is at the individual level. Furthermore, there is no

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information available on the marital status of all participants of the studies from Chapters 2-5. What we can take away from the above discussion, is that numeracy/financial knowledge questions are not enough to give a nuanced explanation for financial decision-making. Enriching the concept of financial literacy with topic-specific knowledge and self-assessed financial knowledge and also taking into account behavioural factors such as need for cognition, attitudes and future time perspective can shed new light on economic analysis from a different angle.

6.2 Contributions

This dissertation provides several scientific contributions. First, this dissertation contributed to the economic literature on financial decision-making and pension planning by taking a multidisciplinary approach in designing the field experiments and the treatment materials. It combined the expertise from economics, linguistics and communication science and carefully designed the (different versions of the) pension information documents and the survey questions eliciting information on economic variables (financial literacy, income), socio-economic factors and behavioural factors (attitudes, need for cognition, time preferences) to answer an economic research question. After all, studying effective pension communication is driven by investigating how consumers can be assisted in making informed financial decisions. Secondly, the studies described in Chapters 2-5 generated new experimental data on effective pension communication using real online behaviour of pension plan participants allowing the estimation of causal (Chapter 3) or conditionally causal (Chapter 4) effects of tailoring pension information. Thirdly, to the best of my knowledge, this is the first analysis of the financial literacy level of a household head and his or her partner relating this to household consumption in Chapter 2.

Finally, this dissertation also makes a conceptual contribution by proposing a multi-dimensional concept of financial literacy. Next to constructs that have already been used in economic literature (numeracy and knowledge of financial concepts), it also incorporates dimensions from linguistics and communication science (vocabulary and topic-specific knowledge) and adds a subjective dimension as well (self-assessed financial literacy) which complements the definition of financial literacy offered by Huston (2010).

6.3 Policy implications

After having discussed the results of the studies from the previous chapters and reflected upon the contributions to the literature, I will mull over the policy implications of the research presented in this dissertation.

Primarily, it is important for pension plan providers and policy makers alike to focus on activating younger participants (below 45 years) and women in becoming more involved financial

decision-makers. This applies to pension information behaviour but also to financial decisions such as household consumption. In fact, pension decisions and consumption decisions are eventually interdependent as a sufficient level of retirement benefits ensures consumption smoothing at older age. The problem is that younger participants do not recognise the urgency of starting with financial planning as early as possible. In the case of preparing for retirement, it is of course not necessary for young people to know every detail of the pension arrangement. However, a general awareness that pensions are an important employee benefit (in the case of the workplace pension scheme) would be a good start.

Women are a vulnerable group deserving attention as it comes to motivating them to delve into their pension situation or be involved with financial decision-making. Women were consistently less likely to log in to the digital pension environment. Moreover, women in general have a lower financial literacy level (see Chapter 2) and that financial literacy becomes relevant for consumption decisions for single women above 65 years old. Creating awareness about financial concepts and pensions as early as possible in the life-cycle of people can also contribute to increase confidence in one's financial knowledge, which is also an essential part of what financial literacy entails.

Combining conveying knowledge with immediate feedback can be a way to activate those two groups. One possibility, which relates to the way Statistics Netherlands (CBS) wants to keep a high awareness for handling data with care, is to offer one "awareness question" right before or after logging in to the pension environment before proceeding to checking other pension matters. Giving the correct answer immediately afterwards could achieve a learning effect without flooding people with too much information. This can apply to pension-related knowledge but also to more general financial knowledge.

We have established that pension information provision using more out-of-the-box ways can be a way to activate certain population groups to engage in financial planning. It is crucial though to protect consumers from information overflow and provide customised information once they have been triggered to access a source for pension communication. In the light of the current pension discussion, it is important to keep up the public debate on the trade-off between freedom of choice and tailoring information. Of course, consumers would argue that discounts and indexation are most important as this is what they will essentially observe in their pockets. A great chunk of attention though should also go to what pension plan providers and regulators can do to offer transparency in which choices are relevant for particular segments of the population. That said, pension actors should take care of providing information without being too paternalistic or overloading people with too much information.

Offering personalised information only has an added value if a large share of pension plan participants actually reads this information. As we have seen in Chapter 3 and 4, only a small percentage of participants (12 and 5 per cent respectively) logged in and accessed the pension information documents. Research into better ways of offering tailored information will only have a greater (societal) impact if more people can be reached. Although logging in with the Dutch digital identity is easier relative to other log in methods where participants have to remember all kinds of user names and passwords (which also need to be periodically changed), it is still a considerable hurdle in accessing relevant pension information. Figuring out more convenient ways to log in— which still conform to today's strict privacy standards— and lowering the technical barriers, especially for the senior participants, should precede more rules and regulations about pension communication provision. It almost seems ironic then, that providing small financial incentives— as found by Bauer et al. (2017)— to log in to a digital environment might be the way to go: An immediate (uncertain) small reward has proven to be effective in activating participants to check how they are doing with saving for their pension, a substantial reward for their lifetime of hard work.

Lastly, given the rise of social media and digitalisation during the last decade, Big Data has become a buzzword, treated equally with fear and curiosity. It can be worthwhile to consider the costs and benefits of using Big Data when exploring possibilities to offer more personalised pension information to participants. Patterns in browsing behaviour or activity on social media could provide more information about real (not stated) time and risk preferences which could enable pension plan providers to offer tailored information to the needs of their customers. In this case, regulators like the Netherlands Authority for the Financial Markets (AFM) should take on a more active role in monitoring whether pension funds and insurers are complying to their duty of care and treat that valuable data with caution.

6.4   Limitations and directions for future research

Naturally, the studies that are part of this dissertation also have some limitations that should be mentioned. There are several reasons why the results in Chapters 2 and 5 do not describe causal relations. In Chapter 2 which studied the relationship between financial literacy and household consumption, financial literacy is only measured once, implying that the assumption is needed that financial literacy is exogenously given and that individuals have already reached the optimal financial literacy level. In fact, financial literacy is endogenous as people can invest in financial literacy and accumulate it over the years, an instrumental variable (IV) approach with strong instruments could help to identify a causal relationship. As shortly mentioned in Chapter 2, IV regressions using the number of books and using the education levels of the parents of the

respondent (which were also available in the LISS panel) were conducted, but the model was still under-identified. Furthermore, longer observation periods for household consumption (and financial literacy) would facilitate cleaner estimates of the consumption growth equation.

Whereas Chapter 3 presents causal tailoring effects for the field experiment, the second experiment described in Chapter 4 yields causal effects that need to be conditioned on participants having logged in to their digital pension environment. This is because the subsample of participants who have logged in and whose navigation behaviour could be measured are not representative of the research population of all newly enrolled pension plan participants. Regarding Chapter 5 which dealt with the relationship between financial literacy and login behaviour, the estimated results are associations rather than causal. This is due to the relatively small overlap between survey respondents— the financial literacy constructs and the behavioural factors were elicited by means of a survey— and participants in the experiments.

Another issue worth mentioning is that the research population (employees of an insurance company) from the experiment in Chapter 3 is not representative of the Dutch population. It can be argued that they have a higher affinity with financial markets than the average Dutch citizen which could result in a low variation in education level and financial literacy level. Finding (conditional) tailoring effects for this rather homogenous research population can be an indication that the differences, and hence tailoring effects, can be considerably larger once the field experiment has been conducted amongst a more representative research population. We should be careful generalising the results to the general Dutch population. In comparison, the research population for the field experiment described in Chapter 4 is more representative as it comprises employees of almost 350 companies.

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A suggestion for the design of future field experiments is to approach more representative research populations. For instance, instead of employees of a large company or customers of the same pension insurer, all inhabitants of a municipality might be more representative. Then, the share of women, education level and the age distribution are expected to be more comparable to the Dutch population. Another point of concern is that it is important to choose the right moment to approach participants in order to avoid low response due to the risk of being regarded as spam when sending an email invitation. We took this issue into account by approaching only newly enrolled pension plan participants. This way, we were dependent on how many new customers would the cooperating insurance company have within the fixed time-frame of the field experiment.

Naturally, the tailoring approaches used in Chapters 3 and 4 are one way to manipulate pension information. The variation possibilities in tailoring information are many as you can tailor

in different communication phases (trigger, navigation, content), but also by using language, visuals or organising information in a different way. Replication of those results might therefore be difficult if the researchers have not chosen the exact same approach.

Segmentation of participants based on easily observable characteristics as age and gender can be a good strategy as it is less costly— those characteristics are already known by the pension plan providers. Yet, what we learned from Chapter 3, was that it can be hard to come up with a good strategy how to approach different segments in a different way. Perhaps a gender-tailoring effect could not be found as the differences in the email invitation were not that pronounced between the gender-tailored version and the generic version.

Lastly, collecting more data on behavioural factors like attitudes, need for cognition and time preferences can help to better understand the motivation behind not reading an email, clicking through or the problems experienced with logging in. More field experiments are needed to understand what pushes from and pulls people to pensions and other financial decisions. In behavioural economics, laboratory experiments have often been applied to study game strategies – often using students as the research population. In communication sciences, laboratory experiments have a different set-up: There, a relatively small sample (where age, gender and education distributions are ideally similar to the general population) can be asked to perform a task and is assisted by a researcher who asks questions to clarify specific choices. The results of such a laboratory experiment from the field of communication sciences can be very useful in understanding the choices people make and can help to calibrate the design of larger-scale field experiments and surveys. This is another example of how multidisciplinary methods can help to answer economic questions.

6.5 General conclusion

This dissertation studied the effect of tailoring pension information and the role of financial literacy in pension and consumption decisions. In the case of tailoring the invitation letter to log in to a digital pension environment based on age and gender, there were mixed results pertaining to the effectiveness of tailoring. Those results could be explained by crowding out motivation to act upon an invitation letter as it might have been too persuasive (the forewarning effect).

Tailoring the general structure of a digital pension document based on age proved to be successful in motivating senior participants in clicking on relevant pension information and in distracting them from clicking at less relevant pension information. In general, young and middle-aged participants were less susceptible to tailoring and were also less active in looking up their pension situation.

High financial literacy of men in couples' households and single women above 65 years old was associated with higher household consumption levels suggesting that higher financial literacy may lead to better financial decisions which translates into higher lifetime consumption. Furthermore, expanding the financial literacy concept of numeracy and knowledge of financial concepts by pension knowledge, perceived knowledge and vocabulary, has added value.

Considering behavioural factors like attitudes toward pension information and need for cognition in explaining economic behaviour can provide insights in factors that are left unobserved in general economic analysis. Pension *is* coming after all.

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Nederlandse samenvatting

Veel mensen in Nederland zijn weinig gemotiveerd om zich te verdiepen in informatie over hun pensioen. Twee redenen (die met elkaar verbonden zijn) voor dit gedrag zijn gebrek aan urgentie en uitstelgedrag. Tegelijkertijd worden mensen met steeds meer informatie geconfronteerd door pensioenuitvoerders, die hun verplichting als gevolg van de Wet Pensioencommunicatie van 2015 na willen komen. Het gebrek aan motivatie in combinatie met informatie-overload kan er toe leiden dat mensen niet in staat zijn om weloverwogen financiële beslissingen te nemen.

In dit proefschrift worden de volgende algemene onderzoeksvragen beantwoord:

1) Hoe effectief is maatwerk in pensioencommunicatie in mensen te motiveren om geïnformeerde pensioenbeslissingen te nemen?
2) Wat is de rol van financiële geletterdheid in het nemen van financiële beslissingen (pensioenplanning inbegrepen)?

De volgende deelvragen helpen bij het beantwoorden van de onderzoeksvragen:

- In welke mate is dagelijkse consumptie van huishoudens gerelateerd aan financiële geletterdheid?
- Wat is de effectiviteit van maatwerk in pensioencommunicatie?
- In welke mate is pensioencommunicatie op maat gerelateerd aan financiële geletterdheid?

Dit proefschrift bestaat uit vier studies waarin (experimenteel en empirisch) de effectiviteit van maatwerk in pensioencommunicatie getoetst wordt en in kaart gebracht wordt welke rol financiële geletterdheid speelt in de beslissing om zich in pensioeninformatie te verdiepen en in financiële beslissingen zoals huishoudelijke consumptie van verbruiksgoederen. De laatste studie richt zich op de relevantie van psychologische factoren als cognitiebehoefte (*need for cognition*), toekomstperspectief (*future time perspective*) en attitudes over pensioeninformatie als verklaring voor beslissingen omtrent pensioeninformatie. Hieronder volgt een overzicht van elk van de vier studies en, tot slot, een korte algehele conclusie van dit proefschrift.

Consumptie, consumptiegroei en financiële geletterdheid

Hoofdstuk 2 richt zich op het verband tussen huishoudconsumptie en financiële geletterdheid voor Nederlandse huishoudens. Het economische raamwerk is een levenscyclusmodel van consumptie, waarin financiële geletterdheid het rendement op het financiële vermogen beïnvloedt. Dit model voorspelt een positieve correlatie tussen financiële geletterdheid en consumptieniveaus voor plausibele waardes van de intertemporele substitutie-elasticiteit en een positieve correlatie tussen financiële geletterdheid en consumptiegroei.

Deze theoretische voorspellingen werden getoetst met behulp van Nederlandse data van het LISS household panel.

Consumptie van verbruiksgoederen van koppels en het niveau van financiële geletterdheid van de mannelijke partner zijn sterk positief gecorreleerd. Er kon geen verband tussen consumptiegroei en financiële geletterdheid worden aangetoond. De analyses in dit hoofdstuk houden rekening met opleidingsniveau, maandelijks inkomen, het financiële vermogen, interesse in financiële geletterdheid en de verschillende fases van de levenscyclus.

Effect van maatwerk om pensioendeelnemers te stimuleren zich te verdiepen in hun pensioensituatie

Hoofdstuk 3 toetst of het aanbieden van pensioeninformatie op maat, gebaseerd op leeftijd en geslacht, een manier is om mensen te motiveren zich te verdiepen in hun pensioensituatie.

Er werd een gerandomiseerd veldexperiment doorgevoerd, waarbij 3.286 werknemers van een verzekeringsmaatschappij per e-mail uitnodigingen ontvingen. Daarmee kon een online tool, de zogenaamde Pensioencheck, worden doorlopen om meer over de persoonlijke pensioensituatie te weten te komen. Dit hoofdstuk beantwoordt de volgende onderzoeksvraag: kan maatwerk deelnemers motiveren om de Pensioencheck te voltooien? Het experiment leverde data over (1) het doorklikken door deelnemers naar de webpagina van de Pensioencheck vanuit de link in de uitnodigingsmail, (2) het inloggen in de Pensioencheck en (3) de benodigde tijd om de Pensioencheck te voltooien.

Via deze maatwerkmethode kon in Hoofdstuk 3 een negatief leeftijdseffect en een negatief geslachts- en leeftijdseffect aangetoond worden voor jonge vrouwen en mannen van middelbare leeftijd om door te klikken en in te loggen. Jonge deelnemers hadden een positief maatwerkeffect op de tijd die zij doorbrachten in de Pensioencheck.

Het effect van maatwerk op het navigatiegedrag van pensioendeelnemers

Hoofdstuk 4 beschrijft een gerandomiseerd veldexperiment met het doel om te toetsen of het aanpassen van de structuur van pensioeninformatie aan de leeftijd van deelnemers een effect heeft op hun navigatiegedrag. Het experiment werd uitgevoerd onder 8.563 nieuwe deelnemers aan een werknemerspensioenregeling bij een Nederlandse verzekeraar.

Voor elk van de drie leeftijdscategorieën definieerden wij in samenwerking met pensioenexperts doelen die de meeste aandacht bij het opstellen van pensioencommunicatie verdienen. Dit resulteerde in drie versies van pensioeninformatie op maat, naast de generieke versie. Voor jonge deelnemers wordt het belangrijk geacht te weten hoe hun pensioen geregeld is. Oudere deelnemers en deelnemers van middelbare leeftijd willen geïnformeerd worden over de

keuzes die zij hebben binnen hun pensioenregeling en of ze op koers liggen met sparen voor hun oude dag. Deelnemers ontvingen een generieke uitnodiging om in te loggen op hun digitale persoonlijke pensioenomgeving. Vervolgens werd hen aselect een digitaal pensioendocument op maat of een generiek pensioendocument toegewezen. Deze studie bestudeerd het effect van maatwerk op navigatiegedrag door te kijken naar de tijd die in de digitale pensioenomgeving besteed werd door de deelnemers en door het klikgedrag op relevante pensioeninformatie per doel te meten.

Wat betreft de tijd die besteed werd in de digitale pensioenomgeving zijn er geen aantoonbare significante verschillen tussen de handelingen van deelnemers met generieke pensioeninformatie en die met informatie op maat. Maatwerk in de navigatiestructuur van pensioencommunicatie slaagt erin om jonge deelnemers af te leiden van (nog) niet relevante informatie maar slaagt er niet in hen te motiveren om op relevante informatie te klikken. Hetzelfde resultaat geldt voor deelnemers van middelbare leeftijd. Alleen voor oudere deelnemers had maatwerk het beoogde effect: zij klikten significant meer op de voor hen relevante informatie.

Financiële geletterdheid en inloggedrag van pensioendeelnemers

Hoofdstuk 5 toetst of financiële geletterdheid de kans kan voorspellen dat pensioendeelnemers zich in hun pensioensituatie gaan verdiepen. Financiële geletterdheid wordt hier als een uitgebreider concept beschouwd dan in Hoofdstuk 2. Naast de gebruikelijke vragen over financiële geletterdheid (rekenvaardigheid en financiële kennis) zijn er ook een vraag over de zelfinschatting van de eigen financiële kennis, vragen die pensioenkennis toetsen en een woordenschattoets toegevoegd.

11.797 werknemers en klanten van een grote pensioenverzekeraar ontvingen een vragenlijst die financiële geletterdheid, relevante gedragspsychologische en demografische factoren bevroeg. Het inloggedrag van alle bevraagden in hun persoonlijke digitale pensioenomgeving werd gelinkt aan hun financiële geletterdheidsscore en gedragspsychologische factoren als cognitiebehoefte, attitudes over pensioeninformatie en toekomstperspectief.

Deelnemers met een hogere pensioenkennis en kennis over samengestelde interest hadden een hogere kans om in te loggen in de persoonlijke digitale pensioenomgeving. Attitudes, cognitiebehoefte en toekomstperspectief zijn direct gerelateerd aan inloggedrag. Het verband tussen financiële geletterdheid en inloggedrag wordt niet door gedragspsychologische factoren beïnvloed.

Algehele conclusie

Dit proefschrift laat verschillende studies zien die het effect van maatwerk van pensioeninformatie en de rol van financiële geletterdheid in pensioen- en consumptiebeslissingen bestuderen. Maatwerk op de uitnodigsbrief om in te loggen in de persoonlijke digitale pensioenomgeving blijkt niet altijd effectief te zijn. Een verklaring kan zijn dat deelnemers de uitnodigingsbrief als te sturend waarnemen en hun intrinsieke motivatie daardoor vermindert (het *forewarning effect*).

Door het aanpassen van de structuur van pensioeninformatie op basis van leeftijd klikten oudere deelnemers vaker op relevante pensioeninformatie en minder vaak op minder relevante pensioeninformatie. Over het algemeen stonden jonge deelnemers en deelnemers van middelbare leeftijd minder open voor maatwerk en verdiepten zij zich minder actief in hun pensioensituatie.

Wat betreft de rol van financiële geletterdheid, is er een positieve associatie tussen financiële geletterdheid en huishoudconsumptie, zowel bij mannen met een partner als bij alleenstaande vrouwen boven de 65 jaar. Dat wijst erop dat hogere financiële geletterdheid tot betere financiële beslissingen kan leiden, wat in een hogere consumptie over het hele leven vertaald zou kunnen worden.

Gedragspsychologische factoren zoals cognitiebehoefte of attitudes over pensioeninformatie als verklarende factoren voor economisch gedrag kunnen inzichten bieden die door economische analyses over het algemeen niet waargenomen worden. Bovendien had het uitbreiden van het concept financiële geletterdheid— bestaande uit rekenvaardigheid en kennis van financiële concepten— met pensioenkennis, zelfinschatting van financiële kennis en woordenschat een aantoonbare toegevoegde waarde.

Deutsche Zusammenfassung

Wappnet euch, die Rente naht:

Konsum, Finanzkompetenz und maßgeschneiderte Renteninformation

Viele Menschen in den Niederlanden sind wenig motiviert, sich eingehend über ihre Rente zu informieren. Zwei Gründe dafür, miteinander verbunden, sind fehlende Dringlichkeit und Aufschiebeverhalten. Gleichzeitig werden Menschen immer mehr Informationen durch Versorgungsträger ausgesetzt, die ihrerseits ihren Verpflichtungen nachkommen wollen aufgrund des Rentenkommunikationsgesetzes von 2015. Fehlende Motivation kombiniert mit Informationsüberflutung führt dazu, dass Menschen nicht mehr im Stande sind, wohlerwogene finanzielle Entscheidungen zu treffen.

In dieser Dissertation werden folgende allgemeine Forschungsfragen beantwortet:

- Wie effektiv ist Maßarbeit in der Rentenkommunikation, um Menschen zu motivieren, informierte Rentenentscheidungen zu treffen?
- Welche Rolle spielen Finanzkompetenzen bei finanziellen Entscheidungen (Rentenplanung inbegriffen)?

Um diese Forschungsfragen beantworten zu können, haben wir drei Teilfragen formuliert:

- Wie verhält sich täglicher Haushaltskonsum zu Finanzkompetenzen?
- Wie effektiv ist Maßarbeit in der Rentenkommunikation?
- In welcher Relation stehen Rentenkommunikation und Finanzkompetenzen zueinander?

Die Dissertation besteht aus vier Studien, die experimentell und empirisch die Effektivität von Maßarbeit in der Rentenkommunikation testen. Weiterer Gegenstand der Studien ist die Rolle der Finanzkompetenzen bei der Beschäftigung mit der Renteninformation, und bei finanziellen Entscheidungen wie Haushaltskonsum von Verbrauchsgütern. Die letzte Studie thematisiert die Relevanz von psychologischen Faktoren wie Kognitionsbedürfnis (*need for cognition*), Zukunftsperspektive (*future time perspective*) und die Ansichten über Renteninformationen als Erklärung für bestimmte Rentenentscheidungen.

Maßarbeit in der Email-Einladung mit dem Ziel, sich in der persönlichen digitalen Rentenumgebung einzuloggen, erweist sich als nicht immer effektiv. Eine Erklärung dafür wäre, dass Rententeilnehmer die Einladung als zu steuernd wahrnehmen, was ihre innerliche Motivation vermindert (der *forewarning effect*).

Die Struktur der Renteninformation wurde nach Altesgruppen differenziert. Ältere Teilnehmer wählten öfter eine für sie relevante Renteninformation und seltener eine für sie weniger relevante Renteninformation. Im Allgemeinen standen junge Teilnehmer und Teilnehmer mittleren Alters weniger offen für Maßarbeit und befassten sich weniger mit ihrer Rentensituation.

Es konnte eine positive Assoziation zwischen Finanzkompetenzen und Haushaltskonsum, sowohl bei Männern mit einem Partner als auch bei alleinstehenden Frauen über 65 Jahren, festgestellt werden. Daraus lässt sich schlussfolgern, dass eine höhere Finanzkompetenz zu besseren finanziellen Entscheidungen führen kann, die sich in einem höheren Konsum im Laufe des Lebens äußern.

Verhaltenspsychologische Faktoren wie Kognitionsbedürfnis oder Ansichten über Renteninformation als Erklärung für ökonomisches Verhalten können Einsichten bieten, die durch herkömmliche Wirtschaftsanalysen im Allgemeinen nicht wahrgenommen werden. Ein Mehrwert in dieser Dissertation bietet das Konzept der Finanzkompetenz: Rechenkompetenz und Kenntnis finanzieller Konzepte, erweitert mit Rentenkenntnis, Finanzwissen Selbsteinschätzung und einem Wortschatztest.

Summary (in Bulgarian)

Подготви се, пенсията идва:

Потребление, финансова грамотност и пенсионна информация по мярка

Много хора в Нидерландия нямат мотивация да се задълбочават в информация относно пенсията си. Две възможни причини за това (взаимно свързани) са: усещане за липса на спешност и склонност към отлагане. В същото време, на базата на Закона за пенсионна информация от 2015 г., на хората се предлага информация от различни пенсионни институции. Липсващата мотивация, комбинирана с прекомерния информационен поток водят до това, че тези хора не са в състояние да вземат адекватни и премерени финансови решения.

В настоящата дисертация се дава отговор на следните научноизследователски въпроси:

1) Колко ефективна е приспособената към индивидуалните нужди („напаснатата") пенсионната комуникация за мотивиране и вземане на информирани решения?

2) Каква роля има финансовата грамотност при вземане на финансови решения (вкл. при планиране на пенсия)?

За да се отговори на горните въпроси, формулирахме следните подвъпроси:

- До каква степен ежедневното битово потребление зависи от финансовата компетентност?

- Каква е ефективността на споменатото „напасване" или приспособяване на пенсионната комуникация към индивидуалните нужди ?

- До каква степен пенсионната комуникация е съотносима към финансовата грамотност?

Настоящата дисертация се състои от четири проучвания, които експериментално и емпирично разглеждат ефективността на пенсионната комуникация. Предмет на проучванията съставлява също така въпросът за ролята на финансовата грамотност при възприемане на пенсионната информация и при вземане на финансови решения, като например битовата консумация на потребителски стоки. Последното от четирите проучвания разработва уместността на психологическите фактори — като необходимостта от познание (*need for cognition*), перспектива за бъдещето (*future time perspective*) и отношението към пенсионната информация — като възможни обяснения при определени пенсионни решения.

Прилагането на индивидуален подход чрез покана по ел. поща за влизане в личния цифров профил (*personal digital environment*) съобразена по възраст и пол не се оказа ефективен. Това може да се обясни с това, че пенсионните участници възприемат поканата като прекалено насочваща, променяйки тяхната вътрешна мотивация (т.н. *forewarning effect*).

Чрез напасването на структурата на пенсионната информация (съобразно възрастта), възрастните участници по-често избират съществена за тях пенсионна информация и по-рядко избират несъществена пенсионна информация. Като цяло, младите участници и участниците на средна възраст са по-малко отворени към индивидуално напасната информация и по-рядко се задълбочават в собствената си пенсионна ситуация.

Относно ролята на финансовата грамотност, се намери положителна връзка между финансовата грамотност и битовата консумация, както при мъже с партньор, така и при самотните жени над 65 години. Това предполага, че по-добрата финансова грамотност води до по-добри финансови решения, което от своя страна предполага по-висока консумация, разпределена в продължение на целия живот.

Поведенческо-психологичните фактори, като необходимостта от познание или отношението към пенсионната информация, за обясняване на икономическото поведение могат да дадат научни резултати, които не произлизат от приетите икономически анализи. Освен това, настоящата дисертация показва ползата от разширяването на концепцията за финансова грамотност включваща математическата грамотност и познанието на финансови концепции с пенсионно познание, самооценка на финансовото познание и тест на лексиката.

Curriculum Vitae

Milena Dinkova was born on 11 January 1988 in Sofia (Bulgaria). After having moved forth and back between Bulgaria and Germany, she finished high-school in Germany (Aachen) in 2008. In 2011, she obtained a BSc degree in Economics and Business economics and in the fall of 2013— a MSc degree in Multidisciplinary Economics. Both degrees were obtained at the Utrecht University School of Economics (U.S.E.). Between the fall of 2013 and March 2015, she started a position as a junior lecturer at U.S.E. where she taught and mentored Bachelor students in various courses. She commenced as a Phd candidate at the same institution (U.S.E.) in April 2015. Since September 2018, Milena is employed as a researcher at the Netherlands Bureau for Economic Policy Analysis (CPB). Thinking it was time now for something completely different, she has been conducting policy-relevant research on cybersecurity, digitalisation and science ever since. As of September 2019, she will pick up the topic of this dissertation and will start as a part-time post-doctoral researcher for the Netspar project on the effectiveness of decision aids in pension communication with Hans Hoeken and Adriaan Kalwij next to her position at the CPB.

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People generally do not like to think about intricate financial decisions and even less about long-term decisions like pensions. It comes naturally to postpone those decisions and enjoy the now instead of bracing yourself for a winter that might seem far away. Excessive information provision causing information overload does not help consumers either to deal with pension planning. This dissertation contributes to the quest to offer a way out of the information overload and to activate people to become more involved pension planners. It consists of four studies that experimentally and empirically test the effectiveness of tailored pension communication and financial literacy on pension planning and consumption decisions.