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Meeting your Future Self:

Exploring the Impact of Augmented Reality on Psychological Connectedness and Financial Decision-Making

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Meeting your Future Self: Exploring the Impact of Augmented Reality on Psychological Connectedness and Financial Decision-Making

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Abstract

People often fail to save adequately for the future and are left to suffer from poverty in retirement. A stream of research suggests that myopic financial behaviour is partly caused through a lack of perceived psychological connectedness to the future self. Drawing on theories of personal identity, mental imagery and vividness that suggest that people fail to identify with their future self due to a lack of vividness, I propose that enhancing participants imagination of their future selves through Augmented Reality (AR) cultivates future-oriented decisions across four financial decision-making tasks[1]. Specifically, I assume that the positive impact of AR use on future-oriented financial decision-making is rooted in a sequential mediation process of increased perceived vividness and connectedness. Based on the argument that people often fail to consider the consequences of their decisions, I further investigate the role of opportunity costs as a boundary condition for connectedness to influence financial decision-making. In an online experiment, I empirically demonstrate that augmenting the imagination of people's future selves through AR (vs. mere thinking) decreases how much money people allocate to the future through sequentially decreasing perceived vividness and connectedness. Besides, the results reveal that this effect does not depend on whether opportunity costs are primed or not. Finally, I highlight the thesis' limitations and offer potential explanations for the counterintuitive results, which may serve as a starting point for future research by other scientists.

Keywords: Intertemporal Decision-Making, Augmented Reality, Vividness, Future Self-Connectedness, Opportunity Costs, Pension Engagement, Temporal Discounting

[1] For the purposes of this thesis, future-oriented financial decisions shall mean those decisions that forgo smaller immediate benefits in favour of larger later benefits (e.g., spending a higher percentage of monthly salary on retirement).

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List of Abbreviations

OC	Opportunity Costs
FSC	Future Self-Connectedness
SD	Spending Decision
MA	Money Allocation
TD	Temporal Discounting
AR	Augmented Reality
VR	Virtual Reality
WOM	Word-of-Mouth

1 Introduction

"*I believe that most of us have false beliefs about our own nature, and our identity over time, and that, when we see the truth, we ought to change some of our beliefs about what we have reason to do."*
— Derek Parfit (1984, p. IX)

Human well-being is at the top of the 2030 agenda for sustainable development of the United Nations (2015). In the same vein, research has shown that financial well-being is an important predictor of overall well-being (Netemeyer, Warmath, Fernandes & Lynch, 2018). Despite a historical increase in wealth over the past 40 years, many customers feel financially insecure and fail to implement healthy spending and saving habits. This is especially prevalent in the US: survey data shows that 77% of Americans feel anxious about their financial situation – 41% even report that financial stress leaves them sleepless at night and 68% worry that they will not have enough money to retire (Decision Lab, 2020). The latter being especially alarming as citizens in the US are expected to live about 18 years in retirement and in France even 25 years on average due to globally rising life expectancy (OECD, 2021). To retain a similar lifestyle in retirement, experts suggest saving at least 15-20% of one's annual income (Fidelity, 2021). Yet, real saving rates fall way below this goal: For 2018 the OECD (2021a) reported average household savings rates of 7,96% and 5,18% in the US and European Union, respectively. Thereupon it is no surprise that the OECD (2019) reports that 13,5% of individuals aged over 65 live in relative income poverty globally[2]. The pressing nature of this problem demonstrates that saving behaviour must change to prevent poverty in retirement and improve long-term financial well-being.

A major reason why people fail to save for the future is that they seem to systematically prefer short-term interests at the expense of their long-term interests, a phenomenon called *temporal discounting* (for a review, Frederick, Loewenstein & O'Donoghue, 2002). For example, people often prefer a smaller monetary reward now over relatively larger reward that is delayed in time. How steeply people discount the future does not only depend on temporal proximity, but on a *psychological* distance, particularly, on the degree people feel connected to their future

[2] Relative income poverty is defined as "having an income below half the national median equivalised household disposable income" (OECD, 2019).

selves (Bartels & Urminsky, 2011). The degree of psychological connectedness depends on the extent to which people feel overlap in important attitudes, such as major preferences, beliefs, or values. Previous research has demonstrated that connectedness may influence people's intertemporal decision, especially their financial decision-making. As such, increased connectedness has been associated with decreased customer spending (Bartels & Urminsky, 2015), lower discount rates (Bartels & Rips, 2010), increased retirement saving (Hershfield et al., 2011) and higher accumulated savings (Hershfield, Wimmer & Knutson, 2009a). Yet, some of these findings contrast each other; and whereas some researchers demonstrated positive relations (Hershfield et al.), others did not find evidence for a relation between connectedness and financial decisions (Frederick et al.; Stockdale & Sanders, 2019). Besides, less is known about under which specific conditions connectedness influences financial decision-making and whether it forms a robust predictor across different financial decisions. For instance, Bartels and Urminsky (2015) demonstrated that only when opportunity costs are salient, does connectedness decrease the amount customers spend. However, other researchers (Adams & Nettle, 2009) argued that people high in connectedness automatically consider opportunity costs and that it consequently does not matter if they are primed or not. Thus, it remains unclear if priming opportunity cost forms a reliable boundary condition for financial decisions. A further gap in the body of knowledge is the lack of comprehensive understanding of what constitutes future self-connectedness. Indeed, pioneers in the field of connectedness have urged the importance of identifying reliable antecedents and novel manipulations of future self-connectedness to develop effective interventions useful for policy (Urminsky & Zauberman, 2016; Urminsky, 2017).

To address these gaps in our understanding, I draw on theories of vividness (Loewenstein, 1996) and mental imagery (Schifferstein, 2009). These scientific fields suggest that vivid information exerts stronger influences on customer decision-making and elicits heavier emotional responses (as opposed to non-vivid). Motivated by the promising results of researchers that investigated the influence of Virtual Reality (VR) on customer behaviour (e.g., Hershfield et al., 2011; Yee, Bailenson & Ducheneaut, 2009), this thesis sheds light on the question whether exposing people to their virtual aged selves through Augmented Reality (AR) influences their subsequent financial decision-making. Specifically, I derive three research questions this thesis seeks to answer:

1) *How does the use of AR facilitate participants' future-oriented financial decision-making?*
2) *Does perceived vividness and connectedness sequentially mediate the relationship between the use of AR and future-oriented financial decision-making?*
3) *Does the salience of opportunity costs moderate the relation between the use of AR and future-oriented financial decision-making?*

By doing so, I aim to contribute to the intertemporal choice and connectedness literature in four ways. First, I posit AR as a novel intervention method to increase people's connectedness and influence their financial decision-making. AR technology is compatible with almost any mobile device such as tablets or smartphones (Heller, Chylinski, Ruyter, Mahr & Keeling, 2019), which means that the technology is readily available to billions of customers (Iabm, 2020). To that end, AR constitutes a superior intervention for policymakers. To the best of my knowledge, this thesis is the first to manipulate perceived vividness and connectedness through AR. Second, I theorize that the relation between the use of AR and connectedness is mediated through perceived vividness, and thus aim to establish vividness as an antecedent of connectedness. Third, I operationalize financial decision-making through four different outcome variables and hence seek to test if connectedness forms a robust predictor of different financial decisions. Fourth, I aim to advance the academic body on future self-connectedness through investigating under which conditions connectedness influences financial decision-making.

The remainder of this thesis is structured as follows. First, the relevant literature on financial well-being, intertemporal decision-making, personal identity, future self-connectedness, and vividness is reviewed. This serves as foundation to develop the conceptual model and derive the hypotheses within the next section. In the subsequent chapter, I map out the experimental setup including the employed measures and scales before I shortly elaborate on the statistical analysis and data preparation. This is followed by the presentation of the statistical results in chapter five. Thereupon, I subjectively discuss the results in relation to relevant findings of other scholars. Finally, theoretical, and practical implications, as well as limitations are discussed and new avenues for future research are offered, after which the thesis ends with a conclusion.

2 Literature Review

The following section starts with exploring the composition and consequences of financial well-being and how it is determined by people's intertemporal decision-making. On this basis, I introduce the central concept of future self-connectedness and its relation to future-oriented financial decisions. After elaborating on the role of vividness and mental imagery in the context of connectedness, I posit AR as a novel technology to experimentally manipulate connectedness.

2.1 On Financial Well-Being

In times where many people suffer financially and psychologically from the global pandemic COVID-19, the influence of financial well-being on overall well-being and life satisfaction becomes apparent. For instance, a study on the impact of COVID-19 induced financial stress and corresponding mental health finds that higher levels of financial stress are associated with higher levels of psychological distress and anxiety (Bierman, Upenieks, Glavin & Schieman, 2021). Indeed, Netemeyer et al. (2018) provide further evidence that financial-wellbeing is closely linked to overall well-being: Its magnitude being comparable to the combined effects of other important factors such as job satisfaction, physical health and perceived relationships with others.

Given its great importance, it is no surprise that financial well-being has been studied in various academic fields, such as economics, customer decision-making, psychology and transformative service researc, and under various contexts, such as its relation to well-being (Kahneman, Krueger, Schkade, Schwarz & Stone, 2006; Brüggen, Hogreve, Holmlund, Kabdavi & Löfgen, 2017; Netemeyer et al., 2018), its antecedents and predecents (Vlaev & Elliott, 2014; Shim, Xiao, Barber & Lyons, 2009) or which personality traits influence financial well-being (Strömbäck, Lind, Skagerlund, Västfjäll & Tinghög, 2017; Luhmann, Hofmann, Eid & Lucas, 2012). Importantly, as financial well-being consitutes objective (i.e., actual income or assets) as well as subjective (i.e., perceived financial security) aspects, Brüggen et al. (2017) define financial well-being as "the perception of being able to sustain current and anticipated desired living standards and financial freedom". Not only does this definition capture the perceived psychological dimension, but it also emphasizes the time dimension – especially the importance

of future living standards. Thus, it highlights the fact that long-term financial well-being heavily depends on healthy saving behaviour and early retirement planning.

Brüggen and colleagues (2017) further argue that certain financial behaviours and practices have a specifically strong influence on retirement poverty. They can be classified in either destructive financial behaviours (i.e., overspending, going in debt or paying late) or constructive financial behaviours (i.e., healthy spending and saving habits, relying on "if-then-plans" or early retirement planning). In their quest to enhance the latter, researchers studied a vast amount of interventions on different dependent variables. For instance, contemporative research investigates the effect of positive (vs. negative) message framing on pension engagement (Eberhardt, Brüggen, Post & Hoet, 2020). Other study how interactive elements in online pension planners influence pension engagement (Brüggen, Post & Schmitz, 2019), how decision heuristics (vs. systematic approaches) influence saving behaviour (Binswanger & Carman, 2012) or how financial iteracy is linked to planning for retirement (Lusardi & Mitchell, 2011).

Yet, in order to faciliate the understanding of seemingly non-normative behaviours such as undersaving for retirement on a deeper level, intertemporal decision-making provides a promiseful body of research to facilitate this understanding (Urminsky & Zauberman, 2016). Therefore, this phenomenon is discussed within the next section.

2.2 Intertemporal Decision-Making and Opportunity Costs

At the heart of many decisions affecting financial well-being lie – either explicit or implicit – intertemporal trade-offs between current and future gains (Hoch & Loewenstein, 1991). For some decisions the trade-offs are salient: When making a huge investment (i.e., buying a car or a house) people usually elaborate on the consequences and deliberately weigh costs against benefits. However, for other decisions, temporal trade-offs are hidden: Implicitly, every euro spent in the present entails opportunity costs in the form of foregone future benefits, as the this euro could have been invested alternatively (i.e., in stocks, bonds or a retirement fund). These *opportunity costs* are defined as "the unrealized flow of utility from the alternatives a choice displaces" (Frederick, Novemsky, Wang, Dhar & Nowlis, 2009, p. 1). For example, a person might spend €5 on a Starbucks coffee every morning for one year which adds up to a yearly amount of €1,825. Spending this money on coffee means that it cannot be used for other

purposes. Conversely, the alternative decision of investing these €1,825 into a retirement fund with an annual interest rate of 5% would have left one with a hypothetical amount of €7,888 (opportunity costs) after 30 years. These opportunity costs represent the foregone future benefits of buying a daily €5 latte for a year. The same holds true for decisions in other life domains: while smoking a cigarette might yield temporally pleasure (immediate benefit), it also increases the probability of getting cancer in a later stage of life (future cost) and while eating a full bag of chips offers a delicious taste experience, it might be a further step towards obesity (Urminsky & Zauberman, 2016).

Vast amount of empirical evidence supports the fact that when dealing with the kinds of problems laid out above people systematically prefer sooner over more delayed gains. This tendency to put less subjective value on future gains relative to more immediate gains has been termed *temporal discounting* in academic literature (for reviews, see Frederick et al. [2002] or Urminsky & Zauberman [2016]). In the same way as money is discounted in economics, people tend to discount future benefits (Kirby & Maraković, 1995). By repeatedly opting for the sooner option (i.e., buying an expensive flat-screen TV) instead of the delayed option (i.e., long-term financial well-being), people are bound to save considerably less in the long run (Thaler & Shefrin, 1981). Researchers have commonly branded these behaviours as "self-control failures" and "myopic behaviours" (Ainslie, 1975). Not only does it emphasizes that many of the decisions people make on a daily basis collectively have a significant impact on their long-term financial well-being, but it also raises the question if it is rationally justified to be impatient towards the future (i.e., to discount the future), and if yes, to what extent. This is discussed within the next section.

2.3 Temporal Discounting and Rationality

Consider a person choosing between two options (i.e., €10 in one week or €100 in one year). Assuming that people aim to maximize their utility over their lifetime, it seems rational that people should always stick with the option yielding the greatest utility, which is usually the largest option (i.e., €100). Obviously, when making the decision, a rational actor should also consider economic factors (such as inflation rate changes in preferences) that influence the options future utility (Bartels & Rips, 2010). For instance, if the yearly inflation rate was 90% this would reduce the utility of the larger greater option by €90, making it rational to choose the sooner-smaller option (which is €10 in a week). Fisher (1930) combined these economic

considerations into a single parameter. He argues that when considering all economic influences, the general market discount rate forms a rational benchmark with which it is reasonable to discount future benefits. Therefore, discounting the future with a discount rate below or equal to the market rate is consistent with rationality, whereas discounting above is irrational.

However, the *normative* question how people should rationally behave is different from the *positive* question of how people actually behave in the real world (Bartels & Urminsky, 2011)[3]. Especially when trading off *immediate* over delayed benefits (i.e., a cookie now or in one week), people show time inconsistent effects, and seem to be heavily biased towards the present. That is, people discount future outcomes less steeply the further an outcome is delayed in time, which means that the discount rates are not constant but vary depending on the time horizon (Thaler, 1981; O'Donoghue & Rabin, 1999; Zauberman, Kim, Malkoc & Bettmann, 2009). At the same time, people also express constant long-term discount rates that are well above market interest rates – this has been empirically validated across many studies (Frederick et al., 2002). For instance, people often choose paying products in instalments instead of paying the full amount right away, even though this results in substantially higher total costs. Additionally, Laibson (1997) found evidence that private households usually save considerably less than what market norms rationally justify[4]. A fruitful area of research that offers a normative explanation of the prevalence of high constant discount rates is the concept of psychological connectedness. It is based on the theory of personal identity, which is illustrated in the following section.

2.4 Personal Identity and Multiple Self Theory

As it has been argued above, on logical grounds people should never devalue future benefits more strongly than market rates would predict. However, this view implicitly assumes that present as well as future benefits are consumed and valued by a "constant self" over the lifespan. Bartels & Urminsky (2011) argue that this assumption of a constant self is highly controverse. Indeed, given the fact one can easily imagine how people undergo big personality changes over the course of their life, the notion of a constant self seems questionable.

[3] Normative questions are concerned to answer what rational actors *should do*, whereas positive questions aim to predict what customers *in fact do* (Thaler, 1979).

[4] Interestingly, there is evidence from especially steep annual discount rates (up to 4000%) from rural villagers from South-East-Asia (Kirby et al., 2002; Tanaka, Camarer & Nguyen, 2010).

According to Parfit (1984) a person's "Personal Identity" constitutes his/her core beliefs, assumptions, preferences, desires and so on. Unpredictable and impactful events in life (i.e., marriage, accidents, graduation, or close people dyeing) may lead people to update these, leading to a change in identity or self. To illustrate this point, consider how a nation is the *same* nation it was 50 years ago (numerically identical), but at the same time being a *different* nation today (qualitatively not identical)[5]. Similarly, while a person, Alex, might still be the *same* Alex he was 50 years ago, he is still *different*. Thus, a person's identity constitutes of different (past, current and future) selves over time that vary with regards to their qualitative properties. If the present and future selves differ greatly in personality, Parfit (1984) argues that the future self might even be perceived and treated as a different person:

> "*Reconsider a boy who starts to smoke, knowing and hardly caring that this may cause him to suffer greatly fifty years later. This boy does not identify with his future self. His attitude towards this future self is in some ways like his attitude to other people. We ought not to do to our future selves what it would be wrong to do to other people."* (Parfit, 1984, pp. 319-320).

Consistent with this view, research has found that people indeed treat future selves like different people. For example, Pronin & Ross (2006) show evidence across seven studies that individuals tend to make observer-like attributions about past and future-versions of themselves. Viewing one's distant future self from an observer perspective leads to a failure to consider what this future-self might feel or think. When faced with intertemporal decisions such whether to exercise, smoke, drink alcohol, or save for retirement, these individuals will most likely devalue future consequences based on their failure to consider how present decisions impact future thoughts and emotions.

Similarly, the authors Pronin, Olivia and Kennedy (2008) suggest parallels between people's temporal and social decisions. That is, a person who loves sweets might consume sweets now in exchange for a promise to skip them tomorrow. As with the predisposition to sacrifice the needs of the future self for the present self, people tend to privilege their own needs over those of others. Research has shown that individuals given the choice to distribute money among

[5] Numerical Identity refers to the relation each entity has to itself, whereas qualitative identity refers to the extent to which different entities have the same qualitative properties (e.g., size, colour or form) (Bartels & Rips, 2010). Hence, two different MacBook Pro's might be qualitatively identical, but not numerically.

themselves and others tend to allocate more money to themselves relative to others. Similarly, based on the construal level theory, Wakslak, Nussbaum, Liberman & Trope (2008) found that representations of more distant future selves are more abstract and less structured than representations of a nearer future self.

2.5 Future Self-Connectedness

Following Parfit's (1984) argumentation; if there is no "constant self" which all future utility can be ascribed to – and personality instead constitutes of current and multiple future selves – than the rate of discounting should depend on the degree of "psychological connectedness" between current and future self[6]. That is, the perceived degree of overlap in major beliefs, preferences, values, ambitions, goals etc. between current and future self (Hershfield, 2011; Urminsky, 2017; Bartels & Urminsky, 2011). To the extent that one's current self is experienced as very different and disentangled from one's future self, Parfit (1976) theorizes that it is indeed consistent rationality to care less about the well-being of that future self:

> *"We care less about our further future, not because it is further, but because we know that less of what we are now – less, say, of our present hopes and plans, loves or ideals – will survive into the future. We may, because of this, act knowingly against our own long-term self-interest[...] My further future is less strongly related to me now; so it cannot be irrational to grant it less weight."* (Parfit, 1976, p. 99)

Put differently, if one does not know where he is going to be in 10 years from now on why would he dare to sacrifice his current needs for that future self, for whom he does not even care for? This claim has received vast support from researchers; Frederick et al. (2002) congratulated it to be the most convincing normative argument explaining people's impatience. Therefore, the question of intertemporal preferences is thus expected to depend on the degree of connectedness to the future self, where high connectedness should lead to more future-oriented choices[7].

[6] Note that *psychological connectedness* and *future self-connectedness* as well as *connectedness* are used interchangeably.

[7] Note that this does not necessarily imply that current and future selves are completely different persons, but rather that they vary to a specific degree based on their psychological overlap (Frederick et al. 2002). Indeed, in contrast to the theory of multiple selves, the notion of connectedness aims to provide a normative framework that explains high constant discount rates instead of branding high discount rates as "self-control failures" or "myopic decisions" (Bartels & Rips, 2010).

Researchers have applied and linked future self-connectedness to many different contexts, such as delinquency (Van Gelder, Hershfield & Nordgren, 2013), procrastination (Blouin-Hudon & Pychyl, 2017), motivation theory (Nurra & Oyserman, 2018) and health and exercise behaviour (Rutchick, Slepian, Reyes, Pleskus & Hershfield, 2018). For instance, the authors Nurra and Oyserman found that children feeling more connected to their future selves are more motivated to study and attain higher grades (vs. those low in connection). They show that connectedness to future self helps children to see their effort in school as the path leading to their future selves. Furthermore, Rutchik et al. find a correlation between future self-connectedness and exercise behaviour: the higher the connectedness, the more likely were participants to exercise in the following days.

More importantly for the scope of this research, connectedness has also been linked to the financial domain, namely to temporal discounting as well as saving and spending behaviour (for an overview, see Table 1 below). While being the first to investigate the relation between future self-continuity and temporal discounting, Frederick et al. (2002) found no evidence of such a relation. Conversely, Hershfield et al. (2009a) provide initial empirical evidence that links neural measures of brain activity to temporal discounting. That is, they show that thinking about current self- vs. future self-relevant information activated different parts in the brain that predict temporal discounting. These neural activations are similar when thinking about self- vs. other-relevant information, suggesting common underlying psychological mechanisms at work. In a subsequent paper in the same year, Hershfield, Garton, Ballard, Samanzen-Larkin & Knutson (2009) find that high future self-continuity is associated with larger accumulated assets and valuation of future outcomes. Bartels & Rips (2010) explored the role of future self-connectedness further, providing correlational support for the hypothesis that people who discount the future more steeply feel less connected. Besides, they manipulate connectedness through hypothetical life changes and find that people tend to prefer benefits before large life changes (instead of afterwards), but costs afterwards.

While prior studies have mostly provided correlational evidence for the link between connectedness and discounting, Bartels & Urminsky (2011) provide first causal evidence through experimentally manipulating perceived connectedness.

Table 1. Overview of Studies on Future Self-Connectedness.

Study	Type	Theory base	Manipulation	Independent Variables	Mediators	Moderators	Dependent Variables	Key Findings
Frederick et al. (2002)	Correlation	Rational Choice	-	FSC	-	-	Temporal Discounting	No correlation between perceived similarity and monetary discount rates.
Hershfield et al. (2009a)	Correlation	Personal Identity, FSC	-	FSC	-	-	Accumulated Savings & Temporal Discounting	High future self-continuity is associated with larger accumulated assets and valuation of future outcomes.
Bartels & Rips (2010)	Causal	Personal Identity, FSC	Priming large (vs. low) life changes	FSC	-	-	Intertemporal Monetary Choice Tasks	Decline in long-term discount rates correlates with declining connectedness. People tend to prefer benefits to occur before large psychological changes.
Hershfield et al. (2011)	Causal	Personal Identity, FSC	VR Technology, virtual future (vs. current) self	FSC	-	Socioeconomic Status, Income Stability, Emotions	Retirement Spending & Savings	Participants interacting with a future version (vs. current) of themselves allocate more money to retirement, show lower discount rates, and accept later rewards.
Bartels & Urminsky (2011)	Causal	Personal Identity, FSC	Priming stable (vs. unstable) personal identity	FSC	-	-	Intertemporal Choice Tasks	Individuals high in connectedness accept later-larger rewards, wait longer to save money on purchases, and have lower long term discount rates.
Bartels & Urminsky (2015)	Causal	Temporal Discounting, Ressource Slack Theory	Priming stable (vs. unstable) personal identity	FSC	-	Opportunity Costs, Propensity to Plan	Customer Spending	Joint effect of consideration and valuation of the future on customer spending. Highlighting opportunity costs only reduces spending for customers high in connectedness.
Stockdale & Sanders (2020)	Causal	EFT, Self-Relevance Thinking	Thinking about future (vs. not thinking)	Age Priming	-	FSC	Money Allocation	Age priming does not lead participants to allocate more money to retirement, whether they feel connected to their future self or not.
This Study	Causal	FSC, Vividness theory, Mental Imagery	Augmenting future self through AR (vs. thinking about future self)	Use of AR	Vividness, FSC	Opportunity Costs	Financial Decision-Making (Money Allocation, Pension Engagement, Spending Decision, Temporal discounting)	Use of AR has a significant negative main effect on pension engagement. People in the AR group (vs. control) allocated significantly less money to the future through sequentially decreasing vividness and connectedness. Vividness is positively related to connectedness. Opportunity cost salience does not moderate the relation between connectedness and financial decisions.

To do so, half of the participants are presented with research results indicating that major personality aspects stay consistent over time (stable identity), the other half is presented with research suggesting the opposite (unstable identity). Results indicate that people primed with an unstable identity behave more impatient in subsequent choice tasks. Besides, the authors empirically show that connectedness is distinct from other psychological mechanisms. More contemporary research arrived at mixed results: On the one hand, in a study conducted in Portugal, Marques & Dominic (2018) found connectedness to moderate the relation between age priming and money allocation to the future. On the other hand, Stockdale & Sanders (2020) replicated aforementioned study in the UK context and found no evidence for a moderating effect of connectedness on money allocation to future.

In short, I have argued that people's tendency to act against their best long-term interests is consistent with rationality to the extent that people feel psychologically detached from their future selves. Conversely, feeling connected one's future self should facilitate decisions that are consistent with long-term interests (i.e., financial well-being). This leads to the question: what makes people connect to their future selves? The next chapter is devoted to answering this question.

2.5.1 The Role of Mental Imagery and Vividness

Parfit (1971) posits that people often fail to identify with their future selves due to a lack of accurate imagination. Indeed, research suggests that mental imagery, which has been defined as "an internally generated representation of an object, scene, or event" (Schifferstein, 2009) strongly influences customer preferences, attitudes and behavioural intentions (Roggeven, Grewal, Townsend & Krishnan, 2015). These mental images are evoked through external stimuli and allow customer to mentally relive prior experiences (Park & Yoo, 2020), project visual scenarios of what might happen in the near or far future (Schacter, Addis & Buckner, 2008), or visualize future consumption experiences (Yoo & Kim, 2014). Especially in abstract decisions that lack sufficient visual information, customers utilize mental imagination to fill information gaps (Schwartz & Black, 1999). Interestingly, people even visualize and compare the future consequences of current decisions to decide which option to choose. For example, Hetts, Boninger, Armor, Gleicher and Nathanson (2000) found that customers create visual storylines about their potential vacation experiences when planning holidays.

While the mental images are influenced by various sensory experiences (i.e., odour, smell, or haptics), visual stimuli are believed to exert the strongest impact on customers decision-making (Heller et al., 2019). Indeed, vividness theory suggests that vivid information exerts relatively stronger influences on preferences (Loewenstein, 1996), is more informative and emotionally appealing (Nisbett & Ross, 1980) and mentally more engaging (Li, Daugherty & Biocca, 2001) than non-vivid information. Relatedly, Loewenstein, O'Donoghue and Rabin (2003) argue that people experience "empathy gaps" and hence do not readily understand how present decisions influence their future emotions and well-being. Indeed, given the powerful influence of visual stimuli, more vivid representation of one's future self might increase emotional thinking about that future self. This emotional thinking, in turn, might help people to better understand that their future self will be a real human being with real emotions – and who is affected by the consequences of current decisions (Loewenstein, 1996). For example, physicians that work in drug rehabilitation clinics might consume less drugs than other physicians, as being exposed to the real and vivid negative effects of patients might increase negative emotions linked to drugs (Hershfield et al., 2011). Therefore, a more vivid representation of the future self might let people experience the future self as more real and connectable, which in turn lets them better understand how a failure to save now will impact them negatively in the future.

2.5.2 Augmented Reality as a Tool to Increase Vividness

Some researchers have followed the quest to investigate if vivid representations of their future selves influence subsequent customer behaviour. For example, the authors Van Gelder, Hershfield and Nordgren (2013) hypothesized a relation between seeing a picture of one's future self and the likeliness to commit crimes. They show that those who feel more connected to their future selves were less likely to make delinquent choices (such as insurance fraud or illegal downloading). Others have used virtual reality technology (VR) as a mean to increase vividness and analyse its effects on customer behaviour (Bailenson et al., 2008; Yee et al., 2009). For instance, in a study by Hershfield et al. (2011), participants are directly exposed to virtually rendered avatars of their future (vs. current) selves and subsequently answer retirement saving questions. The results suggest that participants in the future-self-group feel more connected to their future selves and tend to save more relative to those in the current-self-condition.

Although Hershfield et al. (2011) methods of increasing connectedness through VR technology are promising, the method has its downsides. Currently, the technology is quite expensive, time-consuming and drawbacks such as the bulky hardware and technical glitches hinder exhaustive adoption (Statista, 2020). While customers need specific glasses to use VR, AR can be used on any mobile device without the need of additional equipment and is therefore widely available: As 3.8 billion people (48,3% of the whole population) own a smartphone world-wide in 2021 (Statista, 2021), the strong market penetration of active AR users of 810 million (10,7%) is no surprise (Statista, 2021a). Statista (2021b) forecasts the adoption to rise to an amount of 1.73 billion, which represents 22,4% of the total population in 2024. Furthermore, there is a vast amount of free AR apps that let people virtually age themselves (please consult Appendix D for an overview). AR allows users to experience a virtually enhanced reality that blends virtual information and visuals into the real world (Heller et al., 2019). This is particularly useful to support customers' decision-making process. For instance, research has shown that AR increases creative customer engagement and satisfaction (Jessen et al., 2020), assists customer's decision comfort through aiding their mental imagery ability (Heller et al., 2019) or support customers in acquiring a more informed and precise visual understanding of products (Heller et al., 2019a).

The availability as well as the promising research results indicate that AR might provide a practically suitable approach to experimentally induce changes in people's perceived vividness and connectedness to enhance customer's far-sighted financial decisions.

3 Hypotheses Development

Having reviewed and linked the relevant literature on the conceptual variables, the following section develops the hypotheses. They are based on the central concept of future self-connectedness, exploring potential mediating and moderating mechanisms. The conceptual framework is summarized in Figure 1 below.

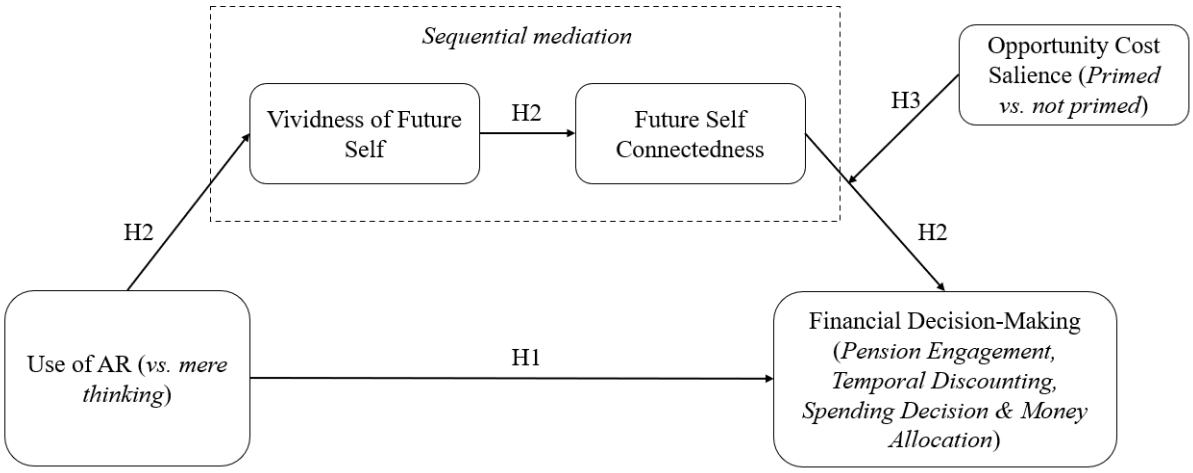

Figure 1. Overview of the Conceptual Model. Own Illustration.

In early work on visualization and intertemporal choice, Klineberg (1968) showed that the ability to prefer larger-later over smaller-sooner rewards depends on the extent to which people perceive future events with a sense of vividness and reality. Specifically, he demonstrated that the more people perceive their future to follow a vivid and realistic path, the more likely they were to subsequently delay rewards into the future. Over the past decades, developments in technology gave rise to immersive virtual environment technology, that allows to either transport people into a complete digital environment (VR) or create a mixed reality by projecting virtual objects and information into the real world (AR) (Yim, Chu & Sauer, 2017).

These technologies sparked novel intervention methods that influence customer behaviour and help to contribute to long-term well-being (Fox & Bailenson, 2009). For example, previous research on VR has shown that people alter their behaviours based on the appearance of their digital avatar. That is, people who interacted with taller avatars behaved more aggressively in subsequent face to face negotiations (Yee et al., 2009). Besides, seeing one's own avatar in a virtual environment using or trying out products increases the intention to purchase those products (Ahn & Bailenson, 2011). Similarly, participants who saw themselves exercising and loosing weight exercised significantly more than those who did not (Fox & Bailenson). Most notably, the authors Hershfield et al. (2011) have used VR as a mean to experimentally connect people to their future selves and analyzed their subsequent saving behaviour with promising results. Specifically, the authors showed that people who interacted with their digital future self contributed significantly more money to a hypothetical retirement fund compared to those who

did not. Motivated by these studies that demonstrate the impact of digital visualization tools on customer behaviour, I hypothesize the following:

> **H1:** *Augmenting people's future self through AR increases future-oriented financial decision-making.*

A highly unpredictable future that could take many different paths leaves people confused, unable to imagine their future self and not knowing with which of the many different future selves they should identify (Hershfield et al., 2011). Vividly imagining the life situation and the looks of one's future self 30 years from now on might thus be an abstract task for participants. Conversely, exposing people to a virtually aged face of themselves conveys them with a specific and definite version of their future self. This might serve as a starting point for further imagination and visualizations, thereby enhancing people's imagination and the extent to which they perceive their future self and its life situation as vivid. Indeed, Hershfield (2011) proposes that imagination supported through graphical renderings may require less effort and attention for participants than imagining from the very start.

In short, merely imagining the future self produces an uncertain and vague image, whereas augmented reality creates a vivid, specific, and relatable virtual rendering which should increase perceived connectedness to that future self. This should in turn increase customers motivation to care for the well-being of that future self, ultimately resulting in more future-oriented decisions. When making intertemporal choices that affect financial well-being, providing people with a virtually aged version of themselves (through AR) might let them perceive their future self as more vivid. Hence, I postulate:

> **H2:** *Virtually augmenting people's future selves through AR facilitates future-oriented financial decisions through a sequential mediation process of increased vividness and connectedness.*

In laboratory studies, discount rates are mostly inferred from choice decisions that are constructed as explicit trade-offs (i.e., would you prefer €100 now or €150 in 3 months). When interpreting these discount rates as temporal preferences predicting impatience across contexts, this implicitly assumes that people always spontaneously consider future consequences

(Urminsky & Zauberman, 2016). However, this is rarely the case in the real world. Most decisions affecting financial well-being entail implicit opportunity costs. For instance, when people buy a latte macchiato at Starbucks, they do not always intuitively consider how much future benefits they forego. This is because people have been shown to be limited in their ability to spontaneously consider opportunity costs (Frederick et al., 2009), have limited processing capabilities or generally fail to plan for future financial decisions (Lynch, Netemeyer, Spiller & Zammit, 2010). Therefore, failing to save for the future might arise not only due to a lack of connectedness, but simultaneously due to people's inability to consider opportunity costs when making decisions.

Likewise, Urminsky & Zauberman (2016) argue that making future-oriented decisions depends on the consideration of future outcomes as well as the valuation of them. Consideration of future outcomes means that people consider the future effects of their current decisions and valuation of future outcomes how much they care and value these future outcomes. Indeed, prior research explored the joint effects of consideration and valuation of future outcomes in the context of customer spending (Bartels & Urminsky, 2015). They provide initial evidence that suggests only when opportunity costs are highlighted does higher connectedness lead to more future-oriented choices. Conversely, when opportunity costs were not highlighted, high connectedness had no influence on spending, presumably because people do not consider the consequences of their decisions (Urminsky, 2017). However, there are no studies investigating the effect of opportunity cost salience on other intertemporal decisions and it is unclear if it is a robust moderator across a wider range of outcome variables. To the extent that opportunity cost salience builds a boundary condition for connectedness to influence customer spending, the same may hold true for other decisions in the context of financial well-being. Therefore, the third hypothesis is derived:

> **H3:** *The positive relationship between connectedness and financial decision-making is moderated by the salience of opportunity costs, such that it is stronger when opportunity costs are primed.*

4 Methodology

After presenting the relevant literature and developing the conceptual model, this section depicts the research methodology. First, the research design explains the experimental setup. Based on this, I justify the choice of the sample and shortly describe it. Afterwards, I present and describe the employed measurements and scales. The section closes by discussing the statistical approach, the data preparation and testing the assumptions.

4.1 Research Design

The data was obtained via a questionnaire that was developed and completed in English. The opening text of the questionnaire provided participants with a short introduction to the purpose of the study. The text stated that the study was conducted within the scope of a master thesis to investigate people's pension awareness. After declaring consent, participants were randomly assigned to either the control or the treatment group, where the manipulation took place. In both conditions (treatment and control) participants were asked to visualize answers to a set of questions about how their life will be like in the future when being old for at least 30 seconds (e.g., How do you spend your time? What is your daily routine?). This was the only manipulation for the *control condition*. In contrast, participants in the *treatment condition* were additionally asked to open Snapchat, search for the filter "Time Machine" and open it. The filter is based on AR technology and allows participants to glimpse into the future by virtually altering one's age using a slider at the bottom. As the slider is dragged to the right, participants grow older the further it is dragged to the right (for illustration purposes, please consult Appendix A). Participants were instructed to use the app to aid their visualization of their future life situation. To enhance identification with their future selves, participants are further asked to move their heads while visualizing (Yee & Bailenson, 2009). Participants in the treatment condition were only allowed to progress to the questionnaire after spending at least 60 seconds on the page, whereas people in the control condition could progress after 30 seconds. Subsequently to the experimental manipulation, participants completed the questionnaire containing the variables and scales of interest. To account for potential confounding factors, data on control variables was collected. Besides, financial decision-making was operationalized using various different measures described in section 4.3.

4.2 Sample Description

The online experiment was setup via Qualtrics and distributed among undergraduate students (n = 511) at Maastricht University, the Netherlands, over the course of roughly two weeks, from 03.05.2021 until 17.05.2021. Students participated voluntary in exchange for course credits. As the app "Snapchat" was needed to participate in the study, only people with an Iphone and Snapchat installed were selected to participate in the study. Participants who a) did not complete they survey (16); b) did not give their consent (1); c) did not have Snapchat installed on their phone (54); e) experienced technical difficulties or indicated that they answered incorrectly (2); and f) failed both attention checks (12), were removed from the study. This resulted in a final sample of 425 participants (51,5% female; 48,5% male; average age = 19.9, range = 18–29) in current between-subjects design ($N_{Control}$ = 214, N_{AR} = 211).

In line with the overarching agenda of fostering financial well-being, sampling especially young people provides two major advantages: Firstly, the nature of compounding and therefore the effectiveness of saving relies heavily on the time horizon with which people save (Eisenstein & Hoch, 2007). In particular, members of generation Y will need to save up to 15-20% of their annual earnings starting from age 25 to attain similar living standards during retirement life members (Brüggen et al., 2017). Secondly, higher age has been identified as an inhibitor of adoption of cutting edge technology such as AR, whereas young people usually express higher levels of technology readiness (Blut & Wang, 2020). Thus, young people are more likely to successfully handle the AR filter compared to their older counterparts. In sum, investigating whether AR may help people to foster financial well-being should be an especially efficient method for young people.

4.3 Measurement and Scales

This section describes how variables (especially dependent, mediators and moderators) were operationalized and which scales were used to measure them. Furthermore, the reliability of the employed scales was tested through performing a correlation analyis (Pallant, 2020); for a summary please see Table 2 below. As the items of the scales were substantially correlated, they were combined into Likert scales through taking the mean of the items[8]. Table 2 depicts

[8] According to Joshi, Kale, Chandel and Pal (2015) Likert scales can be considered interval variables; thus, mean and standard deviation can be used as measures of central tendency and dispersion. Besides, Likert scales are suitable to conduct parametric analysis, such as ordinary least square (OLS) analysis.

an overview of the constructs, including mean, standard deviation (SD) and Cronbach's alpha. For complete constructs and items, please consult Appendix B.

Table 2. Scale Reliability

Scale Label	M	SD	Number of Items	Cronbach's Alpha
Vividness of Future Self	4.27	1.54	3	0.84
Connectedness of Future Self	3.68	1.52	2	0.66
Pension Engagement	3.42	1.81	7	0.88

Dependent Variables. Financial decision-making was operationalized through four dependent variables. Namely, a pension engagement scale, a money allocation task, a spending decision, and a temporal discounting task.

Pension Engagement. To measure participants' behavioural intentions to engage in retirement planning, a six-item (α = .88), seven-point Likert scale (1 = "*Strongly disagree"* to 7 = "*Strongly agree"*) was used (Ajzen & Fishbein, 1969). The scale measures participants' intention to collect information on their personal pension situation as well as their intention to engage in retirement planning (e.g., "I will discuss my retirement finances with friends or family"). This scale has been used and validated by other researchers in the retirement planning context before (e.g., Eberhardt et al., 2020)

Money Allocation Task. The money allocation task was a slightly adapted version based on Hershfield et al. (2011). Participants were told to imagine that they unexpectedly received €1000 from their employer. Subsequently, they were asked to allocate it among four different options: "Use it to buy something nice", "Invest it in a retirement account", "Spend it on a fun trip or holiday", "Invest it into stocks" or "Put it into a current account". Both "Invest it in a retirement account" and "Invest it into stocks" represent future-oriented financial-decisions (i.e., an increased tendency to accept later monetary rewards over immediate rewards). Retirement wealth further relies on a diversified asset allocation between more conservative retirement funds and more risky investments such as stocks (Sundén & Surette, 1998). Thus, they were combined into a single parameter representing "money allocated to the future". The task has been used by other researchers in slightly different versions before (Marques et al., 2018; Stockdale & Sanders, 2020).

Spending Decision. The spending decision was an adapted version based on Frederick et al. (2009). Participants choosed whether to spend 110 Euros on hypothetical noise-cancelling headphones after being introduced to the following scenario: "Imagine that you have been saving some extra money on the side to make some new purchases, and on your most recent visit to the inner city you come across a special sale of some noise-cancelling headphones. These headphones are from your favourite brand, and you have been thinking about buying them for a long time. They are available at a special sale price of 110 Euros." Afterwards, they are asked to indicate whether they would buy the headphones or not. A similar version of this task has been used by Bartels & Urminsky (2015).

Temporal Discounting Task. The temporal discounting task was adapted from Kirby and Maraković (1995). Participants were told that they won the lottery worth €2,000 and the lottery comission provides them with the option of receiving a different amount 30 years in the future. Then they were asked to choose between 17 different choice-pairs, where each pair consisted of either €2,000 now or a larger amount of money in 30 years (i.e., would you rather receive €2,000 now or €8,000 in 30 years?). The immediate amount was fixed at €2,000 and the larger delayed amounts ranged from €6,200 to €50,000. They delay was kept constant at 30 years. The delayed amounts of money were calculated in a way that they represent "realistic" market interest rates. For example, €6,200 after 30 years represents an annual interest rate of 3.8%, whereas €50,000 after 30 years represent an annual interest rate of 11.3%[9]. Similar to Magen, Dweck and Gross (2008) the number of delayed choices were counted to compute an impatience score (i.e., the discount rate) for each participant (ranging from 0 to 16).

Moderator. The moderator *opportunity cost salience* was manipulated through priming opportunity costs salience. It was only primed for the money allocation task and the spending decision, but not for pension engagement and temporal discounting. This is because pension engagement does not include monetary opportunity costs (and they therefore cannot be primed) and the temporal discounting task already primes opportunity costs through the very nature of the task which consists of trading off current vs. future amounts of money. The manipulation slightly differed for both variables.

For the *money allocation task,* they were primed as follows: "Before making your choice, consider how you would use the money in the future if you saved or invest it now: Would you

[9] They were calculated using the compound interest formula $A = P(1 + i)^n$, where A represents the end capital, P the present value, i the annual interest rate and n the amount of years.

use it make a bigger purchase you always wanted to do? Buy your dream house with an amazing garden? How much would your money grow if you invested it? Spend at least 20 seconds thinking about future uses."

For the *spending decision*, the high opportunity cost condition included the following extra piece of information "Keep the 110 Euros for other important purchases.". This is a slightly adapted version from the opportunity cost prime utilized by Bartels & Urminsky (2015).

Mediators. The thesis suggests that the relationship between the use of AR and financial well-being is sequentially mediated through *vividness* and *connectedness to the future self.*

Vividness of Future Self. In order to verify if the experimental manipulation increased vividness, respondents rated a slightly adapted three-item-scale (e.g., "I am able to vividly imagine my elderly future self") seven-point Likert scale (1 = "*Strongly disagree"* to 7 = "*Strongly agree")* which was specifically adapted from Heller et al. (2019) for this study. The internal validity was good ($\alpha = .84$).

Connectedness to Future Self. In order to assess participants connectedness to their future self, the Future Self Continuity Scale (FSCS) based on Hershfield et al. (2009a) was used. It contains two-items ($\alpha = .66$) on a seven-point Likert scale (e.g., "Please select the diagram that best represents how connected you feel to your future self?"). Each point was marked by two circles ranging from no to almost complete overlap (1 = "*No overlap"* to 7 = "*Almost complete overlap"*). Hershfield et al. suggest that the current scale might constitute a more intuitive and tangible way for participants to report their perceived connectedness and thus facilitates comprehension. They also validated the scale in the previously mentioned study.

Control Variable. *Subjective Time Until Retirement.* It might be that participants were willing to save more for retirement simply because they perceived their own retirement to be temporally closer. To rule out temporal proximity to retirement as an alternative explanation of the empirical results, I controlled for subjective time until retirement. To measure people's subjective time horizon until retirement, participants were asked to indicate their answer to the question "How long do you consider the duration between today and the day when you will retire?" by marking a point on a linear line (1 = "*Very short"* to 100 = "*Very long"*). This scale is a slightly adapted version from Zauberman et al. (2009). A similar measure has been utilized by Kim (2010).

Attention Checks. Lastly, two manipulation checks were employed to ensure that participants pay sufficient attention to the content of the study and to increase statistical power of the findings (Oppenheimer, Meyvis & Davidenko, 2009). They were implemented in the middle and at the end of the study through two one-item measures that were added to the bottom of other scales (i.e., It is important that you pay attention in this study. Please tick "strongly agree" if you do). As inattentive participants may contribute substantial error to datasets by failing to read instructions or not elaborating sufficiently on the questions (Oppenheimer et al.), those respondents who failed to pass both attention checks were excluded from the study.

4.4 Data Analysis and Preparation

The purpose of this study is to empirically validate the conceptual model developed in section 3. To do so, the study utilizes a 2 (experimental condition: simple imagination vs. AR use) x 2 (opportunity cost salience: primed vs. not primed) between-subjects design, with four different dependent variables[10]. To analyze this conceptual model, I utilize conditional process analysis from Hayes' PROCESS macro (2018). It combines mediation and moderation analysis, and thus allows a deep understanding of the underlying mechanisms of a relationship between variables. That is, it delineates the conditional nature of a mechanism by which one variable exerts its influence on another (Hayes, 2018, p. 395). It is based on ordinary least squares analysis (OLS) and allows to establish causal relations between predictor and outcome variables. Therefore, it is suitable to test the thesis' conceptual model. The data was analyzed using IBM's SPSS Statistics Version 26.

Before performing the statistical analyses, it is necessary to verify that the data is suitable for the statistical approach and to test for any anomalies. First, as outliers may bias the results, they should consequently be excluded from the analysis (Pallant, 2020)[11]. To that end, the data was checked for outliers by visually inspecting boxsplots and further investigating descriptive statistics for all relevant variables. There were no outliers detected (please consult Appendix C for descriptive statistics). Second, the statistical methodology relies on several assumptions. Hayes (2018) states that the violation of one or more of these assumptions may cause potential problems in the validation of statistical inference and reduce the statistical power of the tests. To that end, he highlights several assumptions that are of particular importance. First, the

[10] Note that opportunity costs were only primed for two of them, namely the money allocation task and spending decision. I do elaborate on the reasons in section 4.3.
[11] Outliers are data points that deviate more than 2.5 SD from the mean (Pallant, 2020).

relation between the predictor and outcome variables must be linear[12]. This can be checked by visually inspecting the shape of the relations between independent and dependent variables, as suggested by Pallant (2020). The distribution shapes take a linear form (as opposed to exponential or quadratic), which indicates linear relations between predictor and outcome variables. Second, the error terms need to be normally distributed[13]. A visual inspection of the distribution plots of the error terms reveals a non-normal distribution for most of the relevant variables, which is confirmed by a Shapiro-Wilk test. However, due to the central limit theorem the violation of normality can be neglected if samples sizes are large enough (Hayes, 2018). Given the sample size of this study (n = 425), normality should therefore neither bias the results nor cause interpretation problems. Lastly, the data should be homoscedastic. In simple terms, homoscedasticity means that the variability of the predictor variables should be relatively similar at all values of the outcome variable (Pallant, 2020). Again, this is best assessed by a visual examination of the shapes of the scatterplots. Indeed, the shapes mostly follow a rectangular distribution, which confirms the assumption of homoscedasticity.

5 Results

Having explained statistical approach, as well as prepared the data and tested the assumptions, the following paragraph empirically tests the thesis' conceptual model and hypotheses. That is, section 5.1 examines the main effect of AR use on financial-decision making (H1), section 5.2 investigates the proposed sequential mediation through vividness and connectedness (H2), and finally, section 5.3 analyzes if the indirect effect of AR use is moderated by opportunity costs (H3). In order to that, I employ a chi-square and an independent samples t-test for H1. The sequential mediation H2 and the moderated mediation H3 are analyzed using Hayes' (2018) PROCESS macro model 6 and 87, respectively. For detailed statistics and results please consult the Tables 3 and 4. Within the text, I focus on interpreting the most important outcomes.

[12] This is of utmost importance, as regression coefficients quantify how much the outcome variable differs based on a change in the predictor variable. This interpretation is *independent* of which value (low or high) the predictor variable takes. If the relation was exponential, this interpretation would not be meaningful (as for exponential relations the estimated difference in the outcome variable depends on values of the predictor variable, such as that the difference in outcome is higher for higher values of the predictor variable) (Hayes, 2018).

[13] People commonly misinterpret the assumption normality in such as that they assume normality refers to the distribution of the scores of the variable (Hayes, 2018). Instead, it refers to the distribution of the error terms.

5.1 Main Effect of AR Use

Hypothesis H1 predicts that participants in the AR condition (vs. control) make more future-oriented financial decisions. To investigate this hypothesis for all dependent variables several independent samples t-tests and a chi-square test of independence were conducted. Surprisingly, the t-tests revealed that participants did not distribute significantly more money to the future (M = 515.64, SD = 329.38) compared to those in the control condition (M = 495.85, SD = 317.12; t(423) = 0.63, p = .528., $\eta^2 = 0.001$), neither did they did they express significantly lower discount rates (M = 10, SD = 4.56) compared to those in the control condition [(M = 10.21, SD = 4.56; t(423) = 0.46, p = .643, $\eta^2 = 0.001$), see Table 3]. Similarly, the chi-square test of independence revealed that there was no significant association between the use of AR and the likeliness to engage in a spending decision (χ^2; 1, N = 425) = .69, p = .406).

Table 3. T-test Results for Equality of Means including Effect Sizes

This table reports the t-test results for dependent variables. Means and standard deviation for the AR group as well as control group are reported in the second and third; and fourth and fifth column, respectively. Besides, degrees of freedom (df), p-values and effect sizes (eta squared) are depicted.

	AR Use		Control					
Dependent Variables	M	SD	M	SD	df	t	p-value	Eta Squared
Pension Engagement	3.11	1.31	3.73	1.39	423	4.72	<.001	0.05
Allocation to Future	515.64	329.38	495.85	317.12	423	0.63	.528	0.001
Temporal Discounting	10	4.56	10.21	4.56	423	0.46	.643	0.001

Note. Significance based on two-tailed tests: ***p < .001, **p < .01, *p < .05, +p < .1.

However, participants in the AR condition were significantly less likely to engage with their pension situation (M = 3.11, SD = 1.31) compared to those in the control condition (M = 3.73, SD = 1.39; t(423) = 4.72, p < .001, $\eta^2 = 0.05$). The effect was of medium strength.

In brief, out of the four dependent variables, only pension engagement was significantly influenced by the use of AR. Contrary to my prediction, the effect pointed in the opposite direction. That is, it revealed that participants in the AR condition were less likely to subsequently engage with their pension situation. Hence, H1 is rejected for pension engagement, yet can neither be rejected nor confirmed for money allocation, spending decision and temporal discounting.

5.2 Sequential Mediation

Hypothesis H2 predicts that looking at an augmented virtually aged future version of oneself (vs. simply thinking about it) sequentially leads to an increase in perceived vividness, connectedness of that future self, and lastly to more future-oriented choices over a range of financial decisions. To investigate this hypothesis, I tested for sequential mediation utilizing Model 6 from the PROCESS macro[14] (Hayes, 2018). To differentiate the effects from confounding factors (Hayes, 2018), I controlled for perceived temporal proximity of retirement in all the analysis. It could be that being exposed to one's aged self simply lets participants perceive their retirement to be temporally closer – instead of being more motivated to care for their future self. Model 6 is split into three different regression models; detailed results are depicted in Table 4.

I first regressed perceived vividness on AR use (coded 0 = imagining future self, 1 = virtually augmented future self). The results revealed that AR use has a significant negative effect ($\beta = -0.61$, $p < .001$). In line with the results of the previous t-tests, the results indicate that participants using AR to visually augment their imagination perceived their future self as less vivid compared to those who merely imagined their future self. Next, testing the sequence of effects, I regressed future self-connectedness on vividness and found that vividness, in turn, significantly increases connectedness ($\beta = 0.22$, $p < .001$). Notably, AR use has also had a direct negative effect on connectedness ($\beta = -0.41$, $p = .002$). These preliminary results may indicate that the relationship between experimental condition and connectedness is indeed mediated through vividness.

In the last regression model, I regressed all of the dependent variables on connectedness and vividness. Out of the four resulting regression models (Table 4), only the models for pension engagement and money allocation were significant with $F(4, 420) = 11.90$, $p < .001$, $R^2 = .1$, and $F(4, 420) = 4.72$, $p < .01$, $R^2 = .04$, respectively. These models further provided evidence for mediation as hypothesized in H2: connectedness had a positive and significant effect on pension engagement ($\beta = 0.1$, $p = .043$), while the direct effect of AR use remained significant and negative ($\beta = -0.53$, $p < .001$). Moreover, connectedness also significantly increased the

[14] Note that this thesis, following Hayes (2018, p. 171-172) suggestion, refrains from using the terms *partially* or *complete* mediation. Hayes argues that the concepts are too-sample size dependent and distinguishing between them provides no theoretical value and that they should therefore be abandoned.

share of money allocated to the future (β = 28.43, p = .02), while the direct effect from AR use to money allocated to the future became nonsignificant (β = -3.96, p = .902).

Table 4. Sequential Mediation Analysis Results (Model 6)

Panel A: Regression Results.

Panel A shows the results regression results. From left to right regression coefficients and standard errors in parentheses are reported for mediators and dependent variables. Besides, model fit statistics are reported. The regression estimates ß represent unconditional effects. That is, they can be interpreted as the effect of X on Y by one unit increase in X, holding all the other variables in the model constant (= 0) (Hayes, 2018).

Independent Variables	Vividness	FSC	Pension Engagement	Money Allocation	Spending Decision	Temporal Discounting
Constant	5.63***	2.71***	4.05***	611.22***	-1.03	7.38***
	(0.31)	(0.40)	(0.44)	(105.46)	(0.72)	(1,51)
a AR Use	-0.61***	-0.41**	-0.53***	-3.96	-0.4	-0.08
	(0.13)	(0.13)	(0.13)	(32.06)	(0.22)	(0.46)
$ß_1$ Vividness	-	0.22***	0.08	6.58	0.08	0.15
		(0.05)	(0.05)	(12.17)	(0.08)	(0.17)
$ß_2$ FSC	-	-	0.10*	28.43*	0.15+	0.02
			(0.05)	(12.13)	(0.08)	(0.17)
SRT	-0.01***	0.003	-0.01***	-2.9**	0.01*	0.03*
	(0.004)	(0.004)	(0.004)	(0.89)	(0.006)	(0.01)
R^2	0.08	0.09	0.1	0.04	-	0.01
MSE	1.695	1.63	1.74	100870.64	-	20.81
F	17.81***	13.56***	11.90***	4.72**	13.89+	1.14
df	2, 422	3, 421	4, 420	4, 420	4, -	4, 420

Panel B: Indirect Effects of AR Use on Financial Decision-Making Variables.

Panel B presents the indirect effects of AR use on the respective dependent variables, indirect effect keys are reported below the table. The indirect effects of AR use are essentially derived by multiplying the regression estimates of the respective pathways (Hayes, 2018). For instance, the indirect effect of AR use on how much money people allocate to the future through vividness and connectedness is the product out of -0.61*0.22*28.43 = -3.86. To infer causality, bootstrap confidence intervals are utilized. They are calculated by resampling the observations of the sample (n = 425) with replacement for 5000 times to calculate the regression coefficients $ß_i$ each time. The empirical sample distribution of $ß_i$ is then used to infer in which range the coefficient will with 95% probability (Hayes, 2018).

Dependent Variable	Indirect Effect Pathways	Indirect Effect	SE	95% Bootstrap Confidence Interval		
Pension Engagement	Total	-0.10	0.04	-0.19	to	-0.03
	Ind1	-0.05	0.04	-0.12	to	0.02
	Ind2	-0.04	0.03	-0.10	to	0.01
	Ind3	-0.01	0.01	-0.04	to	0.01
Money Allocation	Total	-19.42	9.74	-39.64	to	-0.72

	Ind1	-4.03	7.94	-20.19	to	11.14
	Ind2	-11.52	6.45	-25.92	to	-0.98
	Ind3	-3.86	2.02	-8.31	to	-0.50
Spending Decision	Total	-0.13	0.07	-0.27	to	-0.01
	Ind1	-0.05	0.05	-0.16	to	0.05
	Ind2	-0.06	0.04	-0.16	to	0.01
	Ind3	-0.02	0.01	-0.05	to	0.01
Temporal Discounting	Total	-0.1	0.13	-0.38	to	0.14
	Ind1	-0.1	0.12	-0.34	to	0.13
	Ind2	-0.01	0.08	-0.18	to	0.14
	Ind3	0.0	0.03	-0.06	to	0.05

Note. The numbers in parentheses are standard errors. This table provides unstandardized coefficients. Significance based on two-tailed tests: ***p < .001, **p < .01, *p < .05, +p < .1.

Indirect Effect Key:
Ind1: AR use → Vividness → Money Allocation
Ind2: AR use → FSC → Money Allocation
Ind3: AR use → Vividness → FSC → Money Allocation

To further formally probe the sequential mediation (H2), Hayes' (2018) bootstrapping procedure was applied. The indirect effects for the AR use → Vividness → FSC → DV pathway, as well as the AR use → FSC → DV were nonsignificant for pension engagement, temporal discounting and spending decision as the confidence intervals did not include zero (see Table 4, Panel B). However, the indirect effect of AR use → Vividness → FSC → Allocation to future revealed a negative and significant indirect effect, as the confidence intervals of the bootstrapping mediation with 5000 samples did not include zero (β = -3.86, $CI_{95\%}$ = -8.31, -0.50; see Table 4, Panel B). Furthermore, the indirect effect for AR use → FSC → Allocation to future was also negative and significant (β = -11.52, $CI_{95\%}$ = -25.92, -0.98). This implies that using AR indirectly influences how much money allocation to future through a process of decreased vividness and connectedness. That is, augmenting people's future self through AR (vs. merely thinking about it) indirectly *decreases* people's perceived vividness through its sequential negative effect on vividness and connectedness.

In sum, out of the five dependent variables, only one, namely money allocation, contrasts H3, in the sense that the indirect effect pointed in the opposite direction, while all other variables were nonsignificant. Hence, H3 is rejected for money allocation, and can neither be confirmed nor rejected for pension engagement, spending decision and temporal discounting.

5.3 Moderated Mediation

To test whether the indirect effect of AR through connectedness on financial decision-making conditionally depends on whether opportunity costs (coded 1 = OC highlighted, 0 = OC not highlighted) were primed (H3), I tested for moderated mediation (or conditional process analysis) using model 87 from Hayes' (2018) PROCESS macro. All continous predictor variables were mean centered and I again controlled for subjective time until retirement[15]. As the sequential mediation was tested previously (H2), the parameters of interests are the moderator opportunity costs as well as the interaction term between opportunity costs and connectedness. For detailed results, please consult Table 5.

Table 5. Moderated Mediation Results (Model 87)

Panel A: Regression Results

Panel A presents the regression results of the moderated mediation. Path a represents the direct effect of AR use on the the mediators and dependent variables. Importantly, the parameters $ß_1$ and $ß_2$ cannot be interpreted as main effects. Rather, they represent conditional indirect effects of vividness and connectedness on financial making at a specific value of the moderator opportunity costs, namely OC = 0. Besides, $ß_3$ represents the effect of opportunity costs on financial decisions at the mean of connectedness (as connectedness was mean centered).

Independent Variables	Vividness	FSC	Money Allocation	Spending Decision
Constant	5.63***	-0.97*	719.41***	-0.19
	(0.31)	(0.40)	(103.15)	(0.53)
a AR Use	-0.61***	-0.41**	-2.45	-0.04
	(0.13)	(0.13)	(32.15)	(0.22)
$ß_1$ Vividness	-	0.22***	7.06	0.08
		(0.05)	(12.20)	(0.08)
$ß_2$ FSC	-	-	38.38*	0.16
			(16.64)	(0.12)
$ß_3$ OC	-	-	-14.04	-0.47*
			(30.89)	(0.21)
$ß_4$ FSC x OC	-	-	-21.11	0.02
			(23.23)	(0.16)
SRT	-0.01***	0.003	-2.89**	-0.01+
	(0.004)	(0.004)	(0.89)	(0.01)
R^2	0.08	0.09	0.05	-
MSE	1.70	2.126	10103.97	-
F	17.81***	9.099**	3.31**	13.89*
df	2, 422	2, 422	6, 418	7, -

[15] While mean centering is not necessary per se, it may protect readers from mistakenly interpreting $ß_3$ OC as meaningful main effect. This is especially problematic in those cases, when the value zero is not meaningful in the measurement systems of the moderator and the independent variable (Hayes, 2018, p. 310). As the values zero is meaningful for the dichotomous variable opportunity costs, but not for connectedness, only the latter was mean centered.

Panel B: Conditional Indirect Effects of AR use.

Panel B depicts the conditional indirect effects of AR use on money allocation and spending decision through vividness and connectedness. That is, it shows the effect of AR use through vividness and connectedness when opportunity costs are primed (OC = 1) and when they are not primed (OC = 0).

Dependent Variable	Opportunity Costs	Indirect Effect	Standard Error	95% Bootstrap Confidence Interval
Money Allocation	0.00	-5.21	2.94	-11.91 to -0.47
	1.00	-2.35	2.41	-7.01 to 2.61
Spending Decision	0.00	-0.02	0.02	-0.06 to 0.01
	1.00	-0.02	0.02	-0.06 to 0.01

Note. The numbers in parentheses are standard errors (SE). This table provides unstandardized coefficients. Significance based on two-tailed tests: ***p < .001, **p < .01, *p < .05, +p < .1

First, highlighting opportunity costs significantly decreased how people's likelihood to purchase new headphones (β = -0.47, p = .027), but did not significantly influence how much money people allocated to the future (β = -14.04, p = .649). Second, the interaction term connectedness and opportunity costs was nonsignificant for both allocation to future (β = -21.11, p = .365) and spending decision (β = 0.02, p = .901). This is confirmed by the indeces of moderated mediation, as they were nonsignificant for both money allocation as well as spending decision, because the bootstrap confidence intervals did not include zero[16]. Given nonsignificant interaction terms, there was no need to further investigate the interaction through probing it (Hayes, 2018, p. 259). Yet, the conditional indirect effects of AR use when opportunity cost were primed and when they were not are reported in Panel B of Table 5[17]. The finding suggests that the relationship between connectedness and financial decision-making is not moderated by opportunity costs. That is, the extent to which connectedness influences people's allocation to future as well as their likeliness to sponteously buy new headphones does not differ whether opportunity costs were salient or not. As there were no significant relations found, H3 can neither be confirmed nor rejected for both money allocation and spending decision.

[16] The index of moderated mediation is essentially the difference between the conditional effects of AR use. Specifically, the effect of AR use at OC = 1 minus the effect of AR use at OC = 0 (Hayes, 2018).

[17] A significant interaction term means that the relation between X and Y conditionally depends on specific values of the moderator. Yet, it does not imply that the relation is significant at *every value* of the moderator. Hence, probing an interaction serves to investigate at which specific values of the moderator the relation is significant. Conversely, simply because the relation between X and Y is significant at *some* values of the moderator does not imply moderation (as in this example for money allocation when OC were not primed). Moderation is ultimately a test if two conditional effects are significantly different from each other (Hayes, 2018, p. 260).

5.4 Overview of Hypotheses Tests

Finally, Table 6 provides an overview of the results of the empirical hypotheses tests including the proposed and actual relations for each dependent variable, respectively. In general, none of the hypotheses (H1, H2 & H3) can be confirmed, as the actual relation of the effect pointed in a different direction than expected. Specifically, rather than increasing vividness and connectedness, the use of AR decreased how vividly people perceived their future self, as well as how connected people felt. Yet, H1 can be rejected for pension engagement, as the use of AR exerted a significant negative effect on how likely people were to engage with their pension situation. Similarly, H2 can be rejected for money allocation, as the use of AR decreases how much money people allocate to retirement. The rest of the proposed relations can neither be confirmed nor rejected, as they turned out to be nonsignificant (NS).

Table 6. Overview of Hypotheses Tests

Hypothesis	Dependent Variable	Proposed Relation	Actual Relation	Results
H1	Pension Engagement	+	-	Rejected
	Money Allocation	+	/	NS
	Spending Decision	-	/	NS
	Temporal Discounting	-	/	NS
H2	Pension Engagement	+	/	NS
	Money Allocation	+	-	Rejected
	Spending Decision	-	/	NS
	Temporal Discounting	-	/	NS
H3	Money Allocation	+	/	NS
	Spending Decision	-	/	NS

6 General Discussion

Financial well-being is one of the most important influence of people's overall well-being – its effect comparable to the combined effects of job satisfaction, physical health and perceived relationships with others (Netemeyer et al., 2018). It is jointly determined by the financial decisions people take each day. These decisions often involve sacrificing (smaller) immediate gains in exchange for (greater) delayed gains. When presented with such decisions, a tendency

termed *temporal discounting* leads people astray – to advance their short-term interests at the expense of their long-term interests. Therefore, people often fail to save adequately for the future and are left to suffer from poverty in retirement. In their quest to foster citizens well-being, governments and institutions are still facing difficulties in fully understanding the underlying psychological mechanisms at work. An emerging stream of research suggests that myopic behaviour is partly caused through a lack in perceived psychological connectedness to the future self. Motivated through studies that used VR technology to manipulate connectedness with promising results (Hershfield et al., 2011), in this study I demonstrate the influence of virtually aging people through a novel intervention method on their perceived connectedness and financial decision-making. Specifically, I assumed that the use of AR facilitates future-oriented financial decision-making through a sequential process of increasing vividness and connectedness. Based on Bartels & Urminsky's (2015) argument that people often fail to consider the consequences of their decisions, I further reasoned that priming opportunity costs increases the positive relation from perceived connectedness on future-oriented financial decision-making.

Contrary to the predictions, the study finds a negative main effect of the use of AR on pension engagement, but no effect for any of the other variables. Besides, it reveals that augmenting the imagination of people's future selves through AR (vs. mere thinking) leads to more myopic decisions through sequentially decreasing perceived vividness and connectedness, but only for how much money people allocate to the future. Further, the relation between connectedness and financial decision-making was not moderated by opportunity costs for any financial decision. First and foremost, the varying results per employed dependent variable indicates that the proposed relations are *not robust* among different operationalizations of financial decisions. Presumably, this is because they differ conceptually. Nevertheless, in the following paragraphs the key results are subjectively interpreted and related to other research findings for each of the research question, respectively. In doing so, I further offer potential explanations for the counterintuitive results that can serve as a starting point for future research of other scientists. Due to the limited scope of this thesis and the amount of outcome variables employed, the discussion section does not claim to be exhaustive, but rather focuses on discussing the most important points.

RQ1: How does the use of AR facilitate participant's future-oriented financial decision-making?

Those people in the AR condition were *less likely* to subsequently engage with their pension situation compared to those in the control group. In contrast, prior studies have shown that interactive elements *increase* pension engagement (Brüggen et al., 2019). As AR offers such interactive and playful elements (Yim et al., 2017), this finding is surprising. How can this be explained? As Hershfield (2011) argues, it might be that being exposed to one's own aged face elicits negative emotions and thoughts about one's aging process and limited existence. Research has shown that negative emotions such as disappointment can lead to various coping strategies such as a lust for unhealthy food choices (Macht & Simons, 2000), increased customer spending (Cryder, Lerner, Gross & Dahl, 2008) or certain avoidance behaviours (Yi & Baumgartner, 2004). For instance, Baumgartner and Yi argue that customers often cope with disappointment through mental and behavioural disengagement. Therefore, it might be that looking at their aged face disappointed people, leading them to avoid thinking and engaging with their pension situation (i.e., mental and behavioural disengagement). This would explain why they were subsequently less likely to engage with their pension situation. In contrast, healthy adults generally tend to be positively biased towards the future (Wilson & Ross, 2001). Therefore, they might imagine their future selves as better looking and wealthier than they will actually be. This positive impression may in turn motivate them to be relatively more concerned about their pension situation, which could at least partly explain the counterintuitive results.

However, the use of AR did not influence how steeply people discount the future, how likely they were to purchase headphones and how much money they allocated to the future. This leads to the question why did the use of AR influence pension engagement, but not the other variables? A possible explanation might lie in the conceptual differences between the dependent variables. Most notably, all variables incorporated immediate costs to some extent – except for pension engagement. For instance, to become wealthier at retirement age, people need to forego a part of their salary during working life. Similarly, to save for the future, people need to forego the exciting option of owning new headphones. Looking up your personal pension situation, in contrast, does not require participants to make any present sacrifices. The authors Tversky & Kahneman (2011) found that costs and losses exert stronger influences on people's decisions than gains and advantages. Further, Chang & Pham (2013) show that feelings are more heavily relied on in decisions involving immediate outcomes. Consequently, it might be that the

involved *immediate costs* of sacrificing money triggered heavy emotional responses that mitigated the effect. Put differently, the manipulation might have been strong enough to motivate people to make future-oriented decisions in tasks with low perceived costs (looking up one's personal pension situation), but not when the decisions involved relatively higher associated costs (such as sacrificing money). Nevertheless, this argumentation does not sufficiently explain why similar studies established a positive relation between virtually again people and their temporal discount rates as well as how much money they allocate to retirement (Hershfield et al., 2011). Future research should thus repeat these studies to address this ambiguity.

RQ2: Does perceived vividness and connectedness sequentially mediate the relationship between the use of AR and future-oriented financial decision-making?

Vividness and connectedness did not sequentially mediate the proposed relationships between the use of AR and pension engagement, temporal discounting and spending decision. This contrasts the findings of researchers who established a positive relation between virtually aging people and temporal discounting (Hershfield et al., 2011) as well as those who found connectedness to influence spontaneous spending decisions (Bartels & Urminsky, 2015). These findings are surprising, yet they indicate that the proposed sequential mediation does not represent a robust predictor of different financial decisions. As one can only speculate about the reasons without further investigation of the underlying mechanisms, I will address how future research might help to advance this research gap in the section 6.3.

Nevertheless, the use of AR did exert a significant indirect negative impact on how much money people allocate to the future through *sequentially decreasing* vividness and connectedness. With a difference of 3.86€ (roughly 0.4%) the effect might be low. Yet, given the nature of exponential growing savings (Stango & Zinman, 2009) it does still make a small economical difference if people allocate 0.4% more or less to their retirement fund each month[18]. This has three noteworthy implications, which I will discuss in the following:

(1) Firstly, augmenting people's imagination through AR *decreases* the extent to which people perceive their future self as vivid. Although this effect sharply contrasts the proposed relation, it should be interpreted cautiously as the experiment setup could not ensure that people

[18] For instance, if someone saves €500 per month, an increase of 0,5% equals an increase of €2.5 per month. If these €2.5 are invested each month with an interest rate of 8% for 40 years, they rise to a final capital of 8,728€.

used the app, which I will further elaborate on in the limitations section 6.3. Even so, there might be several explanations. According to self-image congruence theory people judge products and services more favourably when they are congruent with their self-image (Onkvisit & Shaw, 1987). Amplified by people's tendency to being positively biased towards the future (Wilson & Ross, 2001), people may generally have an overly favourable idea of what they will look like in the future and what their living situation will be like. This optimistic imagination can further manifest itself in a specific expectation – and when expectations are not met, they evoke disconfirmation and negatively affect customer satisfaction (Gerstner, 1985; James, 2007). If the virtual renderings of people's future selves convey pictures that are inconsistent or not congruent with their imagined future self-image, this might cause them to experience psychological discomfort, ultimately leading them to perceive their future life situation less vividly. This might further be amplified when people experience the quality of the virtual rendering as poor. Relatedly, customers beliefs have been shown to influence their subjective experience, commonly known as *placebo effect* (Shiv, Carmon & Ariely, 2011). For instance, if a drink has a favourable brand label on it, people perceive it to taste better (McClure et al., 2004). Similarly, a high priced product may be perceived as higher in quality compared to a lower priced one (Shiv et al.). As Snapchat is commonly known as a fun and playful communication tool integrating AR filters, people might not necessarily associate it with high quality. Therefore, this belief might negatively affect the perceived vividness of the virtual rendering.

Moreover, participants might have been distracted by the use and handling of the app. The experiment instructed them to get their phone, open the app and use the filter time-machine, which some of them presumably never used before. This task might have depleted participants' cognitive resources (Pocheptsova, Amir, Dhar & Baumeister, 2009), leaving less resources available for subsequent imagination. In contrast, participants who could fully focus on their imagination had more time to elaborate on all the different aspects of their future self and life situation. Consequently, using the app might have contributed to participants thinking less intensively and clearly about their future self and future life situation. Indeed, being exposed to a visual rendering of one's future self might lead people to put relatively more emphasis on an unidimensional visual appearance of their future self – in contrast to a holistic perspective including the future self's characteristics, emotions, and life situation. However, to perceive the future self as vivid, this emotional thinking and propositional aspects (Hershfield et al., 2011)

might play a more central role than originally hypothesized. This is supported by the fact that people in the AR group scored especially low on imagining the future living situation (M = 3.91), compared to those in the control condition (M = 4.77). Conversely, the difference between the imagination of how the future self would look like was less pronounced (M_{AR} = 3.79 vs. $M_{Control}$ = 4.08).

(2) Secondly, perceiving the future self vividly was *positively* related to connectedness. This relation is in line with my prediction and congruent with the findings of prior research on future self-connectedness, which utilized visual manipulation methods to increase people's connectedness (e.g., Hershfield et al., 2011; Nurra & Oyserman, 2018). Thus, the study empirically confirms that increasing people's vividness of their future self helps people to connect to their future selves and therefore constitutes an important antecedent. Moreover, AR use also exerts a direct negative effect on connectedness, that is even stronger than the effect of vividness on connectedness. This indicates that the use of AR influences connectedness through additional mechanisms apart from vividness that were not hypothesized. Hershfield claims that a more positive impression of one's future self leads to higher perceived connectedness. Building on the previous argumentation that healthy adults generally tend to be positively biased towards the future (Wilson & Ross, 2001), it could be that people who merely imgagined their future self and its life situation imagined it more positively than those who were exposed to a virtual rendering. However, as I did not empirically measure the perceived positity it remains speculative, and it is up to future researchers to put this claim to test.

(3) Thirdly, connectedness was *positively* related to how much money people allocate to the future. This is in line with the findings of a stream of research suggesting positive effects on connectedness on how much money people allocate to retirement (Hershfield et al., 2011). As assumed, the finding demonstrates that people who feel more connected to their future selves are indeed more motivated to save for that future self, in such as that they allocate more money to the future. It further supports Parfit's (1984) normative account on identity, namely that people's motivation to care for their future self depends on how much psychological overlap they experience.

RQ3: Does the salience of opportunity costs moderate the relation between the use of AR and future-oriented financial decision-making?

Based on the premise that people do not always spontaneously consider opportunity costs, my conjecture was that only when people are aware of the future consequences of their decisions does a motivation to care for their future well-being lead to more future-oriented choices. Put differently, if people are unaware of the consequences of their decisions, a high motivation to care for their future self cannot lead to more future-oriented decisions. As opposed to my prediction, the relation between the use of AR and financial decision-making was not moderated by opportunity costs, neither how much money people allocated to the future nor how likely they were to purchase new headphones. This contrasts the finding of Bartels & Urminsky (2015) who demonstrated that only when opportunity costs were highlighted did higher connectedness decrease customer spending. Yet, some researchers have taken an alternative position. Instead of arguing that future-oriented financial decisions are determined by the joint effect of being aware of future outcomes (opportunity costs) and being motivated to care about these outcomes (connectedness), they posit that these factors work independently. For instance, Adams and Nettle (2009) investigated if measures of connectedness and consideration of future consequences are correlated with unhealthy behaviour (such as smoking or body mass index) independently, without considering interaction effects. Hence, results of this thesis are in line with this alternative account and suggest that being aware of future consequences (opportunity costs) and valuing these future outcomes (connectedness) may rather work independently, instead of conditionally depending on each other.

The fact that the opportunity cost prime significantly decreased people's likelihood to purchase new headphones, but not how likely people were to allocate money to the future may further indicate that participants found it conceptually difficult to incorporate long-term opportunity costs in their decision-making process. Indeed, elaborating on foregone future benefits 30 years away in time from failing to save in the present can be a mentally demanding task. If one has absolutely no idea of how life is going to look in 30 years from now on, it therefore may be hard to get a clear impression of the utility of having more money in the future. Conversely, when elaborating on whether to purchase new headphones or use the money for alternative purposes seems straightforward.

6.1 Theoretical Implications

The insights discussed above provide valuable contributions to the existing academic literature on future self-connectedness and how it links to intertemporal choice. While many prior studies merely provide correlational evidence for the relation between connectedness and temporal discounting and other financial decisions, some also experimentally manipulated connectedness through either priming stable (vs. unstable) personality traits or through letting participants elaborate on the future. Moreover, prior results reported mixed results regarding the question if and to what extent connectedness influences intemporal decisions. Grounded on vividness theory and its potential powerful emotional impact, more sophisticated research has demonstrated that connectedness may be manipulated visually by the means of exposing people to their virtually aged selves through VR technology and confirmed its effect on how much money people allocate to retirement. However, the authors did not empirically measure if their VR manipulation increased connectedness through vividness and acknowledge themselves that a VR approach is expensive and time consuming and might therefore form an insufficient solution to increase people's savings (Hershfield, 2011).

To bridge this gap, I test if the use of AR sequentially increases vividness and connectedness, and if connectedness, in turn, emerges as a robust predictor over various financial decisions. In doing so, I mainly base my reasoning on vividness and mental imagery and personal identity theory, for which I all provide relevant new insights. Although AR has been established as viable tool to creatively engage customers (Jessen et al., 2020), enhance their mental imagery ability (Heller et al., 2019), and reduce mental intangibility in the context of retailing (Heller et al., 2019a), this study suggests that AR *decreases* the extent to which customers perceive their future self as vivid. This finding challenges previously mentioned results in the retailing context and presumably indicates that the usefulness of AR may depend on the specific use context as well as the visual quality of the specific AR application. However, further research is needed to investigate the underlying psychological mechanisms and establish under which conditions and for whom AR's potency comes to full fruition. My discussion in the previous section can serve as a starting point.

Following Urminsky's (2017) call to establish antecedents of FSC, this thesis empirically measures perceived vividness, quantifies its effect on connectedness and establishes it as an important predictor of people's psychological connectedness, advancing the academic

understanding of what constitutes the concept of connectedness. In doing so, not only do I demonstrate the profound impact of perceived vividness on connectedness, but also show that perceived vividness does not necessarily depend on visual information but may be fostered through mere imagination. Quantifying the effect of vividness on connectedness further reveals that vividness is not the sole predictor and that there must be other factors accounting for how connected people feel to their future selves. As Hershfield (2011) discusses, it might be that how positive people perceive their future self profoundly impacts their degree of connectedness, yet it is up to future academics to put this claim to test. Regarding the influence of connectedness on financial decision-making, the thesis contributes by showing that connectedness is not a reliable predictor of different financial decisions, indicating underlying conceptual differences between the variables. Ironically, this partially supports previous research's mixed results (Stockdale & Sanders, 2020; Hershfield et al.). Through controlling for participant's subjective time left until retirement, I further point out that the hypothesized effect of the use of AR through vividness and connectedness has a different mechanism than merely reducing the temporal proximity of retirement, which was suggested by the authors Stockdale and Sanders. This adds to the academic body as it rules out a possible mechanism how the manipulation works.

Lastly, through demonstrating that opportunity costs do not moderate the relation between connectedness and how much money people allocate to the future as well as how likely they are to purchase new headphones, the thesis adds to the discussion on how awareness and valuation of future outcomes interplay. The findings provide support for the conjecture that opportunity costs (awareness) and connectedness (valuation) independently influence future-oriented financial decisions, rather than depending on each other. As this sharply contradicts the results of Bartels & Urminsky (2015), it may provide fertile grounds for future researchers to investigate if the interplay of awareness and valuation of future outcomes differs for certain people or under different conditions.

6.2 Managerial Implications

Given the global situation of low saving rates and increasing life expectancy, it has become a competitive advantage for corporations to help employees to prepare sufficiently for retirement (Collinson, 2019). Therefore, the obtained results provide valuable contributions and implications for managers and policymakers alike and add to a growing body of practitioner

literature focusing on how to increase pension engagement (e.g., Brüggen et al., 2019). In this study I illustrate the impact of AR as a widely available mean to connect people to their future selves. However, as AR decreased people's vividness, the practical implications of the study are limited in terms of what technology helps people visualize and connect with their future selves. Although these are preliminary results, corporations are not advised to use AR to foster future-oriented retirement behaviour until further research has validated the results and the underlying mechanisms are better understood.

Nevertheless, the fact that increased vividness helped people to experience their future selves as more realistic and to understand that it is a human being who is affected by today's decisions should motivate scientists to experiment with novels ways to enhance people's vividness. Therefore, organizations and policymakers are advised to channel their efforts on implementing strategies and methods that aid people in visualizing their future life in realistic terms to make them contribute more to their retirement plan. For instance, employers could instead develop personalized short-films or stories that visualize the path of an employee's life based on his personal data (i.e., where he lives, if he is married, if he owns a dog etc.) and distribute them to employees based on an e-mail newsletter. Not only should this help people to get a more vivid image of their future self, but also engage them in a playful way and make retirement planning a more entertaining effort (Hershfield et al., 2011; Brüggen et al., 2019), potentially facilitating positive WOM among the employees. Yet, considering the relative weak economical effect of imagining the future self (vs. AR use) on how much money people allocate to the future, practitioners should utilize many different methods that influence intertemporal choice based on their cost-benefit-ratio, instead of limiting themselves to one approach. Zauberman & Urminsky's (2016) overview might provide organizations with a good starting point.

6.3 Limitations and Future Research

Despite the thorough design and execution of the experiment, there are several methodological limitations that mitigate the implications of the study. Building on these limitations and previously discussed findings, the study provides fertile grounds for future researchers. First and foremost, the online experiment could not guarantee that participants actually used the AR app, as it did not employ an effective monitoring mechanism. Similarly, there was also no way of controlling how long participants interacted with their virtual self despite not letting them advance in the experiment for a specific amount of time. Thus, the results should be interpreted

cautiously. Previous research that experimented with VR as a tool to influence customer behaviour conducted their studies in controlled settings that ensured an adequate manipulation (Hershfield et al., 2011; Bailenson et al., 2008). To further shed light on the relation of the use of AR and vividness the context of intertemporal choice, future researchers should consider conducting laboratory studies, as these controlled settings allow researchers to ensure that participants behave as instructed (Ferry, 2009). This would further nullify the risk of possible technical difficulties participants might encounter during the experiment.

As this study purposefully sampled younger participants[19], it is questionable whether augmenting the future self would hold similar effects for older customers (Yoon, Cole & Lee 2009). The problem of generalizability is further amplified through endogeneity problems, namely customer self-selection (Rutz & Watson, 2019). As Snapchat's "Time Machine" operates solely on the IOS system, only people owning an iPhone were selected for the study. This contradicts the process of random sampling. Consequently, it is unclear to what extent iPhone users possess distinct characteristics compared to Android users, which is why results should not be generalized. Relatedly, the thesis can be criticized for suffering experimental demand characteristics, as it does not employ a sufficient cover story to mask the study's true intentions, nor does it temporally separate the manipulation from the outcome variables. Scholars have widely acknowledged the fact that participants often hold a compliant and assistive attitude towards the investigator. Consequently, there is a considerable chance that participants "report to him [the experimenter] those very things he is most eager to find, and that the very questions of the experimenter [...] suggest the shade of reply expected" (Pierce, 1908, p. 267). To that end, future research should explore the proposed relations in more realistic settings, such as within the scope of a field-study that employs cover story.

Additionally, this study employed only two experimental groups, namely a treatment group in which the future self was augmented with AR and a control group in which participants merely imagined their future self. Although I did not hypothesize that simple imagination tasks are effective, the results suggest that they are relatively more effective than AR in increasing vividness. To probe exactly how effective they are, a third control group, in which participants are not asked to think about their future selves in any way may function as a benchmark against which both other groups can be compared. This would allow researchers to investigate the

[19] Note that the reasons were explained in section 4.2.

effectiveness of hypothetical exercises on the future self (Hershfield et al., 2011) such as mere imagination or writing a letter to the future self, compared to other manipulating techniques, or not thinking at all. Such hypothetical exercises are low in costs and easy to implement, which makes them valuable for practitioners.

Finally, it is of utmost importance to scrutinize why the use of AR exerts a negative influence on pension engagement apart from decreasing perceived vividness and connectedness. A promising starting point could be my argumentation under section 6 – if and to what extent aged images of one's future self elicit negative emotions and thoughts compared to merely thinking about the future self – and how these emotions are linked to pension engagement. Likewise, the results of the thesis prompt the question why the use of AR has a negative rather than positive influence on perceived vividness as well as connectedness. Again, my discussion in section 6 can serve as an inspiration. For instance, to what extent does the actual visual quality of the virtual rendering influence perceived vividness of the future self? Do more sophisticated apps that produce more realistic renderings automatically lead to an increase in perceived vividness? Does it matter to what extent people perceive the virtual rendering to be congruent with their personal-self image? Does the "brand image" alter customer value judgements and subjective performance, and would people derive more value in terms of increased vividness from an app of a different provider (i.e., from credible organizations that are specialized in pension)? Answering these questions would improve the understanding of how and under which conditions *precisely* AR may or may not facilitate future-oriented financial decisions. Considering the importance of early saving behaviour, a deeper understanding of these mechanisms would aid policymakers in their quest to facilitate early pension engagement.

7 Conclusion

Due to the increasing life expectancy of western civilizations, people spend prolonged times in retirement yet fail to sufficiently prepare financially due to their impatient saving and spending behaviours, which is a problem of great societal and economic relevance. To assist people in making more far-sighted financial decisions, this thesis posits AR as a novel intervention method to connect people to their future selves. Contrary to the predictions, the results reveal

that AR use decreases how likely people are to engage with their pension situation, as well as how much money they allocate to the future through sequentially decreasing perceived vividness and connectedness. However, the results are promising in such that they imply that imagination exercises such as thinking about one's own future form a relatively powerful intervention method to facilitate future-oriented financial decisions. From this perspective, I am confident that this research will do its part to promote customer well-being by sparking interest in the important topic of psychological connectedness and motivating scientists to experiment with novel intervention methods. Yet, I shall advice researchers to start today – as what we do today affects the future.

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Appendix

Appendix A. Illustration of Experimental Manipulation

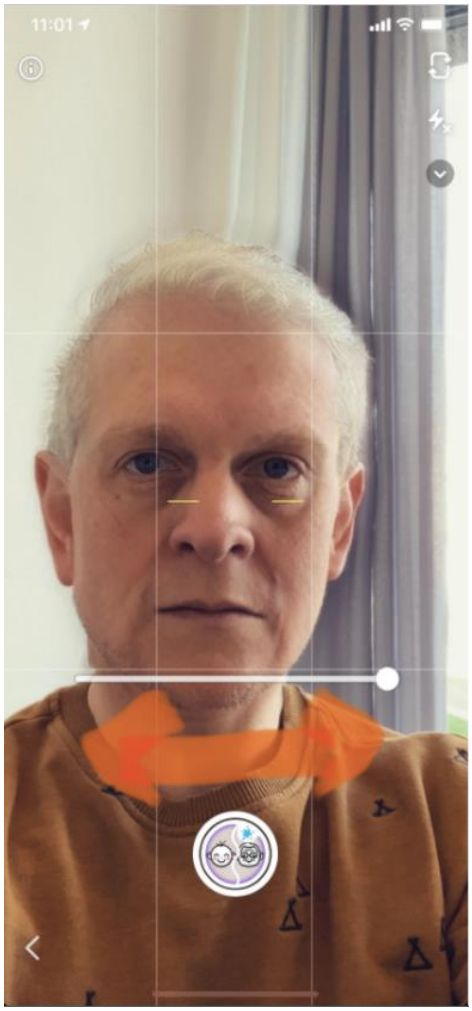
A.1 Experimental Condition: Virtual Rendering of the Future Self through AR

Use the slider that appears to see how you would look like when you are old
(Slide the slider all the way to the right).

Try to visualize answers to the following questions for when you are old in your future:

How you spend your time.
Are you working in any way?
What are your hobbies?
How active are you?
What is your daily routine?

Use the app to aid your visualization of how you would look like when you are old! While you are visualizing answers to the questions above, move your head and play around with your aged self (Spend at least 30 seconds looking at your aged self while thinking about the questions).



A.2 Control Condition: Mere Imagination of the Future Self

Please imagine how you would look like when you are old. Try to visualize how you would look like when you are old (Spend at least 30 seconds visualizing).

Visualize answers to the following questions for when you are old in your future:

How do you spend your time?

Are you working in any way?

What are your hobbies?

How active are you?

What is your daily routine?

Appendix B. Overview of Constructs and Measurements.

B.1 Employed Likert-Scales

Constructs	Items
Vividness of Future Self (Heller et al., 2019)	I am able to vividly imagine my elderly future self. I am able to vividly imagine the living situation my elderly future self will be in. I find it easy to imagine how my elderly future self looks like.
Pension Engagement (Ajzen & Fishbein, 1969)	I'm planning to look up information about my pension in the upcoming months. I will check the balance of my retirement account. I will consult financial or pension related literature or related content from the internet to gain more insights and knowledge about the topic. I will discuss my retirement finances with friends or family. I will speak with a professional financial advisor. I will investigate or take advantage of retirement savings education resources offered by my employer. I will spend time working towards identifying or developing additional savings for my retirement (e.g., long-term investment opportunities outside of government and employer-sponsored plans).

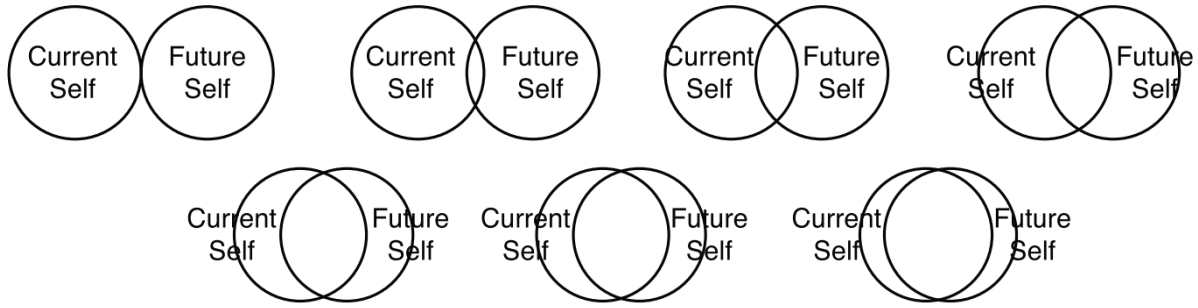
B.2 Overview of Employed Measurement (Mediators, DVs and Controls)

Note. The italic information in brackets indicates how opportunity costs were primed for Money Allocation and Spending Decision (Bartels & Urminsky, 2015).

Future Self-Connectedness (Hershfield et al., 2009)

Please select the diagram that best represents how *similar* you feel to your future self?

Please select the diagram that best represents how *connected* you feel to your future self?



Money Allocation (Hershfield et al., 2011)

Imagine you are working at a company and business is going well. Therefore, the CEO decides to give back to the employees and you unexpectedly receive 1000 Euros.

Please indicate how you would allocate the 1000 Euros among the following options (the sum must be 1000). [*Before making your choice, consider how you would use the money in the future if you saved or invest it now: Would you use it make a bigger purchase you always wanted to do? Buy your dream house with an amazing garden? How much would your money grow if you invested it? Spend at least 20 seconds thinking about future uses.]*

Buy something nice
Invest in a retirement account
Spend it on a fun trip or holiday
Invest it in stocks
Put it into a current account

Spending Decision (Frederick et al., 2009)

Imagine that you have been saving some extra money on the side to make some new purchases, and on your most recent visit to the inner city you come across a special sale of some noise-cancelling headphones. These particular headphones are from your favourite brand, and you have been thinking about buying them for a long time. They are available at a special sale price of 110 Euros.

What would you do in this situation? Please circle one of the options below.

Buy the noise-canceling headphones.
Not buy the noise-canceling headphones. [*Keep the 110 Euros for other important purchases*.]

Temporal Discounting (Kirby & Maraković, 1995)

Imagine you just won a lottery, worth 2000 €, which will be paid to you immediately. However, the lottery commission is giving you the option of receiving a different amount, paid to you 30 years from now.

Which amount would the lottery commission need to offer you to be willing to wait for 30 years? Please indicate for all the different choice options below if you would rather receive the 2000€ immediately OR the indicated amount in 30 years.

2000€ immediately or... 6200; 8000; 11600; 13400; 15200; 17000; 18800; 20600; 22400; 24200; 26000; 30200; 35000; 39800; 44000; 50000€ in 30 years

Subjective Time Until Retirement (Zauberman et al., 2009)

How long do you consider the duration between today and the day when you will retire?

You can respond by placing a mark on a line that ranges from *Very short* to *Very long.*
Note that this question is highly subjective so there are no right or wrong answers.

Very Short ---------- Very Long

Appendix C: Overview of Descriptive Statistics.

Variables	Min.	Max.	M	SD
Vividness of Future Self	1	7	4.27	1.35
Connectedness of Future Self	1	7	3.68	1.33
Subjective Retirement Time	8	100	81.40	17.72
Pension Engagement	1	7	3.68	1.38
Money Allocation	0	1000	505.82	323.12
Spending decision	0	1	0.69	0.46
Temporal Discounting	0	15	10.1	4.56

Appendix D: Overview of AR Applications

Company	Industry	Title	Launched	Device	Function
Snap Inc.	Communication	Snapchat	2011	Phone / Tablet	Social messaging application for mobile devices that allows the exchange of stylized photos or videos ("snaps"), as well as text messages ("chats").
Banuba Limited	Beauty / Cosmetic	Banuba: Face Filter & Effects	2016	Phone / Tablet / Web	Offers various face filters to change the way you look, take selfies or videos and send it to friends via other social networks.
Facebook	Communication	Instagram Face Filters	2010	Phone / Tablet	Offers various face filters to change the way you look, take selfies or videos and send it to friends via Instagram.
I Love Icecream Ltd.	Beauty / Cosmetic	Beauty3000	2019	Phone / Tablet (IOS)	AR App that lets users wear all kinds of make up to create the "perfect selfie or video".
I Love Icecream Ltd.	Beauty / Cosmetic	MRRMRR	2019	Phone / Tablet (IOS)	AR App offering various face filters that alters the way you look, take selfies or videos and send it to friends via other social networks.
I Love Icecream Ltd.	Beauty / Cosmetic	INCREDIMOJI	2019	Phone / Tablet (IOS)	AR App that lets users swap their faces with funny cartoons and/or celebrities.
Perfect Corp	Beauty / Cosmetic	YouCam	2021	Phone / Tablet	Multiple AR Apps that allow users to try on virtual make up, different nails, eye lashes and other filters.
Apple	Retailing	Quick Look	2020	Phone / Tablet (IOS)	AR application that lets users try out products in real space and directly purchase them.
ByteDance	Communication	TikTok	2016	Phone / Tablet	Social messaging application for mobile devices that allows the exchange of stylized photos or videos ("snaps"), as well as text messages ("chats").
Apptly LLC	Beauty / Cosmetic	Oldify	2013	Ipad (only IOS)	Allows people to virtually age themselves live, take pictures and share them with friends.
Bizo Mobile	Beauty / Cosmetic	Old Face Camera	2019	Phone / Tablet	Allows people to virtually age themselves live, take pictures and share them with friends.

Appendix F. Statement of Originality

Official statement of original thesis

By signing this statement, I hereby ackowledge the submitted thesis (hereafter mentioned as "product"), titled:

Meeting your Future Self: Exploring the Impact of Augmented Reality on Psychological Connectedness and Financial Decision-Making

To be produced independently by me, without external help.

Whereever I paraphrase or cite literally, a reference to the original source (journal, book, report, internet, etc.) is given.

By signing this statement, I explicitly declare that I am aware of the fraud sanctions stated in the Education and Examination Regulations (EERs) of the SBE.

Place:	Maastricht, The Netherlands
Date:	09.08.2021
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