



**THE MARKETER'S ANTAGONIST:
LEVERAGING BEHAVIORAL SCIENCE
TO REDUCE UNNECESSARY
SPENDING BEHAVIOR**

**Research Challenge
Technical Report**

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**THINK FORWARD
INITIATIVE**

THE MARKETER'S ANTAGONIST: LEVERAGING BEHAVIORAL SCIENCE TO REDUCE UNNECESSARY SPENDING BEHAVIOR *

TECHNICAL REPORT

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March 2018

Abstract

Consumers utilize physical and cashless currencies in different ways. As people are moving more towards cashless payment methods, it is important to understand how their spending habits change. Individuals using cashless payments tend to become less able to track their various cash flows, increasing their risk of not meeting financial obligations and decreasing their financial well-being. This paper examines techniques for decreasing spending on unnecessary goods through timely behavioural nudges in an online, randomly controlled experiment. These interventions use a combination of content and timing to encourage healthy financial decisions. We further identify a combination of content and timing that leads to a 23.89% ($p < 0.01$) reduction in the amount spent compared to a control group.

Keywords: Nudges, Warnings, Online cashless payments, Framing, Loss aversion, Temptation bundling

* This report has been prepared by the authors for the Think Forward Initiative – Research Challenge.

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1. Introduction

In today's society, it's easy for consumers to spend money that they don't really have on items that they don't really need. This may be attributed to the extent that cashless payment methods are utilized. Individuals are making more online purchases than ever before. Many unnecessary goods do not offer substantial long-term utility and divert funds from their optimal allocation, such as saving for retirement or paying off debt. Consumers are less likely to recall non-cash payments compared to cash alternatives (Alpen-Adria-Universität Klagenfurt 2017) making it difficult to keep track of spending. Considering the increasing proportion of transactions being made online, it is important to take into account the implications that this shift may have on the financial well-being of consumers.

In a large majority of developed economic markets, currency is exchanged digitally and bypasses the hands of consumers with direct deposit paychecks, credit cards, and various embedded digital payment methods. The advancement of payment technology available to industrial sectors has increased the ease for consumers to spend their money online. This shift towards an increasingly digital economy has subsequently increased the difficulty for consumers to maintain a handle on their various cash flows. Utilizing digital payment methods decouples the notion of spending money from the actual purchase and have been shown to increase the variety and

quantity of items that are purchased (Khan & Craig-Lees 2009).

In an effort to enhance the online shopping experience, e-commerce websites have made strides to reduce friction during the digital buying process using various techniques, most notably the "one-click buy" option. While increasing the ease of making purchases online, e-commerce websites have further decreased the saliency of spending money associated with the purchase. As the number of items purchased increases when using digital payment methods, so does the likelihood of engaging in unnecessary spending behaviour. Recurring, small purchases of unnecessary items accumulate over time and can inhibit individuals from fully meeting their financial obligations. This process can further create a vicious debt cycle that has an impact on a macroeconomic level when the behaviour is observed across a large number of individuals.

This paper aims to explore methods to increase the saliency of spending on digital purchases in online, cashless environments to improve consumers' financial standing in the long term. By manipulating the timing and content of interventions in an experimental setting, we aim to identify the optimal combination to reduce unnecessary spending.

2. Prior literature

2.1 Economic transactions are increasingly made through digital payment methods

Individuals are making more purchases online than ever before. While this increase is seen in both developed and lesser developed countries, it is driven by different factors between them. Among the countries that are actively pursuing cashless economies are the Nordic and developed countries of Denmark, Norway, and Sweden (Chakravorti et al. 2016). In these countries, the increase is driven by technological advancements within the digital payment sector, along with the benefits to the countries' central banks which have a better handle on the amount of physical currency in circulation (Rogoff 2017). In these developed countries a robust and socially inclusive digital infrastructure is in place, enabling a smooth transition to digital payment.

In India, however, where the government has taken controversial steps to combat corruption by digitizing currencies through the practice of demonetization, many critics have voiced concerns over the impacts that it may have on financial inclusivity (Mahajan & Singla 2017). These concerns surround the financial inclusion of individuals from lower socio-economic strata who lack access to the digital infrastructure necessary to utilize digital payment methods. While the implications for digitalization within the various countries differ, there is one aspect that must be considered. Regardless of the drivers behind transitioning into digital economies, all countries making the transition must consider how consumers will adjust their relationship to money when it is not in the form of physical currency.

2.2 Cashless transactions complicate the relationship between spending and financial awareness.

Raghubir & Srivastava (2008) found that when purchases are made with instruments other than cash, the amount of money spent is significantly larger than the amount spent using physical currency. Their experiment demonstrated that spending decisions are contingent on the form of payment. In further support of this notion, purchases made with credit cards may increase the variety of different products, as well as the amount of each specific product that is purchased (Khan & Craig-Lees 2009). The difference in spending behaviour between the form of payment is believed to be caused by the separation of the act of purchasing from the saliency of actually parting with money (Raghubir & Srivastava 2008; Zellermayer 1996). When using non-cash payment methods, such as credit cards, the ability to recall the amount previously spent is lower than when using physical cash to purchase goods (Alpen-Adria-Universität Klagenfurt 2017). The recollection of prior spending has been shown to impact the willingness of consumers to spend in the future (Alpen-Adria-Universität Klagenfurt 2017).

Keeping track of spending behaviour has become increasingly difficult in the era of the "one-click buy" option and streamlined user experiences in online marketplaces. The combination of cashless payment options and the extent to which marketing practices can induce spending poses a threat to the financial wellbeing of consumers. In light of the transfer of ideas between marketing and behavioural science, it is important to identify ways

to strike the balance between healthy and unhealthy types of spending.

2.3 Behavioural mechanisms driving financial decision making

In our daily lives, we use various mental models (Hoff & Stieglitz 2015) to guide our judgments and inform our decision making. Kahneman (2011, p. 22) proposes that humans think using two hypothetical mechanisms, the System I and System II. The System I is known for guiding fast, implicit choices that require little mental bandwidth to complete. System II is instead utilized during slow, deliberate moments that require additional levels of attention and analysis. A simple way to understand the difference between the two “systems” is through the example of the ease with which one computes $2+2$ versus the more complicated problem of multiplying 17×24 . System I is fully capable of conducting the first computation, but System II is better suited for the latter. Humans are known for acting primarily with their System I, and only selectively activating their System II when the System I fails to arrive at a conclusion or decision on its own.

As System II is the analytical reasoning mechanism, it can be extrapolated that System II is better suited for long-term financial decision making; however, System II requires a relatively substantial amount of effort to use. Therefore, due to the limited extent to which we are able to think and process volumes of information and situational circumstances, we tend to rely on System I for the majority of our decision making (Kahneman 2011, p. 22). Sole reliance on System I thinking is problematic as this mechanism relies on heuristics, rules of thumb or mental shortcuts when thinking, and biases, which are pre-programed systematic errors in our minds (Tversky & Kahneman 1974). Examples of such errors are putting off important investment decisions to

maximize present happiness (Hershfield 2011), and going out of one’s way for a \$5 discount on an item that costs \$15 but not when it costs \$125 (Thaler 1999).

When committing these systematic errors in decision making, humans contradict standard economic theory. Standard economic theory assumes that humans are rational actors that maximize their personal utility (Hoff & Stieglitz 2015), regardless of the social or environmental context. Noting that humans utilize heuristics and biases in their decision making, behavioural economists have established descriptive theories disregarding the previous assumption that humans are purely rational actors (Kahneman & Tversky 1979). These descriptive theories display how individuals make choices that are sub-optimal, such as choosing to spend instead of saving which would maximize their well-being.

Hoff and Stieglitz (2015) introduce the concept of an Enculturated Actor, an individual who incorporates social factors and past experiences into their decision making. Cultural and social influences create mental models that are used similarly to heuristics when making choices. Stigmas and social pressure surrounding certain behaviours have shown to be extremely impactful on the decisions of individuals, even though it results in diversion from behaviour that is generally seen as positive (Bursztyn & Jensen 2015). Individuals living in an environment that tolerates irresponsible financial behaviour are likely to adopt the behaviour themselves. If individuals living in this environment make an active choice to better manage finances, their surroundings would not provide many beneficial cues to assist in one of the most influential concepts of healthy financial behaviour: mental accounting.

2.4 Mental accounting and its role in financial responsibility

Mental accounting is the categorization of money into intangible accounts along with the tracking of spending that has occurred (Thaler 1999). Just as businesses create yearly budgets and keep track of spending, the practice of mental accounting describes how individuals allocate and keep track of funds using “mental accounts” in their minds. There are three primary components to mental accounting (Thaler 1999):

1. *How we capture, perceive, and evaluate outcomes.*
2. *How we can “ earmark” money depending on what source we are getting them from or what purpose it is intended for.*
3. *How often we attempt to balance and revise these mental accounts.*

Contrary to standard economic theory, another important component of mental accounting is viewing money as non-fungible, meaning that it is not capable of being freely transferred between the mental accounts.

Standard economic theory views a rational choice as one that maximizes the utility of an individual, but it is important to remember that the concept of utility is highly subjective from person to person. This is part of the explanation to why we act “irrationally” according to these standard economic principles. In reality, we are acting in accordance with individual mental models and desires.

If not used appropriately, mental accounting can cause severe misallocations of an individual's resources (Mina-Okada 2001). An example of such misallocation occurs when individuals spend money from a windfall less responsibly than they spend

their paycheck (Thaler 1999). Income from sources like a windfall is often seen as more “spendable” than regular income, even though theoretically, according to standard economic theories, it should be just as difficult to spend as the rest of the funds in other mental accounts. These misallocations occur when an individual decides to spend windfall earnings rather than placing the amount into their savings. If windfall money is not viewed as fungible, we do not “transfer” it from a mental spending account to a savings account even though our financial situation may require it, these misallocations may occur and we spend find this money easier to spend. However, if properly conducted, mental accounting can serve as a self-constraining mechanism. When an individual is facing the tradeoff between leaving money in a savings account or withdrawing it to purchase an additional pair of sneakers, purchasing the pair of sneakers with the misallocated funds would cause a feeling of guilt. To be utilized as a self-constraining mechanism, money should still be seen by the individual as non-fungible, and allocated properly between the mental accounts. When utilizing the mental accounting framework in a healthy way, it is metaphorically painful to spend money allocated for necessary expenses on unnecessary items.

Thaler (1999) states that there is no useful purpose in discussing whether mental accounting is rational behaviour or not. Instead, there exist opportunities to explore the concept as a prescriptive device used to assist individuals with managing their money (Thaler 1999). This paper will explore effective ways to assist individuals in, and remind them to, balance their mental accounts. The purpose of this is to raise the saliency of such spending, which when adhered to, may improve the prospect of financial successes.

While mental accounting has been discussed as a self-constraining mechanism, some marketers have turned it against consumers, utilizing their shortcomings when allocating resources in order to induce unnecessary spending. As an example, consumers tend to divide expenses into daily, monthly, and yearly expenditures. Within this process, price sensitivity tends to be lower for the short term perspective compared to the long term (Estelami 2008). Many insurance policies that provide long term coverage present their prices on a cost-per-day basis rather than as monthly or yearly premiums as this has been shown to increase the likelihood of consumers subscribing to the policies (Estelami 2008).

Financial literacy plays an important role in assisting individuals in efficiently earmarking their money for certain mental accounts. For individuals to make use of mental accounting, it is important to understand why money should be mentally allocated in certain way, not just how. Estelami (2008) identifies that consumers may not fully understand how their financial decisions may impact them in the long run. However, it is not enough to provide financial education as there are other cognitive drivers that impact one's ability to engage in mental accounting (Estelami 2008). There exists the possibility that not all individuals are able to conduct mental accounting processes due to a lack of arithmetic abilities as well as possessing enough cognitive ability to do so (Beilock 2008).

This experiment aims to combine knowledge gained from the aforementioned research to establish effective ways to encourage individuals to utilize their System II thinking and mental accounting principles in cashless shopping environments.

2.5 Previous research on deterring unhealthy behaviour

Nudges: Perhaps the most well-known and commonly used behavioural modification technique is “nudging”. These interventions are often one part of a larger adjustment to what is referred as “choice architecture” - the options presented to an individual in a certain setting in a way that encourages a specific action without, in any way, limiting the individual's ability to choose freely (Thaler & Sunstein 2008, p. 6). Nudges offer the ability to encourage healthier or more socially optimal alternatives without the need for a hardline, paternalistic approach of forcing a choice. Nudges can take the form of messages, default options, and subtle changes to the environment. A famous example of a nudge is requiring individuals to “opt-out” of being an organ donor rather than asking them to “opt in”, resulting in an 56.5% increase in registered donors in 28 European countries (Gimbel et al. 2003). By presenting pre-defined, optimized choice options to an individual at a defining moment, if executed properly, behaviour can be changed or modified without raising awareness, distrust, or confusion.

Nudges have further demonstrated their efficacy in many forms, such as inducing an increase in retirement contributions (Benartzi & Thaler 2004), bettering academic grade outcomes at the collegiate level (Castleman & Meyer 2016), reducing unnecessary electricity consumption (Costa & Kahn 2010), and encouraging individuals to vote through social signaling (Bond et al. 2012). One can think of a nudge as a gentle push towards making a choice that may not be implicitly, or automatically chosen in reliance on System I thinking.

Temptation Bundling: Temptation bundling involves the combination of “should” do behaviour such as

going to the gym with “want” to do behaviour such as watching one’s favorite television show while on the treadmill (Milkman et al. 2014). Temptation bundling reduces the negative valence of the “should do” behaviour by combining it with an action that is known to bring joy or happiness (Milkman et al. 2014).

Framing & Loss aversion: The act of framing involves eliciting a different reaction from a choice set depending on how a particular option is presented to an individual (Tversky & Kahneman 1981). Tversky & Kahneman (1981) conducted an experiment with medical doctors in which they had the doctors evaluate a medical treatment framed with the outcomes of either saving 200 out of 600 lives or losing 400 out of the 600. 72% of the doctors chose to save 200 lives as they were averse to selecting the option that was framed as having a seemingly greater proportion of deaths even though the probabilities of saving a life was the same in both treatments (Tversky & Kahneman 1981). This is due to the natural preference of avoiding losses.

The principle of loss aversion rests on the ideas of prospect theory (Kahneman & Tversky 1979). Prospect theory states that individuals tend to perceive a loss as greater than a gain of identical objective value. Individuals tend to go to a greater extent to avoid losses than to obtain an equivalent gain. Findings of altered behaviour as a result from the combination of these two principles can be seen in a variety of areas ranging from increasing contributions in public goods games (Cookson 2000) to impacting consumer choice when describing product attributes (Levin & Gaeth 1988).

Option Attachment: In evaluating the timing of reducing unnecessary spending behaviour in shopping experiences, research must account for

the distinct phases of product ownership. These phases range from browsing to purchasing with an important time period nestled in between: the deliberation phase. When comparing two objects in a purchasing environment, consumers develop attachments to the extent where these hypothetical attachments mirror those of fully purchasing the items (Carmon et al. 2003). It is this sense of ownership that creates feelings of sadness or loss when a selection between the two items is made and the consumer is dissatisfied with the choice. Carmon et al. demonstrate that as consumers zero in on their product choice, they create pseudo attachments to the items in the choice set regardless if the item is selected or not. Similar to loss aversion (Tversky & Kahneman 1981), consumers will go to certain lengths to avoid the discomfort of separation from the items in their pseudo possession. This impact of open attachment will be critical to understanding the role that the timing of nudges play in the reduction of unnecessary online spending.

2.6 Applying key learnings to improve financial decision making in online shopping environments.

The treatments in this experiment will apply the above-mentioned principles to improve consumer’s financial decision making ability. Through its versatility, the concept of nudging can be implemented to hopefully achieve this desired effect by presenting timely messages that raise the saliency of online spending.

The content of the nudges will be relevant to the successful outcome of the intervention. By combining the purchase of an item as the “wanted” behaviour with the act of saving for future goals as a “should do” behaviour, we foresee the possibility that bundling the two actions together will generate a reduction in the amounts that are spent in an

experimental setting. Furthermore, by framing unnecessary spending behaviour as a future loss of committed goals, we envision similar reductions in spending behaviour. While the actions of consumers in an experimental setting are contingent upon the content of a nudge, the timing of the nudge will likely play an important role considering the impact of option attachment in choice deliberations.

unnecessary spending behaviour in online environments have not yet been explored.

2.7 Developing a methodology to evaluate techniques to reduce unnecessary online shopping behaviour

Online experiments are frequently used in academic explorations of human behaviour in subject areas spanning experimental economics (Davis & Holt 1993) to consumer behaviour (Singh et al. 2017). The internet offers researchers the ability to reach large numbers of eligible participants from around the world. According to Kraut et al. (2004), it is the ability to sample a wide range of individuals that is favored by researchers as it allows for easy data collection and randomization at scale. In the instance of consumer behaviour, experimenters are able to identify and replicate specific behavioural phenomena used to generalize reactions of the larger populations (Hossain & Morgan 2006, Reiley 1999, Birnbaum 2004, Gosling & Johnson 2010).

To better evaluate the extent to which behaviour can be modified in online shopping experiments, behavioural interventions are used to modify the choice set offered to participants. This is done by enhancing the information offered to the participant used in making a decision within the shopping environment (Häubl & Trifts 2000). Prior studies by Soman (2001) and Raghurir & Srivastava (2008) have explored the relationship that consumers have with non-cash payment methods compared with a similar amount of physical currency. However, to our knowledge, novel interventions to reduce

3. Hypotheses

This paper examines the use of digital pop-up nudges in a mock-online store to identify the ways in which unnecessary online spending behaviour can be reduced. These hypotheses and accompanying experimental design have been chosen to best replicate the behaviour observed in the field when facing the trade off between short term and long term utility such as “spending now” and “saving for later”. In order to find an applied solution to the problem, the research focus is centered around gaining a better understanding of the timing and content of such interventions as previously mentioned.

H1: Behavioural nudges will reduce spending behaviour (relative to a control group) in online spending environments.

Similar to the effects seen with using nudges to increase retirement contributions (Benartzi & Thaler 2004), better academic grade outcomes at the collegiate level (Castleman & Meyer 2016), reduce unnecessary electricity consumption (Costa & Kahn 2010), and encourage individuals to vote through social signaling (Bond et al. 2012), we hypothesize that the use of digital nudges in the form of pop-up messages will induce healthy spending behaviour in our online experiment.

H2: The placement of nudges to reduce spending prior to the entry of an online store will reduce spending more so than the nudge(s) placed during the checkout process.

Considering the effect that choosing and deliberating over items has on increasing feelings of a pseudo-ownership, known as the option attachment effect (Carmon et al. 2003), we hypothesize that the placement of pop-up nudges before individuals have the chance to evaluate items in the experimental store will generate the greatest reduction in the amount of money spent. We further believe that this reduction will be due to the aversion to feeling the sadness that often accompanies not purchasing an item that has been evaluated. We believe that the nudge will be more effective in preventing the option attachment from occurring before a choice is made than when attempting to override the attachment that has been formed by selecting specific items.

H3: By bundling the actions of spending and savings in one message, this combination will decrease the amount of spending behaviour relative to a nudge only emphasizing how spending the money now will reduce the ability to reach one's financial goal in the future.

We hypothesize that the nudges containing the temptation bundling (Milkman et al. 2014) text will result in the largest decrease in unnecessary spending within the experimental online shop. By making the need to save more salient than in the treatments framing only the decision to purchase an item as a potential loss of future goals, we believe that the bundling treatments will encourage participants to not spend in favor of saving towards the goal.

4. Methodology

We conducted an online experiment using a 2x2 between-subject design. The treatment groups were split between timing (pre-shopping and pre-checkout) and content (loss aversion and temptation bundling). This experiment was approved by the University of Pennsylvania's Institutional Review Board. All participants in the treatment and control groups were randomly assigned in order to evaluate the efficacy of the timing and content of digital nudges to reduce unnecessary spending behaviour in online environments.

All participants received a fixed “show up” fee that was determined by the panel provider to be appropriate for the amount of time spent on the study in relation to the local hourly wage rate. In order to connect their actions with their incentive, the participants were told without further detail that depending upon their actions and effort in the experiment, they would be entered into a raffle to earn one of six \$10 (€ 8) Amazon.com gift cards. This was implemented in order avoid experimenter demand effects (Zizzo 2010) while still tying their actions to their payoff.

4.1 Design and Procedure

The participants were screened for their country of residence and their ability to read and understand English. Additionally, they were asked to confirm that they had shopped online at least four times within the past year to ensure that they were familiar with online shopping environments and would be willing to make an online purchase in the experiment. The participants were then asked to review and agree to documentation for informed

consent. Next, they were asked to select from a list of eleven pre-determined goals that they wished to complete within the next year. In addition, the participants were provided with the opportunity to write in their own personal goal if they were unable to find one or more from the predetermined list that they did not closely identify with.

The participants then viewed a display with directions for an upcoming Hit-The-Dot task (Chudler 1996, see Appendix Exhibit 1) that would allow the participants to earn Experimental Currency Units to be used in the shopping module. The Hit-The-Dot task required the participants to click as many randomly selected highlighted circles on a 6x10 grid in 30 seconds to earn Experimental Currency Units (ECUs). Following the Hit-The-Dot task, the participants encountered a page informing them that their completion of the Hit-The-Dot task earned them fifty ECUs for completing the exercise, regardless of their score. In addition to congratulating the participants for their work, they were asked to review a set of directions for the upcoming shopping module. The directions then explained that for the purpose of this hypothetical experiment, the 50 ECUs previously earned were converted to €50. The participants were then instructed to shop for items they would have purchased if the money that they earned in the previous exercise was actually deposited into a spending account and the item(s) they selected perfectly matched their style, colour and preference.

Participants were then directed to the shopping module (see Appendix Exhibit 2), which consisted of 45 products randomly displayed across nine

categories, each containing five products. These products consisted of unnecessary goods and were not required to provide food, shelter or safety. The product listings consisted of a one to three word description, an image and the price of each good set in Euros. The categories of items available for purchase in the shopping module were derived from Amazon.com's most popularly chosen item categories and were previously validated for desirability during a preliminary run of the study. All participants, regardless of their assignment to an active treatment or control group, encountered the shopping module and then a mock check-out module consisting of a text entry task to mimic the entry of credit card information (see Appendix Exhibit 3). This page offered participants the ability to return to the shopping module to edit the selection of products if they wished to do so. Following the check-out module, the participants answered several short behavioural, financial literacy, and demographic questions before finishing the experiment and receiving their payment digitally through the panel provider.

4.2 Treatments

Random assignment to an active treatment or control group was automatically performed by the

Qualtrics platform. The treatments employed throughout this experiment used pop-up windows (see Appendix Exhibit 4 for example) to display the various nudges for the participants at the appropriate time as determined by their treatment assignment. For all active treatment groups at the time of display, regardless of the time period, the background of the browser window darkened with a 50% opacity filter and displayed a white rectangle pop-up window that displayed the assigned nudge text (see **Table 1**). Those assigned to the pre-shopping time period (T1 & T2) received their pop-up window 500 milliseconds after the shopping module had loaded on the screen in front of them. Those assigned to the post-shopping time period (T3 & T4) received their pop-up window 500 milliseconds after the checkout module had loaded on the screen in front of them. Those assigned to the control group completed the shopping and check out module sequentially with no interruption or intervention. All participants were allowed to return to the shopping module on the check-out page to account for actions induced by the nudge or if they were dissatisfied with their original selection.

Table 1. Treatment description

	Sample Size	Timing	Content	Intervention Text
Control	n = 116	n/a	n/a	n/a
Treatment 1	n = 120	Pre Shopping	Loss Aversion	<i>"You mentioned that you have goals that you hope to accomplish within the next year. Spending your money on shopping now would reduce your ability to meet your goal(s) in the future."</i>
Treatment 2	n = 122	Pre Shopping	Bundling	<i>"You mentioned that you have goals that you hope to accomplish within the next year. To save for them, 20% of what you would choose to spend should be allocated towards a savings account in combination with your purchase."</i>
Treatment 3	n = 109	Pre Checkout	Loss Aversion	<i>"You mentioned that you have goals that you hope to accomplish within the next year. Spending your money on shopping now would reduce your ability to meet your goal(s) in the future."</i>
Treatment 4	n = 118	Pre Checkout	Bundling	<i>"You mentioned that you have goals that you hope to accomplish within the next year. To save for them, 20% of what you would choose to spend should be allocated towards a savings account in combination with your purchase."</i>
Total (N =):	585			

5. Results

Out of 672 participants recruited through an online research panel, 87 were removed from the analysis for providing unusable data. The removals were based upon a holistic qualitative judgment, taking into account the time spent on certain sections of the study, performance on attention checks, and the participant's behaviour while in the shopping module. After removing the unusable observations, data remained from 585 participants.

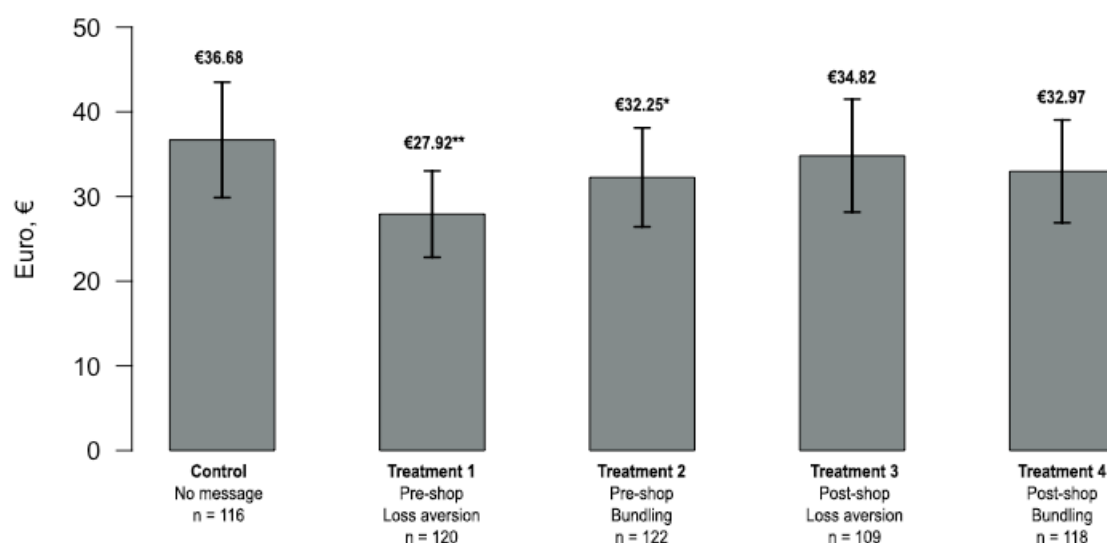
The final study population used in the analysis was comprised of 100 Germans, 94 Austrians, 97 Italians, 101 Portuguese, 99 French, and 94 Dutch. The mean age of the participants was approximately 35 years old, and the population featured 53.33% male and 46.15% female participants. Less than 1% chose to not disclose their gender. 19.83% of the participants reported having an income between €10,000 and €19,000 per year, which was the income bracket containing the largest proportion of participants reporting their yearly income within. Participants

mostly reported either holding part-time or full-time jobs (62.91%) or being a student (13.85%).

5.1 Study Results

The pre-shopping, loss aversion nudge (Treatment 1) saw the lowest average amount of spending in the shopping module ($M_{T1} = €27.92$, $\sigma = 22.42$) (See **Graph 1**). This treatment exhibited a €8.76 (23.88%) lower amount spent on average relative to the control group ($M_{Control} = €36.68$, $\sigma = 20.21$), yielding a statistically significant difference between the two treatments ($t = 3.1566$, $p = \mathbf{0.001807}$, $d = 0.4102$). Treatment 1 further displayed a reduction in the proportion of participants who chose to purchase an item in the shopping module ($P_{T1} = 74.17\%$, 89 out of 120). This difference in the decision to shop is not statistically significant when compared to the control group ($P_{Control} = 84.48\%$, $\chi^2 = 3.2141$, $df = 1$, $p = 0.073$).

Graph 1. Average amount spent by treatment



All statistical significance is given based upon a two sample t-test for the difference in mean. All significance displayed is measured towards the control group.
 * = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$

Result 1: On average, participants in conditions where they were displayed a nudge spent approximately €4.70 (12.98%) less than those were not displayed any nudge.

In addition to examining whether we could successfully decrease the amount spent using the interventions, we analyzed the treatments based on their characteristics (the timing and content used in the nudges). We hypothesized that if the nudges were displayed to the participants before the shopping module, we would observe a decrease in the amount spent that is greater than the treatments in which the nudge is displayed after the items have been selected (H2). The average amount spent when aggregating the treatments by the timing of the intervention can be seen in **Graph 2**.

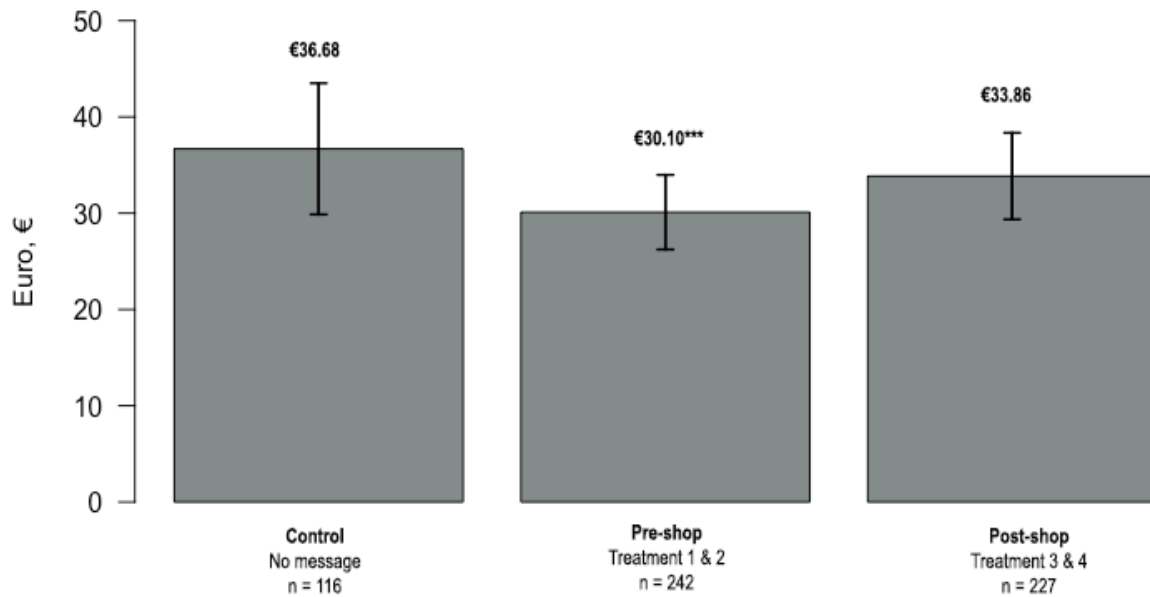
The participants in the aggregated conditions where the nudge appeared before the shopping module spent on average €30.10 ($\sigma = 21.46$). This is a significant decrease from the control group ($M_{\text{Control}} = €36.68$, $M_{\text{Pre-shop}} = €30.10$, $t = 2.8248$, $p = \mathbf{0.005129}$, $d = 0.3123$) of €6.58 (17.93%). In relation to the aggregated treatments where the nudge was displayed right before the checkout module, these participants spent, on average, €3.76 (11.11%) less ($M_{\text{Post-shop}} = €33.86$, $M_{\text{Pre-shop}} = €30.10$, $t = 1.9722$, $p = \mathbf{0.04918}$, $d = 0.1817$). The proportion of participants who made a purchase in the pre-shopping treatments was 7.21 percentage points lower than in the control treatment ($P_{\text{Control}} = 84.48\%$; $P_{\text{Pre-shopping}} = 77.27\%$, $\chi^2 = 2.0866$, $df = 1$, $p = 0.1486$). The post-shopping treatments also exhibited a lower proportion of participants who made a purchase, but with a statistically insignificant margin of 1.22% ($P_{\text{Control}} = 84.48\%$; $P_{\text{Post-shopping}} = 83.26\%$, $\chi^2 = 0.018357$, $df = 1$, $p = 0.8922$). In line with our second hypothesis (H2), our second result is as follows:

Result 2: In the treatment conditions where the nudge was displayed before entering the shopping module, the participants spent on average €3.76 (11.11%) less than when the nudge was displayed before the check-out module. This was a significant decrease of €6.58 (17.93%) in relation to the control group.

Our third and final hypothesis evaluated the content type of the nudge that was displayed to the participant. The average amount spent within the aggregated treatments by the type of messaging content can be seen in **Graph 3**.

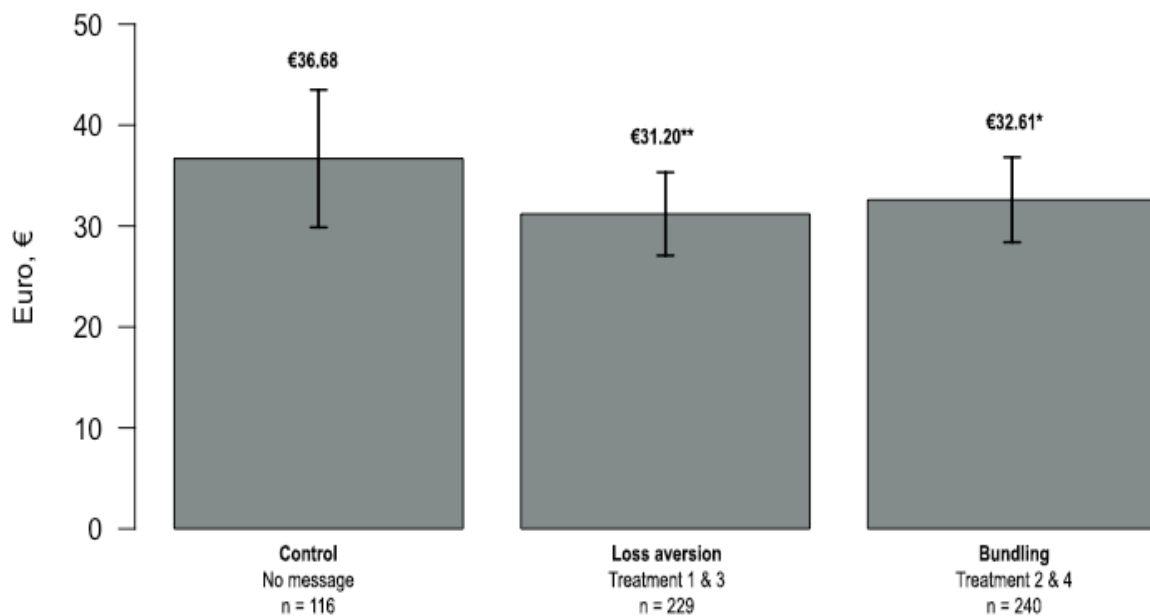
The treatments using loss aversion as a messaging strategy displayed a insignificantly lower average amount of spending behaviour when compared with those using temptation bundling as the message type ($M_{\text{Loss aversion}} = €31.20$, $M_{\text{Bundling}} = €32.60$, $t\text{-stat} = 0.73234$, $p = 0.4643$, $d = 0.0677$). The difference between the loss aversion conditions and the control group represents a €5.48 (14.94%), statistically significant, reduction in the average amount spent ($t\text{-stat} = 2.3358$, $p = \mathbf{0.02032}$, $d = 0.2615$). The collapsed temptation bundling conditions generated a €4.08 (11.11%) reduction in spending behaviour relative to the control group ($M_{\text{control}} = €36.68$; $M_{\text{Bundling}} = €32.60$, $t\text{-stat} = 1.7868$, $p = 0.07531$, $d = 0.2023$). The proportion of participants who chose to make a purchase in the loss aversion treatments was lower than the proportion identified in the control group ($P_{\text{Control}} = 84.48\%$; $P_{\text{Loss aversion}} = 79.04\%$, $\chi^2 = 1.1439$, $df = 1$, $p = 0.2848$). The participants within temptation bundling conditions also displayed a lower proportion of purchasing behaviour when compared with the control group ($P_{\text{Control}} = 84.48\%$; $P_{\text{Bundling}} = 81.25\%$, $\chi^2 = 0.36112$, $df = 1$, $p = 0.5479$). In light of these findings, we must reject our third hypothesis (H3).

Graph 2. Average amount spent by timing



All statistical significance is given based upon a two sample t-test for the difference in mean.
All significance displayed is measured towards the control group.
* = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$

Graph 3. Average amount spent by message content



All statistical significance is given based upon a two sample t-test for the difference in mean.
All significance displayed is measured towards the control group.
* = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$

Result 3: The treatments utilizing only the concept of loss aversion messaging significantly decreased the average amount spent by €5.48 (14.94%) relative to the control group. This was further a decrease of €1.50 (4.60%) in relation to the temptation bundling treatments.

In regards to our previously established hypotheses, two out of three still stands (H1 and H2) after analyzing our data. In addition to answering our hypotheses, we gathered additional data throughout the experiment in order to make further inferences regarding the population.

5.2 Additional findings

Along with spending within one's means, savings are commonly seen as an integral component of responsible financial behaviour. To evaluate the effect that the nudges had on increasing savings behaviour, we examined the amount of money that the participants reported they would place in a savings account versus a spendable checking account if not spent in the store. Our data show that there is no significant difference between the treatments when examining the rate of saving. This lack of increase in savings further supports Result 3, showing that the bundling treatments are not effective in increasing hypothetical saving rates. The largest amount of hypothetical savings behaviour was seen in Treatment 1, which coincidentally generated the largest reduction in the amount spent in the shopping module ($M_{\text{Control}} = €28.21$, $M_{T1} = €30.60$, $t = -0.84712$, $p = 0.3978$, $d = 0.1103$).

To further evaluate the impact that the nudges had on reducing the decision to purchase items, we examined the proportion of participants who utilized the option to go back and change the items that they had selected. The post-shopping, pre-check out

nudges were responsible for the largest amount of participants who returned to the store to edit their selections ($P_{T3} = 11.93\%$; $P_{T4} = 9.32\%$). This proportional difference was significantly larger from the control group in Treatment 3 ($P_{\text{Control}} = 2.59\%$, $\chi^2 = 6.0755$, $df = 1$, $p = \mathbf{0.01371}$), but not for Treatment 4 ($\chi^2 = 3.5968$, $df = 1$, $p = 0.05789$). We attribute this effect to the participants who were exposed to the nudge as those who were more likely to go back and change their selection, reflecting the impact of the nudge.

In addition to the proposed hypotheses, we wanted to examine the average amount spent per treatment between the different countries and their associated fiscal cultures. While our sample characteristics cannot be generalized to the European population as a whole, we chose to weight our sample in a secondary analysis according to the country's population sizes. Upon weighting the results, the participants in Treatment 1 still displayed the lowest amount spent on average ($M_{T1} = €28.82$). The participants in the control group spent €35.21 on average, which was the highest across all treatments, but the difference in mean towards Treatment 1 was not statistically significant at the 95% confidence level ($p = 0.07531$). The reduction of statistical significance indicated that there were differences in spending between the participants from different countries. To further examine these differences, we broke down the average amount spent across the treatments within each country in **Table 2**.

Table 2 demonstrates there are non-systematic variations between countries when broken down by treatment. The analysis of the specific mechanisms underlying the varying behaviour across the countries is best suited for another study to analyze. We make no inferences to the reasons behind these

differences due to the small and unrepresentative samples used in this experiment. However, due to the discussion in the literature review regarding social influences of behaviour, we would be interested to explore further how varying levels of cultural nuances within each country impacts spending behaviour. This difference must be carefully considered when deploying interventions across countries with varying cultures in one economic zone.

Lastly, 77.44% (453 out of 585) of participants were able to properly recall how much money they had

spent in the shopping module when they were asked later into the experiment. Interestingly, those who were able to properly recall how much they spent, spent on average €30.66 and those who were unable to properly recall the amount spent on average €40.42. This recall difference of €9.76 (24.14%) is significant at the 95% confidence level ($p < 0.01$). While there may be an unknown underlying mechanism relating the amount spent and the recall proportion, variables to help explain this difference were not included in the original study design.

Table 2. Average amount spent by country

Country	Relative population size to the whole sample	Control	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Collapsed treatments
Austria	0.0353	29.44	30.48 (+4%)	36.74 (+25%)	34.33 (+17%)	29.71(+1%)	32.96 (+12%)
France	0.2658	36.33	30.65 (-16%)	38.13 (+5%)	43.67 (+20%)	41.36 (+14%)	37.91 (+4%)
Germany	0.3354	37.27	16.47 (-56%)*	27.37 (-27%)	36.5 (-2%)	31.36 (-16%)	28.46 (-24%)*
Italy	0.2504	42.38	35.45 (-16%)	37.33 (-12%)	41.91 (-1%)	35.00 (-17%)*	37.50 (-12%)
Netherlands	0.0697	30.79	17.35 (-44%)*	23.25 (-24%)	33.41 (+9%)	21.25 (-31%)	24.47 (-21%)
Portugal	0.0435	42.14	32.50 (-23%)	30.00 (-29%)	17.50 (-58%) ***	35.44 (-16%)	29.69 (-30%) **

The number displayed is the average amount spent in each treatment.

() - The percentage in the brackets is the change relative to the control group

All statistical significance is given based upon a two sample Wilcoxon-Mann-Whitney U-test for the difference in mean. All displayed test results are towards the control group.

* = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$

6. Discussion

Our data suggests that the behavioural nudges have the power to decrease the average amount spent on unnecessary goods. Relative to the control group, the treatments were effective at reducing the average amount of money spent, likely activating the underlying mechanism of mental accounting that allocated funds out of fluid spending accounts toward the future accomplishments of the pre-set goals. We furthermore believe that the observed effect is due to the nudge activating the individual's System II thinking processes. This cue to utilize System II thinking is what allowed the participants to better allocate their recently earned funds using mental accounting (Thaler 1990) into cognitive savings and spending accounts.

Our results further indicate that the participants in the pre-shopping treatment conditions tended to spend less than those in the treatments in which the nudge was displayed during the checkout process. We believe that the difference between the timing of the interventions is attributed to participants in the post-shopping treatments having created an attachment to the items that were evaluated in the shopping environment (Carmon et al. 2003). This attachment is stronger than the messaging presented by the post-shopping nudge to save money, resulting in the reluctance of the participants to put the item back on the metaphorical shelf having already made a choice. By presenting the nudges before evaluating the items in the shopping module, participants largely tended to either exit the shop without choosing an item, or not choosing items that would leave them unable to reach their goals. When the participants are aware of the notion that they should not spend

money unnecessarily in the shopping module, we believe that they are able to evaluate the items without forming the fictional sense of ownership or attachment.

The reluctance to part with an item with a perceived ownership is directly related to the concept of loss aversion. This is similar to the sense of ownership which can be extended to merely browsing for an item before completing the purchase. Loss aversion is an integral part of our third result (R3) as it was proven to be more effective by itself than when in combination with temptation bundling. We believe that the loss aversion condition has a stronger effect on the spending behaviour independent from the temptation bundling because the latter imposes what might be seen as a paternalistic instruction (Sunstein 2014). By telling the participants that they 'should' save, as opposed to simply informing them of consequences of not saving, the nudge decreased their willingness to adhere to the information. This behaviour emphasizes the importance of constructing nudges in a way that does not give the impression of limiting the free choice of the individual in order to maximize its effectiveness. By directing the participants to save a set amount of money, we believe that the hardline approach was ignored in favor of freely purchasing items as desired.

Result 3 shows that making the need to save for future goals more salient did not increase the amount that participants were willing to place into their hypothetical savings. While raising the saliency of that the participant should not spend money unnecessarily mostly results in a reduction of

average expenditure, raising the saliency of that the participant should save does not increase their average savings rate. While our experiment did not focus on savings, we are intrigued by this result and hope to see the reasons for this effect explored further, especially noting the success other types of nudges have had on savings behavior (Thaler & Benartzi 2004).

The results found in this study provide an understanding of the effective combination of timing and content to reduce the amount of unnecessary spending in online environments. In light of this research, we are hopeful that the insights can be translated into real world applications which have the ability to financially empower consumers to make better fiscal decisions. Utilizing tools to spend less money unnecessarily, more funds can be diverted into meeting other financial obligations and planning for future financial stability while still spending in a responsible manner.

6.1 Limitations

Sampling Biases

As with most online surveys, a self-selection bias exists as participants self-select into online panels (pools of respondents who are asked to take surveys). In an attempt to correct for this self-selection bias, a panel aggregator was used to assemble participants from many panels to ensure that roughly an equal number of participants were able to engage with the experiment from the available online pool. While every attempt was made to reduce systematic sampling errors, online experiments will come close to, but are unable to achieve a representative sample at scale.

As for the online sample that was acquired from the online research panel, we are unable to extrapolate

any variations of our findings that we identified in this paper to a country or larger European population level. This sample is representative of frequent online shoppers, but due to the biases that exist with using online panels, we were unable to acquire a large representative online sample to use in generalizations to the country-population level.

Implement as field experiment

To best examine the online spending behaviour identified in this experiment, using a field study would be the optimal choice for the experimental design. However, due to the financial impact that this type of experiment would have on e-retailers in the field, it is difficult to envision a way in which this experiment can be conducted in the field. The companies with the bandwidth required to host such a proposed field experiment (i.e. Amazon, Ebay, etc.) would be in direct conflict with the goals of the study. We hope that our findings will provide additional insights into the applicable literature that may evolve into a fulsome field experiment for the ways in which consumers can be nudged into reducing unnecessary spending online.

6.2 Future extensions

In order to make inferences to a larger population, such as the entire European economic area, future extensions would include a sample size capable of including all the populations and fiscal subcultures. This type of research is best suited for an online field experiment on a larger scale in which country level differences can be identified with enough power to generate statistically significant findings. Lastly, future extensions may aim to examine the effect that such financial interventions have on individuals with varying levels of financial literacy.

7. Conclusions

This paper set out to explore the timing and content of digital interventions to reduce unnecessary spending behaviour in cashless environments. The participants in our experiment were less likely to purchase unnecessary items when they were introduced to the nudge that alerted them to the possibility that their financial goals were at risk if going through with the purchase. By evaluating the effectiveness of each treatment relative to a control group, we were able to identify a nudge that used the combination of pre-shopping timing and loss

aversion content to be the most effective in reducing unnecessary spending behaviour. This type of intervention reduced the amount spent in our online shopping environment by an average of €8.76 (23.88%). Our research proposes a simple approach to nudging consumers into spending less money on unnecessary items in cashless environments. In light of these findings, we are excited at the impact that these findings may have on changing individuals' lives for the better.

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9. Appendix

Exhibit 1: Hit-The-Dot Task

Hit-the-Dot

How many colored circles can you click in 30 seconds?

Instructions:

1. Click on the radio buttons as they are selected randomly by the computer.
2. 1 point per hit, minus 1 point per miss.

[illegible]

Exhibit 2: Shopping module

Evaluate the categories of items below for purchase. Should you choose to not purchase any items, click the button to continue and the money will remain in your checking account.

Children's toys

€10 Mobile Playground



€30 Doll house



€15 Lego set



€10 Barbie doll



€5 Toy car



Electronic accessories

€10 Portable keyboard



€20 Phone case



€20 Computer case



€5 Headphones



€10 Portable charger



Kitchen appliances

€15 Crock pot



€15 Waffle maker



€15 Burner



€15 Pasta maker



€10 Scale



Exhibit 3: Check out module

In order to complete the check-out process, please type the sets of 5 numbers below in the reverse order that you see. For example, 29 86 58 39 61 should be entered as 61 39 58 86 29.

95 15 42 87 89

56 36 20 61 29

-
- ☐ I would like to go back to the store and change my selection
- ☐ I would like to continue with my selection

Exhibit 4: Example of nudge pop up window

You mentioned that you have goals that you hope to accomplish within the next year. Spending your money on shopping now would reduce your ability to meet your goal(s) in the future.

Close

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