Digital nudging in a supermarket to reduce theft in self-service solutions

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Abstract

The implementation of Self Checkouts (SCOs) in modern aged supermarkets has increased the possibilities to steal for potential shoplifters, which has become a significant challenge for retailing companies to tackle. It has been well established that the certainty and severity of punishment are effective tools in the deterrence of crime. Therefore, in this experiment, certainty & severity of punishment are combined with nudge theory to test whether they can reduce shoplifting behavior at SCOs. The experiment is conducted in collaboration with Dirk Supermarkets, where digital textual nudges stressing the certainty of being caught and the severity of punishment were implemented at grocery shopping mobile phone applications to review whether they could affect shoplifting behavior. Participants were randomly divided into three conditions: a nudge stressing the certainty of punishment, a nudge stressing the severity of punishment, and no nudge at all (control). The results could not show that implementing a textual nudge stressing certainty or severity was better able to reduce shoplifting behavior than implementing no nudge at all. However, the result could show that a nudge stressing the certainty of being caught was better able to reduce shoplifting behavior than a nudge stressing the severity of punishment. On this basis, nudges stressing the certainty of being caught should be implemented rather than nudges stressing the severity of punishment when the aim is to reduce shoplifting at SCO.

Keywords: SCO, shrinkage, certainty, severity, nudge theory, shoplifting, crime, supermarkets, SWIPERS

Digital nudging in a supermarket to reduce theft in self-service solutions.

Shoplifting, the theft of goods from a public retail company while pretending to be a customer, is as old as shopping itself (Krasnovsky & Lane, 1998). By now, several studies have been conducted searching for the most effective ways to tackle this problem, and even though progress has been made, complete elimination of shoplifting remains far-fetched (Yamato et al., 2017; Krasnovsky & Lane, 1998; McnNees et al., 1976). Over the past decade, a new strain of shoplifting has emerged with the implementation of Self Checkouts (SCOs) in supermarkets (Buit & Odijk, 2020). The implementation of SCOs allows individuals to self-service their grocery shopping session, as it enables the customer to scan their products and pay for their shopping items without the need for any assistance from employees. While this service offers numerous benefits for both retailers, i.e., reduced staffing needs (Dabholkar et al., 2003), and customers, i.e., perceived privacy/autonomy (Hsieh, 2005), it also has a severe drawback, namely increased shrinkage as a result of shoplifting. Shrinkage is the commonly used term for retail losses, mainly caused by theft. With an estimated cost of over $119 billion annually, shrinkage caused by shoplifting has always been a huge problem in the retail industry (Beck & Peacock, 2009). The precise contribution of SCO's remains quite unclear; however, informal claims suggest that SCO's theft rates are potentially five times higher than regular cashier checkout (Krasny, 2012).

Several motives behind shoplifting exist, some psychological of nature such as loneliness, confusion, or excitement gained from cheating the system (Bamfield, 2012; Ray & Briar, 1988), others more economical such as a lack of resources or unemployment (Tonglet, 2002; Thomas, 1980). Another important explanatory perspective on shoplifting behavior arises from deterrence theory, which implicates certainty and severity of punishment as the most important factors in deterring crime (Beccaria et al., 2017). The severity of punishment relates to the severity of consequences when caught, while the certainty of punishment constitutes the probability of being caught while engaging in criminal behavior. Deterrence theory suggests that criminals are expected to be less likely to engage in theft when these dimensions of certainty and severity are high (Beccaria et al., 2017). Furthermore,

one reason which facilitates engagement in shoplifting behavior is the idea that some perceive shoplifting as a “victimless crime” since the victim is not an individual but an “impersonal organization” (Sharma & Scott, 2015). What this suggests is that people who engage in shoplifting do so by using the assumption of “victimless’ as an excuse. Egan et al. pointed out that this “victimless” crime may be the cause of thoughtlessness, driven by the false assumption that shoplifting does not really affect anyone which negatively affects the perceived “realness” of the crime (2000).

When considering shoplifting related to SCOs, the same psychological and economic motivations seem applicable. The main difference between regular shoplifting and shoplifting at SCO is the increased ease of shoplifting at SCO, created by, among others, the increased autonomy for the customers in comparison to a decrease in controlling power for retail companies. However, researchers suggest that with SCOs, opportunity-based shoplifters have become more prominent. These opportunity-based shoplifters related to SCO are defined by Taylor as SWIPERS, being, ‘Seemingly Well-Intentioned Patrons Engaging in Routine Shoplifting’ (Taylor, 2018). According to Taylor, the reasons that individuals provide for theft when using SCO can be broadly categorized into three clusters: low risk (perceived low certainty of detention and severity of consequences), ease (theft at SCO requires little skill or effort), and frustration (caused by, for instance, difficulties in operating the interface). Furthermore, one additional explanation for the increase in opportunity-based thieves at SCO is closely related to the previously mentioned concept of thoughtlessness. Thoughtlessness, which is driven by the false assumption that the crime of shoplifting does not affect anyone, is facilitated by the absence of human interaction when using digital interfaces as checkout systems compared to a regular cashier. The theory here is that it is morally easier to steal from a machine than from an actual human being due to a lack of human confrontation, which would trigger one’s moral compass (Taylor, 2018). Taylor argues SWIPERS to be opportunity-based thieves who engage in shoplifting due to fortunate circumstances. Besides the absence of human interaction, low certainty of being caught, low severity of punishment, and ease, could even further be argued to facilitate the earlier mentioned theory of thoughtlessness. In this case, the perceived low certainty &

severity of punishment and the ease of committing the crime causes failure in realizing the unethical in- and criminal nature of- the shoplifting behavior.

When bearing in mind possible solutions for shoplifting, nudge theory has previously been used effectively to tackle criminal behavior and has the potential to include the principles from deterrence theory, which emphasizes the importance of the certainty of being caught and the severity of punishment. Nudges are interventions to steer people in a particular direction, but they still allow individuals to decide which choices they make (Thaler & Sunstein, 2008). As articulated by Thaler and Sunstein, the theory of nudge assumes individuals occasionally engage in unconscious, non-rational decision making, influenced by contextual cues, which indicates that behavior regarding decision-making can be manipulated. Additionally, Levy (2019) argues that nudges can evoke people's reflective process, allowing individuals to break free from unfortunate dispositions created by environmental cues, which results in more desired behavior by both the society and the individual. Regarding the potential to include principals from deterrence theory, in a pilot study in the Netherlands, nudge theory has effectively manipulated decision-making by focussing on the certainty of being caught. This study aimed to work against potential bicycle thieves by implementing multiple security cameras at a train station's bicycle storage, reducing theft rates by 67% in three years (Klaassen, 2020). The working mechanisms behind the mentioned example originate from the watching eyes effect, which argues that individuals strategically modify their behavior when being observed by others or when subtle cues of being watched are present in the environment (Haley & Fessler, 2005, Markus, 1978; Zajonc, Heingartner, & Herman, 1969).

Ultimately, certainty and severity are proven effective strategies against crime and shoplifting in general (Baily & Smith, 1972; Ray & Briar, 1988; Nagin, 2013; Mungan, 2017; Castriota and Tonin, 2019). Where there seems to be a significant overlap between regular shoplifting and SCO-related shoplifting, SCO-related shoplifting differs to the extent that it can seduce otherwise law-abiding citizens into shoplifting behavior. This seducing potential is because of its related ease, low certainty of being caught, low severity of punishment, and the ability to induce a state of thoughtlessness in

which customers decide to shoplift. Thoughtlessness at SCOs is driven by ease of shoplifting due to low control of retailing companies and the absence of human interaction while checking out. Shoplifters at SCO are likely not to realize the criminality in their shoplifting behavior, making them more prone to steal at SCOs. Suppose customers are aware of the certainty of being caught and the severity of punishment. In that case, they could be argued to be more confronted with the criminality in shoplifting at SCOs, making thoughtlessness less likely to occur.

Furthermore, there is still a lot to discover considering the effectiveness of nudges in the deterrence of crime. Nevertheless, considering the capacity of nudges to evoke people's reflective process, it could be argued that nudges can go against the state of thoughtlessness by making individuals aware of the criminal nature of shoplifting at SCO. Therefore, it is attempted in this research to combine nudge theory and certainty and severity by implementing a digital textual nudge stressing either the certainty of being caught or the severity of punishment in a mobile phone self-checkout application. Taking everything together, this resulted in the following research question: *What effect does a textual nudge stressing either the certainty of being caught or the severity of punishment have on shoplifting behavior at SCO, and which format (certainty of severity) is most effective in reducing shoplifting behavior?*

Literature review

Why do people shoplift?

Examining literature illuminating the motives behind shoplifting quickly reveals that many motives exist. However, a comprehensive characterization of individuals that considers all the many factors directing shoplifting behavior is still lacking (Nadeau, 2019). In an attempt to retrieve insights on the type of shoplifter who is most likely to steal while interacting with SCOs, first, different types of shoplifters will be discussed, and second, the different types of motivations will be assessed.

Types of shoplifters. According to Moore (1984), shoplifters can be roughly divided into five categories based on dimensions such as frequency of shoplifting, attitude towards shoplifting, and the use of stolen goods. The first of five categorizations is the impulsive shoplifter, where the behavior was not planned, the item was inexpensive, and the individual has shoplifted only once or twice before. The second category is the occasional shoplifter, who has shoplifted 3-10 times over the last year mainly because of peer pressure. Third, comes the episodic shoplifter who shoplifts at a periodic frequency, who, as described by Moore, engages in the behavior to "satisfy intense needs for self-punishment." Fourth, shoplifting at least weekly is the semi-professional shoplifter who is most likely to resell the stolen goods and thus act from an economic point of view. Lastly, the largest group (over 50% of the sample size in the study of Moore (1984)) are categorized as amateur shoplifters, who stole approximately weekly. While all classifications of shoplifters are likely to be present among SCO-related shoplifting, the type of shoplifter which is most likely to be explicitly triggered by SCOs is the impulsive shoplifter, whose behavior is unplanned and based on opportunity. This is because the ease, low certainty of being caught, and low severity of punishment when shoplifting while using these machines constitute the motivational opportunity of the impulsive shoplifter.

Motivations for shoplifting

General motivations. Regarding the motivations of shoplifters in general, a rough distinction can be made between two types of shoplifting motivations. First of all, though less well researched, some individuals engage in shoplifting due to economic factors, such as unemployment or a lack of financial resources (Ray & Hooper, 1988). Secondly, some people engage in this behavior because of reasons more psychological of nature, such as pleasure, confusion, or impulses (Durst et al., 2001). First, frequently occurring examples of economic and psychological motives for shoplifting will be briefly discussed in the following paragraphs. Second, more specific motivations most closely related to SCOs will be mentioned and explained.

According to Ray and Hooper, people who shoplift are more likely to be unemployed and have a lower family income when considering the economic motives behind shoplifting. In general, these

same individuals also believe their shoplifting behavior to result from their financial insufficiencies (1988). According to their investigations, the economic hardships of having a low family income and being unemployed increase the likelihood of engagement in shoplifting. When having engaged in shoplifting, individuals are generally reported to have more difficulty finding employment than the average individual and are more concerned about having money for basic necessities and repaying debts (Ray & Hooper, 1988). Simply put, people are more likely to engage in shoplifting when they lack the financial resources to pay for their belonging lifestyle.

Focussing on the psychological dimension of shoplifting illuminated that numerous psychological motives driving the mentioned types of shoplifters exist. First of all, the pleasure and thrill of engaging in theft for many is the main reason to engage in shoplifting (Turner & Cashdan, 1988; Ling & Kramer, 2017). Some shoplifters have self-reported experiencing hedonic pleasure from consuming and acquiring stolen goods (Ling & Kramer, 2017). Related to being driven by pleasure is motivation created by sad emotions such as loneliness, where short-term pleasure gained from shoplifting could be used as a strategy to counter one's sad emotions (Babin & Babin, 1996; Sharma & Scott, 2015). Furthermore, peer influence has also been established as a significant motivator, especially when considering younger shoplifters, where shoplifting behavior arises in an attempt to impress one's peers (Thall, 1973; Prayag & Juwaheer, 2009). Just as with classifications for types of shoplifters, all the so far mentioned motivations are likely to be part of the source of shrinkage created by shoplifting at SCOs; however, several motivations appear to be more specifically related to SCO created shoplifting.

SCO related motivations. First of all, according to several studies, shoplifters often act based on opportunity, where lax security measures create the opportunity to engage in theft, which is, according to multiple authors, able to tempt the most honest customers into stealing (Prayag & Juwaheer, 2009; Cole, 1989; Nettler; 1989). This motivation is argued to be very much associated with SCO shoplifting because lax security measures decide opportunity, and lax security measures constitute a low certainty of being caught, which is argued to go hand in hand with SCO interaction

(Taylor, 2018). Furthermore, the type of shoplifter previously assessed as most closely related to SCOs is the impulsive shoplifter, who acts based upon opportunity, which is an exact description of the motivation.

Second, a psychological mechanism that constitutes motivation for shoplifting is described by Egan et al. (2000) as thoughtlessness. Thoughtlessness ought to underlie many criminal cognitions and is considered when shoplifters do not consciously realize the severity of the crime. Rather shoplifters perceive the crime as not "real," which is discussed to be possibly due to shoplifting being perceived as victimless because the victim is not an individual but an "impersonal organization" (Sharma & Scott, 2015). Thoughtlessness can be further facilitated when potential shoplifters hold negative attitudes towards retailers and the retail environment itself. These negative attitudes derive from the beliefs that retail stores cheat customers, overprice products, and make huge profits which justifies their shoplifting (Prayag & Juwaheer, 2009). Holding these beliefs makes it even more likely for shoplifting to be perceived as not a "real" crime because retail companies deserve it, which increases the probability of shoplifting by customers. Also, ease can be a facilitating factor regarding thoughtlessness. When the crime can be executed with little effort, thoughtlessness prevails as there is little resistance to make people "snap out of it" (Egan & Taylor, 2010).

To conclude, when examining shoplifting and the assessed types and motivations, all seem likely to occur when considering shoplifting at SCO because the ease, low certainty of being caught, and low severity of punishment make shoplifting in general more likely to occur. However, some dimensions seem to be responsible for a more significant proportion of shoplifting at SCOs. When considering the motivations most closely related to SCO, opportunity-based motivations prevail. These motivations are created by ease, low certainty & severity, and thoughtlessness which is created by perceiving the crime as not "real," which is in turn facilitated by ease and negative attitudes towards retailing companies (Sharma & Scott, 2015; Egan & Taylor, 2010; Prayag & Juwaheer, 2009; Egan et al., 2000; Cole, 1989; Nettler; 1989). When considering the type of shoplifter associated with SCO, the impulsive shoplifter, whose behavior was unplanned and opportunity-based, is perceived as

most closely related to SCO shoplifting, because the impulsive shoplifter is motivated by opportunity, created by ease and low certainty & severity.

Nudging

A strategy that might provoke the honest customer in the potential SCO shoplifter is based on nudge theory. Nudges are interventions that steer people in a particular direction and have the potential to invoke people's reflective process and capacities, which could counter impulsive and thoughtless behavior (Thaler & Sunstein, 2008; Levy 2019). Nudge theory builds upon psychological and sociological theory, which dates back to over a century and is created from the ideology that an environment can shape and constrain human behavior (Thaler & Sunstein, 2008). The term "nudge" was first described by Thaler & Sunstein as "any aspect of the choice architecture that alters people's behavior predictably without forbidding any options or significantly changing their economic incentives." (2008). Nudges can be visual, textual, or audible stimuli that have been used in society to saliently promote healthier food choices, less alcohol intake, or provide information about what others are doing (social norm feedback) in order to reach socially desirable behavior. One of the most frequently mentioned examples of nudges is the image of a housefly printed on men's room urinals, causing men to pee inside the urinal rather than everywhere. Other examples include serving alcoholic beverages in smaller glasses to reduce alcohol intake (Wise, 2011).

Nudges are also argued to have the potential to make people aware of their behavior and promote one to make deliberate and intentional decisions rather than in a state of thoughtlessness (Levy, 2019). Levy (2019) states in his paper that nudges take advantage of the predictable dispositions of humans to be influenced by the features of their environment and make decisions based upon these (irrelevant) influences. He claims that where some people argue for nudges to threaten our autonomy, he believes the opposite is true and argues that nudges can invoke people's reflective process, allowing us to break free from the unfortunate dispositions caused by our current environments. The impulsive shoplifter is positioned in an SCO-created environment with stealing opportunities (created by low certainty and severity of punishment, ease, and a lack of human interaction). Therefore, nudges

seem to have the potential to counter this predisposition and make one reflect on himself to make the morally correct decision.

Hypothesis 1

People seem to be more likely to shoplift when using an SCO while checking out at a grocery store because their motivations are opportunity-based and act in a state of thoughtlessness. Opportunity is created by the low perceived certainty of being caught, the low perceived severity of punishment, the ease of stealing, and thoughtlessness created by the lack of human interaction and the ease of engaging in shoplifting. Because nudges are argued to have the potential to evoke peoples reflective proses, and because the certainty of being caught and the severity of punishment are considered as influential factors in the deterrence of shoplifting, the following hypothesis is formulated:

H1: *Individuals who perceive a nudge stressing the certainty of being caught, or the severity of punishment, while using self-checkout are less likely to display shoplifting behavior than those who do not perceive such a nudge.*

Certainty, Severity, and SWIPERS

Taylor (2016) has done quite some research on the relationship between SCO-customer interaction and shoplifting. He concludes that SCO has caused a new emergence of shoplifters, identified as SWIPERS being, 'Seemingly Well-Intentioned Patrons Engaging in Routine Shoplifting.' According to Taylor, the low risk (perceived low certainty of being caught and severity of consequences) associated with shoplifting at SCO is one of the most significant initial driving factors for SWIPERS to engage in shoplifting behavior.

The low certainty of being caught at SCO shoplifting is mainly due to the customer's gained autonomy, which results in less control by supermarkets and their employees. Where regular cashiers will always make sure to scan all the perceived items at check out, when customers are allowed to do this themselves, it is easy to decide not to scan all of one's products. There is a possibility that one receives a rescan to check whether everything is scanned correctly. However, this is not a certainty,

and there are ways to decrease the chances of a rescan. Retail companies using SCOs have incorporated algorithms that determine chances of a rescan based upon the products in one's shopping basket (Hijink, 2018). For example, when someone has added shaving foam to their shopping basket but did not add razor blades, this individual is more likely to receive a rescan. Therefore, when SWIPERS know the factors that increase the likelihood of a rescan, they can try to avoid these stereotypical situations on which the algorithms are based to decrease the chance for a rescan.

The low severity of punishment related to SCO shoplifting is because of how easy it is not to be held for the consequences of being caught. Customers reported that they could easily get away with not scanning all of their items by apologizing and pretending the items concerned were overlooked or forgotten (Buit & Odijk, 2020). Furthermore, customers reported that employees are not determined to prevent shoplifting by performing a rescan. Employees who execute the rescan want to get it over with quickly. In many cases, this rush means that the customer can personally pick a few items and give them to the employee, which they will use for the rescan, allowing one to pick items that they did scan. In brief, where the low certainty of being caught is due to the lack of control by the company and increased autonomy of the customer, the low severity of punishment is due to failure by employees to effectively deter criminal activity.

Certainty versus Severity

The role of certainty and severity in shoplifting at SCO has been mentioned several times by now. However, besides being of importance regarding SCO-related shoplifting, certainty and severity are also considered the two most important factors regarding the deterrence of crime in general (Baily & Smith, 1972). Where in the past, solely the severity of punishment was considered to be effective against crime, by now, history has shown on multiple occasions that punishment in itself is not enough to reduce crime rates (Bailey & Smith, 1972; Ray & Briar, 1988; Nagin, 2013). In 1972, the numbers had already shown that severe punishment could not reduce crime rates given theft, forgery, and even murder (Ray & Briar, 1988). Nowadays, many authors argue that it is the certainty of being caught that has a greater impact on the deterrence of punishment than the severity of punishment (Nagin, 2013).

Certainty refers to the likelihood of being caught in the act of committing a criminal offense. Rather than being scared away by the severity of a given penalty, Nagin (2013) suggests that the certainty of being caught withholds a potential criminal from committing a crime. This claim is also supported by research conducted on the likelihood of hit-and-run road accidents, including the cause for more severe accidents where victims might have died and less severe accidents such as bumping into someone's car while parking. In their research, Castriota and Tonin (2019) found that criminal activities in unexpected circumstances, under intense time pressure, and emotional distress are deterred more by the certainty of legal sanctions than by the severity of legal sanctions. Mungan (2017) tested the, in his words, "widely held presumption among criminologists that the certainty of punishment is a greater deterrent than the severity of punishment." Mungan considered criminal offenses ranging from civil infractions, such as speed tickets, to administrative violations, such as tax fraud. He found that when offenses are committed repeatedly, the certainty of punishment is a greater deterrent, even when the individual offender is claimed to be more responsive to the severity than the certainty of punishment.

Furthermore, in another study by Zhang, Young, and Prybutok (2007), the perceptions of students and hackers on the criminal nature of hacking and shoplifting were compared. Their study found that both students and hackers perceived hacking as less criminal severe behavior, mainly because the perceived certainty of punishment was lower in the hacking condition than the shoplifting condition. This observation remained true even when the perceived severity of punishment was higher for hacking than for shoplifting. Overall, certainty seems to prevail as the stronger deterrent for criminal behavior in several types of offenses compared to severity.

Hypothesis 2

Because research has, on multiple occasions and in many different studies, made clear that the certainty of being caught is more effective than the severity of punishment in deterring crime, the following hypothesis was formulated:

H2: *Individuals perceiving a nudge stressing the certainty of being caught are less likely to display shoplifting behavior while using self-checkout than individuals perceiving a nudge stressing the severity of punishment.*

Materials and Method

The research collaborates with retail software development company Nakko and Detail Result Group, the parent company of major Dutch supermarket chain Dirk. From the 1st of August 2021 until the 4th of September 2021, data from every individual who uses the mobile phone application for self-checkout at Dirk grocery stores was collected.

Research design

The research has a 3 x 1 between-subjects research design, consisting of three conditions. First, there is the certainty condition where participants encounter a nudge stressing the certainty of being caught. Second, there is the severity condition where participants encounter a nudge stressing the severity of punishment. Last, there is the baseline condition where participants encounter no nudge. The effectiveness of the nudge to reduce shoplifting behavior is examined in three ways. First, by measuring the differences in the total value of the final shopping cart purchase between the nudge and control conditions. Second, by measuring the frequency of times when customers did not complete their purchase in the nudge and baseline condition. Third, by measuring the frequency of nudge pop-up cancellations, which will be measured using two different approaches: a nudge stressing the certainty of being caught and a nudge stressing the severity of punishment. Ultimately all participants will be randomly exposed to either one of three conditions.

Sessions/Participants

This experiment was conducted at a total of 67 Dirk supermarkets that have implemented self-service checkout technology, where the data was collected through self-service checkout with the mobile phone application. As a result, the experiment consisted of 2412 unique shopping sessions distributed over 934 participants who used the mobile phone application in their grocery shopping from the 13th of August 2021 until the 10th of September 2021. Unfortunately, because there are no

participants' demographics available through the application, there is no data representing features of the participants (e.g., age, gender). The data points of the experiment will be the separate shopping sessions, which means that data will be collected and analyzed per grocery shopping session. Therefore, one participant can deliver multiple data entries if the participant visited the supermarket multiple times during the data collection period.

Procedure

In the terms and conditions of the application, participants are made aware that data will be collected and used for an experiment. By using the application, customers agree to data tracking while proceeding with their grocery shopping. Participants enter a Dirk supermarket, open the application on their phones, and start scanning their grocery items. After the participants decide they have finished scanning their products, they will continue to the in-store checkout area and round up their shopping session by pressing the "Afrekenen" ("Purchase") button in the application. At this point, participants are presented with a nudge stressing either the certainty or severity of punishment related to shoplifting, or no nudge at all. When a participant receives a nudge, he or she can decide to cancel the nudge by pressing the "Terug" ("Back") button in the pop-up, or the participants can decide to continue to pay by pressing the "Doorgaan" ("Continue") button in the pop-up. In the baseline condition, the participant will directly continue to pay after pressing the "Purchase" button. Participants can receive a rescan executed by an employee directly after the participant has pressed the "Doorgaan" button in the nudge condition or the "Purchase" button in the control condition. If no rescan is needed, or if the rescan is successfully executed (meaning no items were missing), the participant can pay for their grocery items, and the session has ended. They will receive a receipt which they can use to exit the store. Suppose a rescan concludes that the participant did not scan items in the physical shopping cart. In that case, he or she can be asked to scan those additional products, complete their purchase at a cashier, or the supermarket may contact the police for further assistance with the issue.

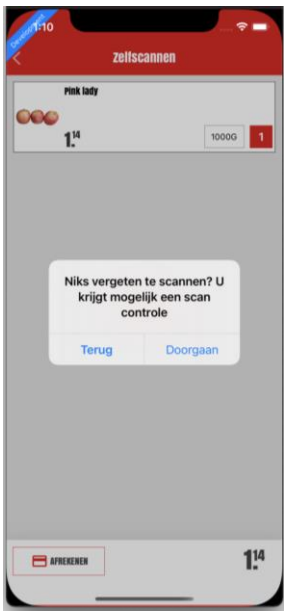
Materials

Participant behavior was measured via the mobile phone application of Dirk, which customers use to carry out their grocery shopping. Besides what is of interest for this experiment, the application can also be used for different activities such as keeping track of special weekly offers or reviewing the catalog of products that Dirk has to offer. When a customer enters a Dirk supermarket, they can open the application and press the button “in de winkel” (“Inside the store”). From here the customer can connect to the Wi-Fi connection in the supermarket and start scanning all of their groceries. When customers are done scanning all of their products, they can continue to the in-store checkout section in the supermarket and press the “Afrekenen” (= purchase) button.

In the certainty & severity conditions, a pop-up will appear directly after having pressed the purchase button, including a textual nudge either stressing certainty of being caught or the severity of punishment (see fig. 1). Customers can either “accept” by pressing “Doorgaan,” after which they can immediately complete their session by payment, or cancel the nudge by pressing “Terug,” which will allow customers to double-check their items and possibly add extra items. Afterward customers can again press “purchase” and complete their payment.

Figure 1

Screenshot certainty nudge



Note. Nakko *(2021), Screenshot of the concept version of the mobile phone application for self- service checkout from Dirk,* Nakko, Diemen.

In the control condition, customers will immediately continue to pay without any pop-up occurrence. The customer is, however, in both conditions, still able to cancel the purchase in order to add extra items or double-check their items while being at the "payment stage" in their grocery session. Hereafter a customer can again press "purchase" to complete their payment.

The two types of nudges which will be used for this experiment are either concerned with the certainty of being caught, or with the severity of punishment while shoplifting when making use of SCO. Initially, the effectiveness of the nudge, in terms of the perceived certainty and severity, was secured based on previously used examples and by using strict language. However, the initial nudges were perceived to be too severe for Dirk Supermarket since encountering them as a customer might negatively affect Dirk's perceived identity. Therefore, in consultation with Dirk, it was decided to formulate the nudges based on ecological validity by deciding for a generally used format of similar grocery stores. This formulation resulted in the following outcome in the certainty and severity nudge conditions.

In the certainty condition, the nudge consisted of the following sentence "Niks vergeten te scannen? U krijgt mogelijk een scan controle" ("Forgot nothing while scanning? You could be checked.") (see fig. 1). This nudge thus emphasizes the certainty of being caught while shoplifting, as it stresses the possibility of being double-checked.

In the second possible nudge condition, severity, the nudge consisted of the sentence: "Niks vergeten te scannen? Op winkeldiefstal staat een fikse geldboete." ("Forgot nothing while scanning? There is a hefty fine on shoplifting."). This nudge thus emphasizes the severity of punishment related to being caught while shoplifting, as it stresses the consequences.

In order to prevent customers from feeling accused of being a potential thief, both nudges start with "Niks vergeten te scannen?" ("Forget nothing while scanning?"). This sentence was included

because it implies that Dirk does not perceive the customer as a potential thief but rather a human being who might have unintentionally made a mistake.

In the control condition, the customer was presented with no nudge at all. This means that after the customer decided to continue to pay, by pressing the allocated begin checkout button, the customer was immediately able to complete payment without the appearance of any pop-up. Customers were, however, still able to cancel the payment procedure after they had pressed the begin checkout button in the no-nudge condition by pressing cancel.

Measures

By collecting the data through FireBase, much data related to various variables were accessible for the experiment. In order to retrieve adequate measures which express shoplifting behavior at SCO, the following most essential variables were computed from the data: *Shrinkage Nudge Canceled*, *Purchase value*, and *No purchase*.

Shrinkage Nudge Canceled constitutes the cancellation of a pop-up containing a certainty or severity nudge in order to revisit one's shopping basket. When this pop-up was canceled, which meant the participant pressed "Terug" instead of "Doorgaan," the issued session would receive a score of 1 on the variable Shrinkage Nudge Canceled. This measure was used as an indicator for shoplifting behavior because participants who canceled the nudge to review their shopping basket could either not be sure whether they had scanned all of their items or actually did not scan all of their products and thus had the intention to shoplift. In the latter situation, the nudge triggered the potential shoplifter to alter his or her shoplifting behavior. Therefore, this is used as the first indicator for shoplifting behavior.

Total Purchase Value constitutes the total value of the final purchase of a shopping session in euros. In essence, the average purchase value would be the same in all conditions if the nudge did not affect stealing behavior. If the nudge has an effect, then it would be expected that the purchase value will increase, since items which without the nudge would be taken without being paid for, will in this situation be scanned and added to the purchase.

Last of all, *No Purchase* constitutes the situation in which a customer did not finish his or her grocery shopping session after having perceived the nudge. When customers finish their shopping session, an event named "purchase" is elicited and stored in the data collection. When this event was missing from a particular session, but the session did include a "begin checkout event," which is immediately followed by a nudge, the session would receive a score of 1 for *No Purchase*. When the nudge stressing the certainty of being caught or the severity of punishment is effective, it might scare the customer who was planning to shoplift away, which could result in the customer simply walking away from the self-checkout without finishing his or her grocery purchase.

Data Cleaning

The collection of data through FireBase allows loading and structuring the data in Google Cloud's platform Big Query. However, the initial data collection is very rough where every single action point of a customer (e.g., start a session, add products, begin checkout) accumulated a lot of poorly structured information. In order to retrieve the desired data per separate session in a structured manner, the data was downloaded from Big Query in a CSV format and first loaded and structured in Excel. From this point, the structured set was again exported to SPSS, from which it was cleaned and further analyzed before performing statistical analysis.

When analyzing the data in SPSS, irregularities were noticed, which have caused several data entries to be excluded from the experiment. First of all, in 234 cases, a session was started where participants never reached the point where they started their checkout, which meant there was no initial intention to complete the session, nor was there the possibility to encounter one of the nudges. Therefore these 234 cases were excluded from the experiment. Secondly, for unknown reasons, one user was wrongly exposed to more than one condition (certainty & severity) and was therefore excluded from the experiment as well. Lastly, in one session, the user elicited two *Shrinkage Nudge Canceled* events which should not be possible and were therefore excluded. Additionally, compared to iOs mobile devices, Android mobile devices did not allow insights on prices expressing the product

value or purchase value; Therefore, analyses related to prices are executed based on available data that expressed the concerned values.

After data cleaning, the data was used to test our hypotheses in the following manner. Considering Hypothesis 1: *Individuals who perceive a nudge stressing the certainty of being caught, or the severity of punishment, while using self-checkout are less likely to display shoplifting behavior than those who do not perceive such a nudge*, shoplifting behavior was first of all measured by comparing the *Total Purchase Value* in the nudge and baseline conditions. As explained before, when the nudge will cause potential shoplifters to add the items to their basket that they were first planning to steal in the nudge condition, this would be expected to lead to a higher average purchase value compared to the baseline condition. Secondly, the completion of shopping sessions by means of *No Purchase* events were compared in both conditions. It was expected that when customers did not complete their grocery purchase, they might have intended to shoplift and were scared off by the nudge.

Considering Hypothesis 2: *Individuals perceiving a nudge stressing the certainty of being caught are less likely to display shoplifting behavior while making use of self-checkout than individuals perceiving a nudge stressing the severity of punishment*, just as with the first hypothesis, *Total Purchase Value*, and *No Purchase* were used as measurement tools. Additionally, the occurrences of *Shrinkage Nudge Canceled* events were compared. As explained, it was reasoned that when customers cancel the nudge to revisit their shopping basket, it is likely they were initially planning to shoplift but were triggered by the nudge to alter their behavior.

Timestamp Limit

When further looking into the data, something suspicious was discovered. The data revealed that participants took quite some time to add additional products after the nudge was canceled in several cases. It would be expected that when participants did (intentionally or unintentionally) not scan all of their products, adding the products after canceling the nudge would take no more than a couple of minutes, because all of the items to be scanned would have already been collected. Nevertheless, when looking at the time between additional scans, in some cases, it looked like the

additional products were not yet in the basket/shopping cart and might have still been retrieved somewhere in the supermarket. It was reasoned that these participants might have accidentally pressed "afrekenen" and therefore canceled the nudge to complete grocery collecting.

However, many items were added after the nudge was canceled in most of these cases. This could mean a couple of things. The customer might have accidentally pressed the "afrekenen" button halfway through his or her session, which is why still many items had to be retrieved, which is why multiple items have been added, which took quite some time. It could also be that the customer indeed did not scan all of the items which have been added afterward. However, it took quite some time because there were so many items, and the customer had to or act as if they had to review and double-check the items in the grocery basket attentively. There are multiple possibilities given the time it took to complete the purchase after the nudge was canceled. This is why an attempt was made to consider both possibilities considering the timestamp limit.

In order to hold for these suspicious cases, it was decided to incorporate a timestamp limit when there were more than three minutes between a shrinkage nudge cancel event and a purchase event in a session, the entry would be excluded from the experiment. The value of the timestamp limit, three minutes, was established by analyzing the median time between a shrinkage nudge cancel event and a purchase event. Because we can not know the exact reasons behind the proportionally large time between begin checkout and purchase, the results without incorporating the timestamp limit are presented in Appendix B.

Statistical Testing

In order to test hypothesis 1, multiple statistical tests will be used. First, a Chi-Square Test of Independence was used to compare *No Purchase* events in the nudge conditions (certainty & severity) and the baseline condition. Second, an Independent Sample T-test was used to compare the *Total Purchase Value* in both conditions. In order to test hypothesis 2, a Chi-Square Test of Independence was used to compare *Shrinkage Nudge Cancel* events, and *No Purchase* events in both conditions.

Additionally, an Independent Sample T-test was used in order to compare the *Total Purchase Value* in both conditions.

Results

After data cleaning, the experiment consisted of 2412 unique grocery shopping sessions, divided over 934 users (participants). The users are more or less equally divided over the three groups, with around 300 users per condition. For more detailed descriptives considering the experiment, see table 1.

Table 1

Frequencies and averages of the experiment's most important variables

	Baseline	Certainty	Severity	Total Nudge*	Total
Sessions	743	781	888	1697	2412
Participants	300	316	318	638	934
No Purchase	5	6	11	17	22
Average Total Purchase Value	€27,67	€26,07	€22,28	€23,99	€25,14
Average Products purchased	14,5	15	12,2	13,7	13,8
	Baseline	**Certainty**	**Severity**	**Total Nudge***	**Total**
Shrinkage Nudge Cancel	-	39	24	91	-
Add after cancel**	-	11	6	44	-
Average added value	-	2,82	5,72	€18,02	-

* = Certainty & Severity conditions combined

** = Number of sessions in which product were added after the nudge was canceled

Hypothesis 1

In order to test the first hypothesis: *Individuals who perceive a nudge stressing the certainty of being caught, or the severity of punishment, while using a self-service checkout, are less likely to display shoplifting behavior than those who do not perceive such a nudge*, we assessed the effect of shoplifting indicators *No Purchase* and *Total Purchase Value*.

Regarding shoplifting behavior measured in terms of *No Purchase* events, unfortunately, due to the sample size, there were not enough sessions where the customer did not complete its session after having perceived the nudge (22 times in total). Therefore, there was not enough data to perform a sufficient statistical analysis. Nevertheless, a Chi-square Test of Independence was performed. When performing the Chi-square Test of Independence, the assumption for a 2 by 2 table, which is that there should be at least 10 counts in every cell, was violated because there were only 5 *No Purchase* events in the baseline condition. Therefore the 1-sided significance value provided by Fisher's exact test was interpreted, which revealed no significant association between experiment condition (nudge or no nudge) and *No Purchase* events, $p = .410$. This outcome means that when shoplifting behavior was measured in terms of shopping session completion, no support for H1 could be found. Therefore, individuals who perceived a nudge stressing the certainty or severity of theft while using self-checkout were not less likely to finish their grocery shopping session than those who did not perceive such a nudge.

Regarding shoplifting behavior in terms of *Total Purchase Value*, an Independent T-test was performed to assess a significant difference between the nudge and baseline conditions. Because the homogeneity of variance is violated, the results for "Equal variances not assumed" in the Independent Sample T-test were interpreted, which resulted in the final purchase value not being significantly higher in the nudge condition ($M = 24{,}0$ euro, $SD = 27{,}0$) than in the baseline condition ($M = 27{,}7$ euro, $SD = 31.4$), $t(1429) = 2.27$, $p = .03$. The large standard deviation is because the normal distribution of the purchase values is skewed to the left with most cases roughly between 0 and 15 euro (50%), where the maximum purchase value was 200 euro (with outliers removed) (for histogram see Appendix A).

Nevertheless, because the variable is normally distributed and because there is one independent categorical variable with two levels (nudge or no nudge) and one continuous dependent variable (*Total Purchase Value*), the independent T-test was made. Thus, the results suggest that when shoplifting behavior was measured in terms of *Total Purchase Value*, no support for H1 could be found. Instead, the results suggest the opposite: individuals who perceived a nudge stressing the certainty or severity of theft at the end of their grocery shopping are less likely to have a higher total purchase value than individuals who do not perceive such a nudge.

Hypothesis 2

In order to test the second hypothesis: *Individuals perceiving a nudge stressing the certainty of being caught are less likely to display shoplifting behavior while making use of self-checkout than individuals perceiving a nudge stressing the severity of punishment*, we assessed the effect of shoplifting indicators *Shrinkage Nudge Canceled*, *Total Purchase Value* and *No Purchase*.

Considering shoplifting behavior indicated by *Shrinkage Nudge Canceled* events, a Chi-square Test of Independence revealed a significant association between experiment nudge condition (certainty or severity) and the cancelation of a nudge, $\chi 2$ (1, N = 1669) = 5.00, p = .014 (for cross-tabulation see table 2). However, by analyzing the Phi coefficient, it was revealed that the relationship between the type of nudge and canceling the nudge constitutes a weak relationship ϕ = -0.06, p = .014. This means that when shoplifting behavior was measured in terms of *Shrinkage Nudge Canceled*, the results suggest that a nudge stressing the certainty of being caught is more likely to result in customers canceling the nudge (7,4%[1]) than a nudge stressing the severity of punishment (4,2%[2]). Therefore, the given results provide support for hypothesis 2.

Table 2

Shrinkage Nudge Cancel event per nudge condition, Cross-tabulation

	Shrinkage Nudge Cancel

[1] percentage of sessions in which the customer canceled the nudge in order to revisit the shopping basket

[2] percentage of sessions in which the customer canceled the nudge in order to revisit the shopping basket

			0	1	Total
Experiment Name	Certainty	Count	742	39	781
	Severity	Count	864	24	888
Total		Count	1606	63	1669

Regarding shoplifting behavior in terms of *Total Purchase Value*, an Independent T-test was performed to assess whether there is a significant difference between the type of nudge (certainty or severity) and total purchase value of the shopping session. Because the homogeneity of variance was violated, the results for "Equal variances not assumed" in the Independent Sample T-test were again interpreted. This resulted in the total purchase value being significantly higher in the certainty condition (M = 26.1 euro, SD = 28.9) than in the severity condition (M = 22.3 euro, SD = 25.2), $t(888) = 2.17$, $p = .030$. The large standard deviation is because the normal distribution of the purchase values is skewed to the left, with most cases roughly between 0 and 15 euro, where the maximum purchase value was 200 euro (see appendix A). However, when analyzing the value produced by Cohen's $d = .14$, it becomes clear that the effect concerns a small effect size (weak relationship). This means that the results suggest that individuals who encounter a nudge stressing the certainty of theft at the end of their grocery shopping are more likely to have a higher total purchase value than individuals who encounter a nudge stressing the severity of being caught. Therefore, again the given results provide support for hypothesis 2.

Regarding shoplifting behavior, in terms of *No Purchase* events, a Chi-square Test of Independence was performed. However, the assumption for a 2 by 2 table, which is that there should be at least 10 counts in every cell, has been violated because there were only 6 *No Purchase* events in the certainty condition. Therefore the 1-sided significance value provided by Fisher's exact test was interpreted, which revealed no significant association between experiment nudge condition (certainty or severity) and the completion of one's grocery session, $p = .240$. This means that when shoplifting behavior was measured in terms of *No Purchase*, the results do not suggest that a nudge stressing the

certainty of being caught is less likely to result in completing the grocery shopping session than a nudge stressing the severity of being caught. Therefore, the given results do not provide support for hypothesis 2.

Discussion

This experiment examined whether shoplifting at Self Checkout Systems could be reduced by incorporating a textual nudge stressing either the certainty of being caught or the severity of punishment. Concerning its effectiveness, two expectations were made and examined by the conducted research. First of all, because the general shoplifter most related to SCO is the impulsive shoplifter who is motivated by opportunity created by the low certainty of being caught and low severity of punishment, and acts in a state of thoughtlessness facilitated by the absence of human interaction and ease of shoplifting, it was expected that *Individuals who perceive a nudge stressing the certainty of being caught, or the severity of punishment, while using self-checkout, are less likely to display shoplifting behavior than those who do not perceive such a nudge.* This hypothesis was formulated based on literature that suggested that nudges can evoke one's reflective process and enable human beings to snap out of undesired automatic behavior (Thaler & Sunstein, 2008; Levy, 2019) and because prior research has indicated that nudges can prevent crime (i.e., the watching eyes effect, where the feeling of being observed could decrease chances of criminal behavior among individuals (Haley & Fessler, 2005)). However, when reviewing the differences between the nudge and baseline condition, the results could not provide support for Hypothesis 1. This could be because we used a textual nudge of which no prior research had established its effectiveness in relation to crime prevention. For instance, would we have used a nudge utilizing the watching eyes effects, this might have been more effective.

Second of all, because research has in multiple occasions made clear that the certainty of being caught is more effective than the severity of punishment in deterring crime, it was expected that *Individuals perceiving a nudge stressing the certainty of being caught are less likely to display shoplifting behavior while making use of self-checkout, than individuals perceiving a nudge stressing*

the severity of punishment. The results were able to provide support for this hypothesis when shoplifting behavior was measured in *Shrinkage Nudge Canceled* and *Total Purchase Value*. However, when reviewing statistical values that report the relationship's strength, the results suggested this relationship to be relatively weak in both cases. When shoplifting behavior was measured in terms of grocery shopping session completion, the result could not suggest the certainty nudge to be more effective in comparison to the severity nudge.

The certainty of punishment compared to the severity of punishment has been studied in multiple settings in literature, such as hit and run road accidents, tax fraud, and speeding. However, research comparing the precise effects of certainty and severity on shoplifting behavior has not yet been conducted. Therefore it is interesting how this study was able to provide support for hypothesis 2 and thereby for the assumption that also in shoplifting, the certainty of punishment is more effective than the severity of punishment.

Limitations

The fact that we could not find any support for Hypothesis 1, *Individuals who perceive a nudge stressing the certainty of being caught or the severity of punishment while using self-checkout are less likely to display shoplifting behavior than those who do not perceive such a nudge* could be due to the absence of an adequate measure for the effectiveness of the nudge. In this experiment, two proxies were used to measure the effectiveness of the nudge in comparison to the baseline condition. *No Purchase* events, which were events in which potential shoplifters might have been scared away after having encountered the nudge, and *Total Purchase Value*, where it was hypothesized that when the nudge would work, potential shoplifters would add the otherwise stolen items to their shopping basket resulting in an overall higher purchase value than in the group were potential shoplifters did not encounter the nudges.

These proxies could be considered insufficient because, first of all, No Purchase events were only reported 22 times over the whole experiment, which was insufficient to conduct adequate statistical tests. Second of all, regarding *Total Purchase Value*, it is questionable whether this proxy is

a reliable measure for the effectiveness of the nudge. Since the results suggested that incorporating no nudge yields a higher Total Purchase Value as opposed to when a nudge is incorporated, which goes in the opposite direction of our expectations. However, it could be that customers acted based on psychological reactance theory where when some authority tells one they cannot or may not do something, they actually want to do it (Mühlberger & Jonas, 2019). If this were the case, customers could have perceived the nudge as directing them not to shoplift, resulting in customers shoplifting. However, this is a doubtful explanation since care was taken in formulating the nudges in a friendly manner in order to not scare away customers, as was in line with Dirk's requirements. Furthermore, multiple customers reacted to the nudge by canceling it to revisit their shopping basket. This is not likely behavior for someone planning to shoplift because of the nudge; since then, it would be more likely that he or she would immediately continue to pay instead of canceling the nudge.

Because it is uncertain whether *Total Purchase Value* can be considered a reliable proxy for measuring the effectiveness of the proposed nudges on shoplifting behavior, this also concerns the outcome for Hypothesis 2. Here support for the hypothesis was, besides *Shrinkage Nudge Canceled*, based upon *Total Purchase Value*. If we can not rely upon Total Purchase Value as an adequate measurement tool, the support for hypothesis 2 would be solely based upon results derived from analyses with *Shrinkage Nudge Canceled.*

Last of all, no manipulation check was incorporated to measure to what extent the incorporated textual nudges were perceived as certain and severe. This means that it cannot be said with certainty that the textual nudges used are perceived as severe and certain enough to yield the hypothesized effects based on the literature. If the nudges were perceived as not severe enough, not certain enough, or both, then the effects of the nudges would not have been utilized to their maximum potential. Therefore the potential effect of nudges stressing the certainty of being caught and the severity of punishment could not have been established.

Future Research

Future research should try to incorporate an adequate measurement tool to measure the effectiveness of the nudge. A proposal would be to enable participants in both conditions (nudge & control) to "cancel the nudge" and revisit their shopping basket to compare participants' reactions to the nudge, which in this experiment was *Shrinkage Nudge Canceled*, to the control condition. If such a tool would be included in future research designs, this might yield different results considering the effectiveness of the nudge on the prevention of shoplifting behavior. Furthermore, future research should perform a manipulation check for the used nudges to make sure that the nudges are perceived as certain and severe enough for them to have maximized their potential effect on shoplifting behavior.

Conclusion

Taking everything into consideration, even though this research could not confirm that individuals are less likely to portray shoplifting when they encounter a textual nudge stressing the certainty of being caught or the severity of punishment, the results do suggest that people react to the nudge by canceling the nudge, revisiting their shopping basket and adding items. This observation makes it interesting for future research to dive further into this subject and develop a research design that can adequately measure the effects of a nudge on SCO-related shoplifting. For now, this research revealed that when one does decide to incorporate a textual nudge at self-checkout, a nudge stressing the certainty of being caught will do better in deterring shoplifting than a nudge stressing the severity of punishment.

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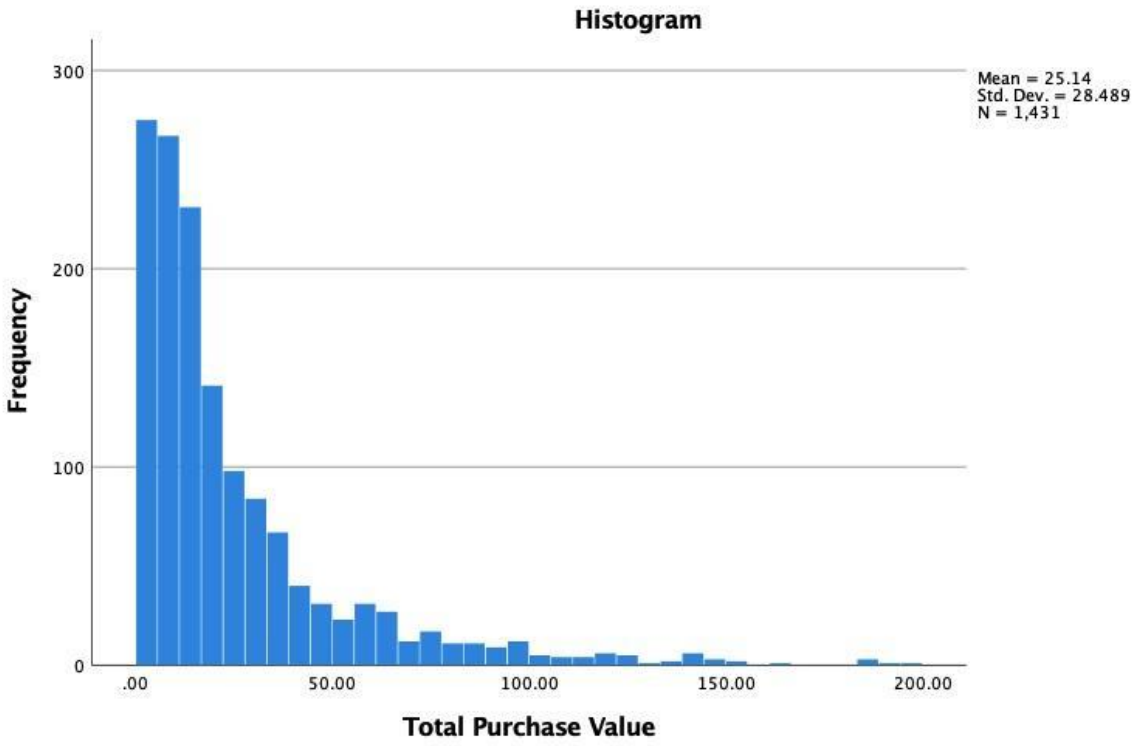
Appendix

Appendix A.

Figure 2

Histogram of the total purchase value of the experiment



Appendix B.

After data cleaning, the experiment consisted of 2440 unique grocery shopping sessions, divided over 936 users (participants). The users are more or less equally divided over the three groups, with around 300 users per condition. For more detailed descriptives considering the experiment, see table 3.

Table 3

Frequencies and averages of the experiment's most important variables

	Baseline	**Certainty**	**Severity**	**Total Nudge***	**Total**
Sessions	743	797	900	1697	2440
Participants	300	317	321	638	936
No Purchase	5	6	11	17	22
	Baseline	**Certainty**	**Severity**	**Total Nudge***	**Total**
Average Final Purchase Value	€27,67	€26,46	€22,74	€24,43	€25,43
Average number products purchased	14,5	15,1	12,4	13,7	13,9

Shrinkage Nudge Cancel	-	55	36	91	-
Add after cancel**	-	27	17	44	-
Average added value	-	€13,10	€25,12	€18,02	-

* = Certainty & Severity conditions combined
** = Number of sessions in which product were added after the nudge was canceled

Hypothesis 1

In order to test the first hypothesis: *Individuals who perceive a nudge stressing the certainty of being caught, or the severity of punishment, while using a self-service checkout, are less likely to display shoplifting behavior than those who do not perceive such a nudge*, we assessed the effect of shoplifting indicators *No Purchase* and *Total Purchase Value*.

Regarding shoplifting behavior measured in terms of *No Purchase* events, unfortunately, due to the sample size, there were not enough sessions where the customer did not complete its session after having perceived the nudge (22 times in total). Therefore, there was not enough data to perform a sufficient statistical analysis. Nevertheless, a Chi-square Test of Independence was performed. When performing the Chi-square Test of Independence, the assumption for a 2 by 2 table, which is that there should be at least 10 counts in every cell, was violated because there were only 5 no purchase events in the baseline condition. Therefore the 1-sided significance value provided by Fisher's exact test was interpreted, which revealed no significant association between experiment condition (nudge or no nudge) and no purchase events, $p = .296$. This outcome means that when shoplifting behavior was measured in terms of shopping session completion, no support for H1 could be found. Therefore, individuals who perceived a nudge stressing the certainty or severity of theft while using self-checkout were not less likely to finish their grocery shopping session than those who did not perceive such a nudge.

Regarding shoplifting behavior in terms of *Total Purchase Value*, an Independent T-test was performed to assess a significant difference between the nudge and baseline conditions. Because the homogeneity of variance is violated, the results for "Equal variances not assumed" in the Independent

Sample T-test were interpreted, which resulted in the final purchase value not being significantly higher in the nudge condition (M = 24,4 euro, SD = 27,5) than in the baseline condition (M = 27,7 euro, SD = 31.4), t(262) = 1.88, p = .06. The large standard deviation is because the normal distribution of the purchase values is skewed to the left with most cases roughly between 0 and 15 euro (50%), where the maximum purchase value was 200 euro (with outliers removed) (for histogram see Appendix A). Nevertheless, because the variable is normally distributed and because there is one independent categorical variable with two levels (nudge or no nudge) and one continuous dependent variable (total purchase value), the independent T-test was made. Thus, the results suggest that when shoplifting behavior was measured in terms of *Total Purchase Value*, no support for H1 could be found.

Hypothesis 2

In order to test the second hypothesis: *Individuals perceiving a nudge stressing the certainty of being caught are less likely to display shoplifting behavior while making use of self-checkout than individuals perceiving a nudge stressing the severity of punishment*, we assessed the effect of shoplifting indicators *Shrinkage Nudge Canceled*, *Total Purchase Value* and *No Purchase*.

Considering shoplifting behavior indicated by *Shrinkage Nudge Canceled* events, a Chi-square Test of Independence revealed a significant association between experiment nudge condition (certainty or severity) and the cancelation of a nudge, $\chi 2$ (1, N = 1697) = 7.01, p = .008 (for cross-tabulation see table 4). However, by analyzing the Phi coefficient, it was revealed that the relationship between the type of nudge and canceling the nudge constitutes a weak relationship ϕ = -0.06, p = .008. This means that when shoplifting behavior was measured in terms of *Shrinkage Nudge Canceled*, the results suggest that a nudge stressing the certainty of being caught is more likely to result in customers canceling the nudge (7,4%[3]) than a nudge stressing the severity of punishment (4,2%[4]). Therefore, the given results provide support for hypothesis 2.

Table 4

[3] percentage of sessions in which the customer canceled the nudge in order to revisit the shopping basket

[4] percentage of sessions in which the customer canceled the nudge in order to revisit the shopping basket

Shrinkage Nudge Cancel event per nudge condition, Cross-tabulation

			Shrinkage Nudge Cancel		
			0	1	Total
Experiment Name	Certainty	Count	742	55	797
	Severity	Count	864	36	900
Total		Count	1606	91	1697

Regarding shoplifting behavior in terms of *Total Purchase Value*, an Independent T-test was performed to assess whether there is a significant difference between the type of nudge (certainty or severity) and total purchase value of the shopping session. Because the homogeneity of variance was violated, the results for “Equal variances not assumed” in the Independent Sample T-test were again interpreted. This resulted in the total purchase value being significantly higher in the certainty condition (M = 26.5 euro, SD = 25.9) than in the severity condition (M = 22.7 euro, SD = 25.9), $t(916) = 2.11$, $p = .035$. The large standard deviation is because the normal distribution of the purchase values is skewed to the left, with most cases roughly between 0 and 15 euro, where the maximum purchase value was 200 euro (see appendix A). However, when analyzing the value produced by Cohen’s $d = .14$, it becomes clear that the effect concerns a small effect size (weak relationship). This means that the results suggest that individuals who encounter a nudge stressing the certainty of theft at the end of their grocery shopping are more likely to have a higher total purchase value than individuals who encounter a nudge stressing the severity of being caught. Therefore, again the given results provide support for hypothesis 2.

Regarding shoplifting behavior, in terms of *No Purchase* events, a Chi-square Test of Independence was performed. However, the assumption for a 2 by 2 table, which is that there should be at least 10 counts in every cell, has been violated because there were only 6 no purchase events in the certainty condition. Therefore the 1-sided significance value provided by Fisher’s exact test was interpreted, which revealed no significant association between experiment nudge condition (certainty

or severity) and the completion of one's grocery session, $p = .236$. This means that when shoplifting behavior was measured in terms of *No Purchase*, the results do not suggest that a nudge stressing the certainty of being caught is less likely to result in completing the grocery shopping session than a nudge stressing the severity of being caught. Therefore, the given results do not provide support for hypothesis 2.