NUDGING E-COMMERCE CUSTOMERS TOWARDS MORE SUSTAINABLE DELIVERY OPTIONS

Word count: <17.240>

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Master's dissertation submitted to obtain the degree of:

Master in Business Engineering: Operations Management

Academic year: 2020-2021

UNIVERSITEIT
GENT

Foreword

This master's thesis is the conclusion to obtaining the master's degree in Business Engineering (specialization: Operations Management). The basis for this master's thesis stemmed from my passion for human decision making and sustainability, making it both challenging and fulfilling.

First of all, my gratitude to my supervisor, prof. Dr. Maggie Geuens. On the one hand, for having the flexibility and patience for me to determine my subject, and on the other hand for her advice, time and very extensive feedback. In addition, I would like to thank my co-supervisor, Mathias Celis, who I could always turn to for feedback, questions about behavioural economics and tips for writing this thesis. Next, I am grateful to the 497 participants for the time they spent participating in the questionnaire. Logically it would not have been possible to complete this master's thesis without them successfully.

Furthermore, I would like to express my gratitude towards Ghent University for making available study places in the historic building "Het Pand", probably the best location to spend many hours working on this dissertation.

Finally, I would like to sincerely thank my parents, sister, brother, family, girlfriend, friends and colleagues for their unconditional support, interest, and encouragement.

Jan Muysoms

Ghent, 20th of May 2021

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1 Introduction

Over the last two decades, e-commerce, "the buying and selling of information, products and services via computer networks" (Kalakota & Whinston, 1997, p. 1), has moved from niche applications to the mainstream crowd, with the global parcel volume reaching 103 billion in 2019 (Pitney Bowes, 2020). With numerous advantages such as time-saving, quick access to information and convenience, it is not hard to see why many customers are opting for online shopping.

Despite the benefits of online shopping, its environmental impact is often not considered by many customers (B2C Europe, 2018). With research conducted by Wygonik & Goodchild (2012), Weideli (2013), and Muñoz-villamizar et al. (2021) indicating the high environmental impact of speed delivery compared to standard shipping, the trend of free one-day shipping could have significant implications for the ecological impact of e-commerce. Due to the continuously increasing scale and impact of e-commerce, the environmental impact has to be taken into account in order to achieve critical climate change objectives (United Nations, 2018).

Traditionally policymakers have focused on tools such as regulations, taxes and subsidies to mitigate the long term effects of human behaviour (Akerlof & Kennedy, 2013). However, with the establishment of Behavioural Economics as a new subfield in modern economics, questions have arisen whether new "soft policy" approaches could be used to improve ecological and environmental economics (Schubert, 2017). One such soft policy that gained significant attention is nudging, which has been popularized by Thaler and Sunstein with their influential book "Nudge: Improving Decisions About Health, Wealth, and Happiness" (Sunstein & Thaler, 2008). Nudging is the concept of altering the choice architecture (i.e., the context in which individuals make choices) with the aim to change behaviour in a predictable way. Within the context of sustainability, many policymakers increasingly rely on behavioural insights to encourage pro-environmental behaviour (Benartzi, et al., 2017) due to its cost-efficiency and scalability.

Nudges are relevant in the context of sustainability as they could contribute to close the "Green gap". The green gap, also known as the climate value action gap, is the discrepancy between people stating that they are concerned about the environment and their actions to sustain the environment (Barr, 2006; Vermeir & Verbeke, 2008; Grimmer & Miles, 2016; ElHaffar et al., 2020). This discrepancy between value and actions is seen as a critical behavioural barrier to climate change adoption (Gifford, 2011; Markowitz & Shariff, 2012).

To tackle the rising problem of the environmental impact of e-commerce, this dissertation aims to apply the concepts of nudging to influence consumer behaviour towards more sustainable delivery options. From the "Catalogue of ten important nudges" (Sunstein, 2014), three promising nudges were selected to be included in an online experiment (default rule, disclosure and social reference).

First, we want to test which of the three included nudge types (default rule, disclosure and social reference) and their combinations are most promising to nudge e-commerce customers towards choosing more sustainable delivery options. Second, this dissertation aims to contribute to the existing literature by gaining a better understanding of the factors that influence the effect of the different nudges by examining the moderating effect of environmental concern and psychological ownership. Finally, the mediating effect of both anticipated guilt and decision basis are considered in order to gain insights into the underlying mechanisms of the different nudges.

2 Literature review

The literature review is structured in two parts. In the first part of the literature review, *e-commerce* will be briefly discussed by first looking at the evolution of e-commerce over the past few years, both globally and specifically for Belgium. Then the environmental impact of e-commerce will be discussed together with customer attitudes towards the environmental impact of online shopping.

In the latter part, *nudges* will be discussed by introducing the concept of nudging together with possible classifications and an assessment of the effectiveness of different nudge types. Thereafter, digital nudges (i.e., nudges in the context of a digital choice environment) and green nudges (i.e., nudges that aim to promote pro-environmental behaviour) will be discussed in more depth, followed by a concluding systematic literature review of green digital nudges and the development of the hypotheses.

2.1 E-commerce

2.1.1 The rise of e-commerce

2.1.1.1 Global trends in e-commerce

Over the last two decades, e-commerce, "the buying and selling of information, products and services via computer networks" (Kalakota & Whinston, 1997, p. 1), has moved from niche applications to the mainstream crowd. According to the Pitney Bowes Parcel Shipping Index, every second, 3,248 parcels are shipped globally (Pitney Bowes, 2020). As shown in Figure 1, parcel volume has increased at a compound annual growth rate of 19% over the last seven years. In 2019, the global parcel volume reached 103 billion (Pitney Bowes, 2020). In the years to come, the global parcel volume is expected to continue increasing. Pitney Bowes predicts the global shipping volume to more than double by 2026 (Pitney Bowes, 2020).
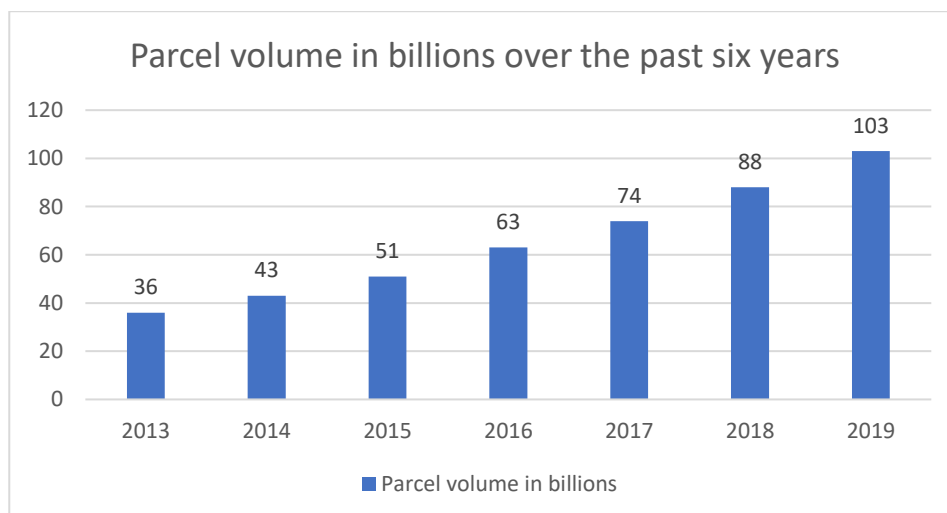
Figure 1 Parcel volume in billions over the past six years (Pitney Bowes, 2020)

2.1.1.2 E-commerce in Belgium

Similarly to many other countries in the world, Belgium has seen its e-commerce activities steadily increase both in the number of transactions and the total value of the transactions. According to the e-commerce barometer, which was published by safeshops.be and the House of Marketing, 85 million online transactions took place in 2019, translating into a Belgian e-commerce market of 8.2 billion euros (SafeShops.be; The house of marketing, 2019).

Furthermore, e-commerce saw an increase in its activities due to COVID-19, with 41% of the Belgian participants stating to shop online more often due to the coronavirus pandemic (Statista, 2021).

The number of individuals in Belgium who have made online purchases has continued to grow over the last few years (Statbel, 2020). In 2019, 66% of the Belgians had shopped online, which is an increase of 5 percentage points in one year (Statbel, 2020). For individuals younger than 44 years of age, 80 percent has made purchases online, while this figure is 68% for individuals between the ages of 45 and 54 (Statbel, 2020).

2.1.2 Environmental impact of e-commerce

To gain insights on the comparison of the environmental impact of shopping online with traditional shopping ("brick and mortar"), research conducted by Wygonik & Goodchild (2012), Weideli (2013), and Muñoz-villamizar et al. (2021) will be discussed below.

In 2012, Wygonik and Goodchild compared the carbon dioxide of personal vehicles with shared-use vehicles for grocery shopping in Seattle (as illustrated in Figure 2). The study showed that grocery delivery trucks produce on average between 17% and 75% less carbon dioxide per customer than when passenger cars travelling to stores across Seattle (Wygonik & Goodchild, 2012). However, this reduction can only be achieved if grocery stores could pick drop-off times and optimize delivery routes. In the scenario where customers could choose the delivery time themselves, the reduction in carbon dioxide by using a shared-use vehicle disappeared (Wygonik & Goodchild, 2012). One of the advantages of slower delivery is that the companies can consolidate more packages onto fewer vehicles.
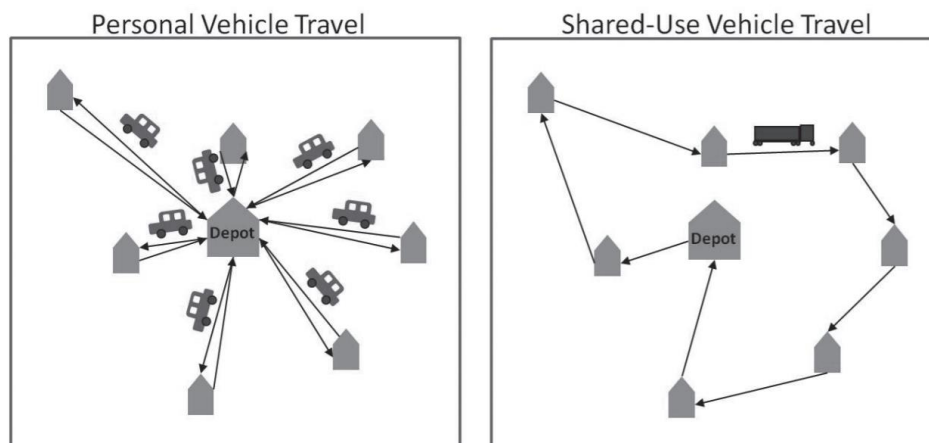
Figure 2 Personal Vehicle Travel Compared to Shared-Use Vehicle Travel (Wygonik & Goodchild, 2012)

Research conducted at MIT Center of Transportation & Logistics by thesis student Weideli shows that for a simple example (the buying process of a toy for customers living in an urban area), purchasing online tends to have a lower environmental impact than traditional shopping, as long as the consumer does not select fast delivery (Weideli, 2013). The author divided the buying process into three main steps: search, buying and return. In the figure below, a comparison can be seen of the carbon footprint of a traditional shopper, compared with a cybernaut (online shopper) and a cybernaut impatient shopper (online shopper that opts for fast delivery) in the scenario where the search step is not yet included (Weideli, 2013).
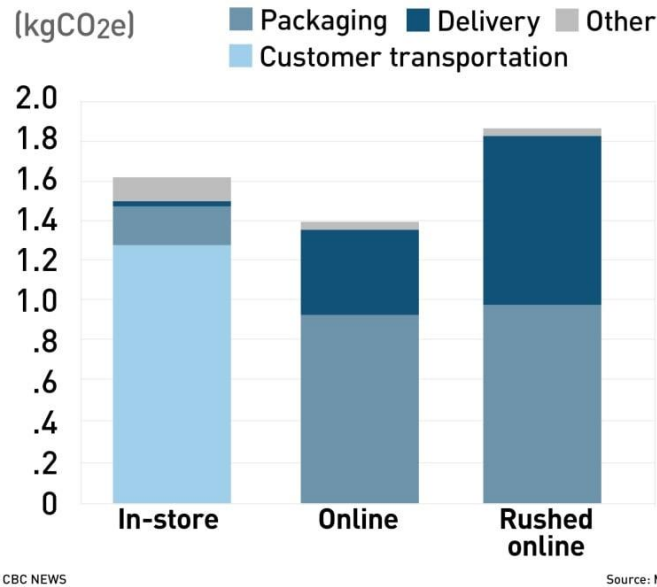
Figure 3 Traditional shopper and Cybernaut: Carbon footprint comparison (Weideli, 2013)

When including the search step in the buying process, Weideli found that the cybernaut's carbon footprint is approximately two times smaller than a traditional shopper due to the fact that some traditional shoppers include multiple trips during the search step (Weideli, 2013).

A recent case study by Muñoz-villamizar et al. (2021) in Mexico shows that delivery speed significantly impacts carbon emissions in inbound transportation.

Demand for fast speed-delivery increases the total emissions and costs up to 15% and 68%, respectively (Muñoz-Villamizar, 2021). The authors also concluded that the increase in emissions occurs due to the strong relationship between fast-shipping and less than truckloads (trucks that start their delivery route with spare capacity), which is in line with the findings of Weideli (2013) and Wygonik & Goodchild (2012).

Given the results of the research done by Wygonik & Goodchild (2012), Weideli (2013) and Muñoz-villamizar et al. (2021), indicating that speed delivery has a higher environmental impact than standard delivery, the trend of free one-day shipping could have significant implications for the environmental impact of e-commerce. According to a whitepaper published by Rakuten Intelligence, from July 2016 to December 2018, the average click-to-door interval dropped from 5.2 days to 4.3 days for Amazon.com and from around 9.0 days to 5.3 days for all other retailers (Rakuten Intelligence, 2019). As seen in Figure 4, most online webshops are now offering one-day/next-day delivery.

Figure 4 Online retailers with next-day delivery options (Accenture, 2020)

At the current growth rates of e-commerce, the number of delivery vehicles on the roadways in the 100 largest cities is predicted to rise by 36% (Accenture, 2020). This growth does not only threaten the sustainability of e-commerce but also creates significant congestion and environmental concern (Accenture, 2020).

Within the context of Belgium, Barbosa et al. (2017) estimated that the average external cost of e-commerce per parcel delivered is 0.24; 0.33 and 0.37 Euro per parcel for urban areas, semi-urban areas and rural areas, respectively (Barbosa et al., 2017). To estimate the external costs, the authors included congestion costs, accident costs, air pollution, noise and climate change in their calculations (Barbosa et al., 2017).

With an increase in awareness of the environmental impact of e-commerce, various initiatives have been launched to tackle the problem. For example, when customers choose to have their products delivered in 4-8 days rather than the regular 4-day delivery, Timberland offers to plant a tree (Reuters, 2020). Similarly, customers who select "FREE No-rush shipping" on Amazon can gain rewards (see Figure 5). On "bewustbezorgd.org", a tool to calculate the CO2 for each package is available to webshop owners (Thuiswinkel.org, n.d.).

Choose your Prime delivery option:

○ **Wednesday, Nov. 1**
$3.99 - One-Day Shipping

○ **Thursday, Nov. 2**
FREE Two-Day Shipping

○ **Monday, Nov. 6**
FREE Standard Shipping

◉ **Wednesday, Nov. 8**
FREE No-Rush Shipping
Get a $5 reward on your next Grocery purchase. Details
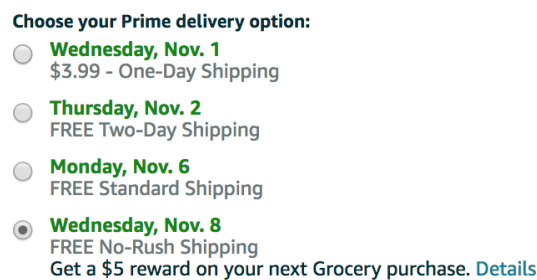
Figure 5 Amazon "FREE No-rush shipping" (Doctor Of Credit, 2017)

2.1.3 Customer attitudes towards the environmental impact of online-shopping

In February 2018, a survey with a sample of 1999 customers across the UK, France and the Netherlands was conducted by B2C Europe with the goal to understand the shopping behaviour and choices of customers in an online shopping environment (B2C Europe, 2018).

According to the survey, more than half of online shoppers (59%) state that they are somewhat to very concerned about the environmental impact when ordering online. However, only a third of the respondents (33%) consider the environmental impact when ordering online (B2C Europe, 2018). A similar customer survey conducted in North America found that 78 percent of US and 68 percent of Canadian shoppers stated to be conscious of the environmental impact of their online deliveries (MetaPack, 2018).

Even though same-day and next day delivery have gained popularity among customers, three-fourths (75%) states to be willing to opt for a more extended delivery period if this would significantly mitigate environmental harm (B2C Europe, 2018). Additionally, research conducted by Accenture states that 57% of customers find green delivery preferable, with 48% willing to pay a premium for environmentally friendly delivery options (Accenture, 2020). When customers choose standard delivery, several orders may be bundled together and shipped in a single journey (B2C Europe, 2018). Compared to the option of express delivery or same-day delivery, fewer packages are bundled, resulting in the need for additional delivery trips (B2C Europe, 2018).

While many customers are keen to make more sustainable choices, many lack the knowledge to see how their choices impact the environment (B2C Europe, 2018). Of the respondents, 42% were unaware of the fact that express delivery has a more harmful environmental effect than regular delivery, while 32% assumed that standard delivery has a more negative impact, as shown in Figure 6 (B2C Europe, 2018).

When respondents are given the information that shorter delivery periods results in more traffic and an increase in air emissions, only 10% opts for express delivery of 1-2 days (B2C Europe, 2018). A large proportion of respondents opts for standard delivery 3-5 days (42%) and Green delivery 6-8 days (43%) (B2C Europe, 2018). The results of the choice of delivery after being aware of the environmental impact are presented in Figure 7.
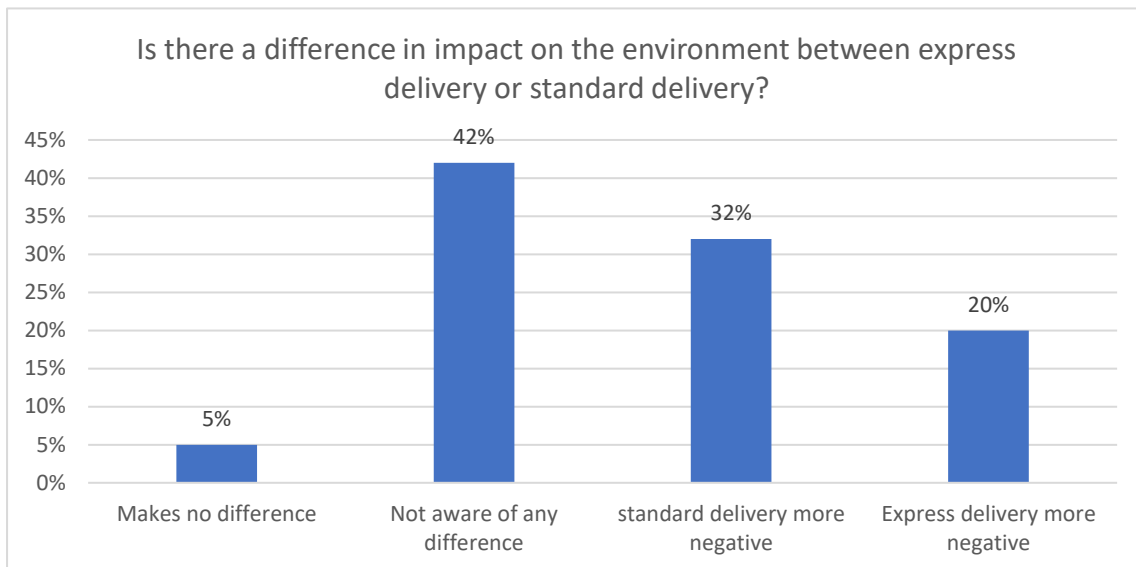
Figure 6 Customers impression of the environmental impact of different delivery options (B2C Europe, 2018)
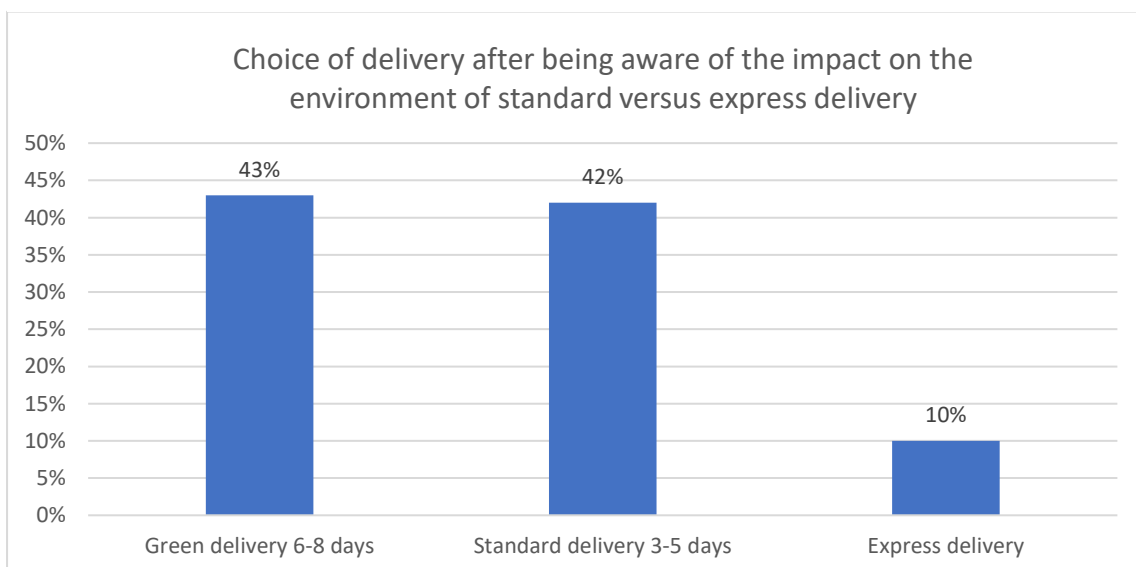
Figure 7 Choice of delivery after being aware of environmental impact (B2C Europe, 2018)

2.2 Nudges

In the second part of the literature review, *nudges* will be discussed by introducing the concept of nudging together with possible classifications and the effectiveness of nudging. Subsequently, digital nudges and green nudges will be elaborated on more specifically.

2.2.1 Nudging
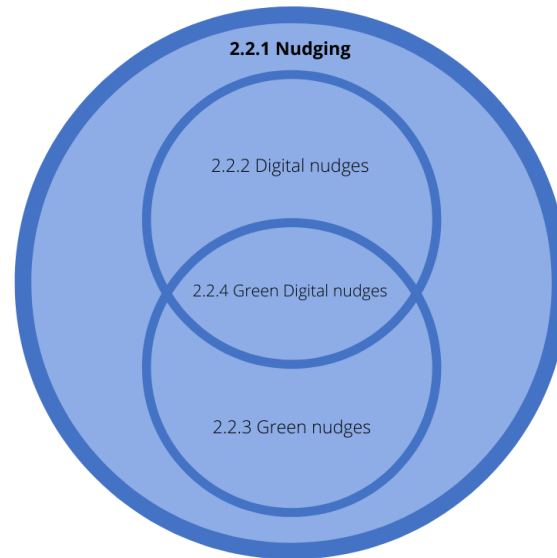
2.2.1.1 Defining nudging

"The purely economic man is indeed close to being a social moron.

Economic theory has been much preoccupied with this rational fool." - Richard H. Thaler

The model for humans in neoclassical economics assumes that all human beings are rational maximizers of self-interest. These "Econs" are regarded as imaginary creatures by many social scientists (Yamagishi et al., 2014). Since the work of Herbert Simon on bounded rationality, which argued that due to the lack of capacity to store and process a large volume of information, people are unable to make economically optimal decisions (Simon, 1947), the rejection of the rationality assumption has led to the development of behavioural economics. Recently, behavioural scientists such as Daniel Kahneman, Roberto Cialdini, and Dan Ariely have confirmed what has been common knowledge for a long time: humans do not always make decisions in their own best interest, even when they are aware of it (bounded willpower) (Heijden & Kosters, 2015).

When faced with a complex problem, people often rely on heuristics to make a decision. These heuristics lead to predictable errors (Thaler, 2018). A well-known example is the availability heuristic: the tendency of people to judge how likely something is based on how easy it is for them to recall occurrences of that type (Thaler, 2018).

The conclusion that people do not make random errors but instead make predictable errors was profoundly important for the development of behavioural economics (Thaler, 2018). By drawing insights from cognitive and social psychology, behavioural economics stresses that due to biases and the decision context, peoples' choices are influenced, often routinely (Lehner et al., 2016).

The context in which individuals make choices is in behavioural science referred to as "choice architecture". In order to change behaviour in a predictable way, the choice architecture can be altered. The concept of altering the choice architecture has been popularized by Thaler and Sunstein as "Nudging" with their influential book "Nudge: Improving Decisions About Health, Wealth, and Happiness" (Sunstein & Thaler, 2008). Even though several definitions of nudging have been suggested over the years, most researchers agree with the original definition by Thaler and Sunstein (Marchiori et al., 2017):

> *"A nudge is any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives. To count as a mere nudge, the intervention must be easy and cheap to avoid. Nudges are not mandates. Putting the fruit at eye level counts as a nudge. Banning junk food does not"* (Sunstein & Thaler, p. 6, 2008).

Although the above definition of Sunstein and Thaler will be used throughout the dissertation, it is important to take into account potential limitations. According to Hausman and Welch, no additional cost in terms of time, trouble or social sanctions should be added, arguing that the definition of Thaler and Sunstein uses a too narrow form of liberty and freedom (Hausman & Welch, 2010). Furthermore, they argue that the definition does not emphasize that nudges should have the intent to benefit those who are nudged (Hausman & Welch, 2010).

Behaviour change strategies such as "nudging" have gained significant attention all around the world. For example, in 2011, David Cameron set up a Behavioural Insights Team within the UK government to foster alternative policy tools to traditional regulation (Baldwin, 2014). In Belgium, a behavioural insights team has also been created to assist with the application of behavioural insights in the preparation, implementation or evaluation of policy (Government of Flanders, 2020). Other examples can be found in Australia (Australian Government, n.d.), the Netherlands (Behavioural Insights Netwerk Nederland, n.d.) and Canada (Government of Ontario, 2020).

Even though numerous classifications have been suggested (e.g., Hagman et al., 2015; Mongin & Cozic, 2017), in Table 1, a brief overview is given of seven interesting and relevant classifications. Interested readers can consult a more in depth description of the different classifications in Attachment 1.

The catalogue of Sunstein is discussed in more details below as it covers a significant fraction of the nudges used in practice. Additionally, the catalogue is used in the quantitative review on the effect sizes that will be discussed in the following section.

Overall, it can be noted that nudging frameworks vary widely with respect to their basis for development, target group and criterion/method for classification. Practitioners and researchers are advised to consider multiple frameworks when designing nudging experiments and select the most appropriate framework for the specific context.

Author	Criterion/method for classification	Types
Hansen & Jespersen (2013)	Consciousness and transparency	1) Transparent type 2 nudges, 2) Transparent type 1 nudges, 3) Non-transparent type 2 nudges and 4) Non-transparent type 1 nudges
Baldwin (2014)	Impact on autonomy	1) First Degree nudges, 2) Second Degree nudges and 3) Third Degree nudges
Sunstein (2014)	Catalogue of ten important nudges	1) Default rules, 2) Simplification, 3) Use of social norms (social reference), 4) increases in ease and convenience (change effort), 5) Disclosure, 6) Warnings, graphic or otherwise, 7) Precommitment strategies, 8) Reminders, 9) Eliciting implementation intentions and 10) Informing people of the nature and consequences of their own past choices
Wansink (2015)	Goal to be accomplished	1) Make it more Convenient, 2) Make it more Attractive and 3) Make it more Normal
Hollands et al. (2017)	Intervention type and intervention focus	1) Availability, 2) Position, 3) Functionality, 4) Presentation, 5) Size and 6) Information
Kraak et al. (2017)	Combined the features of three frameworks	1) Place, 2) Profile, 3) Portion 4) Pricing 5) Promotion, 6) Picks 7) priming or prompting and 8) Proximity
Cadario & Chandon (2020)	Tripartite classification of mental activities (Cognitive, Affective, Behavioral	1) Descriptive nutrition labelling, 2) Evaluative nutrition labelling, 3) Visibility enhancements, 4) Hedonic enhancements, 5) Healthy eating calls 6) Convenience enhancements and 7) Size enhancements

Table 1 Classification of nudges

Catalogue of ten important nudges

Instead of developing a matrix or a framework to classify nudges, Sunstein constructed a catalogue of ten important nudges that seem most promising as a policy tool. This catalogue is not exhaustive, but it aims to cover a significant fraction of the nudges used in practice (Sunstein, 2014).

The following ten nudges are included in Sunstein's catalogue (Sunstein, 2014):

1. Default rules: Default options are predefined courses of actions that will occur if the decision-maker does not make adjustments (Sunstein & Thaler, 2008). Default rules are a relatively simple yet effective tool since no effort is required by the decision-maker and many people tend to stick with the pre-selected default. For example, requiring citizens to opt out if they do not want to donate their organs has resulted in higher donation rates in many countries (Johnson & Goldstein, 2003).
2. Simplification: Simplification nudges aim to reduce the complexity of information. In many countries, public programs regarding education, health, finance, poverty and employment fail partially due to the complexity of, for example, filling out forms. A concrete example is provided by a study in London, which found that simplifying the information on the tax bill increases the payment rate (John & Blume, 2018).
3. Use of social norms (social reference): Social norms are informal rules that signal the appropriate behaviour within a group of people. Informing people that most other people are engaging in a particular type of behaviour (e.g., "most people pay their taxes on time") is one of the most effective nudges (Sunstein, 2014).
4. Increases in ease and convenience (change effort): People often make the easy choice. Reducing various barriers (such as the time it takes to understand what to do) is, in many situations, beneficial when the goal is to encourage a particular behaviour. People being resistant to change is often not only because they disagree with the changes that are being made but also because change often requires time and effort (Sunstein, 2014).
5. Disclosure: Disclosure policies, such as showing the environmental impact associated with energy use or the total cost of certain credit cards, can be highly effective for consumers on the condition that the information is both comprehensible and accessible. An increased amount of information generally helps the decision-makers to make better decisions (Sunstein, 2014).
6. Warnings, graphics or otherwise: Large fonds, bold letters, and bright colours can be helpful to trigger attention when serious risks are involved. An example is the graphic warning of the consequences of smoking on the package of cigarettes (Sunstein, 2014).
7. Precommitment strategies: People's behaviour is often not aligned with the goals that they have set for themselves. People are more likely to do a specific action if they have pre-committed, such as a quit smoking plan. Setting a goal that includes a specific period or moment furthermore increases the likelihood of action being taken (Sunstein, 2014).
8. Reminders: Due to a combination of inertia, procrastination, competing obligations, and simple forgetfulness, people tend not to engage in a certain action. Reminders (such as an email about an upcoming appointment) can have a significant impact (Sunstein, 2014).
9. Eliciting implementation intentions: When people state implementation intentions, they are more likely to engage in the activity since they have thought about the decision in advance. A question such as "Do you plan to vaccinate yourself?" and a statement as "If tomorrow is good weather, I will exercise" can have significant consequences (Sunstein, 2014).

10. Informing people of the nature and consequences of their own past choices (feedback): People lack a comprehensive understanding of their previous decisions and the consequences that resulted from those decisions. Companies and public institutions often have a great deal of information about people's past choices. Given that people often lack such information, obtaining it could help them learn about past decisions and shift their behaviour accordingly (Sunstein, 2014).

2.2.1.3 Effectiveness of nudging

Hummel and Maedche conducted a quantitative review on the effect sizes and limits of empirical nudging studies (Hummel & Maedche, 2019). In this quantitative review, 100 articles were examined, including 317 effects. The analysis revealed that 62% of the nudge interventions were statistically significant. Furthermore, the median effect size is 21% and the effect size depends on the category and the context. As the dependent variables of different studies are very diverse, the authors used relative effect sizes (defined as the percentage change between the dependent variable of the treatment group and the control group). Since not all studies reported the pooled standard deviation, measures such as Cohen's d cannot be calculated and are therefore not used in this review.

In the table below, the different effect sizes are shown by category. Hummel and Maedche (2019) used the catalogue of Sunstein to classify the different nudges.

Nudge	# of studies (# of effects)	Median effect size	Average effect size
Default	21 (62)	50%	87%
Simplification	4 (12)	25%	24%
Social reference	12 (49)	20%	29%
Change effort	14 (41)	25%	43%
Disclosure	3 (18)	11%	20%
Warning/graphics	18 (55)	20%	107%
Precommitment	2 (6)	7%	7%
Reminders	13 (34)	8%	28%
Elicit implementation intentions	3 (8)	39%	85%
Feedback	4(7)	20%	23%

Table 2 Average effect size per nudge type (Hummel & Maedche, 2019)

Besides the effect sizes per nudge type, Hummel and Maedche also evaluated the effectiveness of nudges in different application domains (energy, environment, finances, health, policy-making and privacy). The results revealed that with 44%, nudges within the context of privacy (e.g., the presence of a user's IP address on a website increases the likelihood that the person will notice privacy policies (Rodrıguez-Priego et al., 2016)) had the largest median effect size. Contrarily, nudges in the policy-making context (e.g., Prompting people to write down a date and time to get vaccinated increased the vaccination rate (Milkman et al., 2011)) had with 6% the smallest median effect size.

It is important to note that the results of this quantitative review most likely reflected an overestimation of the effect sizes due to possible publication biases since studies with non-significant results are often not published (Hummel & Maedche, 2019).

2.2.1.4 Are nudges ethical?

In modern online environments, a multitude of smart, persuasive choice architectures are used by platforms to obtain their objectives (Kozyreva et al., 2020). These objectives mainly include maximizing financial return, capturing and sustaining user's attention, monetizing user data, and predict or influence future behaviour (Zuboff, 2019).

For example, Facebook's business model relies on using user data to the benefit of advertisers. Their goal is to maximize the likelihood that an ad captures its target's attention (Kozyreva et al., 2020). In order to achieve this, a variety of design techniques that aim to change users' attitudes and behaviours via persuasive choice and information architectures are used (Kozyreva et al., 2020). It is not a coincidence that notifications are red and that you can find yourself endlessly scrolling on their platform.

With this phenomenon becoming more apparent, Brignull coined the term "Dark patterns". Dark patterns are persuasive online architectures that are manipulative and ethically questionable (Brignull, 2021).

Libertarian paternalism

The concept of nudging builds on Libertarian paternalism (Sunstein & Thaler, 2003), which is an approach to policy to steer people in directions that will promote their welfare while preserving freedom of choice. Even though people are free to make choices, the choice architecture ("nudges") promotes a particular desired behaviour.

Thaler and Sunstein use the following definition:

"Libertarian paternalism is a relatively weak, soft, and nonintrusive type of paternalism because choices are not blocked, fenced off, or significantly burdened. If people want to smoke cigarettes, to eat a lot of candy, to choose an unsuitable health care plan, or to fail to save for retirement, libertarian paternalists will not force them to do otherwise—or even make things hard for them." (Sunstein & Thaler, 2008, pp. 5-6)

Responsibility arises when using specific choice architecture since it uses flaws of individuals to guide their behaviour. Criteria for the moral permissibility of an intentional intervention have been proposed by Libertarian paternalists (Chock, 2020). They argue that any intervention is morally permissible when (Chock, 2020):

- The intervention preserves the freedom of choice and does not forbid or attach incentives/consequences to the possible choices.
- The influence of the intervention is easy to resist, and different options are available.
- People's best interest is kept in mind.

Nudging as a means to manipulate choice?

Ethical questions regarding nudging have been raised since nudging could be seen as a form of manipulation and could restrict a person's autonomy. Hausman and Welch argue that "Systematically exploiting non-rational factors that influence human decision-making, whether on the part of the government or other agents, threatens liberty, broadly conceived, notwithstanding the fact that some nudges are justified" (Hausman & Welch, 2010, p. 136). Important factors that have to be taken into account for the ethical acceptability of nudges are the extent to which the nudge is an infringement into the liberty of a person and the extent to which an intervention is covert (House of Lords, 2011).

2.2.2 Digital nudges
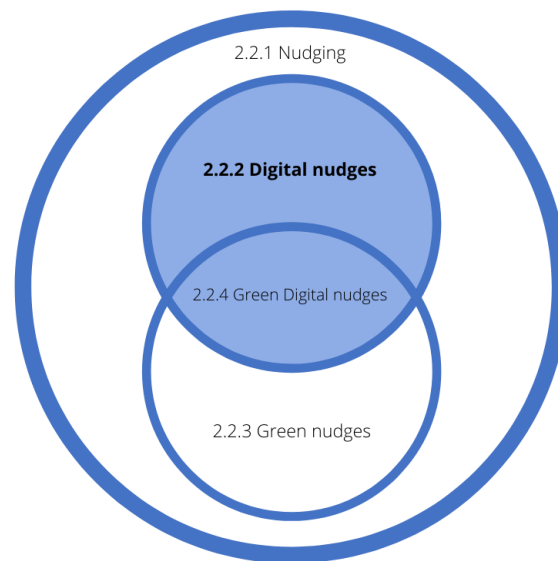
2.2.2.1 *The relevance of digital nudges*

Given that people are increasingly making decisions online, the concept of nudging has gained relevance in the digital sphere. In an online environment, individuals frequently fail to process all the available relevant information to make optimal decisions. People online often make decisions in an automated manner (Benartzi & Lehrer, 2015).

Research on digital nudging is still relatively young since most research on nudging has been done in the offline context. Weinmann et al. (2016) expect that research on digital nudging is likely to become an important area of design science.

2.2.2.2 *Defining digital nudges*

Digital nudging has been defined as "the use of user-interface design elements to guide people's behaviour in digital choice environments" (Weinmann et al., 2016, p. 433). Even though this definition of digital nudges is one of the most cited, Lembcke et al. (2019) argue that this definition is too brief as relevant ethical concerns are missing.

Furthermore, two elements are pointed out by Meske and Potthoff. Firstly, Weinmann's definition does not reflect "the importance of a free decision without coercion or a fundamental change of options and the subtle mode of action" (Meske & Potthoff, 2017, p. 3). Secondly, digital nudges do not have to be limited to the design of user interfaces since the form and content of information or messages can also represent a nudge (Meske & Potthoff, 2017). Taking these two arguments into account, Meske and Potthoff suggest the following definition: "Digital nudging is a subtle form of using design, information and interaction elements to guide user behaviour in digital environments, without restricting the individual's freedom of choice" (Meske & Potthoff, 2017, p. 3).

2.2.2.3 Traditional nudges vs. Digital nudges

Digital nudges, as defined by Weinmann (Weinmann et al., 2016) and Meske & Potthoff (Meske & Potthoff, 2017), occur regularly in everyday life. However, even though digital nudges are being used daily on thousands of sites, research on digital nudging is relatively scarce (Weinmann et al., 2016).

In 2017, Mirsch et al. (2017) argued that since it is currently not sure if research findings regarding nudges in an offline context can be extended to the digital sphere, investigating whether the digital context shows similar predictable effects as in the physical context would be valuable from a behavioural research perspective.

Initial research has shown that the way people make decisions in a digital choice environment differs from an offline choice environment. An empirical study found that due to the higher visuality and the pure mass of available information, digital choice environments tend to stimulate a more automatic and intuitive way of thinking (Benartzi & Lehrer, 2015). Furthermore, information-abundant digital environments lead to choice overloads and decreasing sustained attention spans (Liu, 2005). However, when comparing the results of digital nudges and nudges in an offline environment, Hummel and Maedche concluded that the effect sizes of nudges in digital settings are not statistically different from the effect sizes of nudges in conventional settings (Hummel & Maedche, 2019).

In comparison with nudges in the physical context, digital environments have several advantages for designing and testing nudges (Weinmann et al., 2016):

- Relatively low cost since designers can easily modify the design of the user interface.
- More accessible and testing of different designs so the effect of multiple different designs can be tested with relatively little effort.
- Nudges can be dynamically adapted based on, for example, a user's past decisions or gender.

2.2.2.4 Digital nudges: a move towards personalised nudging?

The internet can provide specific functionalities that would allow the personalization of nudges. This personalization might allow tailoring digital nudges toward specific individuals based on user data (Mirsch et al., 2017). The personalization of nudges could increase their effectiveness (Mirsch et al., 2017). Behavioural nudges have been criticised due to their lack of precision (one-size-fits-all approach) since sometimes people could have benefited from being nudged differently (Mills, 2020). This problem could be solved through the utilisation of personalised nudging (Mills, 2020). For example, Thunströma et al. (2018) found that nudging with the goal to encourage saving can negatively influence the people who are already reluctant to spend money and over-save.

In the context of default nudges, the potential of personalised nudges was already discussed by Sunstein in 2012. He argued that the problems associated with one-size-fits-all defaults could be reduced by using personalised default rules instead of impersonal default rules (Sunstein, 2012). With the increased amount of information becoming available to the decision-makers, Sunstein expects a significant increase in personalised default rules in many domains. Even though Sunstein only discussed the potential of personalised nudges for default rules, there is no reason to believe that the potential of personalised nudges cannot be extended to other types.

With the rapidly increasing amount of data available to decision-makers, Big Data-driven nudges have become an attractive option for personalised nudges. Yeung introduced in 2016 the term "hypernudge", which she defines as "Nimble, unobtrusive and highly potent, providing the data subject [The person being nudged] with a highly personalised choice environment" (Yeung, 2016, p. 6). Unlike the static nudges (nudges that do not change or adapt over time), as popularised by Thaler and Sunstein, Big Data analytics nudges " are extremely powerful and potent due to their networked, continuously updated, dynamic and pervasive nature (hence 'hypernudge')" according to Yeung (Yeung, 2016, p. 1).

Hypernudges work as follows: algorithmic analysis of data patterns (for example, analysis of all the past purchases of a specific customer) can provide insights to adapt the targeted individual's choice environment in a highly personalised way (for example, the analysis has shown that this particular consumer is more likely to be influenced by social reference nudges). These techniques are used to shape the choice context, with the goal to channel the attention and decision-making in the directions preferred by the choice architect (Yeung, 2016).

In an empirical study of personalised nudging in cybersecurity, Peer et al. (2020) noted that heterogeneity represents an opportunity for personalised nudges to improve the effectiveness of nudge interventions.

Furthermore, Peer et al. argued that the personalization of nudges looks promising to improve the welfare of individuals in several aspects (Peer, et al., 2020):

- The overall effectiveness of the nudges can be improved through personalization.
- The possibility to mitigate the risk of harming certain subgroups of the population.

2.2.3 Green nudges
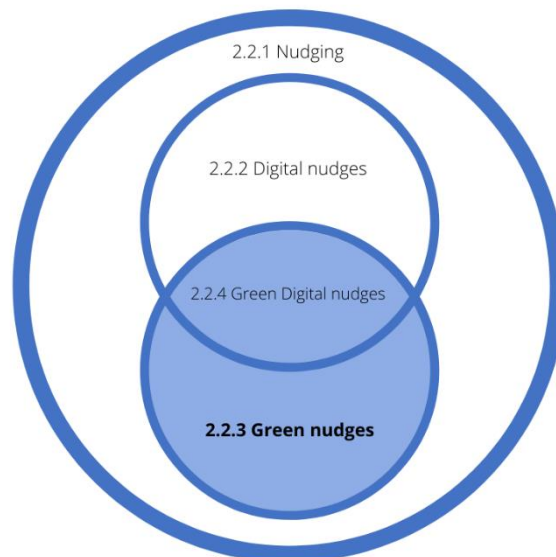
2.2.3.1 Relevance of green nudges

The world's biodiversity is primarily threatened by human behaviour (Akerlof & Kennedy, 2013). The influence of human behaviour happens both directly, through the harvesting of living natural resources, and indirectly, due to habitat destruction, pollution, the introduction of invasive species, and climate change (Akerlof & Kennedy, 2013).

Traditionally policymakers have focused on tools such as regulations, taxes and subsidies to mitigate the long term effects of human behaviour (Akerlof & Kennedy, 2013). With the establishment of Behavioural Economics as a new subfield in modern economics, questions have arisen whether new "soft policy" approaches could be used to improve ecological and environmental economics (Schubert, 2017). The risk, uncertainty, and complexity associated with environmental issues give rise to bounded rationality (Schubert, 2017), where individuals can no longer make economically optimal decisions.

Furthermore, green nudges could contribute to close the "Green gap", also known as the climate value action gap: the discrepancy between people stating that they are concerned about the environment and their actions to sustain the environment (Barr, 2006; Vermeir & Verbeke, 2008; Grimmer & Miles, 2016; ElHaffar et al., 2020). This discrepancy between value and actions is seen as a critical behavioural barrier to climate change adoption (Gifford, 2011; Markowitz & Shariff, 2012).

2.2.3.2 Defining green nudges
Green nudges can simply be defined as "nudges that aim at promoting environmentally benign behavior" (Schubert, 2017, p. 2).

According to Schubert (2017), three types of green nudges can be distinguished as paradigmatic representations of the overall approach to public policy-making:

1. Green nudges that focus on customers' desire to maintain an attractive self-image through sustainable behaviour by either simplifying product information or by making specific product characteristics more salient (e.g., putting eco-labels on products) (Schubert, 2017).
2. Green nudges exploit people's tendency to mimic the behaviour of peers. This can be achieved by conveying certain social norms through peer comparison (e.g., comparing energy usage with neighbours) or by stimulating status competition through encouraging consumers to signal green behaviour to others (e.g., displaying "Electric Vehicle" on electric cars) (Schubert, 2017).
3. Green nudges that use defaults to guide customers towards the sustainable option when they do not actively choose (e.g., green delivery as default option instead of fast delivery) (Schubert, 2017).

It should be noted that this list is not exhaustive as it does not include all the nudge types (e.g., nudges that change effort, making the sustainable options easier). Nevertheless, it covers a significant fraction of the nudges included in experiments that aim to encourage sustainable behaviour.

2.2.4 Green Digital Nudges
2.2.4.1 Systematic literature review
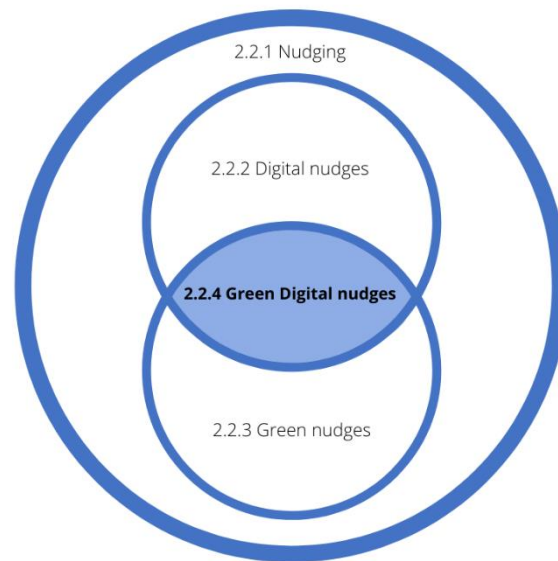
In the last part of the literature review, a systematic literature review was conducted to get an overview of previous studies regarding green digital nudges (i.e., nudges that aim to promote pro-environmental behaviour in the context of a digital choice environment).

Following Hummel & Maedche (2019), the subsequent steps and search criteria were applied. First, keywords* were introduced in three databases (Scopus, Web of Science and ScienceDirect). As before the work of Thaler and Sunstein (2008), the term nudging was barely used; studies before 2008 were excluded. Furthermore, studies after 2020 were not included as the systematic literature review was finalized in early 2020.

The search resulted in 463 results, of which 13 duplicates were removed (see Figure 8). The remaining 450 were screened based on the title and the abstracts. A large number of results were removed as many of the results were not relevant (e.g., "Sustainable business model experimentation by understanding ecologies of business models" or "Affluence and unsustainable consumption levels: The role of consumer credit") due to the large number of included keywords. As a result, the full-text was reviewed of 27 articles, leaving us with 9 articles that were included as related work (Table 3).

*"Green Nudge Digital" OR "Green Nudging Digital" OR "Nudge Sustainability Digital" OR "Nudging Sustainability Digital" OR "Nudge environment Digital" OR "Nudging environment Digital" Or "Nudge sustainable Digital" OR "Nudging Sustainable Digital" OR "Green Nudge Online" OR "Green Nudging Online" OR "Nudge Sustainability Online" OR "Nudging Sustainability Online" OR "Nudge environment Online" OR "Nudging environment Online" OR "Nudge sustainable online" OR "Nudging Sustainable online"

Green Digital Nudges

Number of search results (Scopus) n= 57	Number of search results (Web of Science) n= 57	Number of search results (ScienceDirect) n= 349

Total results from search
n = 463

Total results with duplicates removed
n = 450

Number of abstracts retrieved after removal of non-relevant articles based on document screening
n = 27

Full-text articles reviewed
n = 27

Articles included
n = 9

Figure 8 Systematic Literature Review

Source	Year	Description	Nudge category	Dependent variable	Effect	p-value
(Demarque, Charalambides, Hilton, & Waroquier, 2015)	2015	The use of descriptive norms to promote sustainable consumption	Social Norm	Number of eco-products bought	13%	<0.05
(Székely, Weinmann, & Brocke, 2016)	2016	Nudging people to Pay CO2 Offsets in Flight Booking Processes	Default	Percentage of carbon-offset budget donated	/	<0.05
(Hummel & Maedche, 2018)	2018	Digital Nudges for Sustainable Choices in Digital Retail Channels	Default	Sustainable product choices	32%	<0.001
(Hummel & Maedche, 2018)	2018	Digital Nudges for Sustainable Choices in Digital Retail Channels	Social Norm	Sustainable product choices	-16%	=0.0014
(Hummel & Maedche, 2018)	2018	Digital Nudges for Sustainable Choices in Digital Retail Channels	Warning	Sustainable product choices	5%	=0.2843
(Loschelder, Siepelmeyer, Fischer, & A., 2019)	2019	Norm-based nudging to promote choices regarding sustainable beverage containers	Social Norm	Choice of sustainable beverage container	/	=0.003
(Wyse, et al., 2019)	2019	Changing the position of items on the online menu	Change Effort	% of all lunch orders containing target items	/	=0.490
(Cappa, Rosso, Giustiniano, & Porfiri, 2020)	2020	Feedback regarding personal and/or societal benefit in energy-demand management.	Feedback	The number of (environmentally friendly) suggestions provided by the website that were accepted	57.23%	<0.001
(Antonides & Welvaarts, 2020)	2020	Effects of default option on customer choice of sustainable options with respect to make-up products.	Default	Sustainable product choice	8%	<0.05
(Kuhn, Ihmels, & Kutzner, 2020)	2020	Effects of organic defaults nudges	Default	Amount of Organic products in shopping cart	/	=0.009
(Hankammer, Kleer, & Piller, 2020)	2020	Sustainability nudges in the context of customer co-design for consumer electronics	Default	Carbon level of customized TV	15.79%	<0.001
(Hankammer, Kleer, & Piller, 2020)	2020	Sustainability nudges in the context of customer co-design for consumer electronics	Disclosure (No visualisation)	Carbon level of customized TV	/	=0.416
(Hankammer, Kleer, & Piller, 2020)	2020	Sustainability nudges in the context of customer co-design for consumer electronics	Disclosure (Visualisation)	Carbon level of customized TV	6.53%	=0.052

Table 3 Related work on digital nudges in the context of sustainability

With five occurrences, the default rule was the most examined nudge type in the included related work, followed by social norm (3) and disclosure (2). In total, 9 of the 14 nudges showed significant effects at the 5%-level, with the experiment conducted by Cappa et al. (2020) including a feedback nudge having the most significant effect size (57.23%). Moreover, the study conducted by Hummel & Maedche (2018), including the social norm nudge, showed significant but negative effects of -16%.

The majority of the studies focussed on changing customers' behaviour towards purchasing (more) sustainable products (e.g., Demarque et al. (2015)), while the study conducted by Székely et al. (2016) focused on donations (Percentage of carbon-offset budget donated) and the study by Hankammer et al. (2020) considered customization (Carbon level of customized TV). Instead of focusing on the product's attributes, this dissertation aims to contribute by examining whether popular nudges identified in a product context are also advised to use when nudging e-commerce customers towards more sustainable delivery options. This difference is important as nudging towards more sustainable delivery options does not make the product (choices) itself more sustainable.

From the *Catalogue of ten important nudges* (Sunstein, 2014), three promising nudges are selected to be included in the study (default rules, disclosure and social reference). This selection is based on two main criteria:

1. The effectiveness in both general literature (according to the quantitative review of Hummel and Maedche) and in the context of green digital nudges (according to the Systematic Literature Review).
2. Relevance in the digital context, as some of the ten nudges in the catalogue are less relevant or difficult to implement in an online environment (e.g., Eliciting implementation intentions and Feedback).

Below a brief description of the three nudges is given, followed by hypotheses.

Default rules can be defined (as previously discussed) as predefined courses of actions that will occur if the decision-maker does not make adjustments (Sunstein & Thaler, 2008). Default rules are a relatively simple yet effective tool since no effort is required by the decision-maker and many people tend to stick with the pre-selected default. Many studies have conducted studies with default nudges in various contexts.

According to the quantitative review on effect sizes of nudges conducted by Hummel and Maedche, default rules have the largest median effect size (50%) of all types of nudges (Hummel & Maedche, 2019). Furthermore, given that digital choice environments tend to simulate a more automatic and intuitive way of thinking (Benartzi & Lehrer, 2015)**,** it could be expected that people could be prone to opt for the default option.

Within the context of digital nudges towards sustainable choices, various studies have found significant effects of default nudges (e.g., Hummel & Maedche (2018), Székely et al. (2016) and Hankammer et al. (2020)). We therefore hypothesize:

> **Hypothesis 1:** *Default rule nudges (vs. control condition) positively influence customers opting for more sustainable delivery options.*

Disclosure nudges, such as disclosing the environmental impact associated with energy use, can be highly effective on the condition that the information is both comprehensible and accessible (Sunstein, 2014).

Even though the median effect size in the quantitative review by Hummel and Maedche is relatively low (11%), the survey conducted by B2C Europe (i.e., when respondents are given the information that shorter delivery period results in more traffic and air emissions, a large proportion of respondents opts for standard delivery 3-5 days (42%) and Green delivery 6-8 days (43%) (B2C Europe, 2018)) indicates that within the context of sustainable delivery a disclosure nudge could be effective.

When considering digital nudges that aim to nudge customers towards more sustainable choices, Hankammer et al. (2020) have found significant effects of disclosure nudges on the condition that the visualisation of the nudge is intuitive for customers (e.g., use of simple eco-label instead of complex CO_2 emission calculation). As a result, we propose the following hypothesis:

> **Hypothesis 2:** *Disclosure nudges (vs. control condition) positively influence customers opting for more sustainable delivery options.*

Social reference nudges are informal rules that signal the appropriate behaviour within a group of people. Informing people that most other people are engaging in a certain type of behaviour (e.g., "most people pay their taxes on time") (Sunstein, 2014) can be effective to nudge individuals towards specific behaviour.

While the study conducted by Hummel & Maedche (2018) found significant negative effects, other studies within the context of digital nudges towards sustainable choices (Demarque et al., 2015; and Loschelder et al., 2019) have found significant effects of social reference nudges. Further considering that the quantitative review by Hummel and Maedche showed that the median effect size of social reference nudges equals 20%, we propose the following hypothesis:

> **Hypothesis 3***: Social reference nudges have a positive influence on customers opting for more sustainable delivery options.*

Following Hummel & Maedche (2018), the research model for the first three hypotheses is visualized in Figure 9.
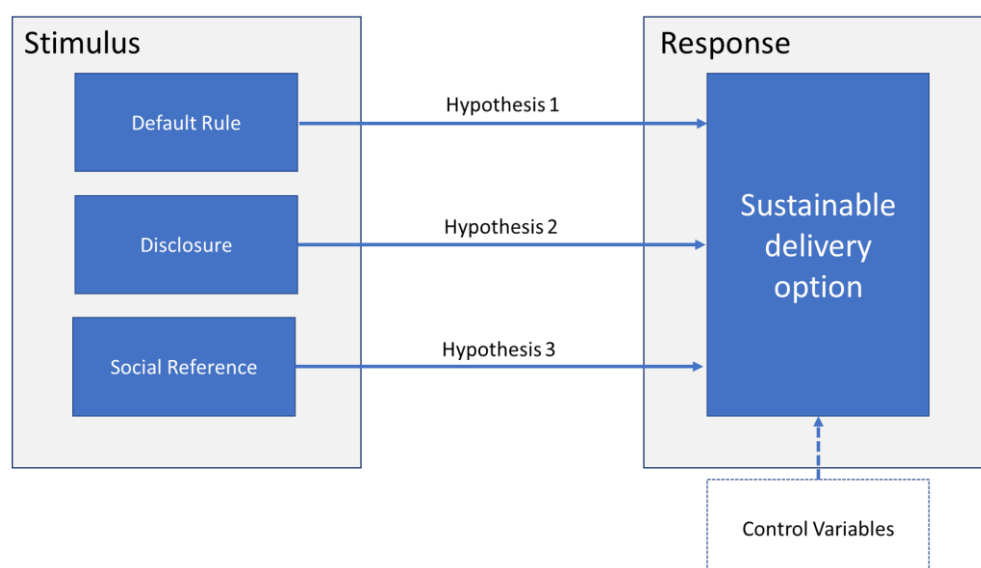
Figure 9 Research model first research question

Additionally, we aim to contribute to the existing literature by directly comparing the three nudge types (default rule, disclosure and social reference) in the same experiment.

Default rules have the largest median effect size (50%) of all types of nudges (Hummel & Maedche, 2019). All of the five default rules included in the related work showed significant positive effects. Therefore, it is expected that default rule nudges have a larger effect size than both the disclosure and the social reference nudges.

The median effect size of the disclosure nudges is relatively low, with a value of 11%. Furthermore, the disclosure nudge with visualisation in the study conducted by Hankammer et al. (2020) showed significant but relatively small positive effects (6.53%), while the disclosure nudge without visualisation was non-significant.

Two of the three social reference nudges included in the related work showed significant positive effects (Demarque et al., 2015; and Loschelder et al., 2019), while one showed significant negative effects (Hummel & Maedche, 2018). As the median effect size of social reference nudges equals 20% (Hummel & Maedche, 2019), it is expected that the social reference nudges are more effective than disclosure nudges resulting in the following hypothesis:

> **Hypothesis 4**: *Default rule nudges are most effective to nudge customers towards more sustainable delivery options, followed by social reference nudges and disclosure nudges.*

2.2.4.3   The combination of multiple nudges

Two studies from the related work combined different manipulations (Loschelder et al., 2019) and Hankammer et al., 2020). However, only nudges that fall into the same category were combined (e.g., a combination of static norms with injunctive norms (Loschelder et al., 2019)).

The study conducted by Hankammer et al. (2020) is interesting as it indicates that combining different manipulations might not always lead to larger effect sizes, on the contrary (i.e., the boomerang effect, as previously detected by Schultz et al. (2007)). The author tested two different disclosure nudges and concluded that while a more comprehensive and more intuitive label worked successfully, the addition of detailed sustainability information reduced the number of people acting in a pro-environmental way compared to the stand-alone intuitive label.

In the context of a digital choice environment that aims to promote pro-environmental behaviour, combinations of different types of nudges have, to the best of our knowledge, not yet been examined. When looking at other contexts, it can be noted that only a few studies have examined the effect of combining multiple nudges (Paunov, Wänke, & Vogel, 2020). An online experiment by Paunov et al. (2020) showed that while both the default rule and disclosure showed a significant effect, the most prominent effect size was observed when combining the two nudges. Similarly, the results of the experiment conducted by Ingendahl et al. (2020) revealed that the combination of a default rule with a social reference nudge worked better than each nudge individually.

In order to examine the effect of combining the individual types of green digital nudges, the following hypothesis is formulated:

Hypothesis 5: *The use of a combination of default rule, disclosure and social reference nudges is more effective to have customers opting for more sustainable delivery options than the stand-alone use of the default rule nudge, social reference or the disclosure nudge.*

To test this hypothesis, the following sub hypotheses, as represented in Table 4, will have to be considered. For example, hypothesis 5.1 is formulated as "The combination of <u>default rule and disclosure nudges</u> is more effective to nudge customers towards more sustainable delivery options than the stand-alone <u>default rule nudge</u>".

Combination		stand-alone	Hypothesis
Default rule and disclosure nudges		Default rule nudge	5.1
Default rule and social reference nudges		Default rule nudge	5.2
Disclosure and default rule nudges	…more effective than…	Disclosure nudge	5.3
Disclosure and social reference nudges		Disclosure nudge	5.4
Social reference and default rule nudges		Social reference nudge	5.5
Social reference and disclosure nudges		Social reference nudge	5.6

Table 4 Sub hypotheses hypothesis 5

As most previous research is limited to combining two types of nudges (e.g., Paunov et al., 2020; Ingendahl et al., 2020), our online experiment will also include the combination of three types of nudges (default rule, disclosure and social reference). Hence the following hypothesis:

Hypothesis 6: *The combination of default rule, disclosure and social reference nudges is more effective to have customers opting for more sustainable delivery options than the combination of the default rule nudge with the disclosure nudge, the combination of the default rule nudge with the social reference nudge, and the combination of the disclosure nudge with the social reference nudge.*

As for hypothesis 5, sub hypotheses are represented for hypothesis 6 in Table 5. For example, hypothesis 6.1 is formulated as "The combination of <u>default rule, disclosure and social reference nudges</u> is more effective to nudge customers towards more sustainable delivery options than the combination of <u>default rule and disclosure nudges</u>".

Combination		the combination of	Hypothesis
Default rule, disclosure and social reference nudges		Default rule and disclosure nudges	6.1
Default rule, disclosure and social reference nudges	…more effective than…	Default rule and social reference nudges	6.2
Default rule, disclosure and social reference nudges		Disclosure and social reference nudges	6.3

Table 5 Sub hypotheses hypothesis 6

Succeeding our hypotheses regarding the effects of the different nudges (and its combinations), it would equally be interesting to gain a better understanding of the factors that influence the effect of the different nudges on the selection of the sustainable delivery option.

First, environmental concern will be considered. Environmental concern can be defined as "the degree of emotional involvement in environmental issues" (Lee, 2008, p. 578). In a review of 53 empirical articles on green purchase behaviour, environmental concern emerged as a significant predictor of consumer green purchase behaviour (Joshi & Rahman, 2015).

In the context of this dissertation, it would be interesting to test if green nudges could contribute to close the "Green gap", also known as the climate value action gap: the discrepancy between people stating that they are concerned about the environment and their actions to sustain the environment (Barr, 2006; Vermeir & Verbeke, 2008; Grimmer & Miles, 2016; ElHaffar et al., 2020). This discrepancy between values and actions is seen as a crucial behavioural barrier to climate change adoption (Gifford, 2011; Markowitz & Shariff, 2012). Green nudges could help environmentally concerned individuals align their actions with their values.

When it comes to default rule nudges, we do not expect that people with high environmental concern will be more likely to choose the more sustainable delivery options based on the following argumentation. To act according to one's values regarding the environment, customers need to be aware of the differences in the environmental impact of the different delivery options. Since 42% of online shoppers were unaware of the fact that express delivery has a more harmful environmental effect than regular delivery, and 32% even stated that standard delivery has a more negative impact (B2C Europe, 2018), we expect that a large fraction of the environmental concern individuals will stick to the default option.

Furthermore, even if a customer knows that express delivery is more harmful to the environment since digital choice environments tend to simulate a more automatic and intuitive way of thinking (Benartzi & Lehrer, 2015), many would possibly stick to the default option anyway.

> **Hypothesis 7.1:** *Default rule nudges have a positive effect on the probability of choosing the more sustainable delivery option irrespective of individuals' level of environmental concern.*

It has been documented that ascribed environmental concerned individuals have a higher probability of choosing the product with a low environmental impact than the more harmful alternative (Bertrandias & Elgaaied-Gambier, 2014). In addition, a more recent study conducted by Neumann and Mehlkop (2020) found that within the context of framing different electricity plan choices, individuals with pro-environmental attitudes were substantially more likely to opt for a green electricity plan (Neumann & Mehlkop, 2020).

Similarly, it could be expected that the likelihood of an individual opting for the more sustainable delivery option will depend on their level of environmental concern, as they want to align their actions with their values. We therefore hypothesize:

> **Hypothesis 7.2:** *Disclosure nudges have a positive effect on the probability of choosing the more sustainable delivery option, but this effect is more pronounced the higher individuals score on environmental concern.*

In the review conducted by Joshi & Rahman (2015), it was concluded that subjective norms, social norms and reference groups have a positive relationship with consumers green purchase behaviour. The social reference nudge that we take into account does not mention sustainability information (e.g., "50% of the customers chose this option" and not "50% of the customers chose the sustainable option"). Therefore, we do not expect that the likelihood of selecting the more sustainable will increase with an individual's level of environmental concern as most people do not possess the knowledge of the environmental impact of the different delivery options.

> **Hypothesis 7.3:** *Social reference nudges have a positive effect on the probability of choosing the more sustainable delivery option, irrespective of individuals' level of environmental concern.*

2.2.4.5 Influence of psychological ownership on behaviour

When ordering a product online, it could be expected that people want the product as soon as possible, as they might have a feeling of ownership. Psychological ownership can be defined as the degree to which an individual feels as though the tangible or intangible object is "theirs" (e.g., "It is mine") (Pierce et al., 1991). Since different people have varying degrees of ownership regarding purchased products online, we could expect people with a high degree of psychological ownership will be less likely to choose the sustainable delivery option (delayed delivery).

To the best of our knowledge, no research has yet been conducted regarding the effect of psychological ownership on the selection of delivery duration. However, in previous research, psychological ownership has consistently been shown to significantly affect product valuation (Vries et al., 2018). In the context of e-commerce, Groening et al. (2020) have shown that increased psychological ownership results in an increased likelihood of purchasing a product (Groening et al., 2020). In addition, the degree of psychological ownership regarding online services has been shown to affect the effectiveness of both gain as loss framed messages (Seo & Park, 2019).

Even though the findings of the above studies cannot be generalized towards the context of this dissertation, they could give a potential indication of the moderating effect of psychological ownership in the context of nudging e-commerce customers towards more sustainable delivery options. Since individuals have varying degrees of psychological ownership regarding purchased products online, it is worthwhile to examine its effects on the tendency of people to select the more sustainable delivery option. For each of the three examined nudge types (default rule, disclosure and social reference), we expect that the higher individuals score on psychological ownership, the less likely they will be to select the more sustainable delivery option. We therefore hypothesize:

> **Hypothesis 8.1:** *Default rule nudges have a positive effect on the probability of choosing the more sustainable delivery option, but this effect is less pronounced the higher individuals score on psychological ownership.*

> **Hypothesis 8.2:** *Disclosure nudges have a positive effect on the probability of choosing the more sustainable delivery option, but this effect is less pronounced the higher individuals score on psychological ownership.*

> **Hypothesis 8.3:** *Social reference nudges have a positive effect on the probability of choosing the more sustainable delivery option, but this effect is less pronounced the higher individuals score on psychological ownership.*

Following Hummel & Mädche (2018), we embed the hypotheses in the stimulus-organism-response (S-O-R) model (Mehrabian & Russell, 1974). As argued by Hummel & Mädche (2018), the S-O-R model is applicable as it has been used in the context of online shopping in various preceding studies (Hummel & Mädche, 2018).

The S-O-R model assumes that the decisions of individuals are affected by stimuli when they are processed by the organism (Mehrabian & Russell, 1974). Within the context of our study (Figure 10), the different nudges (default rule, disclosure and social reference) act as stimuli. The moderating role of environmental concern and psychological ownership are represented by the organism, while the choice of delivery option represents the response.
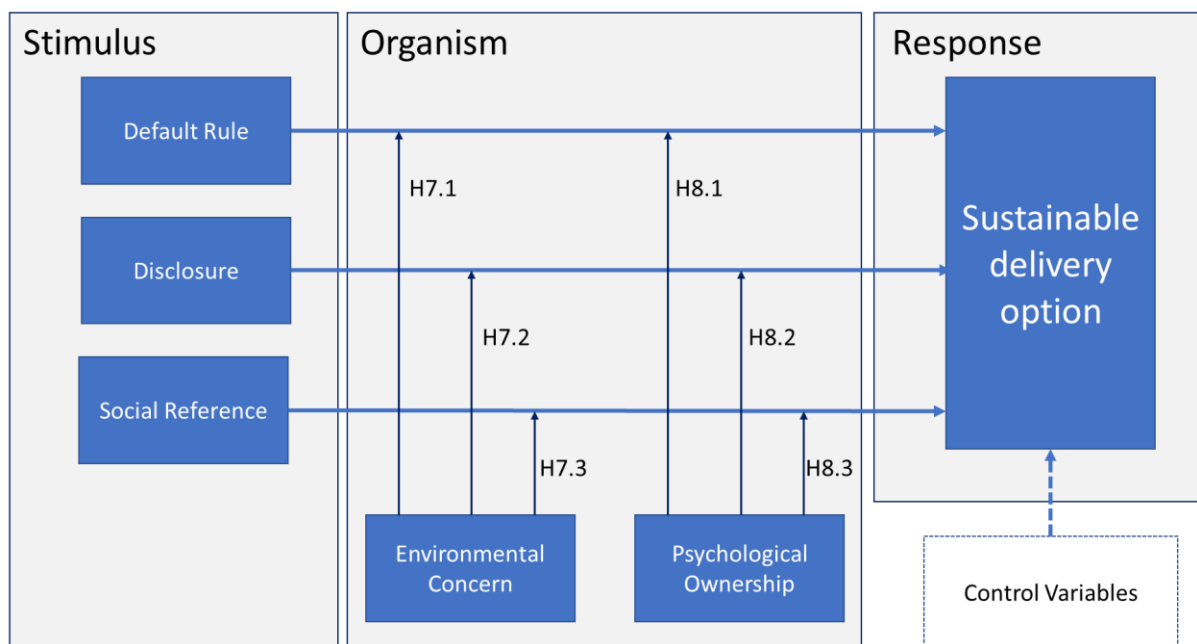
Figure 10 Research model moderators

For the last two hypotheses, we aim to gain a better understanding of what underlies the effect of the different types of nudges when nudging customers towards more sustainable delivery options.

The first potential mediator that will be looked into is anticipated guilt. Guilt as a consumer state is defined by Theotokis & Manganari (2014) as "an incident of regret, remorse, self-blame, penitence, and self-punishment experienced upon transgressing or contemplating transgressing a moral or societal principle" (Theotokis & Manganari, 2014, p. 425). More specifically, anticipated guilt is guilt that "arises from contemplating a potential violation of one's own standard" (Cotte et al., 2005, p. 362).

Results indicate that feelings of guilt directly influence consumer behaviour and may drive consumers towards sustainable purchasing decisions (Joshi & Rahman, 2015). Young et al. (2010) noted that guilt can be seen as a motivator to maintain green criteria since some customers felt guilt for not being able to purchase the greenest product or not researching enough to make a sustainable decision. Exploring the effect of specific emotions such as guilt has been identified as needed future research (Joshi & Rahman, 2015).

As suggested by Theotokis and Manganari (2014), anticipated guilt can be seen as an underlying mechanism that explains why people respond to default policies. To test whether this underlying mechanism is also present within our context, the following hypothesis stated:

> **Hypothesis 9.1:** *The default rule nudge indirectly has a positive influence on the probability of selecting the delayed delivery option through its effect on anticipated guilt.*

A study conducted by Kabadayı et al. (2015) concluded that consumer guilt is a significant predictor of consumer's green purchase intention. In line with this conclusion, it could be expected that a disclosure nudge will indirectly influence the probability of selecting the delayed delivery options through its effect on anticipated guilt; therefore, the subsequent hypothesis is formulated:

> **Hypothesis 9.2:** *The disclosure nudge indirectly has a positive influence on the probability of selecting the delayed delivery option through its effect on anticipated guilt.*

Findings by Onwezen et al. (2013) imply that via a feedback mechanism, anticipated emotions (such as anticipated guilt) are used to evaluate behaviour about social norms and subsequently affect behaviour (through its effect on intentions). Moreover, Trujillo et al. (2021) indicate that by making personal norms (and to a lesser extent social norms) salient, it is possible to nudge people towards pro-environmental products.

> **Hypothesis 9.3:** *The social reference nudge indirectly has a positive influence on the probability of selecting the delayed delivery option through its effect on anticipated guilt.*

In Figure 11, the mediation model of anticipated guilt is displayed.
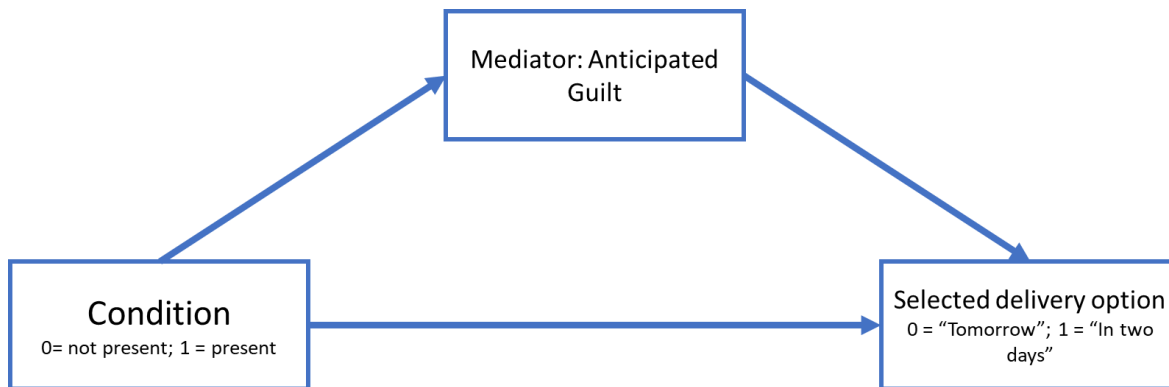
Figure 11 Mediation model anticipated guilt

2.2.4.7 The effect of nudges on behavioural change via decision basis

As described by Shiv & Fedorikhin (1999), decision basis indicates whether the choice made by an individual was driven by their affective reactions (i.e., "their desires and feelings, their impulsive self, their emotional side, and their heart" (Shiv & Fedorikhin, 1999, p. 286)) or by their cognitions (i.e., "their willpower and thoughts, their prudent self, their rational side, and their head" (Shiv & Fedorikhin, 1999, p. 286)).

When a customer does not devote processing resources to a decision, he/she is more likely to make a decision based on affect rather than on cognitions (Shiv & Fedorikhin, 1999). On the contrary, when a customer does devote processing resources to a decision, the decision will likely be based primarily on cognitions (Shiv & Fedorikhin, 1999). Previous research has shown that the majority of behaviours are non-conscious and automatic (e.g., Dijksterhuis et al., 2005; Bargh & Morsella, 2008). This is also the case when it comes to sustainable behaviour, as many behaviours that have environmental implications (e.g., energy and resource use and disposal of products) are strongly habitual and non-conscious (White, Habib, & Hardisty, 2019). More conscious decisions can be stimulated with instructions to deliberate on decisions, for example, by instructing participants to reason deductively or to provide reasons for choosing a particular option (Gestel, Adriaanse, & Ridder, 2020).

Within the context of green digital nudges, disclosure and social reference nudges could potentially stimulate a more deliberate decision as they provide reasons for choosing a particular option. As default rule nudges do not provide additional reasons besides changing the pre-selected option, it is not expected that this type of nudge will simulate the decisions to be based more on cognitions.

> **Hypothesis 10.1:** *Default rule nudges have a positive effect on the probability of choosing the more sustainable delivery option, irrespective of the indirect effect through decision basis.*
>
> **Hypothesis 10.2:** *The disclosure nudge indirectly has a positive influence on the probability of selecting the more sustainable delivery option through its effect on the decision basis.*
>
> **Hypothesis 10.3:** *The social reference nudge indirectly has a positive influence on the probability of selecting the more sustainable delivery option through its effect on the decision basis.*

The mediation model of decision basis is displayed in Figure 12.
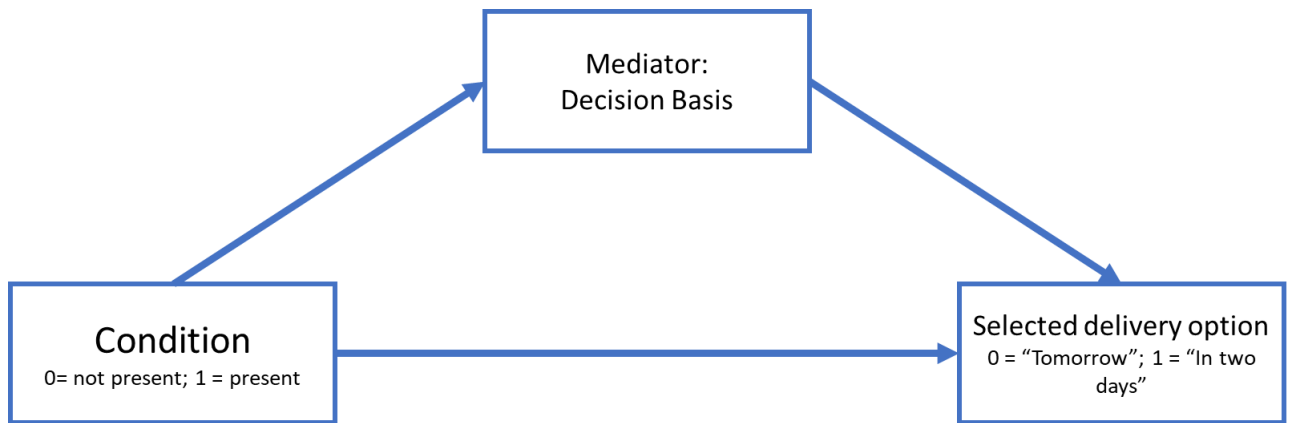
Figure 12 Mediation model decision basis

3 Methodology

3.1 Participants

From 12/04/2021 until 20/04/2021, an online survey experiment (on Qualtrics) was conducted in order to test the stated hypotheses. The sample for this study was made up of 45.5% women, 54.3% men and 0.2% other (Average age: 24.31; SD 8.36). For each condition, a minimum of 60 participants were assigned. With a total of 8 conditions, a minimum amount of 480 participants should be recruited. Given the large number of participants, the non-probability sampling technique, snowball sampling via social media (LinkedIn, Facebook), was opted for. Due to incomplete survey questions or failing the instruction manipulation check, 50 participants have been removed from the sample, resulting in a sample size of 497 participants.

3.2 Design

In order to answer the hypotheses, a two-level full factorial design for three factors is used. The three factors are default rule, social reference and disclosure, which in the study can take on two levels; 0 if this nudge is not present in the condition and 1 if the nudge is present in the condition. This results in a total of eight conditions ($=2^3$). The eight different conditions are displayed in Table 6. Participants are randomly assigned to the different experimental conditions by the Qualtrics software. As a result, the participants were assigned to either one of the treatment groups or the control group.

	Default Rule	Disclosure	Social Reference
Condition 1	1	0	0
Condition 2	0	1	0
Condition 3	0	0	1
Condition 4	1	1	0
Condition 5	1	0	1
Condition 6	0	1	1
Condition 7	1	1	1
Condition 8	0	0	0

Table 6 Overview conditions

3.2.1 Manipulations

The default rule was implemented by pre-selecting the more sustainable delivery option ("In two days"), the disclosure nudge was implemented by displaying "More sustainable", and the social reference nudge was implemented by stating "70% of our customers choose this delivery option". An overview of the different conditions is given in Table 7.

The manipulations are based on existing manipulations from previous research, as our study aims to 1) examine whether popular nudges identified in a product context are context are also advised to use when nudging e-commerce customers towards more sustainable delivery options, 2) test the effect of combining multiple nudges, and 3) evaluate what underlies the effect of the different types of nudges.

Condition	Manipulation	Implementation	Visualisation	Source(s)
1	Default rule	More sustainable delivery option is preselected	Figure 13	(Székely, Weinmann, & Brocke, 2016), (Antonides & Welvaarts, 2020) , (Hankammer, Kleer, & Piller, 2020)
2	Disclosure	Addition of the Eco-label "More Sustainable"	Figure 14	(Hankammer, Kleer, & Piller, 2020)
3	Social reference	Addition of "70% of our customers choose this delivery option"	Figure 15	(Demarque, Charalambides, Hilton, & Waroquier, 2015)
4	Default rule x Disclosure	More sustainable delivery option is preselected + Addition of the Eco-label "More Sustainable"	Figure 16	/
5	Default rule x Social reference	More sustainable delivery option is preselected + Addition of "70% of our customers choose this delivery option"	Figure 17	/
6	Disclosure x Social reference	Addition of the Eco-label "More Sustainable" + Addition of "70% of our customers choose this delivery option"	Figure 18	/
7	Default rule x Disclosure x Social reference	More sustainable delivery option is preselected + Addition of the Eco-label "More Sustainable" + Addition of "70% of our customers choose this delivery option"	Figure 19	/
8	Control	/	Figure 20	n/a

Table 7 Overview manipulations
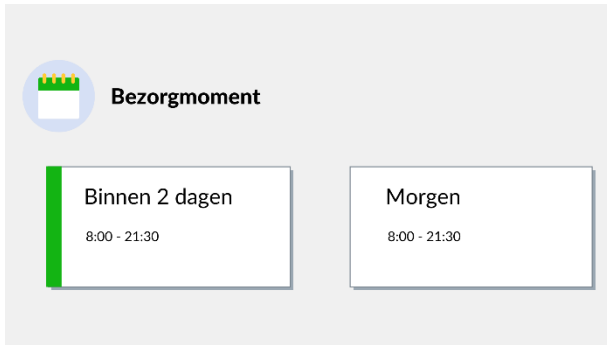
Figure 13 Manipulation: Default rule

Figure 14 Manipulation: Disclosure

Figure 15 Manipulation: Social Reference
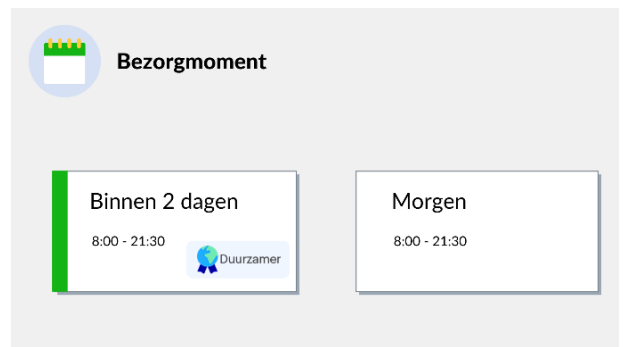
Figure 16 Manipulation: Default rule x Disclosure
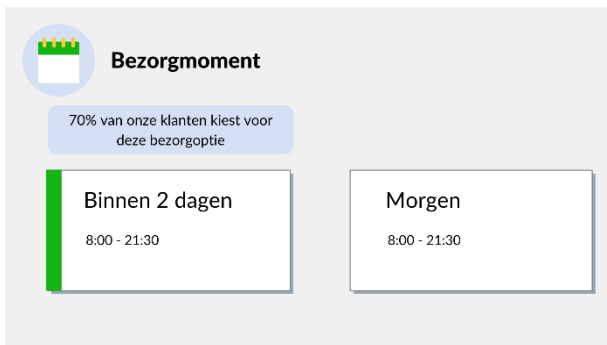
Figure 17 Manipulation: Default rule x Social Reference

Figure 18 Manipulation: Disclosure x Social Reference
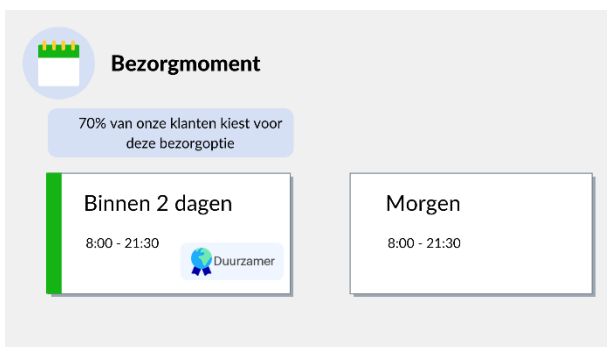
Figure 19 Manipulation: Default rule x Disclosure x Social Reference
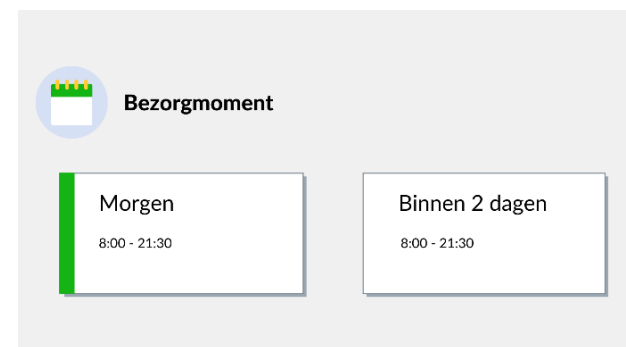
Figure 20 Control

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3.3 Procedure

Participants were informed that they would be going through the decision-making process of buying a book online. As visualised in Figure 21, the participants first had to choose a book, select a payment method and finally select the delivery option.
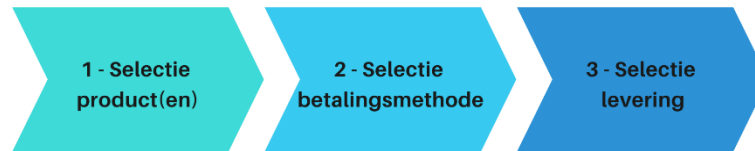
Figure 21 Decision making process of buying a book online as explained to participants

In the following step, participants were asked to answer questions related to the different measures (environmental concern, anticipated guilt, psychological ownership and decision basis), followed by demographic questions.

In order to ensure that choices regarding the book did not (subconsciously) influence the succeeding choices of delivery options, the name and author of the books were chosen using an online name generator. Furthermore, the information regarding average review, the total amount of reviews and price were held constant, as shown in Figure 22.
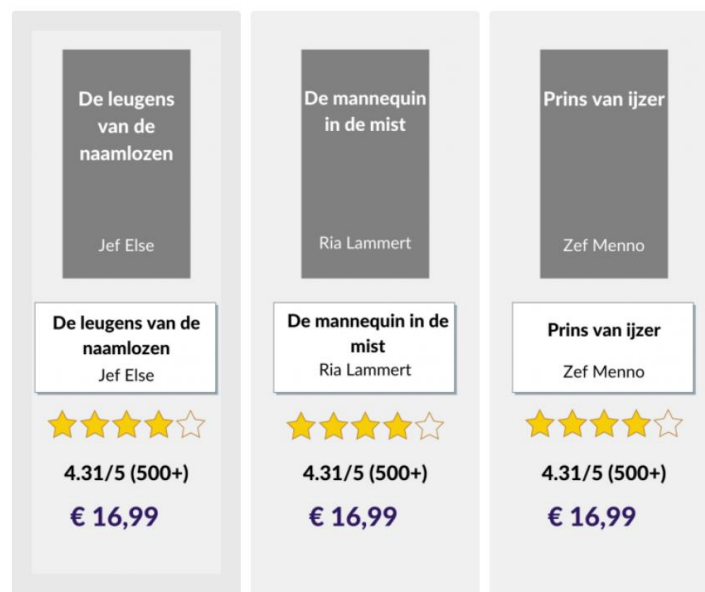
Figure 22 Book choices

3.4 Measures

3.4.1 Environmental concern

To measure green consumption values in a reliable, valid and parsimonious manner, the GREEN scale developed by Haws et al. (2014) is used. The scale consists of six items measured on a 7-point Likert scale from "1= Strongly disagree" to "7 = Strongly agree" (Haws et al., 2014). The six items of the scale are the following:

1. "It is important to me that the products I use do not harm the environment."
2. "I consider the potential environmental impact of my actions when making many of my decisions."
3. "My purchase habits are affected by my concern for our environment."
4. "I am concerned about wasting the resources of our planet."

5. ''I would describe myself as environmentally responsible.''
6. ''I am willing to be inconvenienced in order to take actions that are more environmentally friendly.''

3.4.2 Anticipated guilt

Anticipated guilt was measured with the adapted three-item scale of Theotokis & Manganari (2014). The scale consists of three items measured on a 7-point Likert scale from "1= Strongly disagree" to "7 = Strongly agree". The three items of the adapted scale are the following:

1. I would feel irresponsible if I don't choose the most sustainable delivery option.
2. I would feel guilty if I don't opt for the most sustainable delivery option.
3. I would feel accountable for not helping to protect the environment.

3.4.3 Psychological ownership

Psychological ownership was measured via the four-item scale of Vries et al. (2018), which they based on previous related studies (e.g., Peck et al., 2013). The scale consists of 4 items measured on a 7-point Likert scale from "1= Strongly disagree" to "7 = Strongly agree". The four items of the scale are the following:

With regards to the product I chose…

1. I feel like the product is already mine.
2. I feel a very high degree of personal ownership of the product.
3. I feel like I own the product.
4. I feel attached to my chosen product.

The scale of Vries et al. (2018) was preferred over the more widely used GASP scale (Cohen et al., 2011) since it has a lower amount of items, and we aim for a short survey due to the large number of participants required.

3.4.4 Decision basis

To measure the decision basis ("heart vs head") of the participants, an adapted scale of Shiv and Fedorikhin (1999) was used. The scale consists of 5 items measured on a 7-point Likert scale (Shiv & Fedorikhin, 1999). The scale consists of the following items:

My final decision about the delivery option was driven by…

1. my thoughts (1)/my feelings (7)
2. my willpower (1)/my desire (7)
3. my prudent self (1)/my impulsive self (7)
4. the rational side of me (1)/the emotional side of me (7)
5. my head (1)/my heart (7)

4 Results

4.1 Effectiveness of individual nudges

Descriptive results of effects individual nudges

To estimate the individual effects of the three nudges (default rule, disclosure and social reference), 251 participants were randomly assigned to one of the following conditions: Control (n=62), Default rule (n=64), Disclosure (n=62) and Social Reference (n=63). Note that, to answer our first four hypotheses, we do not take into account the conditions that combine multiple nudges (Condition 4,5,6 and 7).

Our sample consists of more male participants (55.0%) and is mainly composed of students (72.9%) and employees (21.9%). The mean age of the participants is 24.18 years. Furthermore, the individuals in the sample are highly educated, with 49.4% having a Bachelor Degree and 21.9% a Master's Degree as their highest degree. Most participants (43.8%) purchase online products or services on a monthly basis, and in the past 12 months, most have done this using a laptop or desktop as an interface (87.6%).

Similar as stated by Hummel & Maedche (2018), it is here argued that even though the sample is not representative, the demographics (age and gender distributions) of the participants are comparable to previous studies (previous studies also had a slightly larger proportion of male participants and an average age of around 24 years). Furthermore, they argue, in line with other authors (Demarque et al., 2015; Theotokis & Manganari, 2015), that the results can in principle, "be applied to all consumer populations that use a particular shop or website" (Demarque et al. 2015, p. 172). However, as our sample is not representative for the entire population, possible limitations of our findings have to be taken into account.

An apparent difference can be noted when comparing the participants' choices assigned to the different conditions (see Figure 23). While 8.1% of the control group chose the "In two day" delivery option, in the default rule, disclosure and social reference conditions, 34.4%, 59.7% and 14.3% respectively chose for delayed delivery.
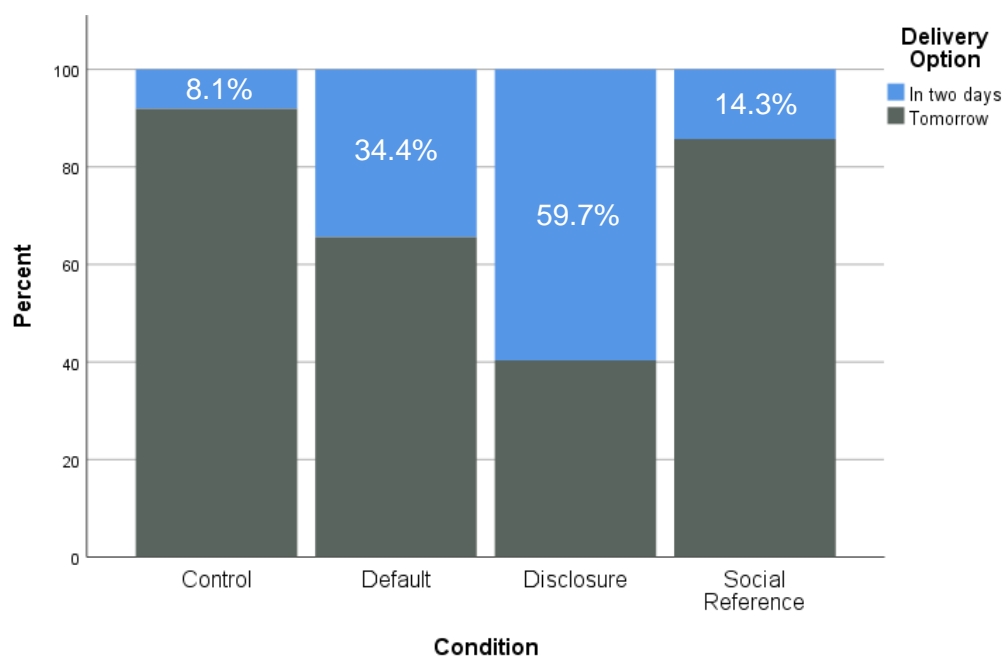
Figure 23 Choice delivery option per individual nudge conditions

Statistical result of individual nudges

Given that we aimed to predict a dichotomous (binary) dependent variable (Delivery option: Tomorrow or In two days), a logistic regression model was used to analyse the data. Within the context of digital nudges, logistic regression models have been used in previous studies (e.g., Hummel & Maedche, 2018; Weinmann et al., 2020).

The regression equation (including control variables Age and Gender) can be represented as follows:

$$Pr(Choice_i = 1) = \beta_0 + \beta_1 * default + \beta_2 * disclosure + \beta_3 * social\ reference$$

$$+ \beta_4 * Age + \beta_5 * Gender$$

In the regression equation, $Pr(Choice_i = 1)$ determines the probability of selecting "In two days" as the delivery option, and i indexes the participants. *Default, disclosure*, and *social reference* represent binary variables: either 1 when the respective manipulation is present or 0 when it is not present. Furthermore, *Age* and *Gender* are included as control variables. The parameter β_0 is the intercept, while β_1, β_2 and β_3 denote the effect of each manipulation. In order to compare the effects of the individual nudges, the conditions with combinations of nudges were not taken into account. The results of the logistic regression model are shown in Table 8.

For clarification, the columns in Table 8 will briefly be explained. The values for the logistic regression equation are represented in the column "B" and are in log-odds. The "Wald" column provides the Wald chi-square values corresponding with a 2-tailed p-value used to test the null hypothesis that the respective coefficient is equal to 0.

For both the default rule and the disclosure nudges, significant effects were found at the 0.1%-level on choosing "In two days" as delivery option (p<0.001), **supporting H1 and H2.** Non-significant effects were found for the social reference nudges (p =0.229); **hence H3 was rejected.**

	B	S.E.	Wald	Sig.
Default	2,146	,601	12,748	<,001
Disclosure	3,249	,601	29,186	<,001
Social Reference	,777	,647	1,445	,229
Gender	,338	,322	1,099	,295
Age	,069	,019	12,913	<,001
Constant	-4,915	,903	29,603	<,001

Table 8 Output logistic regression model individual effects

Chi-squared test to determine statistically significant differences

With 34.4% in the default rule condition, 59.7% in the disclosure condition and 14.3% in the social reference condition choosing for the more sustainable delivery option, apparent differences can be noted. To test if these differences are also statically significant, the Chi-squared test for equality of regression coefficients is used (Paternoster et al.,1998).

Based on the results that are displayed in Table 9, it can be concluded that the disclosure nudge is significantly more effective than the social reference nudge (p=0.005). However, the disclosure nudge is not statistically more effective than the default rule nudge (p=0.194), and the default rule nudge is not statically more effective than the social reference nudge (p=0.121). As the results are not in line with our expectations, **hypothesis 4 is rejected.**

	Reg 1		Reg 2					
	B	S.E.	B	S.E.	B diff	S.E. diff	Z	p-value
Default and Disclosure	2,146	0,601	3,249	0,601	-1,103	0,850	-1,298	0,194
Disclosure and Social Reference	3,249	0,601	0,777	0,647	2,472	0,883	2,799	**0,005****
Social reference and Default	0,777	0,647	2,146	0,601	-1,369	0,883	-1,550	0,121

Table 9 Chi-squared test for the equality of regression coefficients

4.2 Effectiveness of nudge combinations
Descriptive results of effects of combining nudge types

To estimate the individual effects of the three nudges (default rule nudge, disclosure nudge and social reference nudge) and compare it with the effects of the combinations of the different nudge types, 497 participants were randomly assigned to one of the eight conditions: Control (n=62), Default rule (n=64), Disclosure (n=62) and Social Reference (n=63), Default rule x Disclosure (n= 63), Social Reference x Default rule (n= 63), Disclosure x Social Reference (n= 59) and Default rule x Disclosure x Social Reference (n= 61).

Our sample consists of more male participants (54.3%) and is mainly composed of students (72.2%) and employees (21.9%). The mean age of the participants is 24.31 years. Furthermore, the individuals in the sample are highly educated, with 46.3% having a Bachelor Degree and 25.6% a Master's Degree as their highest degree. Most participants (42.7%) purchase online products or services on a monthly basis, and in the past 12 months, most have done this using a laptop or desktop as an interface (86.9%).

As displayed in Figure 24, it can be seen that of the participants in a condition that combines two nudges, a higher percentage chose for the delayed delivery option in comparison with the individual nudges.

Interestingly, while 81.0% of the participants in the condition that combines the default rule nudge with the disclosure nudge chose for the delayed delivery option, adding the social reference nudge resulted in "only" 73.8% of the participants choosing for the delayed delivery option.
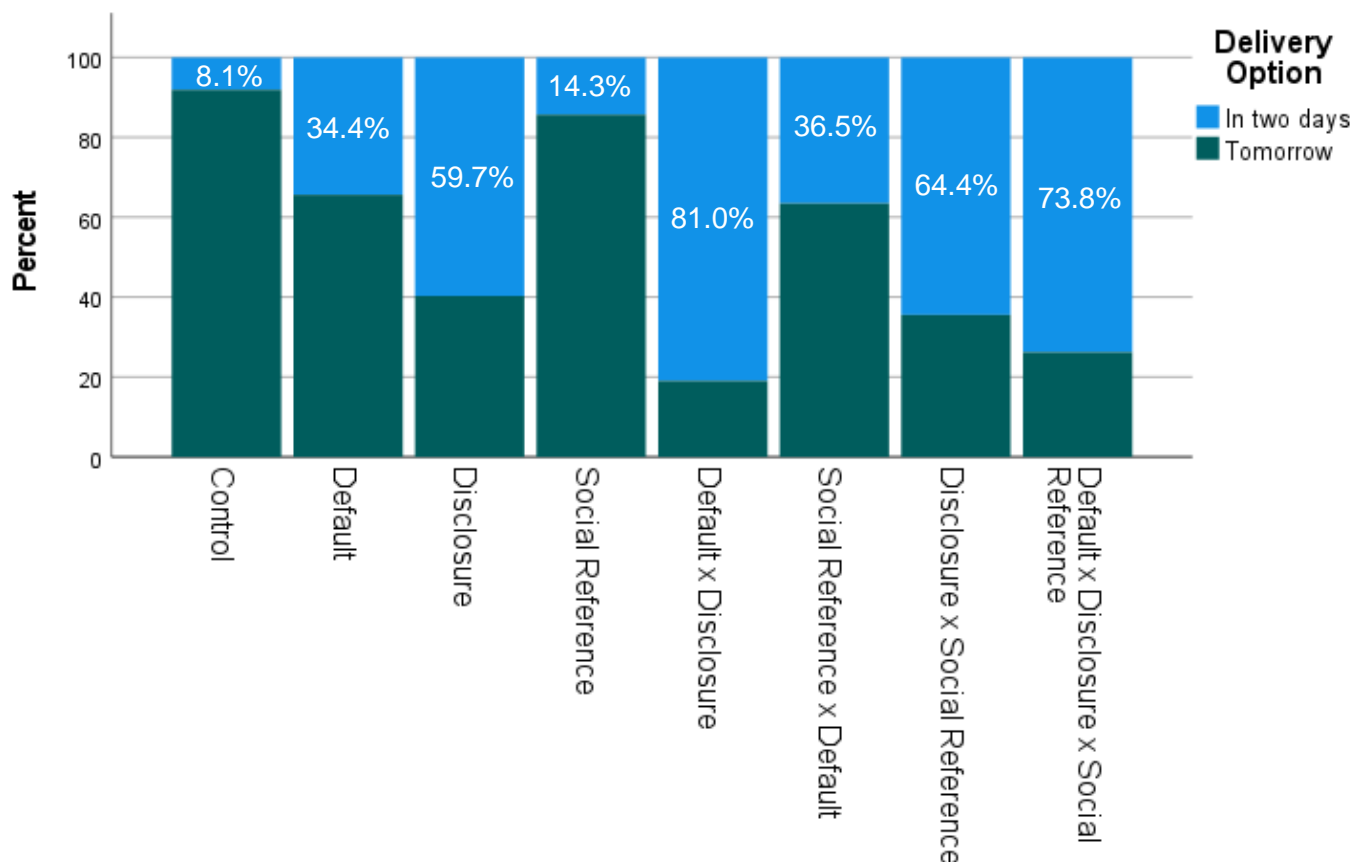
Figure 24 Choice of delivery option per condition

Statistical result of effects of combining nudge types

Similar to the analysis of the effects of the individual nudges, a logistic regression model was used to analyse the data. The regression equation (including control variables Age and Gender) can be represented as follows:

$$Pr(Choice_i = 1) = \beta_0 + \beta_1 * default + \beta_2 * disclosure + \beta_3 * social\ reference$$

$$+ \beta_4 * Age + \beta_5 * Gender$$

In order to test if a certain combination of nudges is statistically more effective than the nudges individually, the addition of a certain type of nudge as a variable in the regression equation was tested if it significantly improves the model.

4.2.1 Stand-alone nudge in comparison with the addition of a second nudge type
As an illustrative example of the obtained p-values in Table 10, we will discuss how the values of the first row (default rule) are calculated.

For the default rule, we wanted to test if the combination of the default rule with the disclosure nudge and the combination of the default rule with the social reference nudge is statistically more effective than the default rule alone. In order to make this comparison, the data of the participants in Condition 1 (Default Rule), Condition 4 (Default Rule x Disclosure) and Condition 5 (Default Rule x Social Reference) were selected.

Then the following logistic regression equation was calculated:

$$Pr(Choice_i = 1) = \beta_0 + \beta_1 * disclosure + \beta_2 * social\ reference$$

$$+ \beta_3 * Age + \beta_4 * Gender$$

Since for each observation, the default rule is present, the $default$ variable is excluded from the equation. Using SPSS, the parameters of the equation are estimated. In Table 10, we can note that the disclosure variable is significant (p<0.001), meaning that the combination of the default rule nudge with the disclosure nudge is statistically more effective than the default rule nudge individually. However, the social reference variable is not significant (p=0.959), meaning that the combination of the default rule nudge with the social reference nudge is not statistically more effective than the default rule nudge individually. Analogously, the other values in Table 11 are calculated. The SPSS output of the logistic regression for the other cases can be found in Attachment 4.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1ª	Disclosure	2,126	,422	25,319	1	,000	8,379
	Social Reference	-,020	,384	,003	1	,959	,980
	Gender	,553	,330	2,812	1	,094	1,738
	Age	,033	,019	2,963	1	,085	1,033
	Constant	-2,259	,737	9,387	1	,002	,105

a. Variable(s) entered on step 1: Disclosure, Social Reference, Gender, Age.
Table 10 Output logistic regression model combining two nudge types

Stand-alone	Additional nudge		
	Default rule	Disclosure	Social Reference
Default rule		p<0.001	p=0.959
Disclosure	p=0.019		p=0.587
Social Reference	p=0.007	p<0.001	

Table 11 p-values for the addition of a second nudge

From the results of the logistics regression summarized in Table 11, the following conclusions can be taken (which are also displayed in Table 12):

- At the 0.1%-level, the combination of default rule and disclosure nudge is more effective than the stand-alone disclosure nudge (p<0.001), **supporting hypothesis 5.1.**
- The combination of the default rule and social reference nudge is not statistically more effective than the stand-alone social reference nudge (p=0.959); **hence we reject hypothesis 5.2.**
- The combination of the default rule and the disclosure nudge is more effective than the stand-alone disclosure nudge at the 5%-level (p=0.019), **supporting hypothesis 5.3.**
- The combination of the disclosure nudge with the social reference nudge is not statistically more effective than the stand-alone disclosure nudge (p=0.587); hence **we reject hypothesis 5.4.**
- Both the combination of the Default rule nudge with the social reference nudge and the combination of the disclosure nudge with the social reference nudge are statistically more effective than the stand-alone social reference nudge (respectively p=0.007 and p<0.001), **supporting hypothesis 5.5 and 5.6**

Combination		stand-alone	Hypothesis	
Default rule and disclosure nudges		Default rule nudge	5.1	Accepted
Default rule and social reference nudges		Default rule nudge	5.2	Rejected
Disclosure and default rule nudges	…more effective than…	Disclosure nudge	5.3	Accepted
Disclosure and social reference nudges		Disclosure nudge	5.4	Rejected
Social reference and default rule nudges		Social reference nudge	5.5	Accepted
Social reference and disclosure nudges		Social reference nudge	5.6	Accepted

Table 12 Overview results sub hypotheses of hypothesis 5

4.2.2 Combination of two nudges in comparison with combination all three nudges

As an illustrative example of the obtained p-values in Table 13, we will discuss how the value of the first row (Default Rule x Disclosure) is calculated.

For the combination of the default rule with the disclosure, we wanted to test if the combination of the default rule and the disclosure with the social reference is statistically more effective than the combination of the default rule and the disclosure.

In order to make this comparison, the data of the participants in Condition 4 (Default Rule x Disclosure) and Condition 7 (Default Rule x Disclosure x Social Reference) are selected.

Then the following logistic regression equation is calculated:

$$Pr(Choice_i = 1) = \beta_0 + \beta_1 * social\ reference$$
$$+ \beta_2 * Age + \beta_3 * Gender$$

Since for each observation, the default rule and the Disclosure are present, the $default$ and $Disclosure$ variables are excluded from the equation. Using SPSS, the parameters of the equation are estimated. In Table 13, we can note that the social reference variable is not significant (p=0.404), meaning that the combination of the default rule nudge and the disclosure nudge with the social reference nudge is not statistically more effective than the combination of the default rule and the disclosure nudges. Analogously, the other values in Table 14 are calculated.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Social Reference	-,374	,448	,696	1	,404	,688
	Gender	1,130	,473	5,716	1	,017	3,095
	Age	,065	,060	1,172	1	,279	1,067
	Constant	-1,646	1,582	1,082	1	,298	,193

a. Variable(s) entered on step 1: Social Reference, Gender, Age.

Table 13 Output logistic regression model combining three nudge types

	Additional nudge		
Combination	Default Rule	Disclosure	Social Reference
Default Rule x Disclosure			p=0.404
Default Rule x Social Reference		p<0.001	
Disclosure x Social Reference	p=0.373		

Table 14 p-values for the addition of a third nudge

From the results of the logistics regression summarized in Table 14, the following conclusions can be taken (which are also displayed in Table 15):

- The combination of the default rule nudge with the disclosure and social reference nudges is not statistically more effective than the combination of the disclosure and social reference nudges (p=0.373) and the combination of the default rule with the Disclosure nudge (p=0.404); **hence we reject hypothesis 6.1 and 6.3.**
- The combination of the default rule nudge with the disclosure and social reference nudges is statistically more effective than the combination of the default rule nudge and the social reference nudge (p<0.001), **supporting hypothesis 6.2.**

Combination		stand-alone	Hypothesis	
Default rule, disclosure and social reference nudges	…more effective than…	Default rule and disclosure nudges	6.1	Rejected
Default rule, disclosure and social reference nudges		Default rule and social reference nudges	6.2	Accepted
Default rule, disclosure and social reference nudges		Disclosure and social reference nudges	6.3	Rejected

Table 15 Overview results sub hypotheses of hypothesis 6

4.2.3 Interaction effects independent variables

Besides looking into the effectiveness of combining multiple nudges, it is equally interesting to consider the interaction effects between the different independent variables. To estimate the interaction effects, the following logistic regression is calculated:

$$Pr(Choice_i = 1) = \beta_0 + \beta_1 * default + \beta_2 * disclosure$$

$$+ \beta_3 * social\ reference + \beta_4 * Int_1 + \beta_5 * Int_2 + \beta_6 * Int_3 + \beta_7 * Int_4$$

$$+ \beta_8 * Age + \beta_9 * Gender$$

With

$$Int\_1 = Default * Disclosure$$

$$Int\_2 = Default * Social\ Reference$$

$$Int\_3 = Disclosure * Social\ Reference$$

$$Int\_4 = Default * Disclosure * Social\ Reference$$

As the three independent variables (default, disclosure and social reference) are all dichotomous, the PROCESS macro (model 3) by Hayes (2019) cannot be used to estimate the logistic regression. PROCESS macro (model 3) would have been our preferred method if the independent variables would have been continuous. In Table 16, it can be noted that both the three two-way interaction effects (Int_1, Int_2 and Int_3) and the three-way interaction effect (Int_4) are non-significant. This means that the addition of the interactions does not lead to a better fit to the data and better predictions from the regression equation.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Default	1,967	0,560	12,331	1	0,000	7,149
	Disclosure	3,106	0,561	30,662	1	0,000	22,333
	Social Reference	0,679	0,612	1,229	1	0,268	1,972
	Int_1	-0,970	0,699	1,924	1	0,165	0,379
	Int_2	-0,739	0,725	1,037	1	0,308	0,478
	Int_3	-0,478	0,722	0,439	1	0,507	0,620
	Int_4	0,173	0,930	0,034	1	0,853	1,188
	Gender	0,598	0,218	7,510	1	0,006	1,818
	Age	0,045	0,013	11,399	1	0,001	1,046
	Constant	-4,588	0,715	41,189	1	0,000	0,010

a. Variable(s) entered on step 1: DefaultNudge, DisclosureNudge, SocialReferenceNudge, Int_1, Int_2, Int_3, Int_4, Gender, Age.

Table 16 Interaction effects independent variables

4.3 Environmental concern and psychological ownership as moderators

4.3.1 Environmental concern as a moderator

The GREEN scale developed by Haws et al. (2014) was used to measure environmental concern. The items on the SCALE were translated to Dutch and were measured on a 7-point Likert scale from "1= Strongly disagree" to "7 = Strongly agree". To test the internal consistency between the items, a Cronbach's alpha reliability test was used. The scale for measuring environmental concern is reliable since the Cronbach's alpha is equal to 0,879.

In order to test if the interaction between the condition (0= nudge type not present, 1 = nudge type present) and environmental concern predicts the probability of choosing the delayed delivery option, we will model the predictors of individuals' choice of delivery option (0="Tomorrow", 1="In two days") as a function of Condition, environmental concern, environmental concern * Condition, Age and Gender. This gives us the following logistic regression:

$$Pr(Choice_i = 1) = \beta_0 + \beta_1 * Condition + \beta_2 * EnvironmentalConcern$$

$$+ \beta_3 * EnvironmentalConcern * Condition + \beta_4 * Age + \beta_5 * Gender$$

The estimations of the logistic regression models are done on SPSS via the PROCESS macro by Hayes (2019). The obtained output for each of the three conditions can be found in Attachment 8. In Table 17, the p-values are presented for each interaction. It can be concluded that for the default rule, disclosure, and social reference, the interaction effect with environmental concern is not significant. **We, therefore, reject hypothesis 7.2 and accept hypotheses 7.1 and 7.3.** The interaction effects are displayed in Figure 25 (see Attachment 8 for a larger display).

Interaction	Chi-square	p-value	Hypothesis	
Default x Environmental Concern	1.4141	0.2344	7.1	Accepted
Disclosure x Environmental Concern	0.0043	0.9475	7.2	Rejected
Social Reference x Environmental Concern	0.0513	0.8209	7.3	Accepted

Table 17 p-values and results sub hypotheses of hypothesis 7
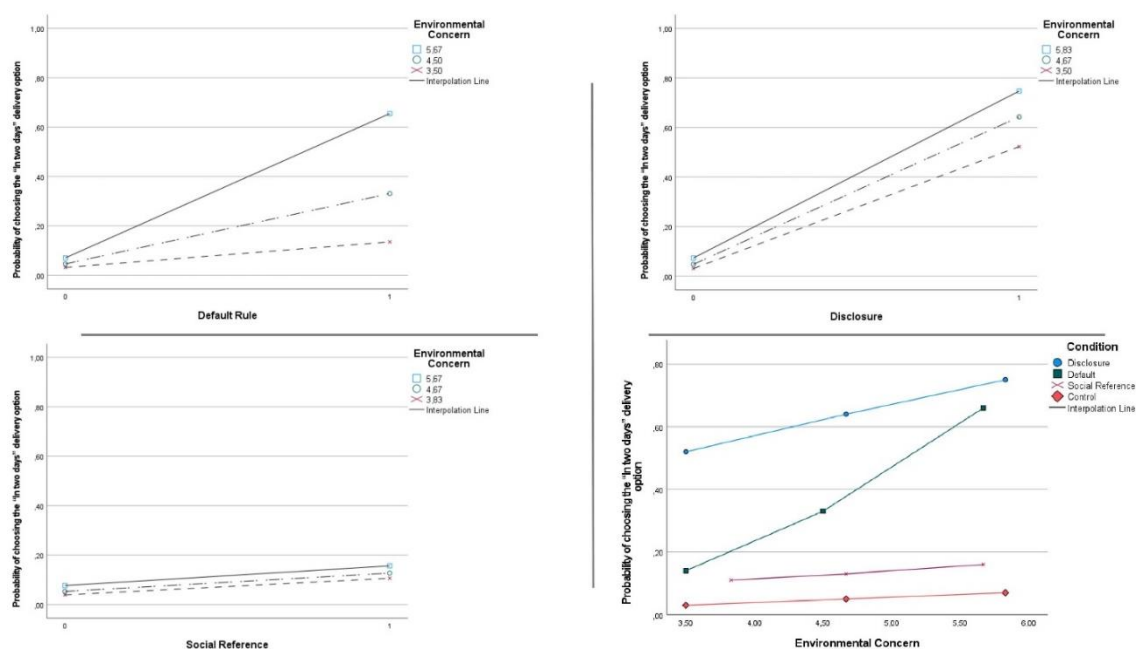
Figure 25 Visualisation Environmental Concern as a moderator

4.3.2 Psychological ownership as a moderator

Psychological ownership was measured via the four-item scale of Vries et al. (2018). The scale consists of 4 items measured on a 7-point Likert scale from "1= Strongly disagree" to "7 = Strongly agree", and the items were translated into Dutch. The four-item scale has a Cronbach's alpha of 0.856 and can therefore be considered reliable.

In order to test if the interaction between the condition (0= nudge type not present, 1 = nudge type present) and Psychological ownership predicts the probability of choosing the delayed delivery option, we will model the predictors of individuals' choice of delivery option (0="Tomorrow", 1="In two days") as a function of Condition, Psychological ownership, Psychological ownership * Condition, Age and Gender. This gives us the following logistic regression:

$$Pr(Choice_i = 1) = \beta_0 + \beta_1 * Condition + \beta_2 * PsychologicalOwnership$$

$$+ \beta_3 * PsychologicalOwnership * Condition + \beta_4 * Age + \beta_5 * Gender$$

The obtained output for each of the three conditions can be found in Attachment 10. In Table 18, the p-values are represented for each interaction. It can be concluded that for the default rule, disclosure, and social reference, the interaction effect with psychological ownership is not significant. **We therefore reject Hypotheses 8.1, 8.2 and 8.3.** The interaction effects are displayed in Figure 26 (see Attachment 11 for a larger display).

Interaction	Chi-square	p-value	Hypothesis	
Default x Psychological Ownership	0.0193	0.8895	8.1	Rejected
Disclosure x Psychological Ownership	0.3706	0.5427	8.2	Rejected
Social Reference x Psychological Ownership	0.4553	0.4998	8.3	Rejected

Table 18 p-values and results sub hypotheses of hypothesis 8
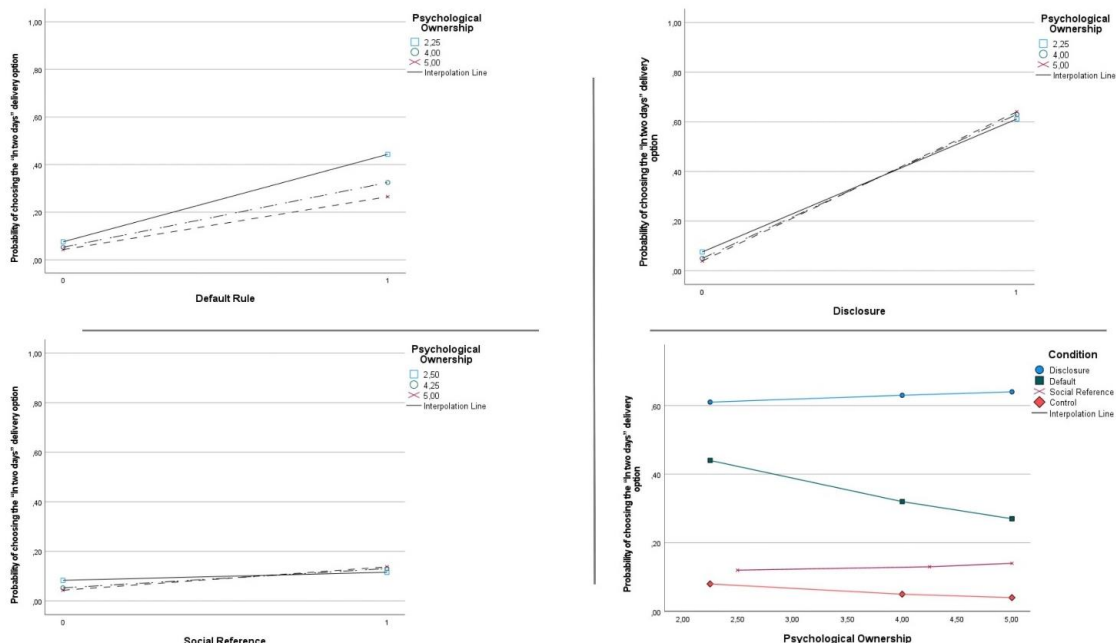
Figure 26 Visualisation Psychological Ownership as a moderator

4.4 Anticipated guilt and decision basis as mediators

Anticipated guilt was measured with the adapted three-item scale of Theotokis & Manganari (2014). The scale consists of three items measured on a 7-point Likert scale from "1= Strongly disagree" to "7 = Strongly agree". Furthermore, decision basis was measured using an adapted scale of Shiv and Fedorikhin (1999). The scale consists of 5 items measured on a 7-point Likert scale. With the anticipated guilt scale and the decision basis scale having a Cronbach's Alpha of 0.850 and 0.775, respectively, we can argue that both scales are reliable (since they are both larger than 0.700).

For each of the three conditions (default rule, disclosure and social reference), a parallel mediation analysis was conducted to test which of the two mediators (anticipated guilt and decision basis) mediate the relationship between the Condition and the selected delivery option. The analysis was conducted using the PROCESS Macro v3.5, developed by Hayes (2019). The SPSS output of each mediation model can be found in Attachment 12.

4.4.1 Mediation analysis default rule

Using a default rule does not significantly increase or decrease the values of anticipated guilt and the decision base. The effect of the default rule on anticipated guilt is equal to -0.3555 (p=0.174), and the effect on decision basis is equal to 0.1809 (p=0.4074). When considering the effects of the mediators (anticipated guilt and decision basis) on the selected delivery option (0="Tomorrow", 1="In two days"), only the decision basis dimension was found to be significant (p=0.0014).

The effect of the default rule is not mediated by the extent to which individuals have high or low values of anticipated guilt (Indirect effect = -0.0986; 95% IC = [-0.5021; 0.0860]) or decision basis (Indirect effect = -0.1529; 95% IC = [-0.6754; 0.2343]).

Since the default rule does not indirectly influence the selected delivery option through its effect on anticipated guilt and decision basis, **we reject Hypothesis 9.1 and 10.1.** The mediation model is visualised in Figure 27.
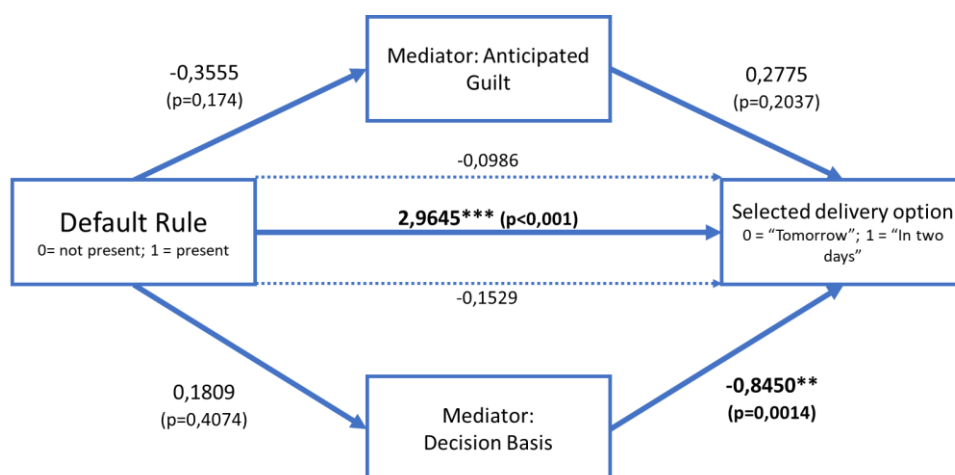
Significance codes: '***' 0.001 '**' 0.01 '*' 0.05 '(.)' 0.1;

Figure 27 Result mediation analysis with default rule as a dependent variable

4.4.2 Mediation analysis disclosure

Using a disclosure nudge does not significantly increase or decrease the values of anticipated guilt and the decision base. The effect of the disclosure nudge on anticipated guilt is equal to 0.1423 (p=0.6065), and the effect on decision basis is equal to -0.0051 (p=0.9818). When considering the effects of the mediators (anticipated guilt and decision basis) on the selected delivery option (0="Tomorrow", 1="In two days"), both the anticipated guilt as the decision basis dimension were found to be significant with respective p-values of 0.0202 and 0.0075.

The effect of the disclosure nudge is not mediated by the extent to which individuals have high or low values of anticipated guilt (Indirect effect = 0.0662; 95% IC = [-0.2391; 0.4160]) or decision Basis (Indirect effect = 0.0033; 95% IC = [-0.3561; 0.3487]).

Since the disclosure nudge does not indirectly influence the selected delivery option through its effect on anticipated guilt and decision basis, **we reject Hypothesis 9.2 and 10.2.** The mediation model is visualised in Figure 28.
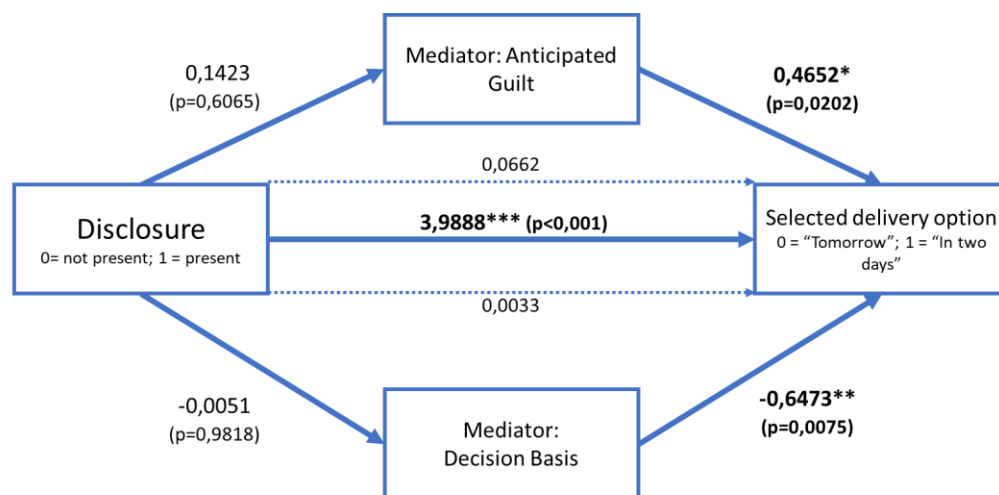
Significance codes: '***' 0.001 '**' 0.01 '*' 0.05 '(.)' 0.1;

Figure 28 Result mediation analysis with disclosure as a dependent variable

4.4.3 Mediation analysis social reference

Using a social reference nudge does not significantly increase or decrease the values of anticipated guilt and the decision base. The effect of the default rule on anticipated guilt is equal to -0.2673 (p=0.3046) and the effect on decision basis is equal to -0.2692 (p=0.1848). When considering the effects of the mediators (anticipated guilt and decision basis) on the selected delivery option (0="Tomorrow", 1="In two days"), both the anticipated guilt as the decision basis dimension were found to be significant with respective p-values of 0.0283 and 0.0082.

The effect of the social reference nudge is not mediated by the extent to which individuals have high or low values of anticipated guilt (Indirect effect = -0.1704; 95% IC = [-1.0041; 0.2133]) or decision basis (Indirect effect = 0.2689; 95% IC = [-0.2114; 1.1919]).

Since the social reference nudge does not indirectly influence the selected delivery option through its effect on anticipated guilt and decision basis, **we reject Hypothesis 9.3 and 10.3.** The mediation model is visualised in Figure 29.
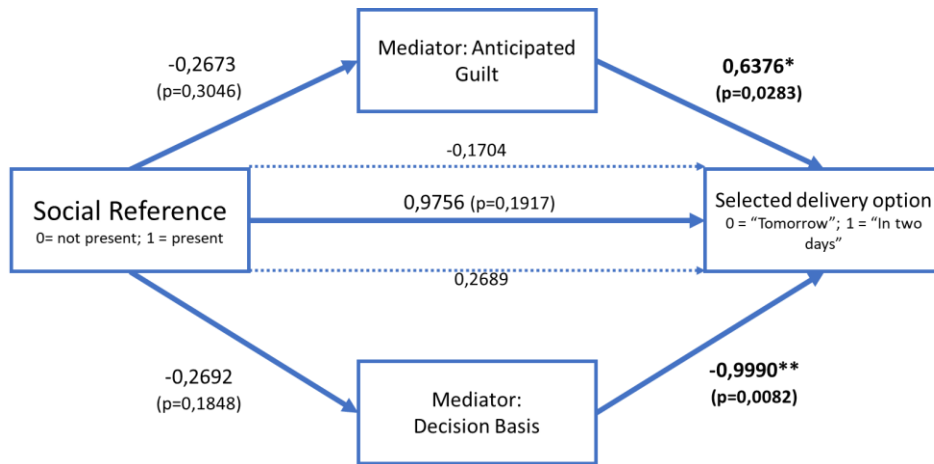
Significance codes: '***' 0.001 '**' 0.01 '*' 0.05 '(.)' 0.1;

Figure 29 Result mediation analysis with social reference as a dependent variable

5 General conclusion and discussion

The aim of this study was to look at the relevant topic of how to encourage sustainable behaviour on e-commerce websites. In order to mitigate some of the environmental impact of e-commerce, different nudge types were examined to test which type (and its combinations) is most effective to nudge e-commerce customers towards more sustainable delivery options. Three types of nudges were compared, namely the *default rule* nudge, the *disclosure* nudge and the *social reference* nudge. The analyses were based on the result of an online survey with 497 valid respondents.

In the first part, the effects of the individual nudges were tested. While 8.1% of the participants in the control group chose the "In two day" delivery option, in the default rule, disclosure and social reference conditions, 34.4%, 59.7% and 14.3% respectively chose for delayed delivery. For both the default rule nudge and the disclosure nudge, statistically significant effects were found, while the effect of the social reference nudge was not statically significant at the 0.1%-level.

Interestingly, these findings are not in line with the results of the quantitative review by Hummel & Maedche (2019), where the median effect size of default rule nudges was almost five times larger than the median effect size of disclosure. A potential cause of this difference in results could be that most customers are not aware of any difference (B2C Europe, 2018), introducing a disclosure nudge could give them the possibility to act in line with their values (and contribute to close the "Green gap").

Our findings confirm previous research on the effectiveness of default rule nudges and disclosure nudges in influencing pro-environmental behaviour but extend them to the context of nudging e-commerce customers towards more sustainable delivery options. The effectiveness of the social reference nudges in the context of a digital choice environment that aims to promote pro-environmental behaviour could not be confirmed in the context of nudging e-commerce customers towards more sustainable delivery options.

Furthermore, it can be concluded that the disclosure nudge is significantly better than the social reference nudge (p=0.005). However, the disclosure nudge is not statistically better than the default rule nudge (p=0.194), and the default rule nudge is not statically better than the social reference nudge (p=0.121).

> The disclosure nudge and the default rule nudge are most effective to nudge e-commerce customers towards more sustainable delivery options, while the effect of the social reference nudge is not statistically significant.

In the second part, our study aimed to test which combinations of the different nudge types are most effective to nudge customers on an e-commerce website towards choosing more sustainable delivery options.

First, it was tested whether the addition of a second nudge type resulted in a larger proportion of the participants opting for the more sustainable delivery option in comparison with the stand-alone nudges. Adding a default rule nudge to the disclosure nudge or social reference nudge resulted in significantly larger positive effects compared to stand-alone disclosure and social reference nudges. Similar results were found when adding the disclosure nudge to the default rule nudge or the social reference nudge. The addition of the social reference nudge to the default rule nudge or the disclosure nudge did, however, not results in significantly larger positive effects.

Secondly, it was tested whether the addition of a third nudge type resulted in a larger proportion of the participants opting for the more sustainable delivery option in comparison with the combination of two nudges. Combining the default rule nudge, disclosure nudge, and social reference nudge is not statistically more effective than the combination of the disclosure and social reference nudges and the combination of the default rule nudge with the disclosure nudge. On the contrary, the addition of the disclosure nudge to the combination of the default rule nudge and the social reference nudge resulted in significantly more significant positive effects.

While 81.0% of the participants in the condition that combined the default rule nudge and the disclosure nudge opted for "In two days" delivery, "only" 73.8% of the participants in the condition that combined the three different nudges opted for this option. This is in line with Hankammer et al. (2020), indicating that combining different manipulations might not always result in larger effect sizes, but could even result in lower effect size (e.g., the boomerang effect).

It was furthermore noted that both the three two-way interaction effects and the three-way interaction effect between the independent variables (default, disclosure and social reference) are non-significant. This means that the addition of the interactions does not lead to a better fit to the data and better predictions from the regression equation.

Our findings contribute to the body of evidence suggesting that combining different nudge types can, in some cases, result in larger positive effects than the stand-alone nudges, while for other cases, the added value of an extra nudge could be negative (e.g., the boomerang effect).

The combination of the default rule nudge with the disclosure nudge resulted in a larger effect size than the stand-alone nudges and the combination of the three different nudges.

The third part examined whether environmental concern and psychological ownership moderate the effect of the different nudges on the selection of the more sustainable delivery option.

As hypothesized, the effect of the default rule nudge and the social reference nudge on the likelihood of opting for the more sustainable delivery option was irrespective of an individuals' level of environmental concern. However, there was no evidence found to support the hypothesis that the effect of the disclosure nudge on the probability of choosing the more sustainable delivery option would be more pronounced the higher individuals score on environmental concern. Furthermore, for none of the three nudge types, evidence was found that the effect of the different nudges would be more pronounced the lower individuals score on psychological ownership.

Environmental concern and psychological ownership do not moderate the effect of the different nudge types on the selection of the more sustainable delivery option.

The last part examined whether the different nudge types indirectly influenced the probability of selecting the delayed delivery option through its effect on anticipated guilt or decision basis. From the results, we can conclude that each nudge type (default rule, disclosure and social reference) does not indirectly influence the selected delivery option through its effect on anticipated guilt or decision basis.

The effect of the different nudge types does not indirectly influence the probability of selecting the more sustainable delivery option through its effect on anticipated guilt or decision basis.

6   Practical Implications for webshops

Our results have important practical implications for webshops. Developers and web designers of e-commerce websites can use our findings to adjust their online choice architecture to guide customers towards more sustainable delivery options. Using four arguments, the potential benefits for online retailers and webshops are briefly discussed.

1. **Reduced environmental impact**

With research indicating that express delivery has a higher environmental impact than standard delivery, the findings in this study can be part of the solution to mitigate some of the adverse effects. Both the default rule nudge and the disclosure nudge were shown to guide a significant fraction of online customers towards more sustainable delivery options. Furthermore, the combination of the default rule nudge with the disclosure nudge resulted in the largest effect.

2. **Reduced transportation costs**

Besides the reduced environmental impact, initial research has also shown that delayed delivery options could additionally reduce transportation costs. When many customers choose delayed delivery, several orders may be bundled together and shipped in a single journey. Compared to the option of express delivery or same-day delivery, were fewer packages are bundled, resulting in the need for additional delivery trips. The reduction in the number of express deliveries or same-day deliveries might, in turn, result in reduced transportation costs. Consolidation drives better efficiency. Research by Muñoz-Villamizar et al. (2021) has shown that fast-shipping can increase costs by 68%.

3. **Nudge for good, not only for profit**

Most modern online environments, including webshops, make use of smart, persuasive choice architectures to obtain objectives such as maximizing financial return and influencing future behaviour (Kozyreva et al., 2020; Zuboff, 2019). Given that these practices are already widespread, why not as well use them to nudge for good instead of profit?

With customers increasingly attaching more importance to sustainability, the introduction of changes to the interface to guide customers towards more sustainability options could help online retailers improve their CSR. The empirical results of research by Dang et al. (2020) show that perceived online retailers' CSR exhibits positively impact consumers' purchasing intentions and enhances word of mouth.

4. **Relatively low effort and cost for implementation**

Compared with nudges in the physical context, digital environments have several advantages when it comes to designing and testing (Weinmann et al., 2016). Web designers can, with relatively low cost, modify the design of the user interface. Changing the default to the more sustainable delivery option or adding "More sustainable" are adjustments that can relatively easily be implemented. Furthermore, the effect of multiple different designs can be tested with relatively little effort.

With some online retailers possessing a large amount of information about their customers, nudges can be dynamically adapted based on, for example, a user's past decisions or gender, on the condition that ethical issues have been taken into consideration by the choice architects. This way, the potential adverse effects of "one-size-fits-all" nudges can be mitigated.

7 Limitations and directions for future research

Following the practical implications of our results, we would like to highlight the limitations of our study and provide suggestions for future research.

As our sample consists of more male participants (54.3%), is mainly composed of students (72.2%) and has a mean age of 24.31 years, it is not representative for the entire population. Therefore, the results cannot simply be generalized towards the entire Belgian internet population. A replication of our experiment, including a representative sample, would be interesting to examine in future research. Furthermore, the experiment was conducted via an online experiment (Qualtrics). The decisions made by the participants did not have any real life consequences. As our experiment was not a real purchase situation, further research could include an empirical study in an actual webshop with real customers.

Our results are restricted to the specific context of ordering an unknown book and cannot necessarily be generalized to other (e.g., more expensive) product categories (e.g., laptop's, smartphones,…). Future research could extend our results to a broader set of product categories. Additionally, the participants of our experiments only had to make one decision regarding the delivery option. As customers in real-life order multiple items spread over time, it would be interesting to see how the effectiveness of the various nudges change over an extended period of time.

Finally, our study only took into consideration the proportion of participants choosing the more sustainable delivery option. Other factors, such as the number of people that cancel their order and customer satisfaction, were not included in this study. Future research could take into account KPI's that are relevant and important to online retailers to ensure that the introduction of certain nudges does not have unintended consequences.

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9 Appendix
Attachment 1 Classification of nudges

Hansen and Jespersen

According to Hansen and Jespersen, nudges can be categorised based on two dimensions: the consciousness (Type 1 or Type 2) and transparency of nudges (Transparent or Non-Transparent) (Hansen & Jespersen, 2013). The two dimensions will be explained below.
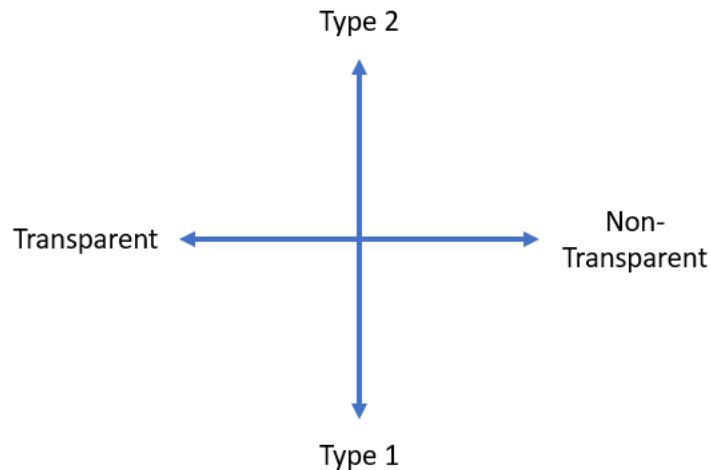
Figure I Classification of nudges according to Hansen and Jespersen (Hansen & Jespersen, 2013)

The consciousness dimension is based on the Dual Process Theory, which states that the human brain works in two distinct ways, automatic thinking and reflective thinking (Hansen & Jespersen, 2013). Daniel Kahneman named these two types of thinking System 1 and System 2 in his book "Thinking, Fast and Slow" (Kahneman, 2011). Automatic thinking (System 1) occurs, for example, when answering the arithmetic equation 1 + 1 = 2. Reflective thinking (System 2) on the other hand occurs when remembering how to multiply with decimals to work out the following equation: 8,24 x 17,67.

Automatic thinking (System 1)	Reflective thinking (System 2)
Uncontrolled	Controlled
Effortless	Effortful
Associative	Deductive
Fast	Slow
Unconscious	Self-ware
Skilled	Rule following

In the table below the different characteristics of the two systems are outlined.

Table I Two cognitive modes of thinking (Hansen & Jespersen, 2013)

Based on the Dual Process Theory described above, Hansen and Jensen suggest that a distinction between two types of nudges can be made (Hansen & Jespersen, 2013). Type 1 nudges are aimed to influence behaviour through automatic thinking (System 1) without involvement of reflective thinking. Type 2 nudges influences the reflective thinking (System 2), by utilizing the automatic system (Hansen & Jespersen, 2013).

The transparency dimension of nudges is defined by Hansen and Jespersen as "a nudge provided in such a way that the intention behind it, as well as the means by which behavioural change is pursued, could reasonably be expected to be transparent to the agent being nudged as a result of the intervention" (Hansen & Jespersen, 2013, p. 16). In contrast, non-transparent nudges are defined as "a nudge working in a way that the citizen in the situation cannot reconstruct either the intention or the means by which behavioural change is pursued" (Hansen & Jespersen, 2013).
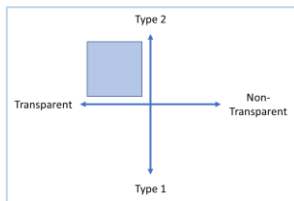
Transparent type 2 nudges: nudges that engage the reflective system in a way that makes it easy for the person to understand the intentions and the way behavioural change is being pursued (Hansen & Jespersen, 2013).

Example: the usage of arrows or footprints in order to nudge people in taking the stairs or throwing litter in the bin (Hansen & Jespersen, 2013).
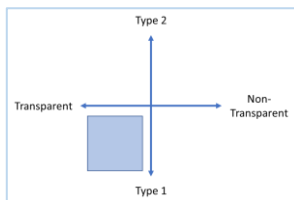
Transparent type 1 nudges: reflective thinking is not engaged in causing the change in behaviour. Reflective thinking can however occur as a by-product, allowing the understanding of the intentions and the way behavioural change is being pursued (Hansen & Jespersen, 2013).

Example: changing printer default settings from one-sided to double-sided printing (Hansen & Jespersen, 2013).
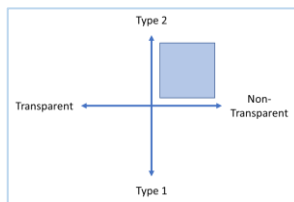
Non-transparent type 2 nudges: nudges that engage the reflective system in a way that citizens are not directly able to understand the intentions and means by which behaviour is being influenced (Hansen & Jespersen, 2013).

Example: putting up posters with human faces in order to increase the compliance with social norms (Hansen & Jespersen, 2013).
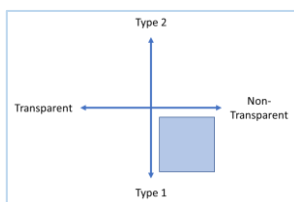
Non-transparent type 1 nudges: nudges that cause behaviour change without engaging the reflective system in a way that citizens are not directly able to understand the intentions and means by which behaviour is being influenced (Hansen & Jespersen, 2013).

Example: reducing the size of plates in a cafeteria to reduce the amount of calories being consumed (Hansen & Jespersen, 2013).

Three Degrees of Nudging

According to Baldwin, nudges can be classified in three different degrees of nudge, accounting for the degree to which a certain nudge impacts a person's autonomy as a decision maker. This classification is made because of the distinct sets of ethical and practical issues that are raised by these three degrees of nudge (Baldwin, 2014).

The first degree of a nudge respects the autonomy of a person, this includes for example, simply providing a person with correct information (Baldwin, 2014).

The second degree has a more significant impact on the autonomy of an individual, an example is the use of a default nudge were people are able to opt out. Hereby is the individual's decision influenced by the promotion (or negation) of a certain behaviour (Baldwin, 2014).

The third degree nudge offers a more serious impact on the autonomy of an individual by using behavioural manipulation to an extent that was not the case in the previous degrees (Baldwin, 2014).

	Typical Characteristics (Baldwin, 2014)	**System 1 (heuristic)/ System 2 (rational)** (Taranu & Verbeeck, 2016)
First Degree Nudge	"Supply of simple information or a reminder with the aim of improving the target's capacity to make an informed, rational and conscious choice."	From System 1 towards System 2
Second Degree Nudge	"Behavioural or volitional limitations are exploited so as to bias decisions in a favoured direction."	System 1
Third Degree Nudge	"Framing strategies, emotional responses or covert techniques are used to influence decisions or shape preferences."	From System 2 towards System 1

Table II Three Degrees of Nudge

CAN approach to changing behaviour

A more intuitive approach to changing behaviour has been presented by Wansink (2015). The CAN approach aims to "make healthy foods appear more convenient, attractive, and normal to choose" (Wansink, 2015). The CAN approach (make it more **C**onvenient, make it more **A**ttractive and make it more **N**ormal), as visualised in Figure 2, starts by making healthy foods more convenient, attractive, and normal to choose and has the ultimate goal to make healthy foods a habitual choice.

This CAN technique has been used in hundreds of various eating behaviour studies at homes, grocery stores, restaurants, and schools to guide parents, consumers, restaurant goers, and students to choose the healthy foods offered without actually altering the foods themselves (Wansink, 2015).

Even though Wansink's research is mainly focused on changing behaviour towards healthier food options, the CAN approach, could furthermore be extended to classify nudges.
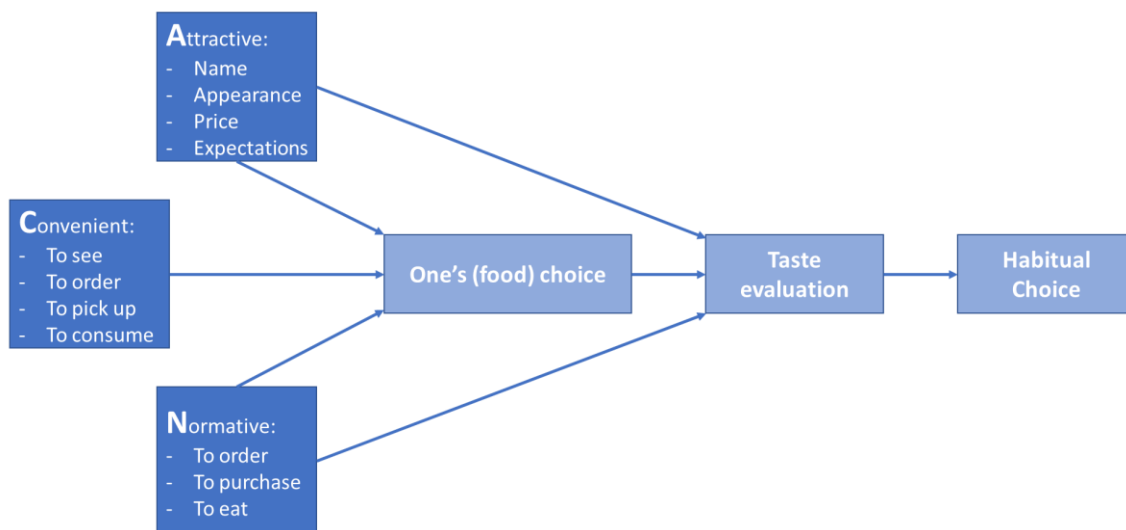
Figure II The CAN approach to changing one's food choice (Wansink, 2015)

TIPPME intervention typology

In order to provide a context for the accurate classification and description of ways in which interventions can change the selection, purchase and consumption of food, alcohol and tobacco products in proximal physical micro-environments, Hollands et al. (2017) developed TIPPME (typology of interventions in proximal physical micro-environments).

TIPPME contains a matrix classification describing six types of interventions and three distinct spatial focal points (see table III). There are six intervention types (rows): availability, position, functionality, presentation, size and information (Hollands, et al., 2017). These six intervention types can be divided into two higher-order classes of intervention: placement and properties. Furthermore, the typology distinguishes between three different spatial focal points: product, related objects and wider environment (Hollands, et al., 2017).

The authors note that although TIPPME interventions may in some ways, map the idea of nudging, this is not a necessary feature of the typology. Instead, it is related to the more general and readily definable concept of the physical environment and the ways in which this can be altered to change behaviour (Hollands, et al., 2017).

		Intervention Focus		
Class	**Intervention type**	**Product**	**Related objects**	**Wider environment**
Placement	Availability			
	Position			
Properties	Functionality	18 possible intervention categories		
	Presentation			
	Size			
	Information			

Table III TIPPME intervention typology (Hollands, et al., 2017)

A marketing and nudge framework for restaurants

With the aim to move towards more healthy eating patterns, various researches have considered nudging as a valuable tool. Within the context of promoting healthy food in a restaurant context, Kraak et al. (2017) adapted existing choice architecture frameworks to develop a new framework. The proposed framework is a combination of the features of three frameworks (Hollands et al., 2017; Münscher et al., 2015; and Gittelsohn & Lee, 2012) and is composed of marketing mix interventions and choice architecture strategies (Kraak et al., 2017). The eight strategies consist of place, profile, portion, pricing, promotion, healthy default picks, priming or prompting and proximity (Kraak et al., 2017). In table 6, the eight strategies with their respective descriptions are listed. The addition of marketing mix interventions within the framework differentiates this framework from the others that were discussed, making it a more tangible framework for restaurant owners in practice.

Strategy	Description
Place	Use light and visual cues to highlight healthy food and beverage choices.
Profile	Use fresh and healthy ingredients to ensure that 50% or more of meals meet recommended nutrient targets.
Portion	Reduce and standardize meal portion sizes.
Pricing	Use pricing strategies to increase sales and revenue for healthy choices.
Promotion	Use responsible marketing practices to promote healthy food and beverages.
Picks	Use environmental cues that are convenient, accepted and expected to socially normalize healthy default choices.
Priming or Prompting	Offer menu labelling and contextual info to help customers make healthy choices.

Table IV Marketing mix and choice architecture framework (Kraak et al., 2017)

Cadario & Chandon's framework

Within the context of healthy eating nudges, Cadario and Chandon (2020) developed a classification that allow them to conduct a meaningful meta-analysis. On the conceptual level, the framework proposed by Cadario and Chandon (2020) is based on the classic tripartite classification of mental activities (Cadario & Chandon, 2020). This classification, which can be traced back to 18th-century German philosophy, makes the distinction of mental activities into cognition, affect and behavior (Hilgard, 1980; Cadario & Chandon, 2020).

Within the context of nudging Cadario and Chandon (2020) made the distinction between the following interventions:

(1) <u>Cognitively oriented interventions</u> that seek to influence what consumers know (e.g. providing the consumer with information about calories) (Cadario & Chandon, 2020).
(2) <u>Affectively oriented interventions</u> that seek to influence how consumers feel without necessarily changing what they know (e.g. enhancing the display of a product to make it more attractive) (Cadario & Chandon, 2020).
(3) <u>Behaviorally oriented interventions</u> that seek to influence what consumers do without necessarily changing what they know or how they feel (e.g. reducing the plates or portion sizes of unhealthy options) (Cadario & Chandon, 2020).

Within each of the three types described above, Cadario and Chandon further distinguish subtypes that share similar characteristics. This subcategorization was made by Cadario and Chandon to enable a meaningful meta-analysis and is based on existing classification, such as the distinction between descriptive and evaluative nutritional labelling.

Cadario and Chandon (2020) further differentiate subtypes of each of the three types mentioned above that share similar characteristics. Existing classification have been used to subcategorize the three types into subtypes (Cadario & Chandon, 2020), as shown in table V. Within the context of sustainability, Vandenbroele et al (2019) have used this framework to conduct a review of interventions that aim to promote sustainable food choices and discourage less sustainable options. Compared with the original categories suggested by Cadario and Chandon, the authors extended the framework by further categorising hedonic enhancements into the main sensory characteristics of nudges (Vision, Taste, Audition, Haptics and Olfaction) (Vandenbroele et al., 2019).

Intervention type	Subtype	Description	Example
Cognitively oriented nudges	Descriptive nutrition labelling	Providing information about nutrients (e.g. on the labels of food packaging).	Nutrition labelling.
	Evaluative nutrition labelling	Providing nutrition information but also helps consumers to interpret the presented information (e.g. usage of colour codes).	Usage of smileys on packaging.
	Visibility enhancements	Informing customers of the availability of healthy food options by increasing their visibility (e.g. placing healthy food options on top of the menu).	Making the healthier options more visible in stores.
Affectively oriented nudges	Hedonic enhancements	Increasing the hedonic appeal of healthy options by using vivid hedonic descriptions or attractive displays, photo's or containers.	Making a product more attractive by enhancing the display or the description.
	Healthy eating calls	Directly encouraging people to be better by placing signs or stickers.	Stickers in a cafeteria that state "Have a salad for lunch".
Behaviorally oriented nudges	Convenience enhancements	Making it physically easier for people to select or consume healthy options.	Introducing a "grab and go" line in the cafeteria for salads.
	Size enhancements	Modifying the size of a plates or portions.	Smaller plates or portions for unhealthy options.

Table V Categorization of Nudge Interventions according to Cadario and Chandon (2020)

Masterproef Jan Muysoms v2

Q7
Beste participant,

Het invullen van de vragenlijst zal **5-6 minuten** duren. Deelnemen aan dit onderzoek is **niet verplicht**, de vragenlijst kan op elk moment afgesloten worden en uw gegevens zullen in dat scenario verwijderd worden. De vragenlijst is volledig anoniem en de gegevens zullen enkel gebruikt worden voor het onderzoek.

Er zijn in deze vragenlijst ook géén juiste of foute antwoorden; we zijn enkel geïnteresseerd in uw mening en voorkeuren.

Na het verzamelen van antwoorden zullen er willekeurig **twee Bol.com cadeaubonnen** ter waarde van **€25,00** worden toegekend aan willekeurige participanten.

Alvast hartelijk bedankt voor uw deelname,

Jan Muysoms
Student master Handelsingenieur, Universiteit Gent
Jan.muysoms@ugent.be

Q37 Door deel te nemen aan deze studie, participeer je in onderzoek van de vakgroep Marketing, Innovatie en Organisatie van de Universiteit Gent. Als participant van dit onderzoek:(1) Neem ik vrijwillig deel aan het onderzoek.(2) Geef ik toestemming aan de onderzoeker om mijn data op anonieme wijze te bewaren, verwerken en rapporteren.(3) Ben ik op de hoogte van de mogelijkheid om mijn deelname aan het onderzoek op ieder moment stop te zetten. Gelieve aan te duiden:

○ Ik heb bovenstaande informatie gelezen en stem er mee in (1)

○ Ik heb bovenstaande informatie gelezen en stem er niet mee in (2)

Q36
In deze vragenlijst willen we u vragen om u voor te stellen dat u online een bestelling zou plaatsen voor een boek.

Het beslissingsproces van het online bestellen van een boek kan vereenvoudigd voorgesteld worden door de volgende stappen: Selectie product(en), Selectie betalingsmethode en Selectie levering.

Bij de hierop volgende vragen zal u voor elke stap in het beslissingsproces een keuze moeten maken met betrekking tot het online aankopen van een boek.

Q41

Q45 **1. Selectie producten(en)**

Q43 Selecteer het boek waar uw voorkeur naar gaat.

○ Image:1 (1)

○ Image:2 (2)

○ Image:3 (3)

Q44 1. Selectie producten(en)

Q46 Selecteer het boek waar uw voorkeur naar gaat.

○ Image:1 (1)

○ Image:2 (2)

○ Image:3 (3)

Q45 1. Selectie producten(en)

Q48 Selecteer het boek waar uw voorkeur naar gaat.

○ Image:1 (1)

○ Image:2 (2)

○ Image:3 (3)

Q47 **3. Selectie betalingsmethode**

Q55

Q58 Selecteer de betalingsmethode waarmee je het gekozen boek wilt betalen.

○ Image:Betalings methode 1 (1)

○ Image:Betalings methode 2 (2)

○ Image:Betalings methode 3 (3)

End of Block: Choice of payment method

Start of Block: Condition 1 - Default rule

Q61 **3. Selectie levering**

Q56

⊙

Q64 Selecteer het (gratis) bezorgmoment.

○ Image:Default 1 (1)

○ Image:Default 2   (2)

End of Block: Condition 1 - Default rule

Q62 3. Selectie levering

Q57

⊙

Q66 Selecteer het (gratis) bezorgmoment.

○ Image:Disclosure 1 (1)

○ Image:Disclosure 2 (2)

Q49 3. Selectie levering

Q58

⊙

Q74 Selecteer het (gratis) bezorgmoment.

○ Image:Social reference 1 (1)

○ Image:Social reference 2 (2)

Q50 3. Selectie levering

Q59

⊙

Q67 Selecteer het (gratis) bezorgmoment.

○ Image:Default + disclosure 1 (1)

○ Image:Default + disclosure 2 (2)

Q51 3. Selectie levering

Q60

⊙

Q68 Selecteer het (gratis) bezorgmoment.

○ Image:Default + Social reference 1 (1)

○ Image:Default + Social reference 2 (2)

Q52 3. Selectie levering

Q61

⊙

Q71 Selecteer het (gratis) bezorgmoment.

○ Image:Disclosure + Social reference 1 (1)

○ Image:Disclosure + Social reference 2 (2)

Q53 3. Selectie levering

Q62

⊙

Q72 Selecteer het (gratis) bezorgmoment.

○ Image:Default + Disclosure + Social reference 1 (1)

○ Image:Default + Disclosure + Social reference 2 (2)

Q54 3. Selectie levering

Q63

⊙

Q73 Selecteer het (gratis) bezorgmoment.

○ Image:Controle 1 (1)

○ Image:Controle 2 (2)

Q64 **Mijn uiteindelijke beslissing over de bezorgoptie werd gedreven door ...**

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)	
mijn gedachten	○	○	○	○	○	○	○	mijn gevoelens
mijn wilskracht	○	○	○	○	○	○	○	mijn verlangen
mijn voorzichtige zelf	○	○	○	○	○	○	○	mijn impulsieve zelf
de rationele kant van mij	○	○	○	○	○	○	○	de emotionele kant van mij
mijn hoofd	○	○	○	○	○	○	○	mijn hart

Q64 **Met betrekking tot het boek dat ik heb gekozen ...**

	1 (Helemaal niet mee eens) (1)	2 (2)	3 (3)	4 (neutraal) (4)	5 (5)	6 (6)	7 (Helemaal mee eens) (7)
Ik heb het gevoel dat het product al van mij is (1)	○	○	○	○	○	○	○
Ik voel een zeer hoge mate van persoonlijk eigendom van het product (2)	○	○	○	○	○	○	○
Ik heb het gevoel dat ik het product bezit (3)	○	○	○	○	○	○	○
Duid "Helemaal mee eens" aan (7)	○	○	○	○	○	○	○
Ik voel me gehecht aan het door mij gekozen product (4)	○	○	○	○	○	○	○

End of Block: Psychological Ownership

Start of Block: Anticipated Guilt

Q68 Ik zou me onverantwoordelijk voelen als ik niet de meest duurzame bezorgoptie heb gekozen

○ 1 (Helemaal niet mee eens) (1)

○ 2 (2)

○ 3 (3)

○ 4 (neutraal) (4)

○ 5 (5)

○ 6 (6)

○ 7 (Helemaal mee eens) (7)

Q69 Ik zou me schuldig voelen als ik niet kies voor de meest duurzame bezorgoptie

○ 1 (Helemaal niet mee eens) (1)

○ 2 (2)

○ 3 (3)

○ 4 (neutraal) (4)

○ 5 (5)

○ 6 (6)

○ 7 (Helemaal mee eens) (7)

Q70 Ik zou me verantwoordelijk voelen als ik niet help om het milieu te beschermen

○ 1 (Helemaal niet mee eens) (1)

○ 2 (2)

○ 3 (3)

○ 4 (neutraal) (4)

○ 5 (5)

○ 6 (6)

○ 7 (Helemaal mee eens) (7)

End of Block: Anticipated Guilt

Start of Block: Environmental Concern - GREEN scale

Q62 **In welke mate ben je het eens met de volgende uitspraken?**

	1 (Helemaal niet mee eens) (1)	2 (2)	3 (3)	4 (neutraal) (4)	5 (5)	6 (6)	7 (Helemaal mee eens) (7)
Ik vind het belangrijk dat de producten die ik gebruik niet schadelijk zijn voor het milieu (1)	○	○	○	○	○	○	○
Ik houd bij het nemen van veel van mijn beslissingen rekening met de mogelijke milieu-impact van mijn acties (2)	○	○	○	○	○	○	○
Mijn aankoop gewoonten worden beïnvloed door mijn bezorgdheid voor het milieu (3)	○	○	○	○	○	○	○
Ik maak me zorgen over het verspillen van de hulpbronnen van onze planeet (4)	○	○	○	○	○	○	○
Ik zou mezelf omschrijven als ecologisch verantwoord (5)	○	○	○	○	○	○	○
Ik ben bereid om milieuvriendelijkere acties te ondernemen, ook al is deze lastiger om uit te voeren (6)	○	○	○	○	○	○	○

End of Block: Environmental Concern - GREEN scale

Start of Block: Purchase behaviour

Q75 Heb je de voorbije 12 maand producten of diensten aangekocht via het internet?

☐   Ja, via een smartphone (1)

☐   Ja, via een laptop of desktop (2)

☐   Ja, via tablet (3)

☐   Neen (4)

☐   Geen idee (5)

Q76 Hoe regelmatig koop je producten of diensten op het internet?

○ Op dagelijkse basis (1)

○ Op wekelijkse basis (2)

○ Op maandelijkse basis (3)

○ Elke 1 tot 3 maanden (4)

○ Elke 3 tot 6 maanden (5)

○ Elke 6 tot 12 maanden (6)

○ Minder dan 1 keer per jaar (7)

○ Nooit (8)

○ Geen idee (9)

Q32 Wat is uw **geslacht**?

◯ Man (1)

◯ Vrouw (2)

◯ Ander (3)

---

*

Q18 Wat is uw **leeftijd**? (in jaren uitgedrukt)

_____

End of Block: Gender and age

Start of Block: Education, employment situation and income

Q56 Wat is het **hoogste opleidingsniveau** dat u hebt voltooid of de hoogste graad die u hebt behaald?

◯ Middelbaar school diploma (BSO/TSO/ASO) of vergelijkbaar (1)

◯ Hoger onderwijs: Bachelor (2)

◯ Hoger onderwijs: Master (3)

◯ PhD (4)

◯ Anders (6) _____

Q57 Welk van de onderstaande opties beschrijft best uw **huidige werksituatie**?

○ Student (1)

○ Werkzoekende (2)

○ Werknemer (3)

○ Gepensioneerd (4)

○ Zelfstandige (5)

○ Anders (7) _____

✳

Q64
Vul uw **e-mailadres** in indien u kans wilt maken op één van de twee **Bol.com cadeaubonnen** ter waarde van **€25,00**:

_____

Bedankt voor uw deelname aan dit onderzoek.

Uw antwoorden werden goed geregistreerd.

Wanneer u in de toekomst nog wenst deel te nemen aan online onderzoek van de vakgroep Marketing van de Universiteit Gent of wilt deelnemen aan studies in het consumentenlab, dan kan u zich registreren voor het onderzoekspanel. U zal dan regelmatig uitgenodigd worden om aan onderzoek van de vakgroep Marketing deel te nemen. Deelname aan studies in het consumentenlab levert u 5 tot 9 EUR op. Bij deelname aan online onderzoek maakt u kans op leuke prijzen, zoals bons van FNAC, Bol.com & Kinepolis.

Geïnteresseerd? Klik dan op onderstaande link om u te registreren:

https://www.consumerlab.ugent.be/nl/formulier.htm

Nogmaals hartelijk bedankt voor uw deelname aan dit onderzoek.

Attachment 3 Demographic characteristics sample

Variable		Percent
Gender	Male	54,3%
	Female	45,5%
	Other	0,2%
Age in Years	12-21	32,4%
	22-31	60,4%
	32-41	0,8%
	42-51	3,0%
	52-61	2,6%
	61+	0,8%
	12-21	32,4%
Education	High School degree	26,8%
	Higher education: Bachelor	46,3%
	Higher education: Master	25,6%
	Other	1,4%
Occupation	Student	72,2%
	Employee	21,9%
	Other	5,9%
E-commerce Use	On a daily basis	0,4%
	On a weekly basis	15,7%
	On a monthly base	42,7%
	Every 1 to 3 months	24,5%
	Every 3 to 6 months	10,9%
	Every 6 to 12 months	3,4%
	Less than once a year	1,6%
	Never	0,6%
	No idea	0,2%

Attachment 4 SPSS output logistic regression individual nudges

Attachment 5 SPSS output logistic regressions H4

Default rule in comparison with Default rule + Disclosure and Default rule + Social Reference

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1ᵃ	Disclosure	2,126	,422	25,319	1	,000	8,379
	Social Reference	-,020	,384	,003	1	,959	,980
	Gender	,553	,330	2,812	1	,094	1,738
	Age	,033	,019	2,963	1	,085	1,033
	Constant	-2,259	,737	9,387	1	,002	,105

a. Variable(s) entered on step 1: Disclosure, Social Reference, Gender, Age.

Disclosure in comparison with Disclosure + Default and Disclosure + Social Reference

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1ᵃ	Default	,989	,421	5,506	1	,019	2,687
	Social Reference	,209	,385	,295	1	,587	1,233
	Gender	,908	,351	6,710	1	,010	2,480
	Age	,024	,029	,694	1	,405	1,025
	Constant	-1,410	,845	2,783	1	,095	,244

a. Variable(s) entered on step 1: Default, Social Reference, Gender, Age.

Social Reference in comparison with Social Reference + Default and Social Reference + Disclosure

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1ᵃ	Default	1,208	,450	7,194	1	,007	3,347
	Disclosure	2,488	,464	28,795	1	,000	12,032
	Gender	,323	,344	,881	1	,348	1,381
	Age	,026	,017	2,521	1	,112	1,027
	Constant	-2,962	,777	14,514	1	,000	,052

a. Variable(s) entered on step 1: Default, Disclosure, Gender, Age.

Attachment 6 SPSS output logistic regressions H5

Default rule + Disclosure in comparison with Default rule + Disclosure + Social Reference

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Social Reference	-,374	,448	,696	1	,404	,688
	Gender	1,130	,473	5,716	1	,017	3,095
	Age	,065	,060	1,172	1	,279	1,067
	Constant	-1,646	1,582	1,082	1	,298	,193

a. Variable(s) entered on step 1: Social Reference, Gender, Age.

Default rule + Social Reference in comparison with Default rule + Disclosure + Social Reference

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Disclosure	1,718	,408	17,722	1	,000	5,576
	Gender	,353	,397	,789	1	,374	1,423
	Age	,026	,021	1,476	1	,224	1,026
	Constant	-1,783	,922	3,736	1	,053	,168

a. Variable(s) entered on step 1: Disclosure, Gender, Age.

Disclosure + Social Reference in comparison with Default rule + Disclosure + Social Reference

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Default	,367	,412	,792	1	,373	1,443
	Gender	1,151	,446	6,653	1	,010	3,162
	Age	,017	,033	,257	1	,612	1,017
	Constant	-1,342	1,061	1,600	1	,206	,261

a. Variable(s) entered on step 1: Default, Gender, Age.

Attachment 7 Cronbach's alpha reliability tests

Environmental Concern

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,895	,895	6

Item Statistics

	Mean	Std. Deviation	N
In welke mate ben je het eens met de volgende uitspraken? - Ik vind het belangrijk dat de producten die ik gebruik niet schadelijk zijn voor het milieu	5,00	1,272	497
In welke mate ben je het eens met de volgende uitspraken? - Ik houd bij het nemen van veel van mijn beslissingen rekening met de mogelijke milieu-impact van mijn acties	4,31	1,470	497
In welke mate ben je het eens met de volgende uitspraken? - Mijn aankoop gewoonten worden beïnvloed door mijn bezorgdheid voor het milieu	3,94	1,495	497
In welke mate ben je het eens met de volgende uitspraken? - Ik maak me zorgen over het verspillen van de hulpbronnen van onze planeet	5,11	1,459	497
In welke mate ben je het eens met de volgende uitspraken? - Ik zou mezelf omschrijven als ecologisch verantwoord	4,02	1,283	497
In welke mate ben je het eens met de volgende uitspraken? - Ik ben bereid om milieuvriendelijkere acties te ondernemen, ook al is deze lastiger om uit te voeren	4,91	1,305	497

Psychological Ownership

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,857	,856	4

Item Statistics

	Mean	Std. Deviation	N
Met betrekking tot het boek dat ik heb gekozen ... - Ik heb het gevoel dat het product al van mij is	4,14	1,720	497
Met betrekking tot het boek dat ik heb gekozen ... - Ik voel een zeer hoge mate van persoonlijk eigendom van het product	3,81	1,560	497
Met betrekking tot het boek dat ik heb gekozen ... - Ik heb het gevoel dat ik het product bezit	3,83	1,654	497
Met betrekking tot het boek dat ik heb gekozen ... - Ik voel me gehecht aan het door mij gekozen product	3,55	1,529	497

Anticipated Guilt

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,850	,850	3

Item Statistics

	Mean	Std. Deviation	N
Ik zou me onverantwoordelijk voelen als ik niet de meest duurzame bezorgoptie heb gekozen	4,11	1,760	497
Ik zou me schuldig voelen als ik niet kies voor de meest duurzame bezorgoptie	4,17	1,757	497
Ik zou me verantwoordelijk voelen als ik niet help om het milieu te beschermen	4,54	1,615	497

Decision Basis

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,775	,775	5

Item Statistics

	Mean	Std. Deviation	N
Mijn uiteindelijke beslissing over de bezorgoptie werd gedreven door ... - mijn gedachten:mijn gevoelens	3,39	1,736	497
Mijn uiteindelijke beslissing over de bezorgoptie werd gedreven door ... - mijn wilskracht:mijn verlangen	4,28	1,659	497
Mijn uiteindelijke beslissing over de bezorgoptie werd gedreven door ... - mijn voorzichtige zelf:mijn impulsieve zelf	4,11	1,618	497
Mijn uiteindelijke beslissing over de bezorgoptie werd gedreven door ... - de rationele kant van mij:de emotionele kant van mij	3,27	1,652	497
Mijn uiteindelijke beslissing over de bezorgoptie werd gedreven door ... - mijn hoofd:mijn hart	3,17	1,633	497

Attachment 8 Moderation analysis Environmental Concern

Moderation analysis Default Rule with moderator Environmental Concern

```
Run MATRIX procedure:

**************** PROCESS Procedure for SPSS Version 3.5.3 ****************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
     Documentation available in Hayes (2018). www.guilford.com/p/hayes3

*************************************************************************
Model  : 1
    Y  : DO
    X  : DN
    W  : EC

Covariates:
 Gender   Age

Sample
Size:  126

*************************************************************************
OUTCOME VARIABLE:
 DO

Coding of binary Y for logistic regression analysis:
       DO   Analysis
      ,00        ,00
     1,00       1,00

Model Summary
       -2LL      ModelLL         df          p    McFadden   CoxSnell   Nagelkrk
     91,4319    39,5022     5,0000       ,0000       ,3017      ,2691       ,4164

Model
              coeff          se           Z           p         LLCI         ULCI
constant    -7,1423      2,9392     -2,4300       ,0151     -12,9030     -1,3816
DN          -1,1176      3,2762      -,3411       ,7330      -7,5389      5,3037
EC            ,3867       ,5146       ,7514       ,4524       -,6219      1,3953
Int_1         ,7659       ,6443      1,1887       ,2346       -,4970      2,0287
Gender        ,3314       ,5422       ,6113       ,5410       -,7312      1,3941
Age           ,0780       ,0274      2,8471       ,0044        ,0243       ,1317

These results are expressed in a log-odds metric.

Product terms key:
 Int_1    :           DN          x           EC

Likelihood ratio test(s) of highest order
unconditional interactions(s):
       Chi-sq          df           p
X*W     1,4141      1,0000       ,2344
----------
    Focal predict: DN        (X)
         Mod var: EC         (W)

Conditional effects of the focal predictor at values of the moderator(s):
```

```
          EC     Effect         se          Z          p       LLCI       ULCI
       3,5000     1,5629     1,1695     1,3364      ,1814     -,7292     3,8550
       4,5000     2,3288      ,7481     3,1127      ,0019      ,8624     3,7951
       5,6667     3,2223      ,8164     3,9470      ,0001     1,6222     4,8223

Data for visualizing the conditional effect of the focal predictor:
Paste text below into a SPSS syntax window and execute to produce plot.

DATA LIST FREE/
   DN         EC         DO         prob        .
BEGIN DATA.
      ,0000     3,5000    -3,4189       ,0317
     1,0000     3,5000    -1,8560       ,1352
      ,0000     4,5000    -3,0323       ,0460
     1,0000     4,5000     -,7035       ,3310
      ,0000     5,6667    -2,5812       ,0704
     1,0000     5,6667      ,6411       ,6550
END DATA.
GRAPH/SCATTERPLOT=
 EC      WITH     DO        BY        DN         .
GRAPH/SCATTERPLOT=
 EC      WITH     prob      BY        DN         .

********************** ANALYSIS NOTES AND ERRORS ***********************

Level of confidence for all confidence intervals in output:
  95,0000

W values in conditional tables are the 16th, 50th, and 84th percentiles.

------ END MATRIX -----
```

Moderation analysis Disclosure with moderator Environmental Concern

```
Run MATRIX procedure:

**************** PROCESS Procedure for SPSS Version 3.5.3 ***************

          Written by Andrew F. Hayes, Ph.D.      www.afhayes.com
    Documentation available in Hayes (2018). www.guilford.com/p/hayes3

*************************************************************************
Model  : 1
    Y  : DO
    X  : DISCN
    W  : EC

Covariates:
 Gender   Age

Sample
Size:  124

*************************************************************************
OUTCOME VARIABLE:
 DO

Coding of binary Y for logistic regression analysis:
      DO  Analysis
     ,00       ,00
    1,00      1,00
```

```
Model Summary
        -2LL     ModelLL        df          p   McFadden  CoxSnell  Nagelkrk
    104,2310    54,5326     5,0000      ,0000      ,3435     ,3558      ,4928

Model
              coeff         se          Z          p       LLCI       ULCI
constant    -7,2591     2,9503    -2,4605      ,0139   -13,0416    -1,4767
DISCN        3,3925     2,9856     1,1363      ,2558    -2,4591     9,2442
EC            ,3866      ,5155      ,7499      ,4533     -,6239     1,3970
Int_1        ,0382      ,5801      ,0659      ,9474    -1,0988     1,1753
Gender       ,3892      ,4891      ,7958      ,4262     -,5694     1,3479
Age          ,0790      ,0301     2,6214      ,0088      ,0199      ,1380

These results are expressed in a log-odds metric.

Product terms key:
 Int_1    :        DISCN     x         EC

Likelihood ratio test(s) of highest order
unconditional interactions(s):
        Chi-sq        df          p
X*W      ,0043     1,0000      ,9475
----------
    Focal predict: DISCN    (X)
          Mod var: EC       (W)

Conditional effects of the focal predictor at values of the moderator(s):

          EC     Effect         se          Z          p       LLCI       ULCI
      3,5000     3,5264     1,1159     3,1600      ,0016     1,3392     5,7136
      4,6667     3,5710      ,7221     4,9450      ,0000     2,1556     4,9864
      5,8333     3,6156      ,8449     4,2795      ,0000     1,9597     5,2716

Data for visualizing the conditional effect of the focal predictor:
Paste text below into a SPSS syntax window and execute to produce plot.

DATA LIST FREE/
   DISCN       EC          DO          prob        .
BEGIN DATA.
     ,0000     3,5000    -3,4340       ,0312
    1,0000     3,5000      ,0924       ,5231
     ,0000     4,6667    -2,9830       ,0482
    1,0000     4,6667      ,5880       ,6429
     ,0000     5,8333    -2,5320       ,0736
    1,0000     5,8333     1,0836       ,7472
END DATA.
GRAPH/SCATTERPLOT=
 EC       WITH    DO       BY       DISCN    .
GRAPH/SCATTERPLOT=
 EC       WITH    prob     BY       DISCN    .

*********************** ANALYSIS NOTES AND ERRORS ***********************

Level of confidence for all confidence intervals in output:
  95,0000

W values in conditional tables are the 16th, 50th, and 84th percentiles.

------ END MATRIX -----
```

L

Moderation analysis Social Reference with moderator Environmental Concern

```
Run MATRIX procedure:

*************** PROCESS Procedure for SPSS Version 3.5.3 ***************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2018). www.guilford.com/p/hayes3

*************************************************************************
Model  : 1
    Y  : DO
    X  : SRN
    W  : EC

Covariates:
 Gender   Age

Sample
Size:  125

*************************************************************************
OUTCOME VARIABLE:
 DO

Coding of binary Y for logistic regression analysis:
       DO  Analysis
      ,00       ,00
     1,00      1,00

Model Summary
        -2LL     ModelLL        df           p  McFadden   CoxSnell   Nagelkrk
     74,0860    13,5831      5,0000       ,0185     ,1549      ,1030      ,2043

Model
             coeff        se         Z          p       LLCI       ULCI
constant   -5,9416    2,8537   -2,0820      ,0373   -11,5348     -,3483
SRN         1,6592    3,4071     ,4870      ,6263    -5,0186     8,3369
EC           ,3935     ,5156     ,7631      ,4454     -,6172     1,4041
Int_1       -,1510     ,6681    -,2260      ,8212    -1,4604     1,1584
Gender      -,3863     ,6628    -,5828      ,5600    -1,6854      ,9128
Age          ,0721     ,0231    3,1264      ,0018      ,0269      ,1173

These results are expressed in a log-odds metric.

Product terms key:
 Int_1   :        SRN       x         EC

Likelihood ratio test(s) of highest order
unconditional interactions(s):
       Chi-sq         df          p
X*W      ,0513    1,0000      ,8209
----------
    Focal predict: SRN      (X)
          Mod var: EC       (W)

Conditional effects of the focal predictor at values of the moderator(s):

        EC     Effect        se         Z          p       LLCI       ULCI
     3,8333    1,0803    1,0303    1,0485      ,2944     -,9391     3,0997
     4,6667     ,9544     ,7103    1,3437      ,1791     -,4378     2,3467
     5,6667     ,8034     ,8090     ,9931      ,3207     -,7822     2,3890

Data for visualizing the conditional effect of the focal predictor:
Paste text below into a SPSS syntax window and execute to produce plot.
```

```
DATA LIST FREE/
   SRN        EC          DO          prob        .
BEGIN DATA.
     ,0000      3,8333    -3,2105       ,0388
    1,0000      3,8333    -2,1302       ,1062
     ,0000      4,6667    -2,8826       ,0530
    1,0000      4,6667    -1,9281       ,1270
     ,0000      5,6667    -2,4891       ,0766
    1,0000      5,6667    -1,6857       ,1563
END DATA.
GRAPH/SCATTERPLOT=
 EC        WITH     DO       BY       SRN        .
GRAPH/SCATTERPLOT=
 EC        WITH     prob     BY       SRN        .

*********************** ANALYSIS NOTES AND ERRORS ************************

Level of confidence for all confidence intervals in output:
  95,0000

W values in conditional tables are the 16th, 50th, and 84th percentiles.

------ END MATRIX -----
```

Attachment 9 Visualisation moderation Environmental Concern

Scatter Plot of prob by EC by Condition
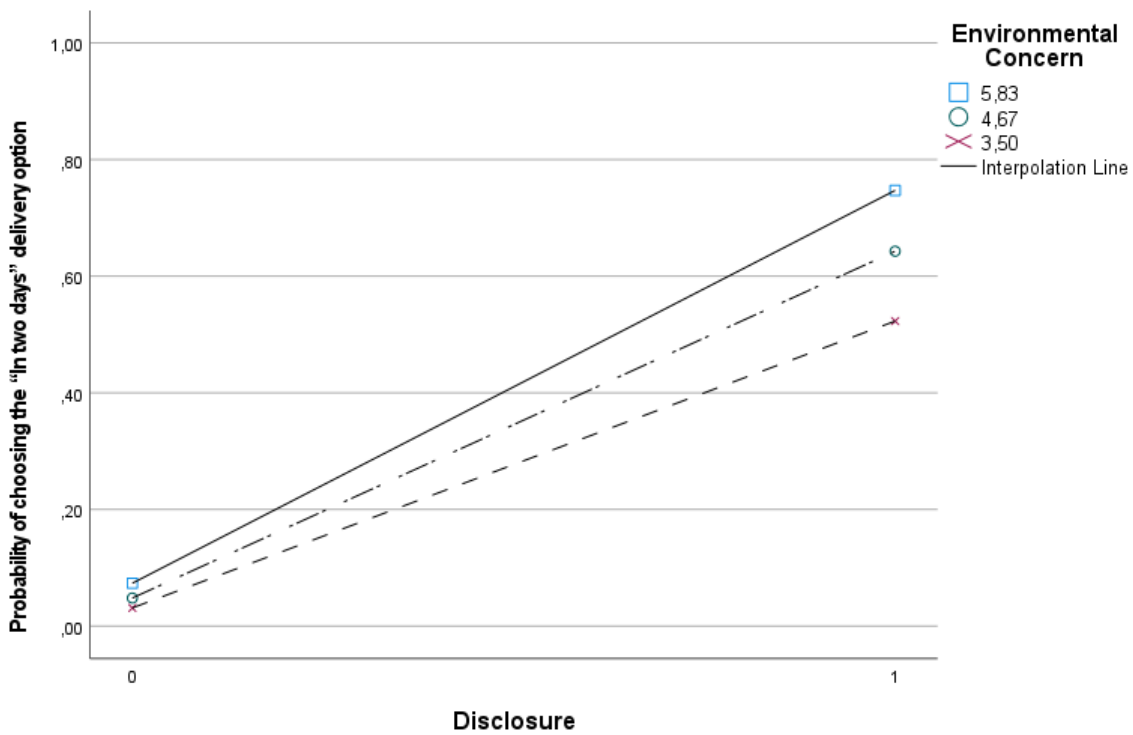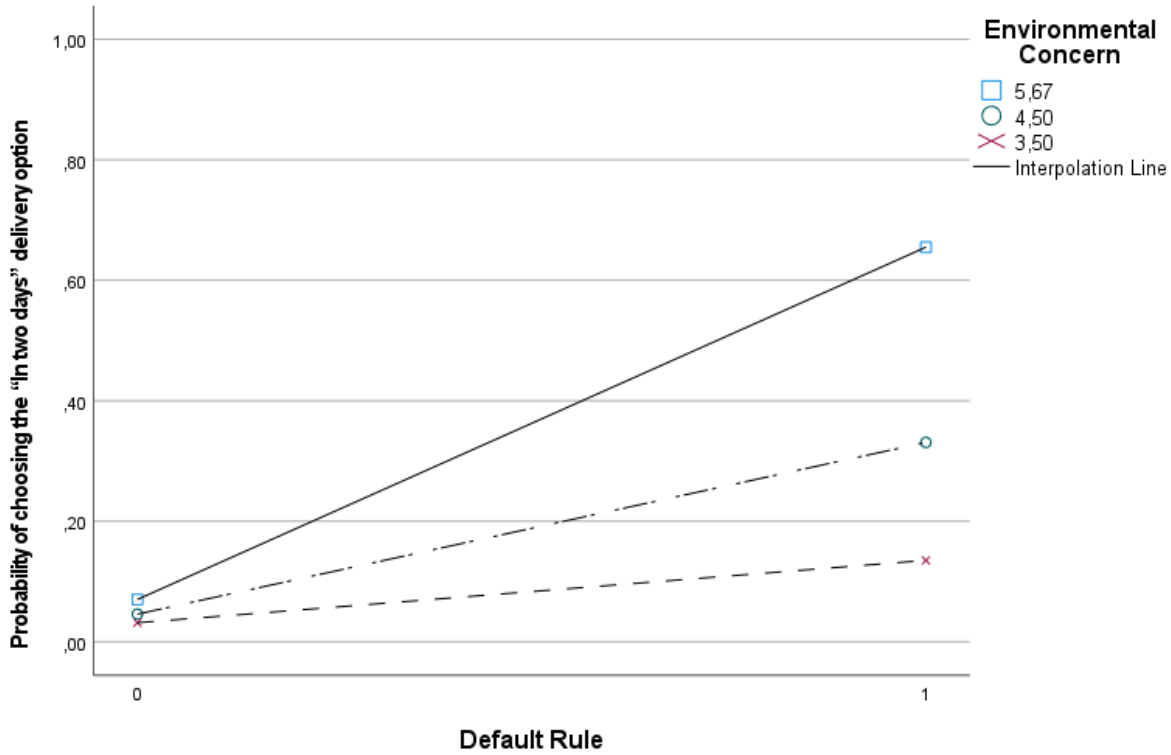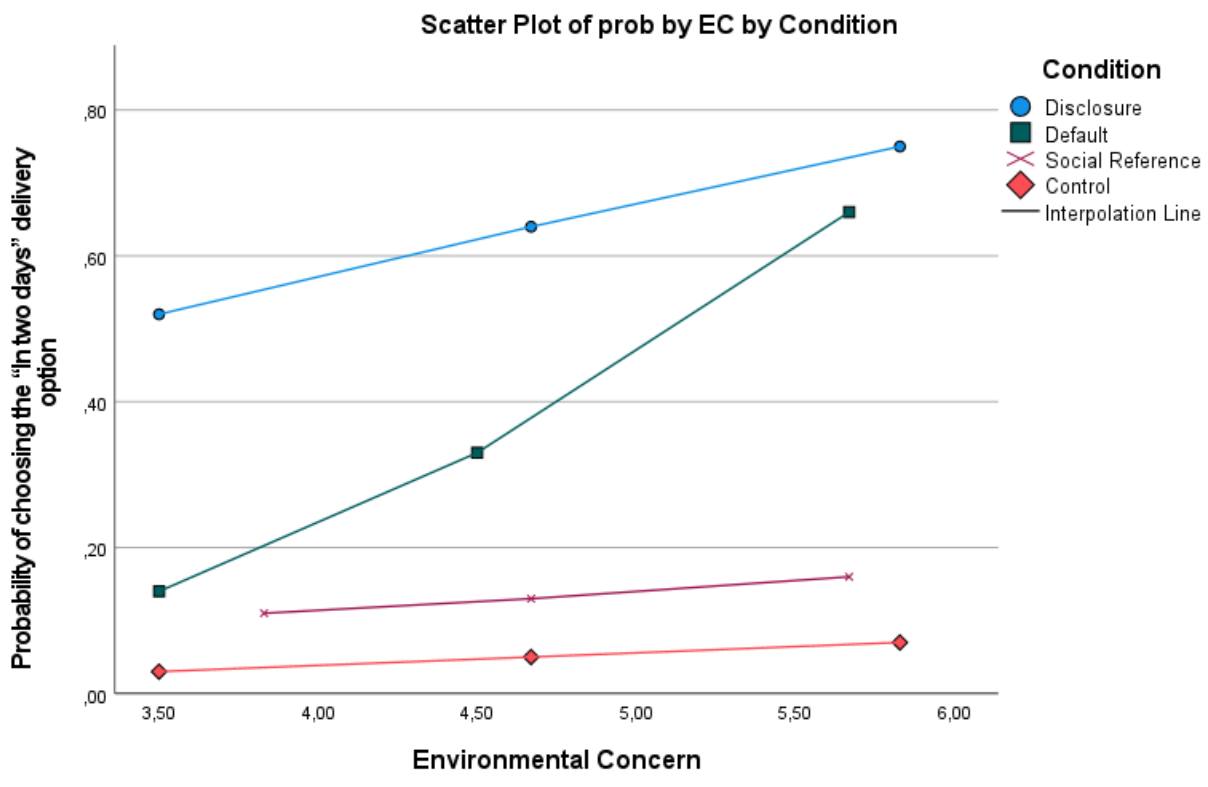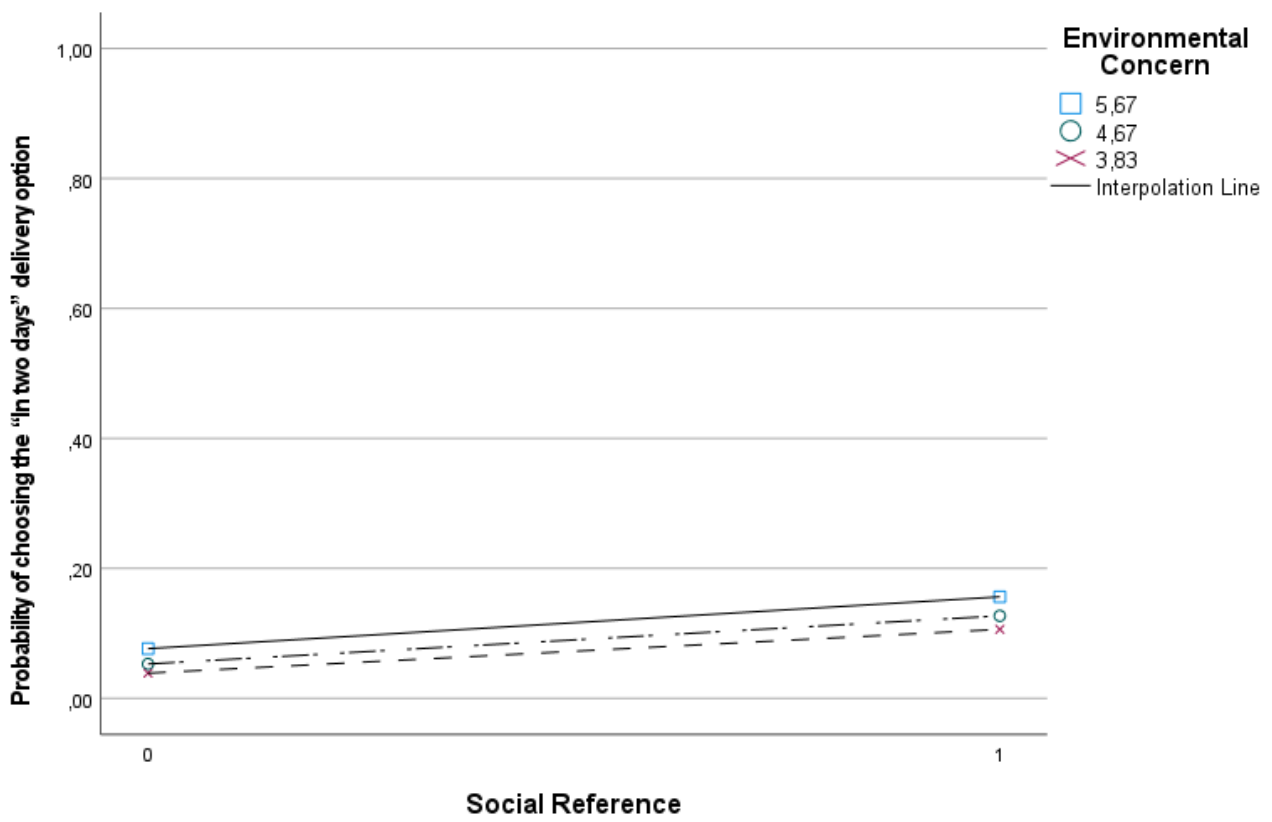
Attachment 10 Moderation analysis Psychological Ownership

Moderation analysis Default rule with moderator Psychological Ownership

```
Run MATRIX procedure:

**************** PROCESS Procedure for SPSS Version 3.5.3 ****************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2018). www.guilford.com/p/hayes3

*************************************************************************
Model  : 1
    Y  : DO
    X  : DN
    W  : PO

Covariates:
 Gender   Age

Sample
Size:  126

*************************************************************************
OUTCOME VARIABLE:
 DO

Coding of binary Y for logistic regression analysis:
      DO  Analysis
     ,00        ,00
    1,00       1,00

Model Summary
       -2LL    ModelLL        df          p   McFadden   CoxSnell   Nagelkrk
   102,5078    28,4263    5,0000      ,0000      ,2171      ,2020       ,3125

Model
            coeff        se         Z          p       LLCI       ULCI
constant  -4,7932    2,0459   -2,3429      ,0191    -8,8030     -,7834
DN         2,4253    1,9006    1,2761      ,2019    -1,2998     6,1505
PO         -,2204     ,4374    -,5038      ,6144    -1,0778      ,6370
Int_1      -,0674     ,4859    -,1387      ,8897    -1,0197      ,8849
Gender      ,5875     ,5045    1,1645      ,2442     -,4013     1,5763
Age         ,0797     ,0275    2,8977      ,0038      ,0258      ,1336

These results are expressed in a log-odds metric.

Product terms key:
 Int_1   :          DN        x         PO

Likelihood ratio test(s) of highest order
unconditional interactions(s):
      Chi-sq         df          p
X*W      ,0193    1,0000      ,8895
----------
    Focal predict: DN        (X)
         Mod var: PO        (W)

Conditional effects of the focal predictor at values of the moderator(s):

        PO     Effect        se          Z          p       LLCI       ULCI
    2,2500     2,2737      ,9478     2,3989      ,0164      ,4160     4,1313
```

```
      4,0000     2,1557     ,6634     3,2495     ,0012     ,8555     3,4559
      5,0000     2,0883     ,9096     2,2957     ,0217     ,3054     3,8712
```

Data for visualizing the conditional effect of the focal predictor:
Paste text below into a SPSS syntax window and execute to produce plot.

```
DATA LIST FREE/
   DN         PO         DO         prob        .
BEGIN DATA.
     ,0000     2,2500    -2,5016       ,0757
    1,0000     2,2500     -,2279       ,4433
     ,0000     4,0000    -2,8873       ,0528
    1,0000     4,0000     -,7316       ,3249
     ,0000     5,0000    -3,1076       ,0428
    1,0000     5,0000    -1,0193       ,2652
END DATA.
GRAPH/SCATTERPLOT=
 PO       WITH    DO       BY       DN        .
GRAPH/SCATTERPLOT=
 PO       WITH    prob     BY       DN        .
```

*********************** ANALYSIS NOTES AND ERRORS ***********************

Level of confidence for all confidence intervals in output:
  95,0000

W values in conditional tables are the 16th, 50th, and 84th percentiles.

------ END MATRIX -----

Moderation analysis Disclosure with moderator Psychological Ownership

Run MATRIX procedure:

**************** PROCESS Procedure for SPSS Version 3.5.3 ****************

          Written by Andrew F. Hayes, Ph.D.   www.afhayes.com
     Documentation available in Hayes (2018). www.guilford.com/p/hayes3

****
Model : 1
    Y : DO
    X : DISCN
    W : PO

Covariates:
 Gender   Age

Sample
Size: 124

****
OUTCOME VARIABLE:
 DO

Coding of binary Y for logistic regression analysis:
       DO   Analysis
     ,00   ,00
    1,00   1,00

Model Summary
       -2LL   ModelLL   df   p   McFadden   CoxSnell   Nagelkrk
    107,1281   51,6355   5,0000   ,0000   ,3252   ,3406   ,4717
```

```
Model
              coeff        se        Z         p        LLCI       ULCI
constant    -4,6588    2,0822    -2,2374     ,0253    -8,7398    -,5778
DISCN        2,2901    1,8941     1,2090     ,2266    -1,4223    6,0025
PO           -,2531     ,4510     -,5613     ,5746    -1,1370     ,6307
Int_1         ,2981     ,4881      ,6106     ,5414     -,6586    1,2548
Gender        ,4156     ,5077      ,8185     ,4131     -,5795    1,4107
Age           ,0877     ,0315     2,7817     ,0054      ,0259     ,1494


These results are expressed in a log-odds metric.

Product terms key:
 Int_1    :       DISCN     x       PO

Likelihood ratio test(s) of highest order
unconditional interactions(s):
        Chi-sq        df          p
X*W      ,3706     1,0000      ,5427
----------
    Focal predict: DISCN    (X)
         Mod var: PO        (W)

Conditional effects of the focal predictor at values of the moderator(s):

         PO     Effect        se         Z         p        LLCI       ULCI
      2,2500    2,9607      ,9527    3,1078     ,0019    1,0935    4,8280
      4,0000    3,4824      ,7007    4,9696     ,0000    2,1089    4,8558
      5,0000    3,7804      ,9530    3,9668     ,0001    1,9126    5,6483


Data for visualizing the conditional effect of the focal predictor:
Paste text below into a SPSS syntax window and execute to produce plot.

DATA LIST FREE/
   DISCN      PO         DO         prob       .
BEGIN DATA.
      ,0000    2,2500    -2,5071      ,0754
     1,0000    2,2500      ,4536      ,6115
      ,0000    4,0000    -2,9501      ,0497
     1,0000    4,0000      ,5322      ,6300
      ,0000    5,0000    -3,2033      ,0390
     1,0000    5,0000      ,5772      ,6404
END DATA.
GRAPH/SCATTERPLOT=
 PO       WITH    DO      BY      DISCN    .
GRAPH/SCATTERPLOT=
 PO       WITH    prob    BY      DISCN    .

*********************** ANALYSIS NOTES AND ERRORS ***********************

Level of confidence for all confidence intervals in output:
  95,0000

W values in conditional tables are the 16th, 50th, and 84th percentiles.

------ END MATRIX -----
```

Moderation analysis Social Reference with moderator Psychological Ownership

```
Run MATRIX procedure:

*************** PROCESS Procedure for SPSS Version 3.5.3 ***************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
      Documentation available in Hayes (2018). www.guilford.com/p/hayes3

***********************************************************************
Model  : 1
    Y  : DO
    X  : SRN
    W  : PO

Covariates:
 Gender   Age

Sample
Size:  125

***********************************************************************
OUTCOME VARIABLE:
 DO

Coding of binary Y for logistic regression analysis:
       DO   Analysis
      ,00       ,00
     1,00      1,00

Model Summary
        -2LL     ModelLL        df          p   McFadden   CoxSnell   Nagelkrk
     74,5316     13,1376     5,0000      ,0221      ,1499      ,0998      ,1979

Model
              coeff         se          Z          p       LLCI       ULCI
constant    -2,9722     1,9417    -1,5307      ,1258    -6,7779      ,8335
SRN          -,5298     2,0852     -,2541      ,7995    -4,6166     3,5571
PO           -,2786      ,4203     -,6628      ,5074    -1,1023      ,5452
Int_1         ,3582      ,5291      ,6769      ,4985     -,6789     1,3953
Gender       -,4291      ,6700     -,6404      ,5219    -1,7423      ,8841
Age           ,0764      ,0235     3,2499      ,0012      ,0303      ,1225

These results are expressed in a log-odds metric.

Product terms key:
 Int_1    :        SRN        x         PO

Likelihood ratio test(s) of highest order
unconditional interactions(s):
      Chi-sq         df          p
X*W      ,4553     1,0000      ,4998
----------
    Focal predict: SRN       (X)
          Mod var: PO        (W)

Conditional effects of the focal predictor at values of the moderator(s):

        PO     Effect         se          Z          p       LLCI       ULCI
     2,5000      ,3657      ,9295      ,3935      ,6940    -1,4560     2,1875
     4,2500      ,9926      ,7124     1,3933      ,1635     -,4037     2,3888
     5,0000     1,2612      ,9379     1,3447      ,1787     -,5771     3,0995

Data for visualizing the conditional effect of the focal predictor:
Paste text below into a SPSS syntax window and execute to produce plot.
```

```
DATA LIST FREE/
   SRN         PO          DO          prob        .
BEGIN DATA.
     ,0000    2,5000    -2,4005      ,0831
    1,0000    2,5000    -2,0348      ,1156
     ,0000    4,2500    -2,8880      ,0527
    1,0000    4,2500    -1,8954      ,1306
     ,0000    5,0000    -3,0969      ,0432
    1,0000    5,0000    -1,8357      ,1376
END DATA.
GRAPH/SCATTERPLOT=
 PO       WITH    DO       BY       SRN       .
GRAPH/SCATTERPLOT=
 PO       WITH    prob     BY       SRN       .

*********************** ANALYSIS NOTES AND ERRORS ***********************

Level of confidence for all confidence intervals in output:
  95,0000

W values in conditional tables are the 16th, 50th, and 84th percentiles.

------ END MATRIX -----
```

Attachment 11 Visualisation moderation Psychological Ownership

Scatter Plot of prob by PO by Condition

Attachment 12 SPSS output parallel mediation models

Parallel mediation model Default Rule with mediator Anticipated Guilt and Decision Basis

```
Run MATRIX procedure:
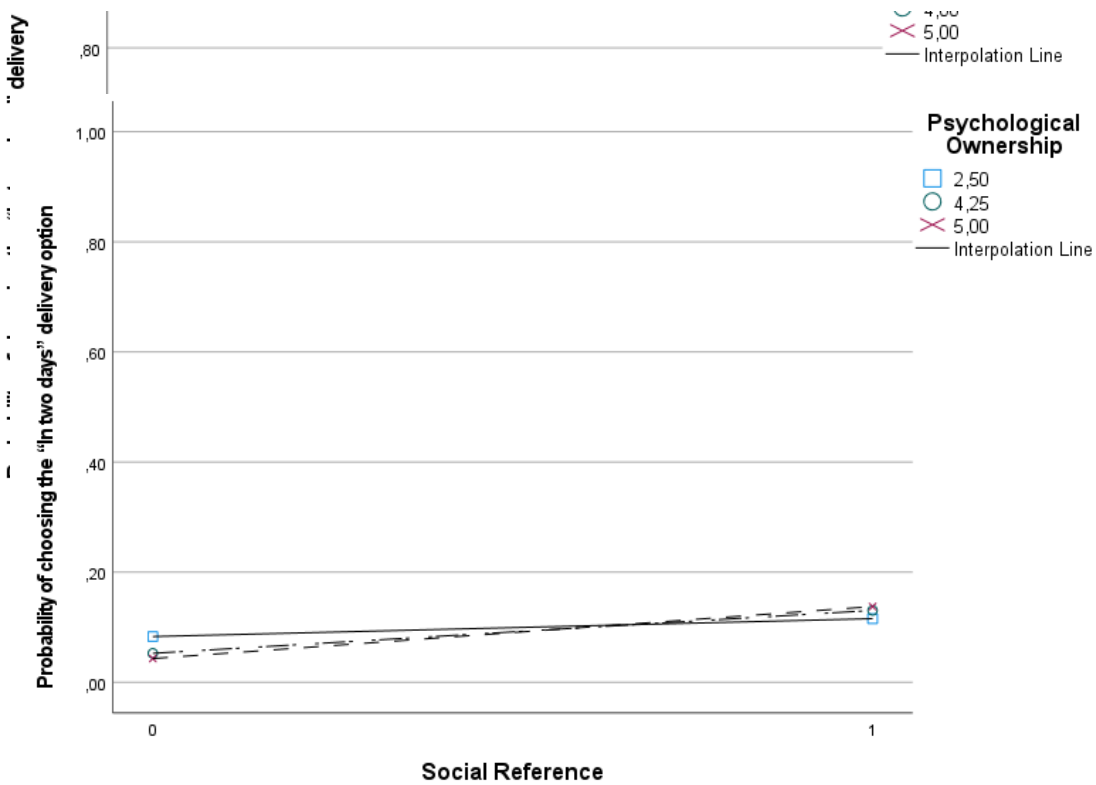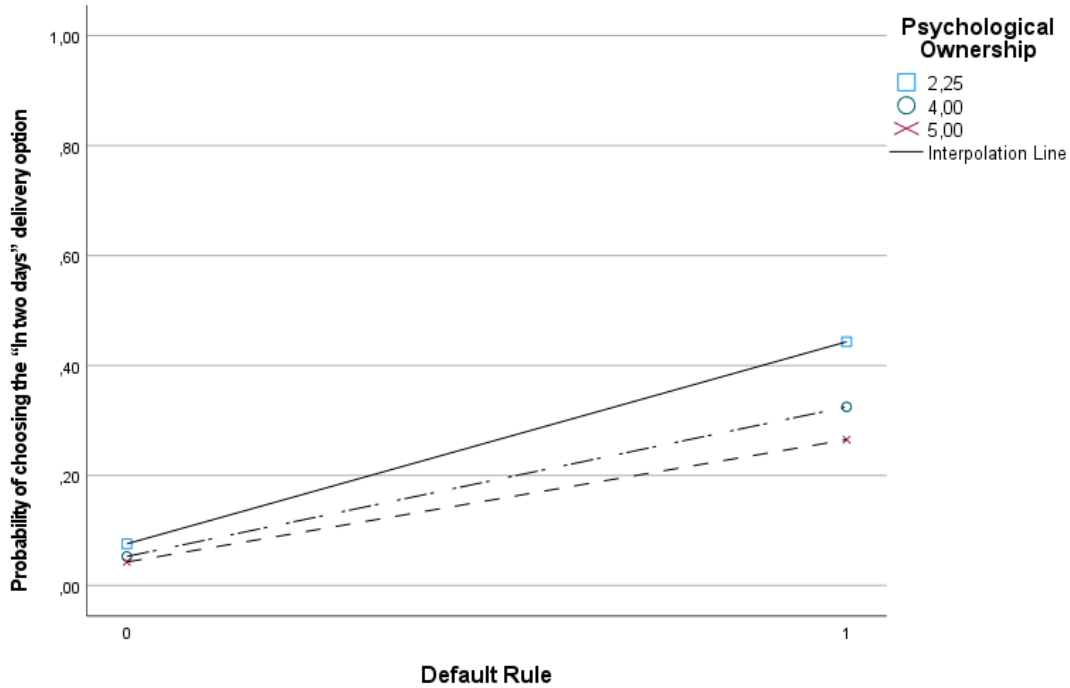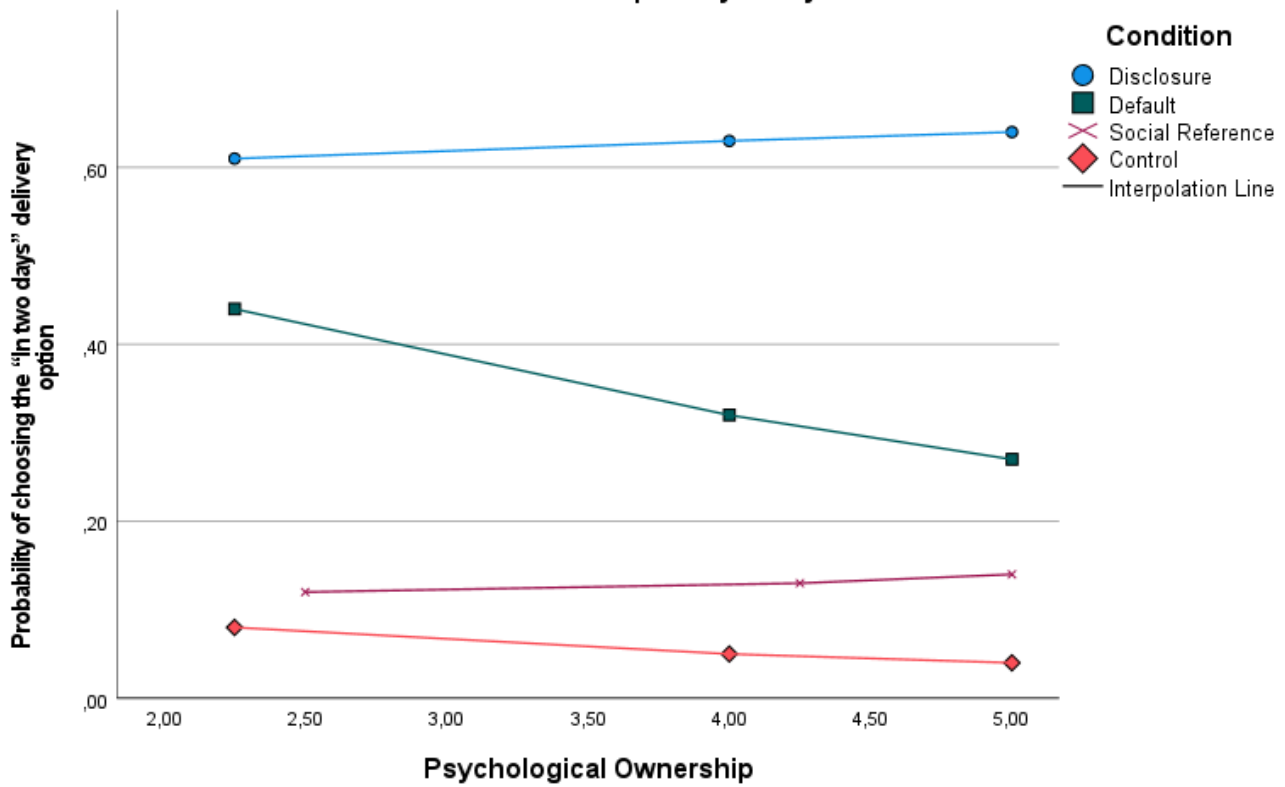
**************** PROCESS Procedure for SPSS Version 3.5.3 ****************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2018). www.guilford.com/p/hayes3

*************************************************************************
Model  : 4
    Y  : DO
    X  : DN
   M1  : AG
   M2  : DB

Covariates:
 Gender   Age

Sample
Size:  126

*************************************************************************
OUTCOME VARIABLE:
 AG

Model Summary
          R         R-sq        MSE          F         df1         df2
p
      ,3219       ,1036      2,1058     4,7023      3,0000    122,0000
,0038

Model
            coeff         se           t           p         LLCI        ULCI
constant    2,6608      ,5490      4,8463       ,0000      1,5739      3,7477
DN         -,3555      ,2600     -1,3673       ,1741      -,8701       ,1592
Gender      ,8310      ,2596      3,2004       ,0017       ,3170      1,3450
Age         ,0190      ,0152      1,2469       ,2148      -,0111       ,0491

*************************************************************************
OUTCOME VARIABLE:
 DB

Model Summary
          R         R-sq        MSE          F         df1         df2
p
      ,1055       ,0111      1,4754       ,4576      3,0000    122,0000
,7124

Model
            coeff         se           t           p         LLCI        ULCI
constant    4,0746      ,4596      8,8661       ,0000      3,1649      4,9844
DN          ,1809      ,2176       ,8314       ,4074      -,2499       ,6117
Gender     -,0858      ,2173      -,3950       ,6935      -,5161       ,3444
```

```
Age            -,0082      ,0127      -,6471       ,5188      -,0334       ,0170

*********************************************************************
OUTCOME VARIABLE:
 DO

Coding of binary Y for logistic regression analysis:
      DO  Analysis
      ,00       ,00
     1,00      1,00

Model Summary
      -2LL    ModelLL       df          p   McFadden   CoxSnell
Nagelkrk
   89,2397    41,6945    5,0000      ,0000      ,3184      ,2817
,4359

Model
            coeff       se        Z          p      LLCI       ULCI
constant  -4,2837    1,6305   -2,6272      ,0086   -7,4794    -1,0879
DN         2,9645     ,7641    3,8795      ,0001    1,4668     4,4622
AG          ,2775     ,2183    1,2711      ,2037    -,1504      ,7053
DB         -,8450     ,2641   -3,2001      ,0014   -1,3625     -,3275
Gender      ,4786     ,5857     ,8171      ,4139    -,6694     1,6267
Age         ,0851     ,0277    3,0750      ,0021     ,0309      ,1393

These results are expressed in a log-odds metric.

****************** DIRECT AND INDIRECT EFFECTS OF X ON Y *****************

Direct effect of X on Y
     Effect        se        Z          p      LLCI       ULCI
     2,9645     ,7641    3,8795      ,0001    1,4668     4,4622

Indirect effect(s) of X on Y:
          Effect    BootSE   BootLLCI   BootULCI
TOTAL     -,2515     ,2858    -,9617      ,1895
AG        -,0986     ,1472    -,4879      ,0779
DB        -,1529     ,2236    -,6702      ,2209

********************* ANALYSIS NOTES AND ERRORS **********************

Level of confidence for all confidence intervals in output:
   95,0000

Number of bootstrap samples for percentile bootstrap confidence intervals:
   5000

NOTE: Direct and indirect effects of X on Y are on a log-odds metric.

------ END MATRIX -----
```

Parallel mediation model Disclosure with mediator Anticipated Guilt and Decision Basis

```
Run MATRIX procedure:

**************** PROCESS Procedure for SPSS Version 3.5.3 ***************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2018). www.guilford.com/p/hayes3

*************************************************************************
Model  : 4
    Y  : DO
    X  : DISCN
   M1  : AG
   M2  : DB

Covariates:
 Gender   Age

Sample
Size:  124

*************************************************************************
OUTCOME VARIABLE:
 AG

Model Summary
          R        R-sq        MSE          F         df1         df2
p
      ,1865       ,0348      2,3351      1,4420      3,0000    120,0000
,2340

Model
            coeff         se          t          p        LLCI        ULCI
constant   3,3175       ,5644      5,8780       ,0000      2,2000      4,4349
DISCN       ,1423       ,2755       ,5164       ,6065     -,4032       ,6877
Gender      ,4920       ,2710      1,8154       ,0720     -,0446      1,0285
Age         ,0123       ,0158       ,7813       ,4361     -,0189       ,0436

*************************************************************************
OUTCOME VARIABLE:
 DB

Model Summary
          R        R-sq        MSE          F         df1         df2
p
      ,1107       ,0122      1,5018       ,4960      3,0000    120,0000
,6857

Model
            coeff         se          t          p        LLCI        ULCI
constant   4,0771       ,4526      9,0078       ,0000      3,1809      4,9732
DISCN      -,0051       ,2209      -,0229       ,9818     -,4425       ,4323
Gender     -,2647       ,2173     -1,2178       ,2257     -,6950       ,1656
Age         ,0021       ,0127       ,1659       ,8685     -,0230       ,0272

*************************************************************************
```

```
OUTCOME VARIABLE:
 DO

Coding of binary Y for logistic regression analysis:
       DO  Analysis
      ,00       ,00
     1,00      1,00

Model Summary
      -2LL     ModelLL        df         p    McFadden   CoxSnell
Nagelkrk
    90,7905    67,9731    5,0000     ,0000      ,4281      ,4220
,5844

Model
            coeff        se         Z         p       LLCI       ULCI
constant   -5,2081    1,7878   -2,9132     ,0036    -8,7121    -1,7041
DISCN       3,9888     ,7813    5,1053     ,0000     2,4575     5,5201
AG           ,4652     ,2003    2,3221     ,0202      ,0726      ,8578
DB          -,6473     ,2422   -2,6723     ,0075    -1,1221     -,1725
Gender      -,0607     ,5309    -,1143     ,9090    -1,1012      ,9798
Age          ,0919     ,0289    3,1822     ,0015      ,0353      ,1485

These results are expressed in a log-odds metric.

****************** DIRECT AND INDIRECT EFFECTS OF X ON Y ****************

Direct effect of X on Y
     Effect        se         Z         p       LLCI       ULCI
     3,9888     ,7813    5,1053     ,0000     2,4575     5,5201

Indirect effect(s) of X on Y:
          Effect     BootSE   BootLLCI   BootULCI
TOTAL      ,0694     ,2495     -,4302      ,5832
AG         ,0662     ,1599     -,2397      ,4174
DB         ,0033     ,1736     -,3626      ,3565

********************** ANALYSIS NOTES AND ERRORS **********************

Level of confidence for all confidence intervals in output:
  95,0000

Number of bootstrap samples for percentile bootstrap confidence intervals:
  5000

NOTE: Direct and indirect effects of X on Y are on a log-odds metric.

------ END MATRIX -----
```

Parallel mediation model Social Reference with mediator Anticipated Guilt and Decision Basis

```
Run MATRIX procedure:

*************** PROCESS Procedure for SPSS Version 3.5.3 ***************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2018). www.guilford.com/p/hayes3

**************************************************************************
Model  : 4
    Y  : DO
    X  : SRN
   M1  : AG
   M2  : DB

Covariates:
 Gender   Age

Sample
Size:  125

**************************************************************************
OUTCOME VARIABLE:
 AG

Model Summary
          R        R-sq        MSE          F        df1        df2
p
      ,2101       ,0441     2,0988     1,8618     3,0000   121,0000
,1397

Model
            coeff         se          t          p        LLCI       ULCI
constant    3,4824      ,5031     6,9216      ,0000     2,4864     4,4785
SRN        -,2673      ,2593    -1,0311      ,3046     -,7806      ,2460
Gender      ,5508      ,2625     2,0982      ,0380      ,0311     1,0705
Age         ,0023      ,0133      ,1713      ,8642     -,0241      ,0286

**************************************************************************
OUTCOME VARIABLE:
 DB

Model Summary
          R        R-sq        MSE          F        df1        df2
p
      ,2645       ,0700     1,2721     3,0344     3,0000   121,0000
,0319

Model
            coeff         se          t          p        LLCI       ULCI
constant    4,2626      ,3917    10,8826      ,0000     3,4872     5,0381
SRN        -,2692      ,2018    -1,3338      ,1848     -,6688      ,1304
Gender      ,1250      ,2044      ,6114      ,5421     -,2797      ,5296
Age        -,0281      ,0104    -2,7120      ,0077     -,0486     -,0076

**************************************************************************
OUTCOME VARIABLE:
```

```
   DO

Coding of binary Y for logistic regression analysis:
      DO  Analysis
     ,00      ,00
    1,00     1,00

Model Summary
      -2LL    ModelLL       df        p   McFadden   CoxSnell
Nagelkrk
   59,2112   28,4580    5,0000    ,0000      ,3246      ,2036
,4039

Model
            coeff        se         Z         p       LLCI       ULCI
constant   -3,3970    2,2148   -1,5338     ,1251    -7,7379      ,9439
SRN          ,9756     ,7473    1,3055     ,1917     -,4890     2,4402
AG           ,6376     ,2908    2,1925     ,0283      ,0676     1,2076
DB          -,9990     ,3781   -2,6421     ,0082    -1,7401     -,2579
Gender      -,7087     ,7373    -,9613     ,3364    -2,1538      ,7363
Age          ,0732     ,0266    2,7530     ,0059      ,0211      ,1253

These results are expressed in a log-odds metric.

****************** DIRECT AND INDIRECT EFFECTS OF X ON Y *****************

Direct effect of X on Y
    Effect        se         Z         p       LLCI       ULCI
     ,9756     ,7473    1,3055     ,1917     -,4890     2,4402

Indirect effect(s) of X on Y:
           Effect    BootSE  BootLLCI  BootULCI
TOTAL       ,0985    6,4779    -,7588    1,0768
AG         -,1704    5,6128    -,9777     ,2182
DB          ,2689    2,9927    -,1687    1,1966

********************** ANALYSIS NOTES AND ERRORS ***********************

Level of confidence for all confidence intervals in output:
  95,0000

Number of bootstrap samples for percentile bootstrap confidence intervals:
  5000

NOTE: Direct and indirect effects of X on Y are on a log-odds metric.

ERROR: Nonconvergence during bootstrapping. Interpet bootstrap results with
caution.

------ END MATRIX -----
```