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The effect of digital nudging on resistance to sustainable innovations.

A STUDY ABOUT THE EFFECTIVENESS OF DIGITAL NUDGING ON REDUCING RESISTANCE TO SUSTAINABLE INNOVATIONS AND HOW THIS DIFFERS FOR HIGH AND LOW PRICES.

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Abstract

The concept of sustainability has been acknowledged as one of the most important issues of the time and this applies a growing pressure on businesses to implement sustainable innovations. Sustainable innovations are not always welcomed with open arms by consumers, in contrast, sustainable innovations are often resisted. Previous research has found that digital nudging reduces resistance to sustainable innovations, but this is still in the early stages. Resistance to sustainable innovations also depends on another important factor, namely price. There is little known if digital nudging has an effect on resistance to sustainable innovations for high and low prices. This study set out to fill in this gap and this study investigates the effect of digital nudging on decreasing resistance to sustainable innovations and how the effect varies for high and low prices. In total, 259 Dutch respondents were randomly assigned to one of the four conditions in a 2 (nudge vs. no nudge) x 2 (high price vs. low price) between-subjects design of an online experiment. The results reveal that digital nudging is an effective strategy on reducing resistance to sustainable innovations. Furthermore, the effect of digital nudging on reducing resistance to sustainable innovations does not differ for a low price compared to a high price. This study ends with an elaborative discussion on the limitations of this research and avenues for future research.

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Introduction

During the last five years, there has been an upsurge in interest in sustainable innovations (Aghion et al., 2009; Montalvo et al., 2011). The world is facing a number of long term challenges such as climate change, aging population, pollution and the scarcity of vital raw materials (Boons et al., 2013). So, sustainability will be one of the biggest priorities in the future. This applies a growing pressure on businesses to implement sustainable innovations (Cillo et al., 2019). The interest in innovations has been reinforced by the development in customer's demands and firm's stakeholders requirements. The implementations lead not only to a competitive advantage, it also provides environmental benefits and creates social well-being (Sustainability Guide, n.d.). Indeed, businesses, customers and stakeholders are increasingly interested in sustainable innovations (Cillo et al., 2019).

Most companies are faced with the failure of innovations (Moore, 2002; Kleijnen et al., 2009). More specifically, 50% of innovations launched in the market fail to achieve a commercial success (Stryja & Satzger, 2019). The failure of innovation also appears in the case of sustainable innovations. Recent studies report failure rates of sustainable innovations between 50% and 90% (Handrich et al., 2010). The environmental success as well as business success of sustainable innovations depends on the extent to which they are accepted by consumers (Noppers et al., 2014). However, innovations that provide a more sustainable way of living are not always welcomed with open arms by consumers (Ozaki, 2011). In contrast, sustainable innovations are often resisted (Stryja & Satzger, 2019). Academic literature describes that most research has focused on factors that contribute to the 'positive' decision to adopt innovations, it is at least as important to understand why customers resist innovations how to overcome this (Kleijnen et al., 2009).

Ram and Seth (1989) define resistance as 'an offering by consumers to an innovation, because it poses potential changes from a satisfactory status quo or because it conflicts with their belief structure' (p.6). Resistance to innovation is a multi-dimensional construct (Huang et al., 2021). According to Ram and Sheth (1989), the Innovation Resistance Theory (IRT) model has two barriers to resist an innovation, namely the functional and psychological barrier. Psychology literature revealed that resistance to innovation can be divided into three dimensions: emotional, cognitive and behavioural resistance (Knowles & Riner, 2007). Castro et al. (2019) has suggested to utilize the psychological side to investigate resistance to sustainable innovations, because the level of uncertainty increases by considering a sustainable

innovation and it is likely to use the dimensions of behavioural, cognitive, and emotional resistance with the high level of uncertainty (Kleijnen et al., 2009; Cillo et al. 2019).

Behavioural economics show that decision-makers in ‘automatic’ mode are sensitized to a certain option (Thaler, Sunstein, & Balz, 2013). Thus, it is important to incorporate small features such as nudges to highlight better alternatives and assist a decision-maker in choosing a commonly desired option (Stryja & Satzger, 2019; Ram, 1989). According to Schmidt and Engelen (2020), a nudge is a communication technique and is defined as ‘any aspect of the choice architecture that alters people's behaviour without forbidding any options or changing their economic incentives’ (p.6). An example is the smart design of supermarkets: putting healthy food options at eye level boosts apple consumption because salient items predictably capture the attention of customers (Arno & Thomas, 2016). Nudging elements have a great potential to encourage sustainable behaviour (Schubert, 2017; Berger et al., 2021). According to Schubert (2017), when a nudge is designed to gently push towards a sustainable decision, it is also called a ‘green nudge’. Nudges can take place in the real world or in a digital environment (Straya & Satzger, 2019). As the design of digital choice environments influences consumers’ choices, understanding the effects of digital nudges can help managers lead consumers to the most desirable choice (Weimann et al., 2016).

Drawing further on the concept of nudging and resistance to innovation, it is also interesting to know if digital nudging will still decrease resistance to innovations for different levels of the functional barriers. This article focuses specially the component value barrier of the functional barriers of the IRT model. Pricing strategies are important marketing strategies to overcome the value barrier (Magloire et al., 2022; Laukkanen et al. 2009; Abbas et al., 2017). Especially, in the movement towards more sustainable consumptions, price remains the main barrier for consumers in purchase decisions (RIVM, 2017; Florencio, 2022).

Price influences consumers’ purchasing decisions (Zhao et al., 2022). In addition, decreasing the price is an important barrier to decrease resistance to innovation (Migliore et al., 2022; Abbas et al., 2017; Hoenink et al., 2020). Since evidence confirms the role of prices on purchase decisions, increases or decreases the prices also influences consumer choices of sustainable products (Florencio, 2022). This is related to price sensitivity (Ram and Sheth, 1989). It is not only the price itself, also price consciousness has an influence on resistance to innovations (Abbas et al., 2017; Dale et al., 2007). Consumers who are price consciousness, are not willing to pay high prices for the product (Munnukka et al., 2005; Rihn et al., 2018).

Several studies suggested that the level of price explains customers' level of resistance (Migliore et al., 2022; Laukkanen et al., 2009; Abbas et al., 2017). It is still not clear if digital nudging has an effect on resistance to sustainable innovations for high and low prices because little research has been done on this. Harbers et al. (2020) describes in a systematic review of 75 studies the effect of nudging on resistance for different prices and describes that the evidence is limited and recommended that high-quality are needed. Research has shown that consumers are willing to pay more for sustainable products (Writer, 2022; Lin & Huang, 2012). Even if customers want to shop with sustainability in mind, many cannot afford or simply do not want to spend more money (Kearney, 2022). According to Kearney (2022), this causes a 'green gap' between consumers' stated intention to act sustainably and their actual behaviours. By examining the effectiveness of nudging on resistance to sustainable innovations for high and low prices, the thesis aims to answer the following question:

What is the effect of digital nudging on reducing resistance to sustainable innovations and how does the effect vary for high and low prices?

Theoretical relevance

The theoretical relevance of this article is threefold. At first, the research on nudging has often been conducted offline (Weimann et al., 2016). As of now, Stryja and Satzger (2019) and Stryja et al. (2017) investigated the positive effect of digital nudging on resistance to innovations, however there is limited research done of digital nudging on resistance to innovations (Stryja & Satzger, 2019; Stryja et al. 2017). In contrast of the article of Stryja et al. (2017), this thesis does not focus on technological innovations and does not compare two different nudges with each other. In contrast of Stryja and Satzger (2019), this thesis focuses on innovations with a sustainable aspect. Literature of digital nudging on resistance to sustainable innovations is lacking since current literature has mainly investigated nudging to encourage sustainable behaviour (Schubert, 2017; Berger et al., 2021). Second, there is little attention in studies concerning the psychological side of resistance to innovation (Castro et al, 2019; Ngafeeson & Manga, 2021). This thesis adds to the existing research by using the psychological scale of resistance to innovation. Third, there is limited research on the effect of digital nudging on resistance to sustainable innovations for high and low prices and more research is needed, because the effect of digital nudging on resistance to sustainable innovations for high and low prices is not consistent in the existing literature (Harberts et al., 2020).

Managerial relevance

This thesis is also relevant from a managerial perspective. This thesis tests a marketing strategy what managers could use to reduce or prevent resistance to sustainable innovations. More specifically, the findings of this study reveal the positive effect of digital nudging on reducing resistance to sustainable innovations. Furthermore, the effect of digital nudging on reducing resistance to sustainable innovations does not differ for a low price compared to a high price. This is useful knowledge for managers who are implementing sustainable innovations. The investigation reveals the effectiveness to make consumers aware of sustainable choices by digital nudging to reduce resistance to sustainable innovations. This could be done by implementing marketing campaigns focused the sustainability aspect. As previously discussed, sustainable innovations are becoming increasingly more important in the contemporary marketplace. Lowering the resistance of sustainable innovations lead not only to a competitive advantage, it also provides environmental benefits and creates social well-being.

Literature review

Resistance to innovation

Innovation literature reports that 50% of the innovations launched in the market fail to achieve a commercial success (Stryja & Satzger, 2019). This failure rate is even higher for sustainable innovations. In the case of sustainable innovations, recent studies report failure rates of sustainable innovations between 50% and 90% (Handrich et al., 2010; Heidenreich & Spieth, 2013). Hence, innovations that provide a more sustainable way of living are not always welcomed with open arms by consumers, despite that consumers are aware of the importance of adopting sustainable innovations (Ozaki, 2011). In contrast, sustainable innovations are often resisted (Stryja & Satzger, 2019). This could be an effect of the pro-innovation bias (Huang et al., 2021; Kleijnen et al., 2009; Kaur et al., 2020). This bias indicates that innovations are inherently good and will be adopted by everyone (Rogers, 1983). Yet, where earlier theoretical work substantiates the existence of the concept of resistance and its implications, newer studies empirically verify the existence of resistance to innovation (Kaur et al., 2020). So, Following Kaur et al. (2020), it is essential for organizations offering solutions to better reduce resistance to innovation, because resistance is a potential factor that can define the success of the innovations in their target market space. Academic literature describes that most research has focused on factors that contribute to the 'positive' decision to adopt innovations, understanding why customers resist adoption is at least as important (Kleijnen et al., 2009). This emphasises that it is important to understand why there is resistance towards innovations and how to overcome resistance to the innovations.

Resistance to innovation has been around for more than 30 years and is based on a consumer's choice (Ram & Seth, 1989). Ram and Seth (1989) define resistance as 'offered by consumers to an innovation, because it poses potential changes from a satisfactory status quo or because it conflicts with their belief structure' (p.6). Resistance to innovation conflicts with the belief structure of consumers or require large behaviour changes from a status quo that consumers find satisfactory (Garcia et al., 2007; Ram & Sheth, 1989). To reduce resistance to innovations, consumers must learn new routines and habits or embrace new traditions and values (Ram & Sheth, 1989).

The conceptualisation of resistance to innovation varies fairly across studies (Heidenreich & Spieth, 2013) and there can be concluded that resistance to innovation can be seen as a multi-dimensional construct (Huang et al., 2021). One of the first theories on resistance is the Innovation Resistance Theory (IRT) (Ram & Sheth, 1989). Ram and Sheth (1989) divide

the IRT into functional barriers and psychological barriers. The functional barriers include usage, value, and risk. The psychological barriers include image and tradition. This thesis focuses on functional barriers and especially the value barrier. Pricing strategies are important marketing strategies to overcome the value barrier. Another theory is active and passive innovation resistance. (Kleijnen et al., 2009; Heidenreich & Spieth, 2013). An important issue of concern is that resistance includes not trying the innovation (Kleijnen et al., 2009). This can be further delineated into three distinct consequences of consumer behaviour: rejection, postponement and opposition (Kleijnen et al., 2009).

Psychology literature has shown that resistance to innovation can be divided into three dimensions: emotional, cognitive and behavioural (Knowles & Riner, 2007). The term of emotional resistance can be defined as the negative emotional reaction on innovations (Pratkanis, 2011). Emotional resistance is a motivational state and therefore consumers try to restore this by rejecting the innovation that threatens this freedom in their opinion (Contzen et al., 2021). Emotional resistance refers to the emotions that are brought up when presented a new innovation (Ngafeeson & Manga, 2021). An example is 'I don't like it.' The second dimension of resistance is cognitive resistance. According to the research of Pratkanis (2011) cognitive resistance is more focused on the content around a certain innovation. For example, a new innovation is introduced into the market and consumers do not believe that it will work. The last dimension of resistance is behavioural resistance. The article of Ngafeeson and Manga (2021) describes behaviour resistance as a rather 'neutral' quality whereby the focus on a consumer side is not of resisting an innovation but focusing on staying put.

Most articles about resistance to innovation use the active/passive model or IRT model (Ram & Sheth, 1989; Heidenreich & Spieth, 2013; Migliore et al., 2022). When consumers are contemplating a sustainable innovation, the level of uncertainty increases (Kleijnen et al., 2009; Cillo et al., 2019). Given the high level of uncertainty that exists within the sustainable innovation context, it is probably that the dimensions of emotional, cognitive and behavioural resistance also exist in the sustainable innovation context (Cillo et al., 2019). Castro et al. (2019) has confirmed that mood and emotion plays an important role in consumer decisions. For instance, the level of consumer happiness affects product choices. Furthermore, when an innovation is introduced, consumers could be sceptical about the innovation and display cognitive resistance toward the innovation (Castro et al., 2019). Also, behavioural resistance to innovation is important, for example, when consumers reject to change their lifestyle for an innovation (Knowles & Riner, 2007). However, there is little attention in studies concerning

the psychological side of resistance (Castro et al., 2019; Ngafeeson & Manga, 2021). In this thesis the dimensions of cognitive, emotional and behaviour resistance to innovations was utilized.

Behavioural economics show that consumers often base their resistance on automated thinking processes, which could introduces biases in decision-making (Stryja & Satzger, 2019). Choices are designed so that decision-makers in ‘automatic’ mode are sensitized to a certain choice (Thaler, Sunstein, & Balz, 2013). Thus, it is important to design and incorporate small features such as nudges into the decision process to highlight better alternatives and assist a decision-maker in choosing a desired option while not restricting their freedom of choice (Stryja & Satzger, 2019; Ram, 1989). However, these strategies were only revealed in a small number of studies and more research is needed in this regard (Huang et al., 2021).

Nudging

Schmidt and Engelen (2020) defines a nudge as ‘any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives’ (p.6). Thus, a nudge can be expressed as ‘pushing someone gently with the elbow’ (p.8) (Dianoux et al., 2019). Nudging refers to the deliberate changes of consumers choice environment in attempts to steer consumers in specific directions (Schmidt & Engelen, 2020).

The nudge is based on four main characteristics (Singler, 2015). First, it changes the current behaviour of consumers by promoting appropriate behaviour. Secondly, a nudge is a communication that leaves the consumer free to behave as she or he wishes. Third, it stimulates behaviour that is beneficial for the consumer in the community or the planet. Finally, the cost of implementation is low and the consequences are high (Singler, 2015; Dianoux et al., 2019). An example is the smart design of supermarkets: putting healthy food options such as apples at eye level, because salient items predictably capture the attention of customers (Arno & Thomas, 2016). Other nudges work though visual designs. For example, horrible pictures on cigarette packs reduce cigarette consumption through emotional responses (Schmidt & Engelen, 2020).

Over the years, nudging becomes popular into environmental policies (Berger et al., 2021). Nudging elements have a great potential to encourage sustainable behaviour (Schubert, 2017). According to Schubert (2017), when a nudge is designed to push a consumer towards a sustainable decision, it is a ‘green nudge’. In the sustainability context, there is evidence to

support ‘green nudging’ as effective in improving more sustainable behaviour (Bonini et al., 2017; Lee et al., 2020).

Nudges can take place in the real world or in digital environment (Straya & Satzger, 2019). Consumers purchase habits have shifted from shopping at physical stores to shopping online the last years (Tsagkias et al., 2021). Many choices are made in online environments the last years (Weinmann & Schneider, 2016; Straya & Satzger, 2019). As the design of digital choice environments influences consumers’ choices, understanding the effect of digital nudges can help managers lead consumers to the most desirable choice. Digital nudging is defined as ‘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’ (p.2) (Jesse & Jannach, 2021). According to Weinmann and Schneider (2016), digital choice environments are user interfaces, such as web-based forms that require consumers to make judgments or decisions. The article of Stryja and Satzger (2019) and Stryja et al. (2017) describes the positive effect of digital nudging on reducing resistance to innovations. However, there is limited research done on it and the article of Stryja and Satzger (2019) does not utilize a sustainable innovation. In contrast of the article of Stryja et al. (2017), this thesis does not focus on technological innovations and does not compare two different nudges to each other.

Different types of nudges could be implemented in an online environment (Berger et al., 2022). For example, default option, reinforce, framing, and priming (Berger et al., 2022; Jesse & Jannach, 2021). According to Berger et al. (2022) priming can be defined as ‘a way of preparing consumers for their choice by stimulating feeling and thoughts through introducing specific topics, moods or information like the consequences of their decision before it takes’ (p.3). Priming is pre-commitment strategy and aims to simulate feelings or thoughts to prepare for the decision or to promote sustainable consumption behaviour (Berger et al., 2022). An example a website page with a visual emphasis on the sustainable collection of the store before forwarding customers to the shopping page to nudge them toward buying more sustainable products (Roozen et al., 2021). The study of Stryja and Satzger (2019) used different digital nudges such as default, giving feedback and priming to investigate the effect of digital nudging on resistance to innovations. The article of Stryja et al. (2017) used the nudges default and priming. The article of Stryja and Satzger (2019) and Stryja et al. (2017) concludes that priming has not a significant effect on reducing resistance to innovation. This thesis still utilizes the nudge priming, because this thesis investigates the effect digital nudging on resistance to sustainable innovations. Different articles describe how exposure to sustainable priming

increases consumers' preferences for sustainable behaviour (Lee et al., 2020; Bilomonte et al. 2019).

The research on nudging has often been conducted offline (Weimann et al., 2016). As of now, the article of Stryja and Satzger (2019) and Stryja et al. (2017) investigates the first indications that digital nudging has a positive effect on resistance to innovations. However, there is limited research done on the effect of digital nudging on resistance to innovations (Stryja & Satzger, 2019; Stryja et al. 2017). The article of Stryja and Satzger (2019) and Stryja et al. (2017) represent the sample of the Germany's population and this thesis focused on the Dutch population. The article of Stryja et al. (2017) also used sustainable innovations with a technological aspect, however, this thesis did not focus on technological innovations and did not compare two different nudges to each other. In contrast of Stryja and Satzger (2019), this thesis did utilize sustainable innovations. Literature on digital nudging in the sustainable innovation context is lacking since current literature has mainly investigated digital nudging to encourage sustainable behaviour (Schubert, 2017; Berger et al., 2021). The article of Stryja and Satzger (2019) and Stryja et al. (2017) did not use the psychological resistance scale of emotional, cognitive and behavioural resistance to innovations. Furthermore, the research of Stryja and Satzger (2019) and Stryja et al. (2017) also used priming and concluded that priming has not a significant positive effect on reducing resistance to innovations. This thesis will still use priming, because different articles describe how priming increases consumers' preferences for sustainable behaviour (Lee et al., 2020; Bilomonte et al., 2019). In summary, academic literature describes the effect of digital nudging on resistance to sustainable innovations, but this is still in the early stages (Stryja & Satzger, 2019; Stryja et al. 2017). Thus, it is predicted that there is a positive effect of digital nudging on reducing resistance to sustainable innovations. The following hypothesis is established:

H1: *Digital nudging has a positive effect on reducing resistance to sustainable innovations.*

So, it is important to investigate if digital nudging reduces resistance to innovations. It is also interesting to know if nudging will still decrease resistance for different levels of the functional barriers of IRT. This thesis focuses specially on the value barrier of the functional barriers. Pricing strategies are important marketing strategies to overcome the value barrier (Magloire et al., 2022; Laukkanen et al., 2009; Abbas et al., 2017). Especially, in the movement towards more sustainable consumptions, price is the main barrier for consumers in purchase decisions for sustainable innovations (RIVM, 2017; Florencio, 2022).

Price

Price influences consumers' purchasing decisions (Zhao et al., 2022). In addition, price influences resistance to innovations and previous studies show that there is a positive effect of price on resistance to innovations (Migliore et al., 2022; Abbas et al., 2017). Price is also an important component in consumers choices of sustainability and is the main barrier for consumers in purchase decisions for sustainable innovations (RIVM, 2017; Florencio, 2022).

Since evidence confirms the importance of prices, increases or decreases the price can influence consumer choices of sustainable choices (Florencio, 2022). This is related to the price sensitivity (Ram & Sheth, 1989). Price sensitivity means that if all other market factors remain constant, a relative price increase leads to a decrease in the quantity demanded (Kagan, 2022; The Economic Times, n.d.). A inelastic demand means consumers are still willing to buy a product even after price increases. A high elasticity means that small price increases may lead to a lower demand. In mathematical form this is:

$$PED = \frac{Q_1 - Q_0}{(Q_1 + Q_0) \div 2} \div \frac{P_1 - P_0}{(P_1 + P_0) \div 2}$$

According to Florencio (2022), the price elasticity depends on the availability of substitutes. When there are more substitutes available, the price elasticity increases. Academic literature describes that price sensitivity has an effect on the purchase intention of consumers towards sustainable innovations (Walia et al., 2020; Kumar & Mohan, 2021). Hence, the higher the price of the sustainable innovation, the lower the demand of the consumers.

Not only the price itself is an important role in pricing, also the price consciousness has an influence on resistance to innovations (Abbas et al., 2017; Dale et al., 2007). Consumers, who are price consciousness are not willing to pay high prices for the product (Munnukka et al., 2005; Rihn et al., 2018). Price consciousness consumers carefully weigh the potential benefits of the innovation against the cost of the innovation. According to Rihn et al. (2018), price consciousness consumers have similar characteristics. For example, income, product involvement, product quality perceptions, upbringing, age, socialization and cognitive beliefs on saving money (Rihn et al., 2018). Price consciousness thus vary across consumers, it also varies across products and situations for the same consumer (Sinha & Batra, 1999). According to Sinha and Batra (1999), consumers could be more or less price consciousness when shopping for certain products in contrast to others, because of differences in the perceived risk of purchasing decisions. According to Ma and Wang (2019), price consciousness has a negative

effect on the purchase behaviour of sustainable innovations. When sustainable products are becoming more expensive, consumers might not be willing to buy sustainable products.

Hence, several studies suggested that the lower the price has an effect on reducing the resistance to sustainable innovations (Walia et al., 2020; Kumar & Mohan, 2021; RIVM, 2017). It is still not clear if digital nudging could reduce resistance to sustainable innovations for high and low prices, because little research has been done on this. Harbers et al. (2020) describes in a systematic review of 75 studies the effect of nudging and pricing on resistance. The research describes that the evidence is limited if the effect of digital nudging on resistance is still effective for high and low prices. Harberts et al. (2020) recommended that high-quality studies focusing on nudges and prices on resistance are needed.

Research has shown that consumers are willing to pay more for sustainable products (Writer, 2022; Lin & Huang, 2012). However, even if customers want to shop with sustainability in mind, consumers cannot afford or simply do not want to spend a high price for a sustainable innovation (Kearney, 2022). The high costs of sustainable innovations can affect consumers' ability and enthusiasm to purchase sustainable innovations (Ma & Wang, 2019). Consumers prefer lower prices, because they view the buying of sustainable innovations as a selfish and rational decision (Ahmetoglu et al., 2014; Ma & Wang, 2019). Consumers are eager to make sustainable choices, however, the price still remains the dominant factor for consumers to buy sustainable innovations (Kearney, 2022; Ma & Wang, 2019). According to Kearney (2022), the purchase intention to act sustainably and the actual behaviour causes a 'green gap'. Therefore, it is predicted that the effect of digital nudging on resistance to sustainable innovations is stronger for innovations with a low price compared to a high price. The following hypothesis is established:

H2: *The effect of digital nudging on reducing resistance to sustainable innovations is stronger when the innovation has a low price compared to a high price.*

Methodology

Design of the experiment

An online experiment was conducted to test the hypotheses. There are several reasons for choosing an online experiment (Nayak & Narayan, 2019). First, online experiment tools are flexible to visualize the data. This online experiment showed a video of a digital nudge, so it is useful that this can be visualized properly. Second, it provides a larger sample size leading to greater statistical power, no need for face-to-face interaction, it can be administered in a time-efficient manner and minimizing the period it takes to get an online experiment into the field and for data collection (Evans & Mathur, 2005; Field, 2018).

A 2 (nudge vs. no nudge) x 2 (high price vs. low price) between-subject design was designed for this thesis. A 2-by-2 between-subject design is a research design that involves two independent variables, each with two levels and two groups (Field, 2018). The nudge condition is per definition a categorical variable. To segment two distinct groups for the variable price, two prices were used. One price is relatively cheap and the other price is relatively expensive.

Sampling

The population for this study was native Dutch speakers, since the experiment was in Dutch. Furthermore, the population was above 18 years old. There were no other characteristics for the population. In total 259 respondents were randomly assigned to one of the four conditions in the experiment. This sample is above the minimum of 50 respondents per condition ($4 \times 50 = 200$ respondents) and was therefore considered a reliable sample (Field, 2018). The sample was recruited through online platforms and social media. A convenience sample was used. A convenience sample simply includes the individuals who happen to be most accessible to the researcher (Scribber, n.d.).

Stimulus material

Sustainable innovation

The sustainable innovation used in the study was a shampoo bar (Appendix 1A). A shampoo bar is a block of solid shampoo (Pacific Spirit, 2023). Where traditional shampoo is liquid, consumers need to wet the shampoo bar to use it. Because of this, the shampoo bar is plastic free and this declines the pollution. According to Florencio (2022), the price elasticity depends on the availability of substitutes. A shampoo bar has a several substitutes, namely the liquid shampoo or shampoos for other prices, flavours and brands. So, the shampoo bar is a price elastic product (Chadd Academy, n.d.). That means that the demand decreases when the price rises. Consumers will easily switch to alternatives or not buy these products when it

becomes more expensive. Furthermore, a shampoo bar is not a complicated product. There is little chance that consumers will not buy shampoo for other reasons that may cause resistance such as uncertainty, complexity, social influence or perceived risk (Abbas et al., 2017). For these reasons, it is suitable to measure if digital nudging reduces resistance to sustainable innovations and for high and low prices.

Digital nudge

In this study, a video was the chosen media. In order to prevent issues regarding intellectual property and copyrights, a video made by the Radboud University was chosen for this study. This was easier and would not cause any problems in the study.¹ The digital nudge in this video consists of showing the consequences of plastic waste in the nature. In line with most video commercials, the video is below the minute, in fact it lasts 54 seconds (Cooler Media, 2022). This makes it a sufficient fit to apply for commercials. The video starts with images of the sea, filled with plastic waste. The harmful effect on animals can also be seen, with animals being trapped and dying. The video clearly shows plastic packaging as a great contributor of the waste. The video continues with showing both underwater and above water shots showing the harmful effect on nature. This video ends with a personal appeal, stating that the viewer is necessary and indicating your influence for stopping pollution. The appeal in this video is based on fear, namely what happens with the planet if the pollution does not decline. Appeals and climate change impacts are common in the media (O'Neill et al., 2017). Fear appeals are only effective when there is perceived threat and perceived efficacy (Witte & Allen, 2000). The message must provide some form of solution or empowerment for recipients to change behaviour (Li & Huang, 2020). This fear and hope dynamic is essential to persuasive success, since the increased physiological arousal caused by fear can consequently make an emotional response to subsequent events likely to be more intense (Nabi et al., 2018). In this case, a viewer might get distressed from watching the polluted ocean but feels hopeful by the idea that the consumer can make a positive influence. The innovation showed after the video increases these feelings by offering a concrete solution to the presented problem. This is the link of the video: <https://www.youtube.com/watch?v=dBaTvVjUsA8>.

The other group did not see a video. The aim of the research is to check whether additional sustainable information (the nudge) could reduce the resistance to sustainable innovations. Hence, another video is not needed. Furthermore, if another video is shown that is not related to the innovation, this could create confusing emotions. In addition, several

¹ Radboud University has given permission to use the video on April 13, 2023.

studies with the topic digital nudging have also not used a control video (Hoenik et al., 2020; Grebitus et al., 2020; Florencio, 2022; Berger et al., 2020).

Key concepts and measurements

Resistance to innovation

This study uses an overarching scale, covering the emotional, cognitive and behavioural aspects of resistance from psychology research (Ngafeeson & Manga, 2021). Emotions, cognition and behaviour represent the core intrapsychic process and have been used in explaining behaviour in psychological research (Lench et al., 2013). However, there is little attention in studies concerning resistance (Castro et al., 2019; Ngafeeson & Manga, 2021).

This scale is used in other research (Bos, 2022; Gommans, 2022; Spaan, 2022; Van Velsen, 2022). However, some alterations were made. One item of cognitive resistance ('I do not see potential in'), caused problems in the convergent validity. This item showed a stronger correlation with the items of emotional and behavioural resistance. Other than removing this item, some other items were added to the list. For example, those proven valid and reliable by Ram (1989) ('I will try out this product', 'I will purchase this product', 'I will obtain more information before buying this product, 'I do not believe such a product can be manufactured'). Other items originate from the work of Castro et al. (2019), resulting in five items per dimension. An overview of the full operationalisation can be found in Appendix 1B.

Construct	Adapted items
Emotional resistance (Ngafeeson & Manga, 2021; De Castro et al., 2019)	ER1: I am irritated by the shampoo bar. ER2: The idea of the shampoo bar makes me happy. ER3: The shampoo bar stresses me out. ER4: The shampoo bar makes me feel excited. ER5: I am frustrated by the shampoo bar.
Behavioral resistance (Cervantes, 2022; Kuijsten, 2022; Langhout, 2022; Rumengan, 2022; Van Nijnatten, 2022; Ngafeeson & Manga, 2021; Ram, 1989)	BR1: I would not switch to the shampoo bar. BR2: I would try as much as possible to avoid the shampoo bar. BR3: I will try out the shampoo bar. BR4: I would purchase the shampoo bar. BR5: I would recommend the shampoo bar to others.
Cognitive resistance (Ngafeeson & Manga, 2021; Ram, 1989; De Castro et al., 2019)	CR1: I am not sure that the shampoo bar will perform as described. CR2: I see several disadvantages regarding the shampoo bar. CR3: I am critical about the shampoo bar. CR4: I will obtain more information before buying the shampoo bar. CR5: The shampoo bar is compatible with my needs and views.

Price

Two prices were compared to manipulate the price. CBS (2019) describes that an average bottle of shampoo costs 2.90 euros in 2018. There is 2.7% inflation from 2018. That means that an average shampoo bottle cost 3,00 euros in 2023. Furthermore, a private label shampoo is around 2.00 euros. The most sold shampoo brand is Andreon and this shampoo costs on average of 4.00 euros (Andreon, n.d.). It makes sense to sit between these prices and prices the cheap shampoo for 3.00 euros. According to other drugstores, the more expensive shampoo costs between 8,99 and 9.99 euros (Kruitvat n.d.; Etos, n.d.). There was chosen to take the price as high as possible. This allows the difference to be measured properly whether the nudge still works at a very high price. 9,99 euros is a psychological price. To compare prices, it is useful to use the same pricing strategies. For this reason, the cheaper shampoo is priced at

2,99 euros instead of 3 euros. So, to manipulate the price, the two different prices were used: 2,99 euros (low price) and 9,99 euros (high price).

Procedure

Step 1: pre-test

A pre-test was conducted for two reasons. The first goal of the pre-test was to find out if 2,99 euros is perceived as a low price and 9,99 euros is perceived as a high price. The respondents filled in the price what they thought was a cheap price and an expensive price for the shampoo bar. The low price varied between 2 euros and 4 euros. The expensive price varied between 7 euros and 10 euros with some outliers to 15 euros. So, 2,99 as a low price and 9,99 as a high price corresponds well. Furthermore, the pre-test was also conducted in order to check the nudge. The goal is to find out whether the nudge priming had effect. The respondents had an open-ended question to what they thought the subject of the video would be. In particular, the answers were sustainability and pollution. Also, this corresponds well with the video. Hence, no adjustments were needed.

Step 2: online experiment

The data were collected through an online experiment using the research platform Qualtrics. The online experiment began with a short introduction regarding the purpose of the study. In addition, the duration of the online experiment and information regarding voluntary participation were presented. Furthermore, participants were assured anonymity and were guaranteed that there are no wrong or correct answers, to assure reliable answers. The respondents were randomly assigned to one of the four conditions. The questions were asked in Dutch, since this study focussed on the Dutch population. In the first block, half of the respondents did see the digital nudge and the other respondent did not see the nudge. After that, the participant did see a picture with the explanation of a shampoo bar. For some respondents a shampoo bar of 2,99 euros did show up and for other respondent a shampoo bar of 9,99 euros did show up. Then, the questions focused on the resistance to innovation (dimension: emotional, cognitive and behavioural). All the respondents were asked about their age, education level and gender. Hereafter, there were asked if the respondents perceived the price as high or low as a manipulation check. The digital experiment is viewed in Appendix 1C.

Data analyse

The reliability and internal consistency of the scales were tested with an exploratory factor analysis (EFA) and several Cronbach's alpha tests. In order to be considered reliable, the Cronbach's alpha value had to be $>.70$ (Field, 2018). Second, to test H1, one DV (resistance)

and one IV with two measurement levels (nudge or no nudge) was used. Hence, an Independent sample t-test was conducted. To test H2, one DV (resistance) and two IV's with both two measurement levels (nudge or no nudge; high price or low price) were used. So, an ANOVA was conducted. Also, a MANOVA was conducted to measure resistance to the sustainable innovation for each dimension (cognitive, emotional and behavioural).

Research ethics

To protect the rights and well-being of the participants, a number of ethical factors were taken into account. First, the respondents were in freedom to withdraw at any time of the research. Every participant was free to stop participating in the study at any time without feeling obligated to do so. Moreover, there were no negative outcomes for respondents who choose not to continue and they were not required to give a reason for leaving the experiment. The duration of the experiment was describing and the incentives that received for participating. In this study, anonymity and privacy was especially important. The name of the respondents was not asked and confidentially was ensured by not sharing the dataset with anyone that was not involved in this research, to preserve the participants' privacy. Besides, all data was kept on password-protected computers. Fourth, surveying children without parental consent was not ethically approved. So, the online experiment was established for 18 years and older. In addition, the RU e-mail address of the researcher was provided at the end of the online experiment so that the respondent could contact the researchers in case of questions or when interested in the results of the study. Besides that, respondents were also thanked for their participation in the debriefing and once again reassured that their answers were completely anonymous and confidential. In adherence to copyright regulations, explicit acknowledgements to the original works of other authors were incorporated in accordance with the APA guidelines. Moreover, the researcher signed an integrity form. By doing so, she believes that she fully complied to the APA Ethics Code (Ethics Office, n.d; Smith, n.d.).

Results

Data preparation

First, the data was accurately examined to assess invalid cases. The total sample of the online experiment was 328 respondents. Since there was a small sample (<400), there was checked if the missing data was above 10% to conclude if the missing data was negligible or not. The missing data was 20%, therefore the missing data was not negligible. Some respondents were excluded from the online experiment for several reasons. 64 respondents did not answer the questions about the resistance scale and 5 respondents did not agree on the terms of participation and conditions. The online experiment was sent to respondents above 18 years old, since further sharing of the experiment was encouraged so underage participants could have been invited. As a result, one participant who are under 18 years old was excluded from the online experiment. These respondents were deleted what results to 259 respondents.

In addition, the code items were reversed that are negatively worded so that a high value indicates the same type of response on every item (Field, 2018). This was done for the following scale items: ER1, ER3, ER5, CR1, CR2, CR3, BR1, BR2, and BR5.

Descriptives

Applying these criteria results to a final sample of $N = 259$ respondent. Of the sample, 63,7% female, 34,7% male and 1,5% other. Of the sample, 8,9% has finished high school, 10,5% finished MBO, 34,9% finished HBO Bachelor, 8,9% finished HBO Master, 18,2% finished WO Bachelor, 17,8% finished WO Master and 0,4% finished PHD. Furthermore, of the sample, 43,6% has an age between 18 and 25 years, 14,3% between 26 and 25 years, 4,3% between 36 and 45 years, 6,1% between 46 and 55 years, 9,8% between 56 and 65 years, 0,6% between 66 and 75 years and 0,3% was 75 years and older.

Reliability

The dimensions of resistance (emotional, cognitive and behavioral) were computed into one variable, namely resistance. To test for reliability and validity, the Cronbach's alpha test resulted in an acceptable reliability score of $\alpha = 0.908$.

Manipulation check

An Independent sample t-test was conducted as manipulation check to compare the perceived low price and high price by the participants. There was a significant difference resistance between the high price ($M = 3.55$; $SD = .756$) and the low price ($M = 2.22$; $SD = .84$); $t(257) = -13,460$; $p < .001$ (Appendix 2A). Hence, it can be concluded that the high price is perceived as an expensive price and the low price is perceives as a cheap price.

Assumptions

To determine if H1 was accepted or rejected, an Independent sample t-test was conducted. To test H2, an ANOVA was conducted. The assumptions for the Independent sample t-test and the ANOVA were tested. The dependent variable should be measured at the continuous level (Field, 2018). Furthermore, the metric dependent variable had to be normally distributed (Field, 2018). A univariate analysis showed that the metric variables had skewness and kurtosis values between -3 and +3, which indicated a normal distribution (Field, 2018) (Appendix 2B). Regarding the next assumption for the ANOVA, the sample size had to be larger than 30 respondents for each condition (Field, 2018). Condition no nudge high price had 68 respondents, condition nudge low price had 69 respondents, condition nudge high price had 57 respondents and condition no nudge low price had 65 respondents. The last assumption tested the homogeneity of variances using Levene's test of equality of error variances. This test was significant for the Independent t-test $t(257) = 2,581; p < .001$ and the ANOVA $F(4,237) = 3, p = .006$ which not meet the homogeneity of variance assumption (Field, 2018). However, there is another way to check homogeneity, which is the Bartlett test for Homogeneity of variance and the Welch test. In Appendix 2B can be seen that the Bartlett test for Homogeneity of variance was non-significant $p = 1.000$. In addition, the Welch test was significant $p = .01$ (Appendix 2B). So, the assumption of homogeneity is met.

Hypothesis 1

The Independent samples t-test was conducted to compare the resistance of the digital nudge and the no nudge (H1) and the results are presented in Appendix 2C. There was a significant difference in resistance between the nudge ($M = 2.20; SD = .54$) and no nudge ($M = 2.40; SD = .72$); $t(257) = 2,581; p < .001$ (figure 1). So, it can be concluded that nudging is an effective strategy to reduce resistance to sustainable innovations and hypothesis 1 can be accepted.

Hypothesis 2

Furthermore, a two-way ANOVA was conducted to compare resistance between the nudge and no nudge; high price and low price conditions (Appendix 2D). There was a significant difference in resistance between the high price ($M = 4.50; SD = .79$) and the low price ($M = 2.26; SD = .75$); $F(1,255) = 6,778, p = .01, \eta^2 = .026$ (figure 2). So, decreasing the price results to decreasing resistance to the sustainable innovation. While not being part of the hypothesized relationships, it is an interesting finding. The interaction effect of price and nudging on resistance to innovation was not significant $F(1,255) = .874 p = .351, \eta^2 = .003$ (Appendix 2D). So, hypothesis 2 cannot be accepted and the positive effect of digital nudging

on reducing resistance to sustainable innovations does not differ for a low price compared to a high price.

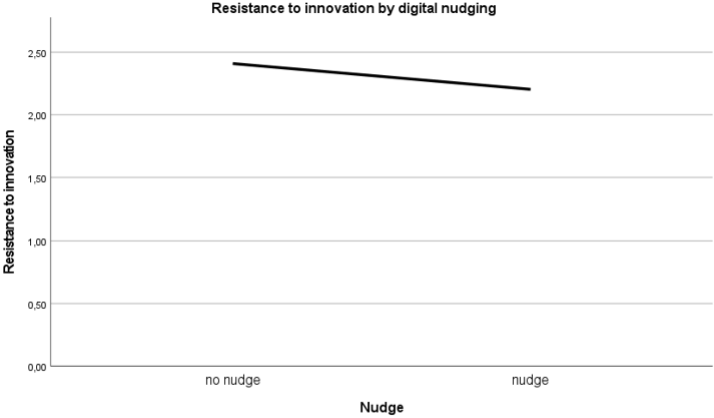


Figure 1: Resistance to innovation on digital nudging

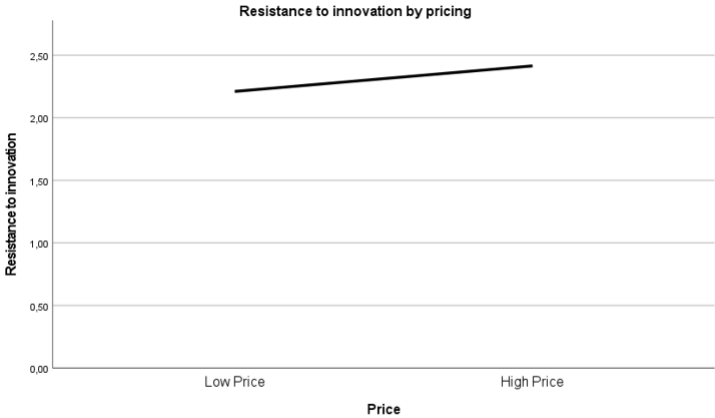


Figure 2: Resistance to innovation on pricing

The scale for resistance consists of three dimensions: emotional, cognitive and behavioural resistance. It is interesting to investigate if the effect of nudging, pricing and the interaction effect differs on each dimension of resistance, this could help interpreting the results or provide more findings for future research. Hence, a MANOVA was conducted to check how nudging, pricing and the interaction effect had an effect on to each dimension of resistance (emotional, cognitive and behavioural).

Factor analysis

To check if the items load correspondingly on the correct construct, a confirmatory factor analysis, with common factor analysis and oblimin rotation was conducted (Field, 2018).

The 15 items of the five scales measuring emotional, cognitive, and behavioural resistance were examined. First, the Kaiser-Meyer-Olkin measure revealed a sampling adequacy of .929 which is above the minimum criterium of .50 (Field, 2018). The Barlett's test of sphericity was significant ($\chi^2(105) = 2479,55, p < .001$), this indicates an adequate sample (Field, 2018). The factor analysis revealed that all items had communalities $< .20$ after extraction. Additionally, three factors were extracted an Eigenvalue > 1 , explaining 68,89% of the variance. These three factors had a correlation of .61 and -.56, which justified the use of oblimin rotation. Furthermore, the pattern matrix confirmed the absence of cross-loaders. However, some items of one scale loaded on different factors. Since the factor analysis is an iterative process, each scale should load on the same construct. Therefore, the items ER2, ER3 ER4, CR2, CR5 and BR5 were deleted (Appendix 2E).

Moreover, additional reliability tests were conducted to examine the reliability of the items for each individual scale. The Cronbach's alphas showed an acceptance reliability for the scale emotional resistance $\alpha = .837$, cognitive resistance $\alpha = .822$ and behavioural resistance $\alpha = .888$.

Additional analysis

A MANOVA was conducted to examine the effect of nudging on the resistance dimensions: emotional, cognitive and behavioural resistance. This resulted in the non-significant effect of nudging on emotional resistance $F(1,255) = 2.141, p = .145, \eta^2 = .08$. Also, nudging showed a non-significant effect on cognitive resistance $F(1,255) = 0.576, p = 0.449, \eta^2 = .002$. However, nudging showed a significant effect on behavioural resistance $F(1,255) = 10.747, p = .001, \eta^2 = .040$. The partial eta2 of digital nudging on the behavioural resistance was small to medium (4%). This indicates that the positive effect of digital nudging reduces the behavioural resistance to sustainable innovations (Appendix 2F).

A MANOVA was also conducted to examine the effect of price on the resistance dimensions: emotional, cognitive and behavioural resistance. This resulted in the significant effect of price on emotional resistance $F(1,255) = 7.229, p = .008, \eta^2 = .28$. The partial eta2 was large (28%). Price showed a non-significant effect on cognitive resistance, $F(1,255) = .976, p = .324, \eta^2 = .004$. Price showed a significant effect on behavioural resistance $F(1,255) = 5.01, p = .026, \eta^2 = .019$. The partial eta2 was small (1%). There was no significant interaction effect of nudge * price on emotional resistance $F(1,255) = .059, p = .808, \eta^2 = .00$, cognitive resistance $F(1,255) = .470, p = .493, \eta^2 = .002$ and behavioural resistance $F(1,255) = .620, p = .432, \eta^2 = .002$ (Appendix 2F).

Discussion

Summary

This chapter first summarizes the results of hypothesis 1 and hypothesis 2. The aim of the research was to find an answer to the research question ‘What is the effect of digital nudging on reducing resistance to sustainable innovations and how does the effect vary for high and low prices?’. Two hypotheses were formed to answer the research question.

H1 describes the positive effect of digital nudging on reducing resistance to sustainable innovations. A significant difference was found. Hence, hypothesis 1 can be accepted and it can be concluded that digital nudging is an effective strategy to reduce resistance to sustainable innovations. H2 describes the positive effect of digital nudging on reducing resistance to sustainable innovations is stronger when the innovation has a low price compared to a high price. There is no significant interaction effect. Hence, hypothesis 2 cannot be accepted and it can be concluded that the effect of digital nudging on reducing resistance to sustainable innovations does not differ for a low price compared to a high price.

In addition, the positive effect of nudging on reducing resistance of each dimension is investigated (emotional, behavioural and cognitive). Nudging has only a significant positive effect on reducing behavioural resistance. Besides that, the independent variable lower price has a significant effect on reducing resistance, especially on the emotional and behavioural dimension of resistance. While not being part of the hypothesized relationships, it is an interesting finding.

Theoretical implications

The theoretical contribution of this study is threefold. First, this study contributes to an enhanced understanding of resistance to innovation to the literature. Academic literature describes that most research has focused on factors that contribute to the ‘positive’ decision to adopt innovations, understanding why customers resist innovations is at least as important (Kleijnen et al., 2009). Furthermore, the research on nudging is often in offline contexts (Weinmann et al., 2016). As of now, the article of Stryja and Satzger (2019) and Stryja et al. (2017) investigates the positive effect of digital nudging on reducing resistance to innovations. This article has theoretical contribution by confirming the positive effect of digital nudging on reducing resistance to innovation which is consistent with the conclusions of Stryja and Satzger (2019) and Stryja et al. (2017). This thesis has theoretical contribution to the article of Stryja and Satzger (2019) on focussing a special type of innovation, namely the sustainable innovation. In addition, the research of Stryja and Satzger (2019) and Stryja et al. (2017) used

priming and concluded that priming has not a positive effect on reducing resistance to innovations. This thesis has theoretical contribution to add a new perspective by contradicting this conclusion, because this thesis concludes the positive effect of priming on reducing resistance to sustainable innovations, especially on behavioural resistance.

Second, this study adds a new perspective to the resistance innovation literature by using the psychological concept of emotional, cognitive and behavioural resistance. Most articles about resistance to innovation used the active/passive model or IRT model (Ram & Sheth, 1989; Heidenreich & Spieth, 2013; Migliore et al., 2022) However, there is little attention in studies concerning the psychological side of resistance to innovation (Castro et al., 2019; Ngafeeson & Manga, 2021). This study contributes to the literature by using the psychological scale of resistance to innovation.

Third, several studies suggested that the higher the price explains the higher the resistance to innovation (Migliore et al., 2022; Laukkanen et al., 2009; Abbas et al., 2017). This thesis confirms this conclusion. According to Harbers et al. (2020), it is still not clear if nudging could reduce resistance to sustainable innovations for both high and low prices, because little research has been done on this. Harbers et al. (2020) describes in a systematic review of 75 studies the effect of nudging on resistance for different prices and describes that the evidence is limited. Harberts et al. (2020) recommended that studies focusing on nudges and prices are needed. This research has theoretical contribution by describing the positive effect of digital nudging on reducing resistance to sustainable innovation does not differ for a low price compared to a high price.

Practical implications

Following Kaur et al. (2020), it is crucial for organizations offering solutions to better reduce resistance to innovation, because resistance is a factor that can define the success of the innovations in their market space. Managers are inclined to think that innovation is a good thing (Godin & Vinck, 2017). It is essential to understand consequences such as resistance towards sustainable innovations and how to overcome this (Godin & Vinck, 2017). In essence, resistance to sustainable innovations provide managers with a challenge they need to overcome to successfully launch innovations.

This study gives an insight on the effect of digital nudging on resistance to sustainable innovations and if this differs for low prices and high prices, which is useful knowledge for managers who are implementing sustainable innovations. The investigation reveals the

effectiveness to make consumers aware of sustainable choices by digital nudging to reduce resistance to sustainable innovations. This could be done by implementing a digital marketing campaign focused on the sustainability aspect. This campaign could stimulate consumers to make the switch to a more sustainable alternative. Specially, focusing on the behavioural component of resistance will decrease the resistance to sustainable innovations. As a manager, it is important to seek solutions for the behavioural resistance by implementing sustainable innovations. For example, managers could set up a digital marketing campaign what makes consumers aware of the impact of their plastic waste in nature. At the end of the campaign, consumers are told that they will receive a sample of a shampoo bar to try it out once they realize a purchase at a certain minimum amount. Hence, consumers will be aware of the importance of sustainable innovations by using the digital nudge in the campaign. Also, the consumers will try out the shampoo bar, which influences the behavioural resistance. This could activate the consumers to consider buying the shampoo bar.

The results showed that lowering the price is also of importance in reducing the resistance to sustainable innovations. However, the positive effect of digital nudging on reducing resistance to sustainable innovations does not differ for a low price compared to a high price. Hence, managers could implement the digital marketing campaign for sustainable products with a high price and with a low price as well. If managers could lead consumers becoming aware of sustainability and trying certain innovations, this could make a difference in the solution towards implementing sustainability innovations.

Limitations and suggestions for future research

The result of this study has several limitations that is discussed. Moreover, these limitations provide suggestions for future research. First, a nudge was used to test the positive effect of digital nudging on reducing resistance to sustainable innovations. One group saw a video with the digital nudge and the other groups did not see a video. To measure if the nudge has an effect, it is necessary that all other factors are being held constant except for the nudge. Further research might add two conditions, namely the nudge, no video and a control video that only has a difference on the sustainability component.

Second, priming is chosen to measure the positive effect of digital nudging on reducing resistance to sustainable innovations. According to Berger et al. (2022), priming is pre-commitment strategy to simulate feelings or thoughts to promote sustainable consumption behaviour. So, this fits well with the sustainable innovation (the shampoo bar). The article of Berger et al. (2022) describes different digital nudges that can be used as a communication tool.

It would be interesting to investigate in further research if other nudges will also have an effect on resistance to sustainable innovations. For example, the nudge ‘simplification’ and ‘framing’ also fits with sustainable innovations.

Third, there are some limitations regarding to the sample. 259 respondents were used to test the effect. This sample size a relatively small sample. Perhaps, the interaction effect will be significant with a larger sample. Also, the results show that most respondents were between the ages of 18 and 35, were women, have a high level of education and all respondents live in The Netherlands. Further research could use a larger and more equally distributed sample for different counties.

The fourth limitation is the psychological scale of resistance that was not optimal. When analysing the items of the scale in the factor analysis, it was concluded that a few factors loaded on the construct and 6 items had to be removed to conduct the MANOVA. In particular, the emotional and cognitive dimension of the scale resistance was not optimal. Only two negative items for emotional and three items for cognitive was conducted for this study. An explanation could be that the items are correct in theory, but not logical in practice. For example, consumers do not easily become 'happy' or 'irritated' with a shampoo bar. The behavioural dimension is more about the purchase, this sounds like a more logical consideration that consumers will make when seeing a shampoo bar. Also, some items were modified from the original scale for a better fit with the study. This may also be a reason that the items were not optimal. More research is needed on scale optimization for resistance to sustainable innovations. Furthermore, it was a better idea to choose another resistance scale to test the resistance of the sustainable innovation (the shampoo bar). There was chosen for the psychological resistance scale, because given the high level of uncertainty that exists within the sustainable innovation context, it is likely that the dimensions of emotional, cognitive and behavioural resistance (Cillo et al. 2019). However, a shampoo bar does not give a high level of uncertainty. This will be with products that have a higher impact to the lives of consumers or hard to understand (Dryer, 2021). Perhaps, it was better to use the IRT model or the passive/active scale to test the resistance of the shampoo bar.

Fifth, there are some limitations to the innovation. The effect of nudging on resistance to sustainable innovations was only tested to one innovation, the shampoo bar. So, no generalisable conclusions could be drawn for other sustainable products. Future research could extend the current study by including multiple sustainable innovations. Some sustainable innovations could be considered for future research, for example a sustainable water bottle and toothpaste tablets. Furthermore, it could be argued that the type of innovation could also affect

the interaction effect of nudging and pricing on resistance to sustainable innovations. In this study, the shampoo bar was chosen as the sustainable product. The shampoo bar is an elastic product. However, non-essential goods such as jewellery and electronics have a higher elasticity (Ross, 2021). A high elasticity means when the price increases consumers will easily switch to alternatives or not buy these products (Kagan, 2022). It could be an idea to utilize a product with a higher elasticity for further research. Perhaps, a significant difference will be measured on the effect of digital nudging on resistance to sustainable innovations for high and low prices. Another reason that no significant interaction effect was found is that the price was not very clearly stated. This was viewed on the picture of the shampoo bar, but this could have been better highlighted that consumers would include it more in their consideration.

Last, this study did not take moderators into consideration on the effect of digital nudging on resistance to sustainable innovation for high and low prices. It is suspected that for example generation, gender and personality could have an influence on the effect of this study. The theory describes that price perception can vary across consumers and this is due to price consciousness and price sensitivity (Zhao et al., 2022). For instance, it could be argued that consumers with a higher income are less price sensitive than consumers with a lower income. Besides that, it could also be argued that older consumers have more resistance to sustainable innovations, compared to younger consumers. In addition, consumers who are more environmental sensitive are more likely to purchase sustainable products than consumers who are less environmental sensitive. Future research could contribute moderators to the current research question for more detailed conclusions.

Concluding statement

To answer the main research question, digital nudging is an effective strategy to reduce resistance to sustainable innovations. Especially, the effect of digital nudging is the most effective on the behavioural component of resistance. Furthermore, the effect of digital nudging on reducing resistance to sustainable innovations does not differ for a low price compared to a high price. Sustainable innovations are becoming increasingly more important in the contemporary marketplace. Lowering the resistance of sustainable innovations lead not only to a competitive advantage, it also provides environmental benefits and creates social well-being. Considering the limitations of this study, future research is required to better understand the concept of digital nudging to resistance to sustainable innovations for low and high prices.

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Appendix

Appendix 1A – Shampoo bar



Appendix 1B – Measurement items of resistance

Construct	Definition	Original items	Adapted item	Translated item	Source
Emotional Resistance	The (negative) emotions that are brought up when presented with a new innovation.	I felt frustrated about how the new EHR system works	I feel frustration towards the shampoo bar	De shampoo bar roept frustratie bij mij op	Ngafeeson & Manga, 2021
		I was irritated by the way the new HER system restricts my pattern of work	I feel irritation when I think of the shampoo bar	De shampoo bar roept irritatie bij mij op	Ngafeeson & Manga, 2021
		I was stressed by the change brought by the new EHR system	I feel stress when I think of the shampoo bar	De shampoo bar roept stress bij mij op	Ngafeeson & Manga, 2021
		I saw _____ and it did not excite me at all	I feel excitement when I think of the shampoo bar	De shampoo bar maakt mij enthousiast	De Castro et al., 2019
		The possibility of purchasing _____ makes me happy	The possibility of purchasing the shampoo bar makes me happy	De mogelijkheid de shampoo bar te kunnen kopen maakt me blij	De Castro et al., 2019

		Purchasing _____ will truly satisfy me	Purchasing the shampooobar will truly satisfy me	Het kopen van de shampooobar zal mij voldoening geven	De Castro et al., 2019
Behavioral Resistance	The observable tendency to react of behave a certain way towards an innovation.	I cannot be bothered to think about switching to another service provider	I would not switch to the shampooobar	Ik zou niet overstappen op de shampooobar	Ngafeeson & Manga, 2021
		I tried as much as possible to avoid some aspects of the new HER system	I would try as much as possible to avoid the shampooobar	Ik zou proberen de shampooobar te vermijden	Ngafeeson & Manga, 2021
		I will try out this product	I will try out the shampooobar	Ik zou de shampooobar bubbel uitproberen	Ram, 1989
		How likely do you feel it is that you would purchase this product?	I would purchase the shampooobar	Ik zou de shampooobar kopen	Ngafeeson & Manga, 2021
		I will hinder the consumption of meat substitutes	I would discourage others to use the shampooobar	Ik zou de shampooobar afraden aan anderen	Cervantes, 2022; Kuijsten, 2022; Langhout, 2022; Rumengan, 2022; Van Nijnatten, 2022
Cognitive resistance	The non- rational and negatively biased evaluation of an innovation.	It may not perform as well as a regular aspirin	I am not sure that the shampooobar will perform as described	Ik weet niet zeker of de shampooobar zal presteren zoals beschreven	Ram, 1989
		I saw several weaknesses with the new EHR system	I see several disadvantages regarding the shampooobar	Ik zie verschillende tekortkomingen met betrekking tot de shampooobar	Ngafeeson & Manga, 2021

	I was critical about the new EHR system	I am critical about the shampooobar	Ik ben kritisch over de shampooobar	Ngafeeson & Manga, 2021
	I will obtain more information about this product before using it	I will obtain more information before buying the shampooobar	Ik zal meer informatie over de shampooobar verkrijgen voordat ik het zou aanschaffen	Ram, 1989
	Using this product is compatible with my needs	Using the shampooobar is compatible with my needs	Het gebruik van de shampooobar past bij mijn overtuigingen	De Castro et al., 2019

Appendix 1C – Online survey

Introduction to the topic

Beste respondent,

Voor mijn afstudeeronderzoek aan de Radboud Universiteit doe ik - onder begeleiding van dr. S.M. Ritter en dr. M.M. Weiss - onderzoek naar de reactie van mensen op innovaties. In dit onderzoek zal u een innovatie zien waarover ik u een aantal vragen zal stellen. Uw antwoorden zullen enkel gebruikt worden voor onderzoeksdoeleinden. Uw deelname is anoniem en vrijwillig. U kunt te allen tijde stoppen en er zijn geen goede of foute antwoorden. De enquête zal ongeveer 3 minuten duren.

Alvast hartelijk dank voor uw deelname!

Nathalie Mattijssen

Voor vragen of opmerkingen kunt u een mail sturen naar het volgende e-mailadres:

nathalie.mattijssen@ru.nl

- Ik stem geheel vrijwillig in met deelname aan dit onderzoek, waarbij mijn onderzoeksgegevens anoniem worden gemaakt en veilig worden opgeslagen volgens de richtlijnen voor het beheer van onderzoeksgegevens van de Radboud Universiteit.
- Ik stem niet in met deelname aan dit onderzoek, ik kies ervoor om de enquête te beëindigen.

Translation

Dear respondent,

For my graduation research at Radboud University, I am conducting research - supervised by Dr S.M. Ritter and Dr M.M. Weiss - on people's reaction to innovations. In this research, you will see an innovation about which I will ask you some questions. Your answers will only be used for research purposes. Your participation is anonymous and voluntary. You can stop at any time and there are no right or wrong answers. The survey will take about 3 minutes.

Thank you in advance for your participation!

Nathalie Mattijssen

*For questions or comments, please send an email to the following e-mail address:
nathalie.mattijssen@ru.nl*

- *I voluntarily agree to participate in this study, where my research data will be anonymised and securely stored according to the Radboud University research data management guidelines.*
- *I do not consent to participate in this research, I choose to terminate the survey.*

Nudge

Niet iedere respondent heeft het filmpje gezien.

<https://youtu.be/EI58XZfvXpc>

Translation

The nudge was not seen by all respondents.

Innovation

Elke respondent heeft de innovatie gezien en gelezen, allen de helft van de respondenten kregen de goedkope prijs te zien en de andere helft kregen de dure prijs te zien.



100%
PLASTICVRIJ



NATUURLIJKE
INGREDIËNTEN



VRIJ VAN
SULFATEN



VEGAN &
DIERPROEFVRIJ



GEMAAKT
IN NL

Hierboven ziet u een shampoo bar. De bar is shampoo in een vaste vorm, hierdoor is er weinig verpakkingsmateriaal nodig (een gerecycled papieren zakje is voldoende) en bespaart u veel plastic. De shampoo bar doet hetzelfde als een reguliere shampoo, alleen bestaat de reguliere shampoo voor 80% uit water waardoor het vloeibaar is en wordt verpakt in een plastic fles.

Het gebruik van de shampoo bar is erg simpel: Maak uw haar nat, wrijf de shampoo bar tussen uw handen en breng het schuim aan op uw haar. De shampoo bar is verkrijgbaar in verschillende geuren en voor verschillende haartypes.

In combinatie met de natuurlijke ingrediënten, effectieve werking en 100% plasticvrije verpakking is dit een goed alternatief dat beter is voor u en de planeet. De prijs van de shampoo bar bedraagt €2,99.



Hierboven ziet u een shampoo bar. De bar is shampoo in een vaste vorm, hierdoor is er weinig verpakkingsmateriaal nodig (een gerecycled papieren zakje is voldoende) en bespaart u veel plastic. De shampoo bar doet hetzelfde als een reguliere shampoo, alleen bestaat de reguliere shampoo voor 80% uit water waardoor het vloeibaar is en wordt verpakt in een plastic fles.

Het gebruik van de shampoo bar is erg simpel: Maak uw haar nat, wrijf de shampoo bar tussen uw handen en breng het schuim aan op uw haar. De shampoo bar is verkrijgbaar in verschillende geuren en voor verschillende haartypes.

In combinatie met de natuurlijke ingrediënten, effectieve werking en 100% plasticvrije verpakking is dit een goed alternatief dat beter is voor u en de planeet. De prijs van de shampoo bar bedraagt €9,99.

Translation

Each respondent saw and read the innovation, all half of the respondents were shown the cheap price and the other respondents were shown the expensive price.

Above you can see a shampoo bar. The bar is shampoo in a solid form, this requires little packaging material (a recycled paper bag will do) and saves a lot of plastic. The shampoo bar does the same as a regular shampoo, only regular shampoo consists of 80% water making it liquid and is packaged in a plastic bottle.

Using the shampoo bar is very simple: Wet your hair, rub the shampoo bar between your hands and apply the foam to your hair. The shampoo bar is available in different scents and for different hair types.

Combined with the natural ingredients, effective action and 100% plastic-free packaging, this is a great alternative that is better for you and the planet. The price of the shampoo bar is €9.99 (or 2,99).

Please take a look at the image below

Demographics

Met welk geslacht identificeert u zich?

- Man
- Vrouw
- Anders, namelijk:
- Zeg ik liever niet

Wat is uw hoogst behaalde opleiding?

- Geen opleiding
- Middelbare school
- MBO
- HBO Bachelor
- HBO Master
- WO Bachelor
- WO Master
- PhD

Translation

What is your gender identification?

- *Male*
- *Female*
- *Other, namely:*
- *Rather not say*

What is your highest level of education?

- *No education*
- *High school*
- *MBO*
- *HBO Bachelor*
- *HBO Master*
- *WO Bachelor*
- *WO Master*
- *PhD*

Questions of resistance (dimension emotional, cognitive and behavioural)

In hoeverre bent u het eens met de volgende stellingen over de shampooobar?
 Helemaal oneens - Oneens - Noch oneens, noch eens - Eens - Helemaal eens

De shampooobar roept irritatie bij me op
 Het idee van de shampooobar maakt me blij
 De shampooobar frustreert me
 De shampooobar maakt me enthousiast
 De shampooobar roept stress bij me op

In hoeverre bent u het eens met de volgende stellingen over de shampooobar?
 Helemaal oneens - Oneens - Noch oneens, noch eens - Eens - Helemaal eens

Ik twijfel of de shampooobar echt werkt
 Ik zie verschillende tekortkomingen met betrekking tot de shampooobar
 Ik ben kritisch over de shampooobar
 Ik zou meer informatie over de shampooobar willen voordat ik het aanschaf
 De shampooobar past bij mijn overtuigingen

In hoeverre bent u het eens met de volgende stellingen over de shampooobar?
 Helemaal oneens - Oneens - Noch oneens, noch eens - Eens - Helemaal eens

Ik zou niet overstappen op de shampooobar
Ik zou proberen de shampooobar te vermijden
Ik zou de shampooobar uitproberen
Ik zou de shampooobar kopen
Ik zou de shampooobar afraden aan anderen

Translation

To what extent do you agree with the following statements about the shampooobar?

Completely disagree - Disagree - Neither disagree nor agree - Agree - Completely agree

The shampooobar provokes irritation in me

The shampooobar makes me happy

The shampooobar frustrates me

The shampooobar excites me

The shampooobar evokes stress in me

To what extent do you agree with the following statements about the shampooobar?

Completely disagree - Disagree - Neither disagree nor agree - Agree - Completely agree

I doubt whether the shampooobar really works

I see several shortcomings regarding the shampooobar

I am critical of the shampooobar

I would like more information about the shampooobar before buying it

The shampooobar fits my beliefs

To what extent do you agree with the following statements about shampooobar?

Completely disagree - Disagree - Neither disagree nor agree - Agree - Completely agree

I would not switch to the shampooobar

I would try to avoid the shampoo bar

I would try the shampoo bar

I would buy the shampoo bar

I would advise against the shampoo bar to others

6. Debriefing

Hartelijk dank voor uw deelname! Uw antwoorden zijn opgeslagen.

Voor vragen of opmerkingen met betrekking tot de enquête of het gehele onderzoek, kunt u contact opnemen met mij via dit e-mailadres: nathalie.mattijssen@ru.nl

Translation

Thank you very much for your participation! Your answers have been saved.

For any questions or comments regarding the survey or the entire study, please contact me at this email address: Nathalie.mattijssen@ru.nl

Appendix 2A - Manipulation check

Independent Samples Test											
		Levene's Test for Equality of Variances				t-test for Equality of Means					
		F	Sig.	t	df	Significance		Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						One-Sided p	Two-Sided p			Lower	Upper
manipulatie prijs	Equal variances assumed	,433	,511	-13,460	257	<,001	<,001	-1,336	,099	-1,531	-1,140
	Equal variances not assumed			-13,507	256,781	<,001	<,001	-1,336	,099	-1,530	-1,141

Appendix 2B- Assumptions

		Statistics														
		ER_1	ER_2	ER_3	ER_4	ER_5	CR_1	CR_2	CR_3	CR_4	CR_5	BR_1	BR_2	BR_3	BR_4	BR_5
N	Valid	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260
	Missing	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68
Mean		1,89	3,61	1,82	3,61	1,85	2,79	2,70	2,97	3,44	3,67	2,59	2,04	3,95	3,44	2,05
Median		2,00	4,00	2,00	4,00	2,00	3,00	3,00	3,00	4,00	4,00	2,00	2,00	4,00	4,00	2,00
Mode		1	4	2	4	1	2	2	4	4	4	2	2	4	4	2
Std. Deviation		,974	1,001	,830	,934	,942	1,134	1,034	1,063	1,076	,878	1,099	,925	,851	,994	,922
Skewness		,983	-,438	1,084	-,431	1,122	,047	,108	-,257	-,532	-,544	,485	,926	-,1201	-,528	,793
Std. Error of Skewness		,151	,151	,151	,151	,151	,151	,151	,151	,151	,151	,151	,151	,151	,151	,151
Kurtosis		,225	-,622	1,382	-,329	,716	-1,206	-1,036	-1,047	-,616	,112	-,589	,587	1,903	-,399	4,68
Std. Error of Kurtosis		,301	,301	,301	,301	,301	,301	,301	,301	,301	,301	,301	,301	,301	,301	,301

Test Results^a

Box's M		23,616
F	Approx.	,258
	df1	78
	df2	7401,762
	Sig.	1,000

Tests null hypothesis of equal population covariance matrices.

a. Some covariance matrices are singular and the usual procedure will not work. The non-singular groups will be tested against their own pooled within-groups covariance matrix. The log of its determinant is -2,725.

Robust Tests of Equality of Means

Average_Resistance

	Statistic ^a	df1	df2	Sig.
Welch	6,762	1	244,436	,010

a. Asymptotically F distributed.

Appendix 2C – Independent sample t-test

		Levene's Test for Equality of Variances		t-test for Equality of Means				95% Confidence Interval of the Difference			
		F	Sig.	t	df	Significance One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Average_Resistance	Equal variances assumed	12,204	<,001	2,581	257	,005	,010	,20585	,07976	,04878	,36292
	Equal variances not assumed			2,600	244,436	,005	,010	,20585	,07916	,04993	,36177

Appendix 2D - Two way-ANOVA

Levene's Test of Equality of Error Variances^{a,b}

		Levene Statistic	df1	df2	Sig.
resistanceANOVA	Based on Mean	4,344	3	255	,005
	Based on Median	3,440	3	255	,017
	Based on Median and with adjusted df	3,440	3	232,112	,018
	Based on trimmed mean	4,150	3	255	,007

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Dependent variable: resistanceANOVA

b. Design: Intercept + Price + Nudge + Price * Nudge

Tests of Between-Subjects Effects

Dependent Variable: resistanceANOVA

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6,323 ^a	3	2,108	5,261	,002	,058
Intercept	1400,922	1	1400,922	3496,910	<,001	,932
Price	2,716	1	2,716	6,778	,010	,026
Nudge	2,883	1	2,883	7,196	,008	,027
Price * Nudge	,350	1	,350	,874	,351	,003
Error	102,157	255	,401			
Total	1513,929	259				
Corrected Total	108,481	258				

a. R Squared = ,058 (Adjusted R Squared = ,047)

Appendix 2E – Factor analysis

Pattern Matrix^a

	Factor		
	1	2	3
ER_1_stress	,001	,095	-,762
ER_2_frustratie	,036	,038	-,883
CR_1_twijfel	-,003	,848	,034
CR_2_tekortkomingen	,077	,691	-,115
CR_3_kritisch	,002	,674	-,053
BR_1_nietoverstappen	,748	,196	,039
BR_2_vermijden	,550	,041	-,327
BR_3_uitproberen	,824	-,131	-,138
BR_4_kopen	,867	,087	,124

Extraction Method: Principal Axis Factoring.

Rotation Method: Oblimin with Kaiser Normalization.^a

a. Rotation converged in 15 iterations.

Appendix 2F- MANOVA

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Average_Resistance_Cognitive	,844 ^a	3	,281	,706	,549	,008
	Average_Resistance_Behavioral	11,645 ^b	3	3,882	5,801	<,001	,064
	EMOAVRAGEDDEF	6,347 ^c	3	2,116	3,308	,021	,037
Intercept	Average_Resistance_Cognitive	1985,882	1	1985,882	4980,128	<,001	,951
	Average_Resistance_Behavioral	1370,424	1	1370,424	2048,010	<,001	,889
	EMOAVRAGEDDEF	887,783	1	887,783	1388,205	<,001	,845
Price	Average_Resistance_Cognitive	,389	1	,389	,976	,324	,004
	Average_Resistance_Behavioral	3,349	1	3,349	5,005	,026	,019
	EMOAVRAGEDDEF	4,623	1	4,623	7,229	,008	,028
Nudge	Average_Resistance_Cognitive	,230	1	,230	,576	,449	,002
	Average_Resistance_Behavioral	7,192	1	7,192	10,747	,001	,040
	EMOAVRAGEDDEF	1,369	1	1,369	2,141	,145	,008
Price * Nudge	Average_Resistance_Cognitive	,188	1	,188	,470	,493	,002
	Average_Resistance_Behavioral	,415	1	,415	,620	,432	,002
	EMOAVRAGEDDEF	,038	1	,038	,059	,808	,000
Error	Average_Resistance_Cognitive	101,684	255	,399			
	Average_Resistance_Behavioral	170,633	255	,669			
	EMOAVRAGEDDEF	163,077	255	,640			
Total	Average_Resistance_Cognitive	2096,667	259				
	Average_Resistance_Behavioral	1558,375	259				
	EMOAVRAGEDDEF	1059,000	259				
Corrected Total	Average_Resistance_Cognitive	102,529	258				
	Average_Resistance_Behavioral	182,278	258				
	EMOAVRAGEDDEF	169,425	258				

a. R Squared = ,008 (Adjusted R Squared = -,003)

b. R Squared = ,064 (Adjusted R Squared = ,053)

c. R Squared = ,037 (Adjusted R Squared = -,026)