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Erasmus School of Economics

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Casting light on dark patterns: can customer awareness reduce unwanted purchases in e-commerce?

Ivan Budimčić

595033

Supervisor: Prof. Dr. Peter Wakker

Second assessor: Andrea Pogliano

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Abstract

The digital environment is a very potent setting for companies to utilize deceptive design practices. Given the growth of e-commerce, this issue raises the necessity for a comprehensive examination of possible interventions that would result in lowering the impact of dark patterns on online spending behaviour. Existing research indicates the extensive usage of dark patterns in e-commerce, emphasizing the negative impact on consumer trust and the need for governmental interventions to protect online customers. This study employed an online experiment with 78 subjects, a between-subjects design, and a controlled simulated shopping environment to examine the effects of the warning and educational interventions on online spending behaviour. Subjects were randomly assigned to one of three groups, each receiving separate introduction messages related to dark patterns. The fact that there was not a significant difference in median expenditure among the three groups highlights the difficulties in dealing with misleading design tactics in e-commerce. These findings underline how vulnerable online shoppers are to deceptive design strategies and suggest developing comprehensive strategies and strict policy enforcement as possible prevention strategies to protect online shoppers from dishonest e-commerce practices.

Keywords: dark patterns, e-commerce, online consumer behaviour, educational and warning interventions

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Introduction

The Internet is a digital environment that makes it easier for online businesses to develop and update information content, as well as manipulate the display and creation of such information content for purposes of deception (Xiao and Benbasat, 2011). Given Lin's (2022) prediction that global e-commerce sales will reach $5.9 trillion in 2023, it is prominent that Xiao and Benbesat's claim that "various innovative technologies supporting e-commerce gave rise to novel forms of deceptive practices" (Xiao and Benbasat, 2011) is as relevant as ever.

One category of deceptive practices that appears on online platforms and interfaces is called dark patterns. Digital Services Act (DSA) defines dark patterns as "practices that materially distort or impair, either on purpose or in effect, the ability of recipients of the service to make autonomous and informed choices or decisions" (Regulation (EU), 2022). According to the same source, these techniques "can be used to persuade the recipients of the service to engage in unwanted behaviours or into undesired decisions which have negative consequences for them." A recent study by Lupiáñez-Villanueva et al. (2022) reveals that there is at least one dark pattern method applied in 97% of the most popular websites and apps used by EU customers.

According to Kollmer and Eckhardt (2023), current research on dark patterns has mostly concentrated on describing dark patterns, developing dark pattern taxonomies, and evaluating the ethical implications of dark patterns. As a result, current research has given us a solid understanding of the conceptual elements of dark patterns but has left us in the dark about the best course of action for legislators to take to reduce or mitigate the effect of these techniques. Based on this result, this study aims to explore whether implementing a simple

warning or actively educating customers about the existence of dark patterns could be beneficial methods to prevent falling for dark patterns in the near run.

The fundamental subject of the main research question and supporting two hypotheses is to determine whether there is any potential value in additional communication with online consumers and what would be the more effective approach for protecting their money.

To test these hypotheses, all subjects of the experimental part of the study received an identical assignment in which they had to make all the purchases from the same to-buy list. Purchases were made in an online store that was specifically curated for this experiment and included five of the most popular dark pattern tactics. Since there were no real-world transactions, as all the subjects were made aware, it was expected that strategies based on product and time scarcity would provide either insufficient or limited results. By excluding these strategies from the study, the experiment's patterns were chosen from the most common ones while staying consistent with the study's objectives.

Subjects were randomly assigned to one of three groups: control, treatment 1 (warning message), or treatment 2 (explicit information on dark patterns). Each group received a unique welcome message when they entered the online store. The control group was given no information about dark patterns and was informed that the study would look into the effect of design choices in e-commerce. Treatment 1 was provided with a statement indicating that they might encounter deceptive design selections, whereas Treatment 2 was presented with a brief explanation of dark patterns followed by three separate examples. The examples provided were specifically chosen to be from a different category from the ones utilized in the online store. The key outcome variable was the average amount of money spent at the end of a simulated

online shopping session, allowing us to see if there was a difference in spending across these groups. During the experiment design phase, it was anticipated that Treatment 2 would spend the least amount of money, followed by Treatment 1 and the control group, respectively.

The potential findings of this study could have significant implications for international governments to explore additional strategies for protecting online consumers against fraud. According to Brignull et al. (2023), the EU has various regulations in place to maintain a fairer internet for users, the most well-known of which is GDPR, with the US counterpart being the FTC. These laws and regulations indicate the growing recognition of the need to address these concerns in an organized and effective manner. That said, the outcome of this research could assist the EU in determining whether it is beneficial to launch an awareness campaign on dark patterns and whether to structure it to inform people about their existence. Another outcome could suggest enacting additional changes to GDPR and FTC, requiring all e-commerce websites to display an entry warning about being cautious when making purchases, potentially reducing the share of people who fall for deceptions.

The results showed that there was no significant reduction in respondents' total spending in the experimental online shop, despite efforts to inform and warn them of the presence of dark patterns. Between the control and two treatments, there were no differences in the median value of total spending or the median spending per individual product. This negative finding emphasizes the complex nature of addressing deceptive design in e-commerce and the need for comprehensive strategies and strong regulatory measures.

Literature Review

A study conducted by Moser et al. (2019) found that about 85% of Americans reported making impulsive purchases in stores and online. Their research on the top 200 retail websites in the US revealed that all of them contained at least four features that encourage impulse buying. Although the study did not specify whether these features were used in the favour of customers, it highlighted that retailers have almost no incentive to lower consumers' desire to curb their impulse buying.

Another study by Mathur et al. (2019) analysed 11000 of the most popular online shopping websites and found that 1254 of them, that is 11.1%, employed dark patterns. Additionally, the study found that a website's probability of using dark patterns increases with its popularity.

Dark patterns are especially prevalent in e-commerce, yet, according to studies on user perception, employing dark patterns can backfire on the firms using them. Xiao and Benbesat (2011) found that when consumers are reluctant to make purchases online for fear of deception, online businesses as a whole suffer from a loss in sales and reputation. Another study, done by Advocacy Team (2021), found that 24% of consumers thought negatively of a company that used dark patterns, and 16% said they stopped using a website or app (temporarily or permanently) because of the use of dark patterns.

Brignull (2011) offered suggestions as to why dark patterns are so common, stating that they frequently perform very well in A/B and multivariate tests and that misleading users into taking a certain action is likely to result in a higher conversion rate than if the user makes an informed decision. As Luguri & Strahilevitz (2021) remarked, dark patterns are effective in

nudging customers to act against their own preferences. Furthermore, as mentioned by Navala (2020), the fact that everyone employs dark patterns establishes them as an industry standard, further encouraging other online retailers to abide by the same practice.

This study will follow a taxonomy developed by Mathur et al. (2019), who built their framework on a meta-analysis of dark patterns, combining their research with the work of multiple authors. They categorized dark patterns into 15 distinct types, all of which fall into one of 7 groups, each containing a common theme. The seven categories are as follows:

Sneaking

Gray et al. (2018) defined sneaking as the act of keeping important information from the users to manipulate their behaviour. This strategy often involves hidden costs or bait-and-switch tactics to influence consumer behaviour. Mathur et al. (2019) highlighted an example of sneaking, where buying a bouquet in the online store avasflowers.net automatically added a greeting card to the basket, all without the buyers' knowledge.

Urgency

According to Cialdini (2008), the concept of urgency capitalizes on the effect of loss aversion by increasing people's desire for things with limited availability. An example of a fake urgency dark pattern could be a limited-time message that indicates a fake deadline for a product sale (Mathur et al. 2019).

Misdirection

Dark patterns falling under the "Misdirection" subcategory use language, visuals, and emotions to distract customers either towards or away from making a specific decision, without

restricting the total set of available choices (Mathur et al. 2019). According to Luguri and Strahilevitz (2021), confirmshaming is one instance of this category, where a pattern that plays on emotions is demonstrated. In this case, the option of declining the data protection program was made explicitly discouraged through the statement "I don't care about protecting my data or credit history."

Social Proof

Cialdini (2008) defines social proof as a psychological and sociological phenomenon in which people mimic the behaviour of others when deciding how to react in a given situation. Mathur et al. (2019) claim that the "Social Proof" dark pattern takes advantage of this influence to accelerate user purchases and decision-making by capitalizing on the cognitive bias associated with the bandwagon effect. One such example is the "Activity Notification" pattern, which is a frequently occurring and striking message that is displayed on product pages to indicate the activity of other users. These may be dynamic and recurring alerts that indicate other users had recently purchased a product (e.g., "Abigail from Michigan just bought a new stereo system"), or static or dynamic message that indicates how many users had added a certain item to their cart (e.g., "35 people added this item to cart").

Scarcity

To enhance the perceived desirability of their products among consumers, marketers have the capacity and frequently employ the strategy of scarcity in their promotional pitches (Jung and Kellaris 2004). According to Mathur et al. (2019), the absence of a precise number display in the low-stock notification leads to ambiguity, heightened product attractiveness, and impulsive buying behaviour among consumers.

Obstruction

Gray et al. (2018) define obstruction as delaying a task flow by making an interaction more complex than it naturally needs to be to discourage an activity. Obstruction frequently appears as a significant obstacle to a specific task that the user wants to complete. Gray et al. (2018) gave an example of a job-search website theladders.com that, even though many jobs posted on the site are also published elsewhere, requires an account to browse jobs and a premium, paid account to apply for a position.

Forced Action

Forced action, according to Gray et al. (2018), is any circumstance in which users are required to carry out a specific action to access (or keep accessing) a particular functionality. This could be presented as a choice that will be of great benefit to the user, or it could be a necessary step to finish a procedure. In their collection, one example of forced action comes from the Windows 10 operating system, which prevents users from shutting down or restarting their device without updating when a system update is available.

In addition to the categorization, Mathur et al. (2019) also structured taxonomy across five distinct dimensions, each of them representing a manipulation strategy they utilize:

1. Asymmetric: Refers to the unequal imposition of weights or burdens on the choices presented to the user within the interface. A common example is the placement of a prominent "Accept" button for cookies while making the "Opt-out" option less visible or accessible.

2. Covert: Pertains to the concealment of the interface design's influence on user decision-making. It involves steering users into specific actions without their conscious awareness, often employing cognitive biases like the decoy effect.
3. Deceptive: Involves inducing false beliefs through affirmative misstatements, misleading statements, or omissions. An instance could be the presentation of a seemingly time-limited discount that renews upon webpage refresh, misleading users about the urgency of the offer.
4. Hides Information: Focuses on the obscuring or delaying of the necessary information from users, such as concealing additional charges until the final stages of checkout.
5. Restrictive: Relates to the limitation of choices available to users, like the requirement to sign up using existing social media accounts, thereby enabling the platform to gather more user information.

Table 1. Categories and types of dark patterns along with their description, prevalence, and definitions. Legend: ●= Always, ◐= Sometimes, ○= Never

Category	Type	Description	# Instances	# Websites	Asymmetric?	Covert?	Deceptive?	Hides Info?	Restrictive?	Cognitive Biases
Sneaking	Sneak into Basket	Adding additional products to users' shopping carts without their consent	7	7	○	○	◐	●	○	Default Effect
	Hidden Costs	Revealing previously undisclosed charges to users right before they make a purchase	5	5	○	○	◐	●	○	Sunk Cost Fallacy
	Hidden Subscription	Charging users a recurring fee under the pretense of a one-time fee or a free trial	14	13	○	○	◐	●	○	None
Urgency	Countdown Timer	Indicating to users that a deal or discount will expire using a counting-down timer	393	361	○	◐	◐	○	○	Scarcity Bias
	Limited-time Message	Indicating to users that a deal or sale will expire will expire soon without specifying a deadline	88	84	○	◐	○	●	○	Scarcity Bias
Misdirection	Confirmshaming	Using language and emotion (shame) to steer users away from making a certain choice	169	164	●	○	○	○	○	Framing Effect
	Visual Interference	Using style and visual presentation to steer users to or away from certain choices	25	24	◐	●	◐	○	○	Anchoring & Framing Effect
	Trick Questions	Using confusing language to steer users into making certain choices	9	9	●	●	○	○	○	Default & Framing Effect
	Pressured Selling	Pre-selecting more expensive variations of a product, or pressuring the user to accept the more expensive variations of a product and related products	67	62	◐	◐	○	○	○	Anchoring & Default Effect, Scarcity Bias
Social Proof	Activity Message	Informing the user about the activity on the website (e.g., purchases, views, visits)	313	264	○	◐	◐	○	○	Bandwagon Effect
	Testimonials	Testimonials on a product page whose origin is unclear	12	12	○	○	◐	○	○	Bandwagon Effect
Scarcity	Low-stock Message	Indicating to users that limited quantities of a product are available, increasing its desirability	632	581	○	◐	◐	◐	○	Scarcity Bias
	High-demand Message	Indicating to users that a product is in high-demand and likely to sell out soon, increasing its desirability	47	43	○	◐	○	○	○	Scarcity Bias
Obstruction	Hard to Cancel	Making it easy for the user to sign up for a service but hard to cancel it	31	31	○	○	○	◐	●	None
Forced Action	Forced Enrollment	Coercing users to create accounts or share their information to complete their tasks	6	6	●	○	○	○	●	None

Figure 1. Summary of dark pattern categories and types, including brief descriptions of each type, their frequency in the Mathur et al. experiment, dimensions, and the cognitive biases they are associated with (adapted from Mathur et al. 2019)

As illustrated in Figure 1, Mathur et al. recognized various cognitive biases exploited by dark patterns, providing a link between these biases and the specific dark pattern types.

1. Anchoring Effect: a disproportionate effect on decision-makers to make decisions that are biased toward an initially provided value (Tversky and Kahneman 1974).
2. Bandwagon Effect: the tendency of an individual to give in to the viewpoint of the majority in cases where their own viewpoint is different (Bindra et al. 2022).
3. Default Effect: pre-selecting one of the options to improve the probability of adoption (Jachimowicz et al. 2019).
4. Gain-Loss Framing Effect: the effect where people react differently to a given decision based on whether it is presented as a gain or a loss (Tversky & Kahneman 1989).
5. Scarcity Bias: we perceive an object or resource to be more valued when it is less readily available (for example, due to a restricted supply or time) (Cialdini 2008).
6. Sunk Cost Fallacy: the tendency to continue with a project even when the present costs are greater than the potential benefits (Jarmolowicz et al. 2016).

It is worth noting that the link between behavioural economics and dark patterns was also acknowledged by Bösch et al. (2016) who incorporated Dual Processing Theory explained by Kahneman (2011) and argued that dark patterns exploit System 1's automatic decision-making processes rather than System 2's rational deliberation to sway customers into making decisions favourable for the e-commerce. Another connection with behavioural economics is made by Luguri and Strahilevitz (2021) who classified dark patterns as a form of sludge.

97% of the most widely used websites and apps among EU customers featured at least one dark pattern, according to the mystery shopping experiment. The most prevalent variations

included sneaking, misdirection, obstruction and forced action (Lupiáñez-Villanueva et al., 2022). Although tech giants such as Google and Facebook got fined for using dark patterns to try to force consent, governments and the EU Commission still appear to be reluctant to impose sanctions when needed (Lomas 2022). Some action has been taken to protect consumers from dark patterns, but these efforts are still limited and inconsistent (Advocacy Team 2021). One way to potentially improve the protection could be through investigating the effect of prevention techniques. To put this to the test, this study will seek to answer the main research question:

"Do educational and warning initiatives have different effects on the reduction of online expenditure among e-commerce customers?"

To help answer this question, the study will test two main hypotheses:

H1: "Does educating customers about common dark patterns on an e-commerce website result in lower spending?"

H2: "Does warning customers about potential ongoing deceptions on the e-commerce website result in lower spending?"

As global legislation on deceptive practices continues to develop with each new implication, identifying the most efficient strategy to avoid falling for dark patterns could be extremely beneficial to both lawmakers and internet users, possibly improving the quality of online regulations. According to Cooper (2023), with the adoption of the Digital Markets Act and Digital Services Act, and the negotiation of the upcoming legislative proposals, the European institutions are setting the tone for 2023 for more transparency and accountability in digital markets. Cooper adds that, as regulation won't be limited to a single regulation, there

would be a greater enforcement of dark patterns. One such example is where data protection authorities are also exploring the use of dark patterns in the processing of personal data and digital marketing. As conveyed by Lupiáñez-Villanueva et al. (2022): „the Commission aims to tackle online commercial practices that disregard consumers' right to make an informed choice, abuse their behavioural biases or distort their decision-making processes, such as dark patterns and hidden advertising."

Methodology

To test the aforementioned hypotheses, an online experiment was conducted in October 2023 through a fictional online shop. This online shop was developed specifically for this thesis through WordPress and WooCommerce platforms and it used the VWO tool to randomize the splitting of the sample. To avoid potential learning effects, the research design implemented a between-subjects approach, separating the sample into three groups. This online shop introduced several dark patterns that were consistent with the classification system presented by Mathur et al. (2019) and were based on the real-world examples provided on the website https://www.deceptive.design.

The experiment passed ethical approval, used data screening to exclude underage subjects and was further shared via word of mouth and social media (primarily LinkedIn and Instagram). No private information was collected, and each purchase ID is not traceable to the individual shopper.

Using the G*Power software, a power analysis was performed to calculate the sample size needed to reduce the type 2 error. The recommended sample size to detect a moderate

effect in this experiment ($\delta = 0.5$) at the established $\alpha = 0.05$ significance level was 42 subjects in total, or that would be a minimum of 14 per group.

Experimental Design

Upon visiting the online shop, subjects were randomly assigned to one of three groups as follows:

Control group: The information provided to the control group contained no information about potential deceptive patterns they could encounter during their shopping experience, and were informed the experiment would analyse how particular design decisions affect online consumer purchasing behaviour.

First treatment group: In addition to the same information that the control group was provided, the first treatment group had a line that explicitly mentioned they might encounter design decisions that could negatively impact consumers. The goal behind this was to remind them that not everything they encounter in the e-commerce environment is for their good by warning them of potential negative presence.

Second treatment group: The information provided to the first treatment group was further enriched with the definition of dark patterns, and subjects were presented with examples of Fake scarcity, Hard to cancel and Fake urgency. These examples were designed to inform about certain types of dark patterns, specifically those that were not a part of the experiment.

To assess the influence of the "warning" and "education" treatments, a dependent and independent set of variables was used. The dependent variable was represented through the

total amount spent, while the independent variables were the prices of each line of product. Products that had dark patterns implemented were constructed to have a way out of avoiding the pattern, specific to individual items.

The protocol is as follows: each subject received a thoughtfully curated shopping list that was a mixture of daily used products, following the consumer basket sets according to Gooding (2021), and several expandable products not often bought. This approach attempted to produce a representative sample of biweekly typical online supermarket purchases, as well as a couple of consumer goods products that most of us buy only when in need. Each product is considered an independent variable, while the total amount spent during a single shopping session is considered the dependent variable. Products without deceptive designs are excluded from the computation of dependent variables as their function was to act as a decoy for manipulated products, filling the consumer basket. In addition to investigating the average total expenditure, a secondary analysis was performed to compare the mean expenditure of each product across all groups, thereby evaluating the impact of each dark pattern individually.

The experiment's structure maintained flexibility, allowing subjects to navigate the provided list as they saw fit. Each time they revisited the shopping list, subjects were reminded that the goal was to purchase all of the mentioned products while keeping the spending to the minimum. Upon completion, the usual buyer information was transformed to include demographic and several control questions, keeping privacy in mind, and not containing any personal information that could be traced back to an individual. Due to technical limitations, subjects at the beginning of the experiment were given a Group ID, which was an indication of whether they were in the control group, treatment 1, or treatment 2 groups. To avoid potential naming biases, instead of selecting a number, each group was given a different name. The

control group was named "ducks". Treatment 1, the warning group, was assigned "dogs". Treatment 2, the group that received information about dark patterns, was assigned "cats". At the end of the experiment, subjects were asked to select the name of the group they were in. To prevent data contamination, those who did not put their group name in the end were excluded from the study.

Individual products were associated with dark patterns as the following: chicken breast product that subjects were required to buy had a confirmshaming message that was designed to push customers toward more expensive tofu. Through confusing language and confusing visualization, glasses and apples contained a misdirection that would prevent a simple pricing comparison. The low-contrast product description of the earphones combined visual interference with hidden costs. T-shirts involved pressured selling and visual interference. Shipping voucher employed a form of sneaking into a basket. Visual representation is available in the appendix.

Additionally, once they submitted their answers, as a debriefing, all subjects were given information and examples of dark patterns, further encouraging learning about the mentioned practices through the provided links.

Results

Along with the group correspondence, questions about demographics such as age, gender, household income, education level, familiarity with the concept of dark patterns, the assistance used during the online shopping experience, and the confirmshaming control question were posed. Table 1 shows the prevalence of countries of residence, Table 2 summarizes categorical data, and Table 3 does the same for continuous variables.

Countries	Frequency	Percent
Australia	1	1.28
Croatia	39	50
Finland	1	1.28
Germany	6	7.69
Great Britain	1	1.28
Greece	6	7.69
Hungary	2	2.56
Italy	1	1.28
Japan	1	1.28
Netherlands	15	19.23
Portugal	1	1.28
Spain	1	1.28
United States of America	3	3.85
Total	78	100.00

Table 1. Sample by country of residence

The data represents a diverse group of individuals, consisting of a total of 78 individuals from different parts of the world. The biggest percentage of the sample is made up of subjects from Croatia, with the Netherlands, Germany, and Greece following behind. The findings show a somewhat higher representation of female subjects, with most subjects falling between the ages of 25 and 34. When it came to education, most of the respondents said they had completed at least one university degree, where 89% of subjects earned a bachelor's or master's degree.

Variables	Frequency	Percentage
Group ID	78	100.00
Control	23	29.49
Warning Treatment	28	35.90
Information Treatment	27	24.62
Gender	78	100.00
Female	46	58.97
Male	30	38.46
Undisclosed	2	2.56
Age	78	100.00
18 – 24	13	16.67
25 – 34	47	60.26
35 – 44	13	16.67
45 – 54	2	2.56
55 – 64	3	3.85
Education	78	100.00

High school or less	4	5.13
Applied University	2	2.56
University degree (Bachelor/ Master)	70	89.74
Doctorate or Professional degree	2	2.56
Familiarity With Dark Patterns	78	100.00
Not familiar at all	52	66.67
Some level of familiarity	18	23.08
I am familiar with the concept	8	10.26
Used Assistance (e.g. calculator)	78	100.00
Yes	17	21.79
No	61	78.21
Used Discount Code (6.99)	78	100.00
No	53	67.95
Yes	25	32.05
Confirmshaming Control	78	100.00
Switched to tofu because of the description	8	10.26
Chose tofu as default	2	2.56
No impact of the description	68	87.18
Shipping Voucher	78	100.00
6.99	76	97.44
13.98	2	2.56

Table 2. Summary statistics of categorical variables

Since 66% of the subjects said they were not familiar with the idea of dark patterns, there was not a significant impact from any potential prior knowledge. Furthermore, 78% of subjects did not report using any kind of help when they were buying online, such as a calculator to find out how many apples go in a kilogram.

Variables	Observations	Mean	Std. dev.	Min	Max
Income	78	33287.17	44764.75	0	231000
Apples	78	2.403846	0.6531527	2	7
Chicken/Tofu	78	7.527821	1.969372	6.99	14.98
Earphones	78	51.19756	10.63374	24.59	84.58
Glass	78	9.113077	0.3969668	7.96	10.98
T-shirt	78	17.02821	2.740477	15.99	31.98
Total Amount Spent	78	92.19936	13.27118	58.56	136.22

Table 3. Summary statistics of continuous variables

The continuous variables' summary statistics reveal the subjects' spending patterns in several product categories that were affected by dark patterns. Subjects across all three groups spent an average of €92.20 overall, with the total expenditure ranging between €58.56 and

€136.22. Four individuals achieved the lowest feasible total amount, which is the point at which the price-increasing impact of dark patterns was avoided. Furthermore, the average amount spent on individual products (apples, tofu or chicken, earbuds, glasses, and T-shirts) offers information about subjects' purchasing regarding the specific dark patterns implemented within the products. Since they did not exhibit any dark patterns, other items on the shopping list were excluded from the analysis to remove their impact on the variance in total expenditure. Further examination was conducted to determine if there was a significant variance in individual product expenditure between the three mentioned groups. However, none of them produced a significant result.

After filtering through the data to remove non-compliant entries and incomplete responses, the sample size was reduced to 78 individuals.

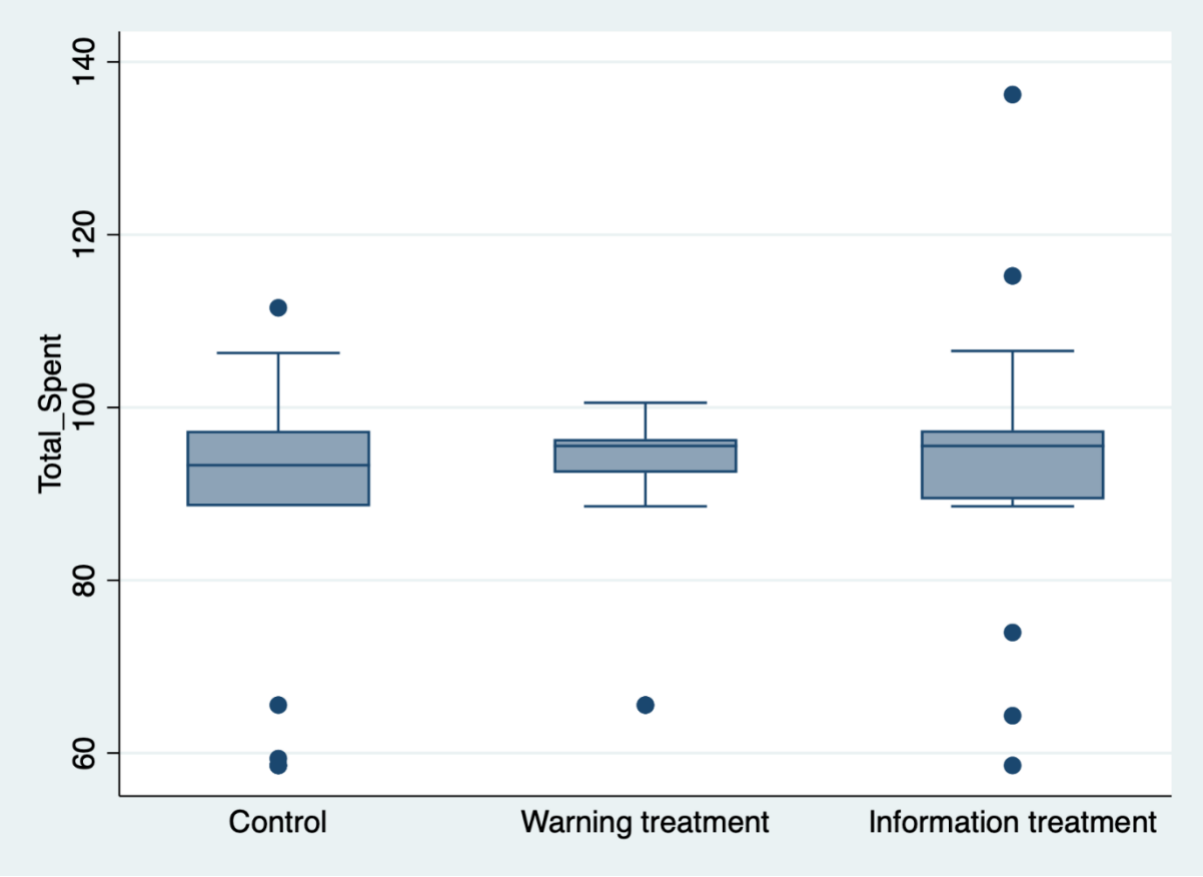

Figure 2. Total expenditure by all three groups

Note: [Each box plot shows the distribution of the Total_Spent variable within each of the three groups. The interquartile ranges (IQR) are shown by the box lengths, while the medians are indicated by the central lines in each box. Tails reach the furthest data points, which are within 1.5 times the box's IQR. Individual dots that extend past the tails are outliers. Based on the visual analysis of the box plots, we can infer that the distributions in each group have the same shape, that is the same variability, therefore allowing us to continue with the Kruskal-Wallis test.]

Variables	Observations	W	V	Z	Prob>z
Total Spent in Control	23	0.83551	4.302	2.976	0.00150
Total Spent in Treatment 1	28	0.64795	10.631	4.867	0.00000
Total Spent in Treatment 2	27	0.85269	4.331	3.011	0.00130

Table 4. results of the Shapiro–Wilk W test for normal data

A preliminary check from the Shapiro-Wilk test, as seen in Table 4, revealed that the sample did not meet the normality assumptions required to perform one-way ANOVA testing. As a result, the Kruskal-Wallis test, a non-parametric alternative, was used to analyse the data. As seen in Figure 2, the assumption of an identically shaped and scaled distribution holds for all three groups. Therefore, the null hypothesis indicates that the medians of the total expenditure are equal across all three groups, and the alternative hypothesis states that at least one group’s median total expenditure is different. There was insufficient evidence to reject the null hypothesis that there is a significant difference in the median total expenditure across the three groups, as indicated by the Kruskal-Wallis test p-value of 0.4755. As such, there was no indication that educating customers about common dark patterns or warning them about potential deceptions resulted in reduced online spending, rejecting both hypotheses of this research.

Discussion

The research question, "Do educational and warning initiatives have different effects on the reduction of online expenditure among e-commerce customers?" remains unanswered at present. If anything, our findings further illustrate the nuances and complexities of tackling deceptive practices in e-commerce.

Although this study did not yield significant results, the suggestion is that protecting online customers should not be approached from the perspective of leaving them to their rationality. Even when presented with a brief instruction on deceptive design patterns, subjects were exploited by underlying cognitive biases and deception.

In addition, a more comprehensive and extensive field experiment could be conducted to measure consumer behaviour in an actual setting, avoiding the limitation of this online shop having a clear experimental purpose. Other limitations of this study include having a small sample size of 78 useful entries, and a high attrition rate since there was a total of 126 contributions. The remaining difference of respondents either failed to buy all the products deemed as necessary for the analysis or failed to select their group. Both limitations would have required a more specialized online shop environment, which the technical capabilities used for this research could not support.

Although subjects of this study may suffer from the Hawthorne effect, that is that they were subconsciously modifying their behaviour knowing they were taking part in an experiment (McCarney et al. 2007) rather than spending their money on products, the fact that the average of the total expenditure is 163.5% of the minimum baseline is an important consideration. This percentage is limited to this particular experiment, so it should not be

interpreted as a price on dark patterns per se, but rather as a cautionary tale about how vulnerable the typical online consumer is to choice architecture that promotes impulsive buying and increased spending.

With all the mentioned, initiatives such as Brignull's www.deceptive.design website are still a great way to draw attention and raise awareness of the issue of dark patterns, which is the first step towards the goal of successful policy implementation. In addition to providing information about dark patterns and their classification, the website brings a "hall of shame" segment that lists examples and companies that actively use deceptive design. Given that this appears to be a potential solution that might lead to the reduction of dark patterns usage, official bodies could adopt a similar strategy and compile a blacklist of companies and online shops employing these tactics. Coupling it with being more assertive in enforcing sanctions would also be beneficial, as we can learn from the grey market example, which illustrates that deterrence can occur only when multiple enforcement components are combined (Antia et al. 2004). This suggests that the best strategy for addressing a challenge of this dimension is to tackle it from several angles at once.

Conclusion

The purpose of this study was to explore whether online shoppers could protect their online spending by being informed about dark patterns or being warned about potentially running into them. The experiment consisted of three groups: a control group, a group that received a warning message, and a group that received explicit and brief education on dark patterns. All groups were given the assignment of going through an identical shopping list and buying every product listed. The results of the Kruskal-Wallis test showed that neither the educational initiative nor the warning had a significant effect on subjects' reduction in

spending. These findings suggest that there is no easy way to solve the problem of mitigating the impact of dark patterns.

A small sample size, technical limitations and a possible Hawthorne effect from the experimental design were three of the study's limitations. The www.deceptive.design website and other similar initiatives are useful resources for bringing attention to the issue of dark patterns. One way to reduce the use of dark patterns could be for authorities to publicly list all the companies that utilize deceptive design methods and then impose sanctions on those companies.

Overall, this study emphasizes the challenges in protecting online customers from unethical behaviour happening in e-commerce settings and highlights the importance of creating a comprehensive approach to tackle those issues. Additional research using real-world scenarios and larger sample sizes could provide additional evidence for suitable strategies for protecting online shoppers.

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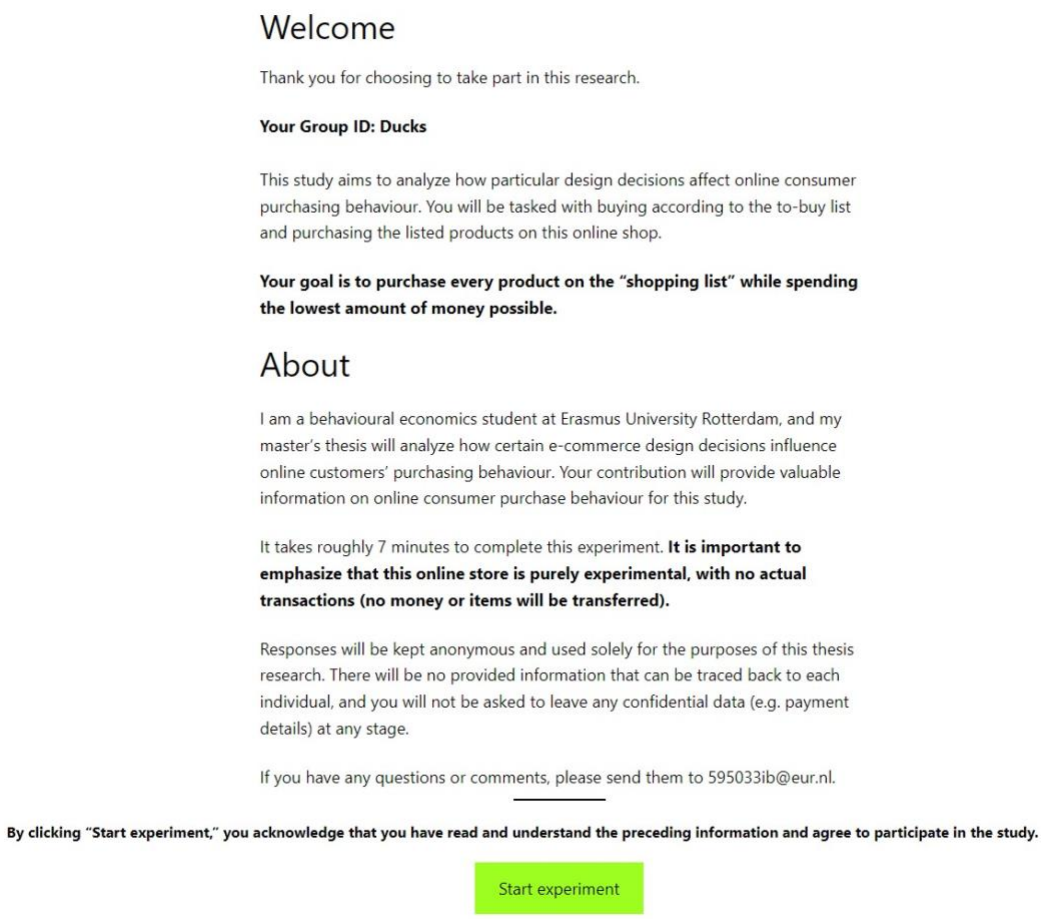
Appendix

Online shop where the experimental section was conducted



Welcome

Thank you for choosing to take part in this research.

Your Group ID: Dogs

This study aims to analyze how particular design decisions - whether they have a positive or negative impact on consumers like you - affect online consumer purchasing behaviour. You will be tasked with buying according to the to-buy list and purchasing the listed products on this online shop.

Your goal is to purchase every product on the "shopping list" while spending the lowest amount of money possible.

About

I am a behavioural economics student at Erasmus University Rotterdam, and my master's thesis will analyze how certain e-commerce design decisions influence online customers' purchasing behaviour. Your contribution will provide valuable information on online consumer purchase behaviour for this study.

It takes roughly 7 minutes to complete this experiment. **It is important to emphasize that this online store is purely experimental, with no actual transactions (no money or items will be transferred).**

Responses will be kept anonymous and used solely for the purposes of this thesis research. There will be no provided information that can be traced back to each individual, and you will not be asked to leave any confidential data (e.g. payment details) at any stage.

If you have any questions or comments, please send them to 595033ib@eur.nl.

Your Group ID: Cats

This study aims to analyze how particular design decisions - whether they have a positive or negative impact on consumers like you - affect online consumer purchasing behaviour. You will be tasked with buying according to the to-buy list and purchasing the listed products on this online shop.

Before you continue, it is important that you get familiar with the concept of dark patterns. Deceptive patterns (also known as "dark patterns") are tricks used in websites and apps that make you do things you didn't mean to, like buying or signing up for something. For example:

Example 1 - Fake scarcity works by creating an artificial sense of limited availability around a product or service, pushing users to act quickly out of fear of missing out. This is achieved by displaying misleading messages about low stock levels or high demand. By tapping into the scarcity cognitive bias, this deceptive pattern preys on users' natural tendency to assign more value to items that appear rare or exclusive, pushing them into making hasty purchasing decisions without fully evaluating their options.

Example 2 - Hard to cancel (aka "Roach Motel") is a deceptive pattern where it is easy to sign up for a service or subscription, but very difficult to cancel it. This typically involves hiding the cancellation option, requiring users to call customer services to cancel, and making the cancellation process overly complex and time-consuming. This can cause users to give up trying to cancel, and continue paying for the service for a longer period.

Example 3 - Fake urgency. When a user is placed under time pressure, they are less able to critically evaluate the information shown to them because they have less time and may experience anxiety or stress. Providers can use this to their advantage, to push them into completing an action that may not entirely be in the user's interest.

Your goal is to purchase every product on the "shopping list" while spending the lowest amount of money possible.

Shopping list

Note: remember to purchase every product on this list and to keep your spending to a minimum.

- **Food & non-alcoholic beverages**
  - Granny Smith Apple – 4 apples
  - Chicken breasts or tofu 1 kg
  - Ground coffee 250 g
- **Alcohol & tobacco**
  - Sauvignon Blanc
- **Clothing & footwear**
  - T-shirt – medium size
- **Household goods**
  - Glass 25 cl – 5 pieces
  - Laundry detergent – 32 washes
- **Health**
  - Replacement toothbrush heads – 3 pieces
  - Toilet paper (14 pack)
- **Recreation & culture**
  - Book – The Catcher in the Rye
  - Earphones
- **Pets**
  - Dry dog food – 3 kg

Start shopping

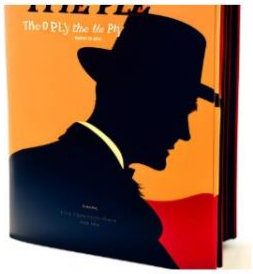
Home / Shop

Shop

- Products (23)
  - Alcohol & tobacco (1)
  - Clothing & footwear (2)
  - Food & non-alcoholic beverages (8)
  - Health (3)
  - Household goods (5)
  - Pets (1)
  - Recreation & culture (3)

Showing 1–16 of 23 results

Default sorting



Book – The Catcher in the Rye by J.D. Salinger

€ 8,99 – € 11,99

Select options

Chicken breast 1kg

~~€ 7,99~~ € 6,99

Add to cart

Coffee filter

€ 0,99

Add to cart

Dry dog food

€ 2,99 – € 22,99

Select options

Earphones

€ 54,59

Add to cart

Glass 25 cl

€ 1,99

Add to cart

Glass 25 cl (6 pack)

€ 8,99

Add to cart

Granny Smith Apple 1 piece

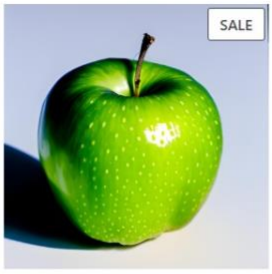
€ 0,70

Add to cart

Granny Smith Apple 1kg

€ 2,00

Add to cart



Granny Smith Apple Eco

~~€ 2,50~~ € 1,99

Add to cart

Ground coffee (filter) 250g

€ 7,99

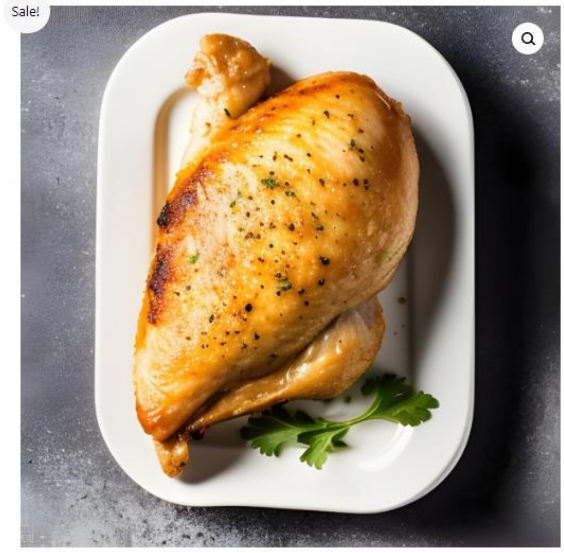
Add to cart

Ground coffee + filter bundle

€ 0,99 – € 7,99

View products

Home / Products / Food & non-alcoholic beverages / Chicken breast 1kg



Chicken breast 1kg

~~€ 7,99~~ € 6,99

Consider for a moment whether meat is really worth the cost to innocent lives. Each bite contributes to an industry that CAUSES ANIMAL PAIN. If you are a decent person and have any morals at all, you will pick any sensible alternative like tofu.

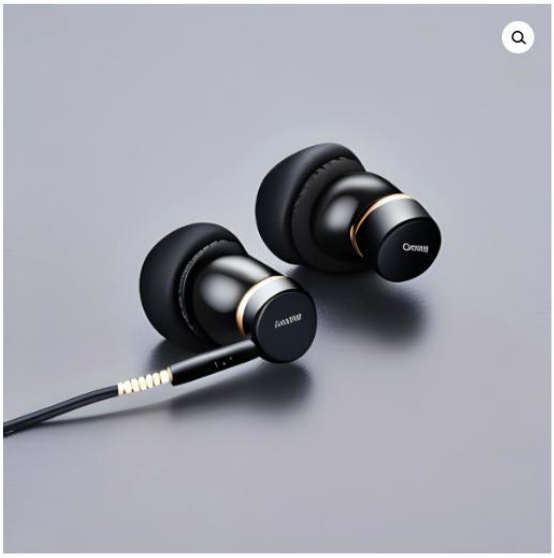
1 Add to cart

Category: Food & non-alcoholic beverages

Description Reviews (0)

With our tender chicken breasts, you may enjoy delectable dinners. These breasts are fresh and juicy, making them ideal for a variety of meals. Our finest chicken breasts will take your meals to the next level.

Home / Products / Recreation & culture / Earphones



Earphones

€ 54,59

1 Add to cart

Category: Recreation & culture

Description Reviews (0)

With our premium earbuds, you may lose yourself in sounds that is second to none. Acoustic clarity and ergonomic comfort for longer listening. This offer comes bundled with a 6-month subscription to our music service, which will kickstart your auditory adventure right away!

Note that once purchased, the music service subscription is non-refundable and costs 5 euros per month. If you prefer to buy the product without the music subscription, please click here.

Glass 25 cl

€ 1,99

Add to cart

Glass 25 cl (6 pack)

€ 8,99

Add to cart

Shipping voucher

~~€ 9,99~~ € 6,99

1 in cart

T-shirt

€ 12,99 – € 21,99

Select options

T-shirt – size M

~~€ 24,99~~ € 18,99

Add to cart

Home / Products / Clothing & footwear / T-shirt

T-shirt

€ 12,99 – € 21,99

Size M Clear

€ 15,99

1 Add to cart

SKU: N/A Category: Clothing & footwear

Description | Additional information | Reviews (0)

Experience comfort and style with these versatile tees, perfect for everyday wear. Crafted with premium materials, they offer a flattering fit and enduring quality.

Home / Products / Shipping voucher

Sale!

Shipping voucher

~~€ 9,99~~ € 6,99

1 Add to cart

Category: Products

Description Reviews (0)

This is your shipping fee.

If you want to discard it, you can use coupon code "free-shipping" during the checkout.

Checkout

Have a coupon? Click here to enter your code

Billing details

Country *

Select a country / region...

Enter your Group ID *

Raccoons ×

Select your age *

18-24 ×

Select your gender *

Male ×

What is the highest level of education completed? *

High school or less ×

Your order

Shipping voucher × 1	**€ 6,99**
Subtotal	**€ 6,99**
Total	**€ 6,99**

SUBMIT RESULTS

What is your gross annual household income? (in €) *

eg. 40000

How familiar are you with the concept of dark patterns? *

Not familiar at all

Have you used any form of assistance (e.g. calculator) when comparing products? *

Yes

Did the details provided in the product description impact your decision to choose tofu over chicken when making a purchase? *

Yes, the product description my decision influenced my decisi...

Additional information

Comments (optional)

Share your thoughts about the experiment here!

Thank you! I appreciate you taking the time to support me in finishing my thesis.

The goal of this experiment is to determine the most effective way to protect people from falling under "dark patterns", a form of deceptive design strategies.

Dark patterns (also known as "deceptive patterns") are tricks used in websites and apps that make you do things you didn't mean to, like buying or signing up for something.

Read more about dark patterns here: https://www.deceptive.design/types

Example 1 – Fake scarcity

Fake scarcity works by creating an artificial sense of limited availability around a product or service, pushing users to act quickly out of fear of missing out. This is achieved by displaying misleading messages about low stock levels or high demand. By tapping into the scarcity cognitive bias, this deceptive pattern preys on users' natural tendency to assign more value to items that appear rare or exclusive, pushing them into making hasty purchasing decisions without fully evaluating their options.

Example 2 – Hard to cancel

Hard to cancel (also known as "Roach Motel") is a deceptive pattern where it is easy to sign up for a service or subscription, but very difficult to cancel it. This typically involves hiding the cancellation option, requiring users to call customer services to cancel, and making the cancellation process overly complex and time-consuming. This can cause users to give up trying to cancel, and continue paying for the service for a longer period.

Example 3 – Fake urgency

Fake urgency is precisely what it sounds like. When a user is placed under time pressure, they are less able to critically evaluate the information shown to them because they have less time and may experience anxiety or stress. Providers can use this to their advantage, to push them into completing an action that may not entirely be in the user's interest.