Dissecting Optional Micro-Decisions in Online Transactions: Perceptions, Deceptions and Errors

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Online firms frequently increase profit by selling optional extras. However, opt-in rates tend to be low. In response, questionable design practices have emerged to nudge consumers into inadvertent choices. Many of these design constructs are presented using an opt-out design. Using eye tracking and think-aloud data techniques, this research investigates the impact of the framing and optionality of micro-decisions on user perceptions and error rates. Focusing on opt-out decisions, the study found: up to one in three users make errors in decision-making; there is a higher error rate for rejection-framed opt-out decisions; users widely misinterpret decision framing; and failure to read decision text results in rushed and unsighted decisions, even leading users to automatically construe un-ticked checkboxes as opt-in decisions. In talking afterwards about their experiences, users expressed strong negative emotions, feeling confused, manipulated and resentful. Many suggested they would, in practice, steer away from similar encounters toward more unambiguous and honest sites. These findings might alert managers and developers, tempted to use dark patterns, that such a strategy might backfire over time.

CCS CONCEPTS • Human-centered computing~Human computer interaction (HCI)~Empirical studies in HCI • Human-centered computing~Interaction design~Interaction design process and methods~User interface design

Additional Keywords and Phrases: Micro-decision, Opt-out, Decision framing, Eye tracking, Dark patterns, Visual focus

1 INTRODUCTION

In this paper, we look at various opt-out constructs used on business-to-consumer (B2C) websites and analyze their impact on the decision performance of users; that is, whether or not they made a decision that was contrary to their

intended course of action. Traditionally, the essential purpose of disciplines such as human factors, ergonomics, and user experience (UX) design is to optimize individual performance and enable users to achieve their goals easily and effectively. Krug [53] asserts that, in practical terms, the most important metric of systems usability is "the amount of thought required and the amount of uncertainty about whether I'm making the right choice". Unfortunately, in recent years, there has been a growth in the adoption of so-called 'dark patterns', which are the very antithesis of UX design. Dark patterns are design choices that provide benefit to an online seller "by coercing, steering, or deceiving users into making decisions that, if fully informed and capable of selecting alternatives, they might not make" [59].

The notion of design patterns can be traced back to the work of Christopher Alexander in the field of architectural design in the 1960s, and subsequently adopted by disciplines such as software engineering and UX design. A 'pattern' is a good, reusable solution to a commonly found problem. Dark patterns are an affront to the noble principles of design disciplines because they attempt, quite intentionally, to use common tricks to deceive users into making incorrect choices by obfuscating or concealing information and causing confusion. For example, findings from a recent UK study reveal that the majority of B2C websites are flagrantly breaching data protection legislation and using dark patterns to deliberately entice consumers into making hasty or ill-informed decisions [63].

Many online firms try to increase profit by selling optional extras, such as insurance cover, extended warranties, and other ancillary items to consumers. The use of prompts for the purpose of 'suggestive selling' is long established in marketing [67]. In online selling, the sale of optional extras can be prompted using opt-ins or opt-outs. Sometimes, in what seems to be a premeditated attempt to confuse consumers into making an incorrect decision, an alternating mixture of the two is used. 'Opt-in' is defined by The Cambridge Dictionary [77] as the act "of choosing to take part in an activity, arrangement, etc. rather than being forced to take part". It defines 'opt-out' [78] as "to choose not to be part of an activity or to stop being involved in it". Opt-in rates, despite the best efforts of online marketeers, have tended to be low. For this reason, opt-outs are commonly encountered on B2C websites.

It is now the norm for consumers to encounter a variety of ambiguous opt-in and opt-out constructs offering numerous services and products as they traverse the transactional process [10]. These generally low-cost, optional extras are frequently presented to consumers as a sequential series of quick 'micro-decisions'. A micro-decision is "a small decision with a short time horizon" [65]. We use this term to refer to decisions made by a consumer during an online transaction, upon which they typically deliberate for no more than a few seconds. Prior to commencing the transaction, the consumer may have invested a substantial amount of time deciding what particular product or service they want to buy and who to buy from (e.g., by comparing online reviews), and they may also have decided that they are not interested in any optional add-ons that might be presented to them. With those bigger decisions made in advance, the consumer must then make smaller decisions as they navigate their way through the transaction. For example, a person may have decided to cancel an online subscription service, but in order to do so, they will typically be confronted with a number of decision points that will attempt to dissuade them from doing so. This study helps to build a deeper understanding of how users engage with these micro-decisions and how they feel about the use of dark patterns, and is therefore of direct relevance to many concerned with human interaction with computers. While prior research has been conducted into the impact of framing and default value on user choice, much of the research examines privacy settings or explores users actively making a decision to opt-in or opt-out of an offering. In contrast, this study examines the likelihood of the user making an error in their interaction with various decision construct types when they have already decided on their preferred course of action prior to the interaction. Additionally, in this study, the option offered to the user has a financial cost associated with it, in contrast to much of the published research. As we carefully dissect the flow and reasoning of consumer micro-decisions, using detailed eye tracking data and Cued Retrospective Think-Aloud

(RTA) protocols, we analyze perceptions (how users believed they were performing) and deceptions (the impact of dark patterns on performance).

2 BACKGROUND AND HYPOTHESES

In economics and other disciplines, decision-making is traditionally seen as a rational process whereby individuals carefully consider alternatives and choose the most appropriate option for their needs. According to this perspective, the order in which alternatives are presented, and the wording of them, will not impact choice. However, researchers in a variety of fields, such as HCI, behavioral economics and psychology, have challenged this theory [8, 12, 50, 55, 56, 71, 82, 84], and have shown that consumers can be: persuaded by the framing (positive or negative) of the information presented; influenced by the way the choice is presented; persuaded by influential labeling; and impacted by whether the option uses an opt-out or opt-in decision construct. On B2C websites, sellers commonly seek to boost their sales revenue by manipulating the manner in which purchase decision constructs are designed and presented to consumers.

2.1 Persuasive techniques used by B2C website designers

A number of techniques are commonly used by designers to persuade users into certain courses of action. These include opt-out constructs, option framing, and default value. Although efforts have been made in some countries to out-law these techniques, many website designers continue to use them.

Within the European Union (EU), Article 22 of the Consumer Rights Directive [29] stipulates that consumers are entitled to reimbursement of any optional additional payments "if the trader has not obtained the consumer's express consent but has inferred it by using default options which the consumer is required to reject in order to avoid the additional payment". EU member states have transposed this directive into effect within their own national statute books with varying levels of stringency. For example, in Ireland it is an offence to use a pre-selected checkbox to lure a consumer into buying an optional extra [69]. However, in the neighboring jurisdiction of the United Kingdom, who legislated whilst still a member of the European Union, it is not an offence per se; rather, the seller is merely obligated to issue a refund, with the exception of transactions relating to certain types of services, such as insurance, credit or banking [86]. Notably, it is in industry sectors such as these excepted areas where the practice of using default values to trick consumers into purchasing unwanted add-ons persists.

Similarly, as regards privacy legislation, exploitative on-line sellers tend to take liberties with loose provisions pertaining to opt-out decisions. For example, the California Consumer Privacy Act of 2018 gives consumers a right to 'opt-out' of their personal information being shared, but goes no further than to say that a clear and conspicuous 'Do Not Sell My Personal Information' link must be visible to consumers [19]. Unscrupulous designers can very easily circumvent this by using dark patterns [59] to dupe users into not opting out, when in fact it was their intention to do so. In the European Union, the General Data Protection Regulation (GDPR) is more explicit and lays down that "consent should be given by a clear affirmative act … silence, pre-ticked boxes or inactivity should not therefore constitute consent" [30]. However, in practice, recent research shows that the vast majority of websites are non-compliant with GDPR and are using pre-ticked boxes to mislead consumers [63]. In recognition of the widespread use of such deceptive practices, two US senators brought forward a proposal that would make it illegal "to design, modify, or manipulate a user interface with the purpose or substantial effect of obscuring, subverting, or impairing user autonomy, decision-making, or choice to obtain consent or user data" [33]. This is an interesting idea but whether or not it is feasible remains to be seen. The history of dark patterns shows that regulation has had little effect in practice, because of continually evolving workarounds being devised by a cohort of designers who are motivated by a concern for profit rather than users' best

interests. Narayanan, Mathur, Chetty and Kshirsagar [62] trace the evolution of dark patterns, seeing them as emanating from the confluence of three marketing trends: deceptive retail practices, manipulative nudging, and growth hacking aided and abetted by purposeful A/B testing. Several taxonomies of dark patterns have been put forward in the literature [16, 36, 59]. Our work is most closely associated with those categories of patterns referred to by Mathur, Acar, Friedman, Lucherini, Mayer, Chetty and Narayanan [59] as 'Misdirection' and 'Trick Questions', the intention of which is to steer users away from or towards making a particular decision by means of deceptive language and other affective mechanisms. However, unlike those previous studies, we focus not so much on the means of implementation of patterns but rather on the higher order concepts and constructs that underpin those patterns.

Opt-out constructs have been used to encourage or direct people towards positive choices such as improved diet [89], converting to renewable energy [60], becoming an organ donor [50, 87], environmental action [27, 49], and saving for retirement [13, 57]. However, in recent years, many online companies, including airlines, car rental and comparison sites, have started using unusual design techniques that appear to be designed specifically to achieve self-serving outcomes by 'encouraging' users towards the result desired by the firm [10]. The techniques include ambiguity when presenting options, resulting in users making inadvertent choices, or separating out the price of a product where taxes and other similar charges are presented as choices but are actually compulsory components of the service or product [9, 10].

Bellman, Johnson and Lohse [12] examined ways in which firms can guide users towards consent. They determined that the use of framing and defaults 'can almost guarantee' consent. It has been clearly demonstrated that question framing can affect user decisions [2, 54, 55, 56, 84], with positive framing resulting in more users opting-in. The framing of a question, coupled with the default (i.e. checked or unchecked), impacts user selection [55]. When presented with an opt-in using a checkbox, the likelihood of the user choosing an unchecked opt-in is higher than the user choosing an opt-in that is checked. The positive, or acceptance, language appears to influence the decision. They observed no difference for opt-outs. Bauer, Bergstrøm and Foss-Madsen [11] stated deliberate design of cookie banners can significantly impact user choice. In particular, they determined that using multiple manipulations (salience, framing and effort required to select) can have an additive effect in increasing user consent. Anaraky, Knijnenburg and Risius [1] refer to companies using defaults and framing to achieve "mindless user compliance" and thus nudge users towards the company's privacy preferences while Jin, Zhang and Chen [48] determined users are more likely to make a purchase and will do so quicker when presented with positively framed message than when presented with a negatively framed message. Defaults (the outcome if no action is taken) are the most frequently used nudge and are effective in achieving the goal of pushing consumers towards a particular course of action [47]. Nudging is traditionally perceived as being more benign than dark patterns. Nudging is persuasive and encourages users towards a belief that a particular choice will make them better off or be better for society. In contrast, dark patterns are designed specifically to trick users into taking unintended actions [64]. However, the ethicality of nudging (even when the outcome has societal benefits) can be questioned, as it can be used for manipulation purposes, resulting in users making choices which may not reflect their true preferences and is frequently used by companies to push users to choose particular settings [1]. To increase ethicality, Zimmermann and Renaud [92] suggest the use of a hybrid nudge, where additional information is provided to the user, to increase transparency and provide a more politically acceptable approach to nudging.

2.2 Taxonomy of decision construct types

Options in the B2C transactional process consist of several dimensions. The research on framing discussed in section 2.1 generally considered a single dimension, relating to a singular decision where the user chose one of two options. However, much of the interactions that consumers now face can be more finessed in terms of the way choice is

presented, and its optionality. Previous research [41, 81] demonstrated the variety of ways options can be presented to consumers. Some are simple, with clear choices and defaults. Others are more difficult to understand and require effort on the part of the user to determine what is the default and what, if any, action is necessary to reach their goal. Some options are offered to the user in a straightforward manner, while others employ persuasion of varying degrees, presumably in an effort to guide them towards the vendor's desired outcome.

Table 1. Decision construct taxonomy

Decision Construct	Default Outcome	Typical Presentation	Framing
Un-selected opt-in	The option is not received	Un-selected	Acceptance, Rejection or Neutral
Pre-selected opt-in	The option is not received	Selected	Acceptance
Un-selected opt-out	The option is received	Un-selected	Rejection
Pre-selected opt-out	The option is received	Selected	Acceptance, Rejection or Neutral
Must-opt	Cannot progress	Several choices presented, all un-selected	Generally acceptance
Un-selected essential decision	Cannot progress	Several choices presented, all un-selected	Generally acceptance
Pre-selected essential decision	Pre-selected item received	Several choices presented, one selected	Generally acceptance

It is clear that various facets can complicate micro-decisions, potentially making the user more prone to error [2]. In earlier work, the authors conducted a detailed survey of B2C websites and analyzed decision constructs in common use, with the aim of identifying a list of all variants [41]. This resulted in a taxonomy (see Table 1) defining all the different decision constructs that are encountered in the online transactional process. Decisions can be essential or optional. An essential decision is one that must be made in order to complete the transaction. Examples include choosing a delivery method or choosing a shoe size. There may be a cost associated with an essential decision but frequently, there is none. On the other hand, optional decisions are additional extras offered to the consumer. They can be presented as an opt-in construct, an opt-out construct, or a must-opt construct. A must-opt is a hybrid construct, being neither opt-in nor opt-out but having elements of both. A must-opt requires the user to either explicitly reject or explicitly accept the option in order to progress within the transactional process. The final classification is the default value, which can be pre-selected or un-selected. A checkbox that is ticked would be pre-selected while one that is unticked would be un-selected. The authors confirmed the use of each of these constructs in practice [7]. As part of that study, it was determined that the majority of the constructs are not particularly problematic to the user but that the opt-out is frequently presented in a way that can result in user error, with the user inadvertently receiving an unwanted option.

As opt-outs were found to be more problematic than other construct types, the authors carried out a further analysis of 57 different websites to identify the basic elements of the presentation of options utilizing opt-out decision constructs on B2C websites. The majority of the websites used opt-ins only, but 42 opt-outs in total were identified on 17 (30%) of the websites. These were then examined to determine the elements used in their construction.

The main elements of option presentation were identified as: *UI control type* (e.g., checkbox, radio buttons); *default value* (un-selected or pre-selected); *framing* (rejection, acceptance or neutral language); *persuasion measures* (e.g., articulation of the positives associated with the option); and *purpose of the construct* (e.g., generation of revenue or requesting permission for data retention). The only UI control type examined in this study is the checkbox as it is the one most frequently used for micro-decisions on B2C websites. Since the multi-faceted scope and complexity of persuasion

does not lend itself to discrete analysis, it was removed in order to simplify the model. Therefore, the elements investigated herein are framing and default value. Finally, as the focus of this study is the B2C transactional process, only constructs that are intended to generate revenue are considered. In elaboration, a checkbox that is already ticked when presented to the user is considered to be pre-selected whereas an unticked checkbox is considered to be un-selected. Additionally, the framing can be either acceptance (e.g., "I want…."), rejection (e.g., "I do not wish to…") or neutral (generally presented using only the name of the option offered).

This study seeks to extend previous research by hypothesizing that the type of opt-out construct presented to the user can affect: decision performance, i.e. the likelihood of actually making an error; user perception of their performance when interacting with the construct; and how accurate that perception is. Therefore, the following hypotheses are proposed:

H1: The decision construct type presented to a user influences decision performance.

H2a: The decision construct type presented to a user has an impact on perceived performance.

H2b: The decision construct type presented to a user has an impact on the accuracy of perceived performance.

2.3 Visual focus of attention

A person's gaze can indicate where in their visual field their interest currently lies [4] as their visual attention will tend to focus on parts of the screen that interest and attract them [45]. Their gaze indicates what they are focusing on and is known as the *visual focus of attention*. This visual attention is a key component in filtering out extraneous information and enabling the viewer to concentrate on the stimulus of interest [3, 91]. Visual attention is closely linked to reading comprehension [73, 79].

A variety of studies have explored which eye tracking measures of visual attention can be used to identify text that is difficult to comprehend for the reader. Different measures are recommended. For example, Underwood, Hubbard and Wilkinson [85] state that fixation duration is a reliable indicator of reading ability and reading comprehension, with shorter fixations evident in stronger readers with better comprehension skills. They concluded fixation count was a less reliable measure. Other research [34, 68] indicates that readers fixate for longer on text that is more difficult to understand or process. A higher fixation count and longer fixation duration were also shown to correspond to deeper processing of text [23, 39]. Henderson, Choi, Luke and Desai [39] have demonstrated that fixation duration in reading tasks is correlated with activity in the parts of the brain associated with attention and the processing of language.

Negative language in sentences has been shown to increase user error and the length of time required to process text, with double negatives (e.g., using the word 'not' together with the prefix 'un') being particularly problematic [74, 75]. Marketing researchers have long been acutely aware of the potentially very puzzling effect of using double negatives on surveys [51], yet some unscrupulous practitioners from within the same discipline deliberately choose to exploit this known problem to confuse on-line consumers. Opt-outs have also been found to cause confusion [10, 17], [40, 49]. This confusion is likely to reduce the reader's understanding of the text and consequently to require increased visual focus of attention in order to decipher the message. This study seeks to investigate this by hypothesizing that the decision construct type can affect levels of visual focus of attention.

H3: The decision construct type presented to a user affects visual focus of attention.

Visual focus of attention is an indicator of text that is more difficult to understand. However, no research has been found regarding whether high levels of visual focus of attention can predict user error when engaging with micro-decisions on websites. This study seeks to address this gap by hypothesizing that higher levels of visual focus of attention on a construct can predict user error when making micro-decisions.

H4: Visual focus of attention can predict decision performance.

The hypotheses are visually presented in Figure 1.

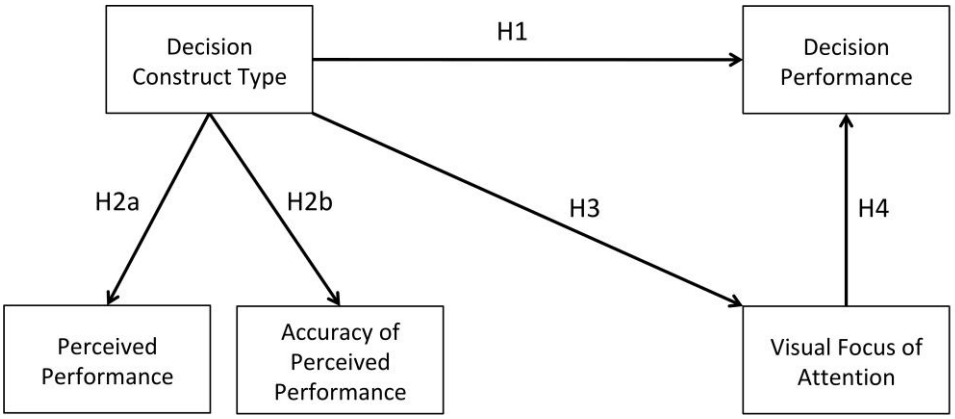

Figure 1 – Research model

3 METHOD

3.1 Experiment design

Prior to designing this experiment, a pilot study was conducted to ensure the research approach was appropriate [6]. The initial intent was to examine each of the constructs in the taxonomy (see Table 1). However, during the pilot it became apparent that this was not practical as participants were likely to lose focus when confronted with an excessive number of distinct constructs. Therefore, in the experiment described in this paper, it was decided to focus on the most challenging constructs in the taxonomy, namely, opt-outs. Their problematic nature is further evidenced by the fact the EU prohibit the use of opt-outs in distance selling [29].

Each of the opt-out constructs in the taxonomy (see Table 1) was evaluated in this study. These consisted of the two rejection framed constructs (pre-selected (PSR) and un-selected (USR)), the acceptance framed pre-selected construct (PSA), and the neutrally framed pre-selected construct (PSN).

3.2 Participants

The study included an eye tracking experiment with 114 participants partaking in 456 experiment trials. Of these participants, 23 also completed a Cued Retrospective Think-Aloud (RTA) interview. Participants were a convenience sample of students, most of whom were postgraduate business students, and all of whom had substantial online purchasing experience. 38 of the participants were female and 76 were male. They ranged in age from 18 to 51 with a

median of 28.3 years. All participants were fluent English speakers. The majority of participants were educated to bachelor's degree level. The demographic profile of our sample very closely resembles that of on-line shoppers in the European Union in general [28].

3.3 Eye tracking experiment

Physiological data depicting user interaction during online purchasing activity was gathered using eye tracking technology. Specifically, it was used to monitor the gaze patterns of users while interacting with decision constructs, thus capturing quantitative eye movement data as an objective measurement of their unique interaction. These measurements of the users' pattern of visual focus add a useful objective perspective to subjective data gathered by asking users to describe their interaction experience.

Eye tracking has been widely used in human-computer interaction and usability research [18, 21, 22, 25, 26, 44, 66, 70]. In particular, it can be used to study what users are looking at, and conversely, what they are not looking at. In so doing, the focus of their attention may be identified [66]. Examining the patterns of eye movement can facilitate an understanding of user decision-making strategies [20, 35, 44].

3.3.1 The laboratory

The EyeLink 1000 Plus System, produced by SR Research, was used in this study. Broadly, it consists of two connected computers, a Host PC and a Display PC. The Host PC detects eye movement events, such as a fixation (a period of focus), blinks, pupil size, and saccades (movement of focus from one point to another). A specialized video camera, focused on the participant's eyes, communicates with the host. EyeLink software manages the set-up and calibration of the system, as well as the transmission of real-time data and its recording. Preparation for, and the conduct of, the experiment is relatively time-consuming. Each participant presents uniquely for the experiment, bearing physical differences in eye-related characteristics such length of eyelashes; sight-aids; and distractors such as excessive blinking and make-up, all of which must be adjusted for.

The Display PC was used to present web pages to participants during the experiment and to control functionality such as calibration, observation and collection of data relating to eye and gaze position. The Display PC was also used to replay elements of participant interactions during the Cued RTA session.

3.3.2 The experiment

A counter-balanced within-subject design was used. Each participant was presented with four screens, each representing a consumer decision corresponding to the opt-out constructs in Table 1. The screens were variants of a web page presenting a car breakdown insurance option. The option was an add-on feature called 'Rescue Plus', costing €5.75 per month and offering a variety of benefits in the event of a breakdown. The locus of attention is a decision point with an adjacent checkbox. Each screen contained different pairings of a ticked and non-ticked checkbox with instructional framing (see Table 2). Participants were asked twice to buy the option and twice not to buy it. Participants were told to work as they would normally, not to feel under time-pressure, and to look at, and read, the screen as they would do usually. To control for precedence bias, the four screens were randomized, as was the 'buy' versus 'don't buy' instruction.

Table 2. Decision constructs used in the experiment

Construct Type	Decision Construct
Pre-selected Acceptance (PSA)	☑ Rescue Plus includes free car hire and travel expenses. I want to purchase Rescue Plus.
Pre-selected Neutral (PSN)	☑ Rescue Plus.
Pre-selected Rejection (PSR)	☑ Rescue Plus includes free car hire and travel expenses. If you would rather not purchase Rescue Plus, please untick this box.
Un-selected Rejection (USR)	☐ Rescue Plus includes free car hire and travel expenses. If you would rather not purchase Rescue Plus, please tick this box.

3.4 Cued Retrospective Think-Aloud

A think-aloud assessment, which involves the user articulating their thought process while interacting with the system, can be either concurrent (conducted while the user is completing the task) or retrospective (conducted after completion of the task) [46]. The aim of the process is to gain insight into users' attitudes, thoughts and feelings when interacting with the system. In addition to being a useful technique for identifying problematic elements of the design [42], it can also give insight into which parts of the design require more processing by the user [31]. The sessions are recorded, with additional notes taken relating to the users' comments and actions [61]. It was decided that concurrent think-aloud (CTA) was not appropriate for this study as requiring the user to articulate their thought process whilst interacting with the system would impact on their visual fixations [52] and task performance [88]. Retrospective think-aloud (RTA) can be problematic when used alone, as the participant must recall what they were thinking and why they took certain actions. This can result in information not being recalled or the participant justifying their actions retrospectively, and thus result in inaccurate data [5].

A more effective approach is Cued RTA which prompts the participant's memory by asking them to articulate their thought process while watching a recording of the interaction [5]. Cued RTA tends to be comparable to CTA in identifying usability problems [88] and provides an accurate account of what users are attending to during the interaction, as well as providing detail on their strategies and inferences during task completion [37]. A key benefit of Cued RTA is that it allows the gathering of both qualitative and quantitative data, as timings are not impacted. A major advantage of using Cued RTA with eye tracking is the additional ability to understand why participants are focusing on specific areas of the screen, rather than only seeing the pattern of movement [46]. Understanding why participants focus on screen elements is essential as the focus may be due to positive or negative reasons (e.g., a fixation of extended duration can indicate interest or difficulty in understanding).

A total of 23 of the participants participated in Cued RTA sessions. An animation of their eye movements while interacting with each of the four decision constructs was shown to them. They were asked to articulate the feelings and thoughts they recalled from the interaction. Audio recordings were created, and each session was documented by a scribe.

3.5 Heat maps

Heat maps were used to demonstrate aggregated gaze concentration (by way of duration) on screens [14, 24]. This aggregated visual summary allows the viewer to effectively absorb and understand large volumes of data. Aggregated heat maps were created for all participants and for specific individuals, for certain aspects of analysis such as construct

type or correct versus incorrect decisions. The heat maps used represent this concentration by showing the most frequently fixated areas painted red and the least frequently fixated areas painted green [72].

3.6 Measures

3.6.1 Visual focus of attention

Mean fixation duration was used to measure visual focus of attention for three of the constructs. It was decided not to include PSN due to the disparity in word count between it and the other constructs. Neither of the other typical eye tracking measures (i.e. dwell time and fixation count) were considered suitable as the differing word count may have impacted on the measures. The rejection framed constructs (USR and PSR) had the same number of words (21) in the construct. However, the acceptance framed construct, while broadly comparable, had fewer words (15). It was therefore decided mean fixation duration was the most appropriate measure of visual focus of attention as it mitigated against the differing word counts and is a recognized measure.

3.6.2 Decision performance

Decision performance was measured by calculating the error rate for each construct. An error was defined as the participant buying the product when instructed to not buy and vice versa.

3.6.3 Perceived performance

After each decision, participants were asked to rate their interaction with the construct in terms of their perceived performance. Perceived performance is used in this study to assess how accurately participants gauged their success or otherwise in their interactions. Perceived performance was measured using a 5-point scale as follows:

Performance: How would you rate your performance on this task? 1= Poor, 5 = Good

It was explained to the participants that they should respond to this question by considering how confident they were in their performance when interacting with the construct. Good performance indicated full confidence that they had succeeded in buying/not buying as instructed while poor performance indicated a lack of confidence in their performance.

4 RESULTS: USER PERFORMANCE DATA

4.1 Decision performance

The overall error rate, used to measure performance while interacting with the decision construct, was high (see Table 3), with a 26% error rate in total. However, the rate varied between construct types, with pre-selected acceptance framing (PSA) having 18% incorrect selections and un-selected rejection framing (USR) having an extraordinarily high 37% incorrect selections. To test H1, that the decision construct type influences decision performance, Chi-square was used to examine the relation between decision performance and construct type. The test showed a significant difference (χ^2 (3, N=456) = 11.715, $p<0.01$), with a weak association (ϕ = 0.158), indicating 2.5% of the variation is accounted for by construct type. Therefore, H1 was accepted.

Table 3. Error Rate

Construct Type	Incorrect	Correct	Total
PSA	20 (18%)	94 (82%)	114
PSN	27 (24%)	87 (76%)	114
PSR	28 (25%)	86 (75%)	114
USR	42 (37%)	72 (63%)	114
Total	117 (26%)	339 (74%)	456

This high error rate supports previous reports [12] of problems with opt-out constructs. It would appear that while all opt-outs appear to be prone to error, some present more problems to the user than others.

4.2 Accuracy of perceived performance

Participants were asked to rate their perceived performance immediately after each interaction. They were asked 'How would you rate your performance on this task?' on a scale of 1 to 5, with 1 being Poor performance and 5 being Good performance. As can be seen in Table 4, perceived performance was highest for PSA and lowest for PSR.

Table 4. Perceived performance for construct types

Construct Type	Perceived performance
PSA	3.25
PSN	3.1
PSR	2.89
USR	2.98

To test H2a, that the decision construct type has an impact on perceived performance, ANOVA was conducted, and a significant difference was observed ($F=2.894$, $p = 0.035$). Post-hoc tests showed the perceived performance for PSA was significantly different to the perceived performance for PSR ($p = 0.005$, $d = 0.369$) and for USR ($p = 0.04$, $d = 0.283$). No significant difference was observed between PSR and USR. Additionally, no significant difference was observed between PSN and any of the other constructs. This suggests the framing of the construct (i.e. rejection versus acceptance framing) has a small effect on perceived performance, with acceptance framing having higher perceived performance than rejection framing. Therefore, H2a was partially accepted.

To test H2b, that the decision construct type has an impact on the accuracy of perceived performance, perceived performance was then assessed against actual performance. Perceived performance was categorized according to how accurate it was. Those who correctly carried out the task and rated their performance as 4 or 5 (good performance) were categorized as 'accurate'. Similarly, those who carried out the task incorrectly and rated their performance as 1 or 2 (poor) were also rated as 'accurate'. Conversely, those who performed the task correctly but rated their performance as poor (1 or 2) were categorized as 'inaccurate', as were those who performed the task incorrectly but rated their performance as good (4 or 5). All those who rated their performance as 3 were categorized as 'unsure' (see Table 5).

Table 5. Actual vs perceived performance for construct types

Construct Type	Inaccurate	Accurate	Unsure
PSA (N = 114)	14 (12%)	82 (72%)	21 (16%)
PSN (N = 114)	20 (18%)	75 (66 %)	19 (17%)
PSR (N = 114)	29 (25%)	62 (54%)	23 (20%)
USR (N = 114)	38 (33%)	52 (46%)	24 (21%)
Total (n = 456)	101 (22%)	271 (59%)	84 (18%)

As can be seen in Table 5, participants were more likely to perceive their performance incorrectly for USR, with 33% of participants inaccurate and 21% unsure. In contrast, for PSA only 12% were inaccurate and 16% unsure. Both of the rejection framed constructs (USR and PSR) had high levels of inaccuracy or uncertainty in perceived performance, with only 54% accurate for PSR and 46% accurate for USR. Chi-square was conducted and showed a significant difference (χ^2 (6, N = 456) = 22.26, $p < 0.01$) with a weak association ($\phi = 0.221$), indicating 5% of the variation is accounted for by construct type. Therefore, H2b was accepted. Further insight was provided by the Cued RTA analysis and is discussed in Section 5.

The data was further broken down to determine whether those who were inaccurate in their perceived performance were overly confident or underly confident in their perception. To do that, accuracy of perceived performance was examined separately for those who were successful (see Table 6) and for those who were unsuccessful in the tasks (see Table 7).

4.2.1 Actual versus perceived performance for correct action

For those who were successful in the tasks (see Table 6), an exact significance test was chosen for Pearson's chi-square as analysis indicated one cell with an expected count less than five. There was a relationship between construct type and accuracy of perceived performance (χ^2 (6 N=339) = 13.423, $p<0.037$) with a weak association ($\phi = 0.199$), indicating 4% of the variation is accounted for by construct type.

Table 6. Actual vs perceived performance for construct types for correct action

Construct Type	Inaccurate	Accurate	Unsure
PSA (n =94)	2 (2%)	80 (85%)	12 (13%)
PSN (n =87)	5 (6%)	71 (88%)	11 (14%)
PSR (n =86)	9 (11%)	59 (69%)	18 (21%)
USR (n =72)	6 (8%)	48 (67%)	18 (25%)
Total (n = 339)	22 (7%)	258 (76%)	59 (17%)

For all construct types, the majority of participants who were successful in the task were accurate in their perceived performance and believed they had performed well. However, there was a clear divide between the rejection framed constructs (PSR and USR) and the other two. The accuracy for the rejection framed constructs was similar, with PSR slightly higher at 69% than USR at 67%. The acceptance and neutral framed constructs also had similar levels of accuracy, with PSN slightly higher than PSA (88% vs 85%). The higher accuracy in perceived performance suggests the

participants found the interaction easier and were more confident in their actions for PSA and PSN than they were with the rejection framed constructs where many who, even though they were successful, believed they had performed poorly.

4.2.2 Actual versus perceived performance for incorrect action

The analysis was then repeated for those who were unsuccessful, i.e. incorrect in their action. In this case five cells (see Table 7) had an expected count of less than 5 and so an exact significance test was selected for Pearson's chi-square. For those who were unsuccessful in the task, no relationship was seen between construct type and perceived performance ($p = 0.618$).

Table 7. Actual vs perceived performance for construct types for incorrect action

Construct Type	Inaccurate	Accurate	Unsure
PSA (n =20)	12 (60%)	2 (10%)	6 (30%)
PSN (n =27)	15 (56%)	4 (15%)	8 (30%)
PSR (n =28)	20 (71%)	3 (11%)	5 (18%)
USR (n =42)	32 (76%)	4 (10%)	6 (14%)
Total (n = 117)	79 (68%)	13 (11%)	25 (21%)

While no significant relationship was observed between perceived and actual performance for those who were unsuccessful in completing the task, it is worth noting few were accurate in their perception of their performance. This clearly contrasts with cases where the correct action was taken. It tells us that, across all construct types, participants who had taken the incorrect action were over-confident and less aware of their mistakes. It is particularly interesting to note the lowest level of accuracy was related to USR. It seems a large percentage (76%) of those who incorrectly interacted with this construct were confident that they had completed the task successfully.

4.3 Visual focus of attention

4.3.1 Reading of instructions

In order to assess visual focus of attention on the constructs, it was first determined whether participants read the instructional text in the constructs. For each construct, the relevant wording was identified (e.g., for USR the phrases "would rather not" and "please tick" were deemed to provide the information required to understand what action to take;). A participant was classified as not reading the instruction if they had no fixations on any of the words in the relevant instructional text. PSN was excluded from this analysis as the text was so short the participants were likely to peripherally focus on the words while looking at the checkbox, as evidenced by the fact only one participant did not focus any visual attention on the text of the construct.

Table 8. Visual focus of attention (n=114)

Construct Type	Read text	Ignored text
PSA	104 (91%)	10 (9%)
USR	88 (77%)	26 (23%)
PSR	95 (83%)	19 (17%)

As can be seen in Table 8, the majority of participants read the instructional text for each construct. USR had the highest number who did not read the instructional text. This was followed by PSR, with PSA having the lowest number who ignored the instructional text. Chi-square was then used to examine the relation between reading of instructional text and the construct type. The test showed there was a significant difference (χ^2 (2, N=342) = 8.363, p=0.015), with a weak association (ϕ = 0.156), indicating 2.4% of the variation is accounted for by construct type.

Table 9. Constructs ignored by type

Ignored PSA only	**Ignored USR only**	**Ignored PSR only**	**Ignored PSA & PSR**	**Ignored PSA & USR**	**Ignored PSR & USR**	**Ignored all**	**Total**
3	11	5	1	2	9	4	35

Many who ignored instructional text did so for more than one construct (see Table 9). However, of those who only ignored one construct, most ignored USR. The USR, in contrast to PSA and PSR, had an unticked checkbox. Chi-square was used to examine the relationship between the default value (i.e. ticked vs unticked) and ignoring the text (see Table 10) This showed a significant difference (χ^2 (1, n=342) = 5.731, p=0.017), with a weak association (ϕ = 0.129), indicating 1.7% of the variation is accounted for by the default value. This suggests participants are more likely to make a decision based only on the state of the checkbox for un-selected, than for pre-selected, constructs.

Table 10. Constructs ignored by framing

Framing	**Read text**	**Ignored text**
Rejection	199	29
Acceptance	88	26

4.3.2 Visual focus of attention on constructs

Eye tracking measures were examined to determine whether there were differences in the level of visual focus of attention paid to the text, both between the constructs, and between those who made an error and those who didn't, within each construct. As in Section 4.3.1, those participants who read no words of the instructional text in the decision construct were excluded. When comparing the constructs, only participants who had read the instructional text in all constructs being compared were included.

Table 11. Mean fixation duration

Construct Type	Mean (ms)	Std. Deviation	N
PSA	231.3	45.922	79
USR	244.6	49.256	79
PSR	251.9	45.648	79

The level of visual attention for the acceptance framed, and the two rejection framed, constructs was measured using mean fixation duration (see Table 11). The neutral framing construct was excluded from this analysis due to the disparity in number of words between it and the other constructs. While the number of words in the other constructs was broadly comparable (PSA had 15, USR and PSR had 21), it was decided that mean fixation duration was the most appropriate measure to compare the level of attention as it was not impacted by number of words [38]. To test H3, that the decision construct type presented to a user affects visual focus of attention, mean fixation duration was compared using a one-way within-subjects ANOVA.

For mean fixation duration, Mauchly's test indicated sphericity was not violated, so no correction was required. A significant difference was observed ($F = 9.893$, $p < 0.001$). Post-hoc tests showed the mean fixation duration for PSA was significantly different to the mean fixation duration for PSR ($p = 0.006$, $d = 0.317$) and for USR ($p < 0.0001$, $d = 0.503$). No significant difference was observed between PSR and USR. This indicates the framing of the construct (i.e. rejection vs acceptance framing) has a small to moderate effect on the level of visual attention paid to the construct. Therefore, H3 is partially accepted.

To test H4, that higher levels of visual focus of attention on the construct impacts decision performance, binary logistic regression was performed with error as the dependent variable and mean fixation duration, fixation count and dwell time as predictor variables for each of the construct types. For each construct, those who did not read the instructional text were excluded. The predictor variables did not predict decision performance successfully for any of the construct types, meaning level of visual focus of attention is not a predictor of the likelihood of a user making an error for the constructs encountered in this study and thus, H4 was rejected.

4.4 Results of hypothesis testing

A summary of the results of the hypothesis testing can be seen in Table 12. The only hypothesis rejected was H4 (visual focus of attention impacts decision performance). While additional insight as to why this might be the case was gained from the Cued RTAs, further analysis examining the way in which users read and examine the construct detail would provide more clarity. This is discussed below in Section 7.

Table 12. Hypotheses tests

	Hypothesis	Test result	Research Finding
H1	The decision construct type presented to a user influences decision performance.	Accepted	The percentage of errors varied by construct type, with un-selected rejection having the highest error rate and pre-selected acceptance, the lowest.
H2a	The decision construct type presented to a user has an impact on perceived performance.	Partially accepted	Participants were more likely to be under confident in their performance when interacting with rejection framed constructs (PSR and USR) than the acceptance framed construct (PSA). No difference was seen between neutral framing and the others.

	Hypothesis	Test result	Research Finding
H2b	The decision construct type presented to a user has an impact on the accuracy of perceived performance.	Accepted	Participants were less likely to have an accurate perception of their performance for rejection framed constructs, particularly USR.
H3	The decision construct type presented to a user affects visual focus of attention.	Partially accepted	The level of visual focus of attention was significantly higher for rejection framed constructs than acceptance. There was no significant difference between the two rejection framed constructs.
H4	Visual focus of attention impacts decision performance.	Rejected	Level of visual focus of attention was not a predictor of accuracy of performance.

5 FURTHER RESULTS: HEATMAPS AND QUALITATIVE DATA

The results from the eye tracking data were further explored and enhanced using heat maps and Cued RTA to identify patterns and to understand why participants behaved as they did. These techniques (described earlier in Sections 3.4 and 3.5) provided interesting insights which supplement the quantitative data analysis discussed in Section 4 above.

5.1 Decision performance

The error rate for all constructs was high, with USR being considerably higher than the other constructs (see Section 4.1). Some insight into the problems encountered in decision performance can be gained by examining the heat maps in Figures 2 – 5. Figure 2 shows user focus for the PSA construct which had the lowest error rate while illustrates focus on USR, the construct with the highest error rate. It is apparent from the heat maps that participants focused more on the text using rejection framing ("If you would rather not purchase…") than they did on the text using acceptance framing ("I want to purchase…"). In spite of this extra effort, the error rate for USR was still twice that of PSA, indicating that the intensity of focus was due to confusion or difficulty in understanding.

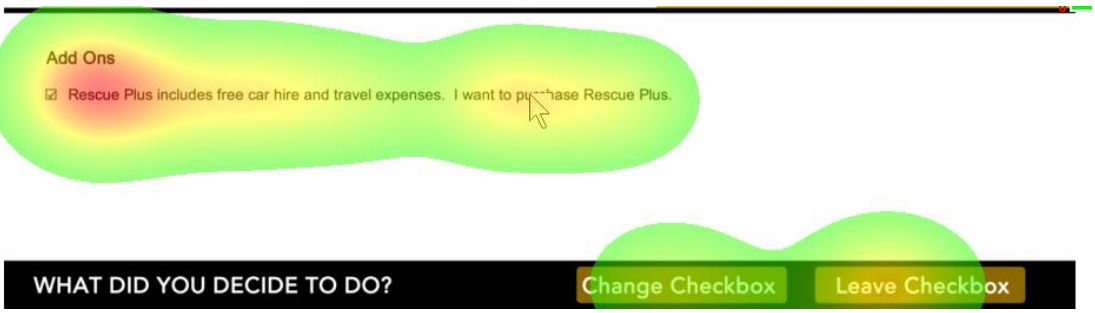

Figure 2 – Aggregated heat map PSA

The Cued RTA provides additional insight into the error rate. PSA had fewest errors of all the construct types. The lower, albeit substantial, rate of error for the PSA may to be explained by previous user experience of this presentation format for this construct type, which tends to be the most commonly encountered opt-out [8], and their likely assumption that a pre-selected checkbox is an opt-out, as evidenced by comments during the Cued RTA. As one participant stated: the checkbox "tells you what you need to know". This assumption, coupled with lower levels of expressed confusion regarding the wording (e.g. "simple and clear", "language is clear and concise"), is likely to have resulted in higher levels of accuracy than for the other constructs.

Despite most participants feeling the pre-selected nature of the checkbox reinforced the wording, the wording was clear, and they were “more likely to get it right”, there was still unease that action was not required to purchase the product, with one participant stating, “you need to make sure to leave the checkbox” and another that they had to “read the whole lot” again. It would thus appear some of the errors for PSA were as a result of an inherent belief that action should be required to purchase and inaction to avoid purchase, the converse of the actions required for an opt-out. In other words, they believed optional extras should be presented using an opt-in, rather than an opt-out, construct.

Figure 3 – Aggregated heat map for USR

For USR (see Figure 3), the extremely high error rate appears to be due to two main reasons: the assumption that the construct was an opt-in rather than an opt-out, and confusion caused by the wording of the rejection framing. Many participants believed the construct was an opt-in due to the un-selected state of the checkbox, with some participants not reading the text of the construct at all (see Figure 8 for one participant’s heat map demonstrating they only looked at the checkbox). A contributory factor to this belief may be as a result of familiarity. Un-selected opt-ins are the most commonly encountered decision constructs [41] and so encountering an unticked checkbox is likely to lead to the expectation that the construct is an opt-in. Comments such as “you tick it to buy it” and “it is weird … if you left a checkbox unticked you’d get something” show that the visual design of the construct led to erroneous assumptions on the part of participants. Even when the construct was deliberated over, some still believed it to be an opt-in. One participant initially said, “at first glance it looks OK” (probably assuming it to be an opt-in decision), but as he read the text, confusion and misinterpretation mounted, concluding “OK! It’s more clear, to buy it I would tick [the box]”. This conclusion was in fact erroneous. Other participants clearly demonstrated confusion, citing the need to “read the text over again” and “I just had to read and re-read and check the text above”.

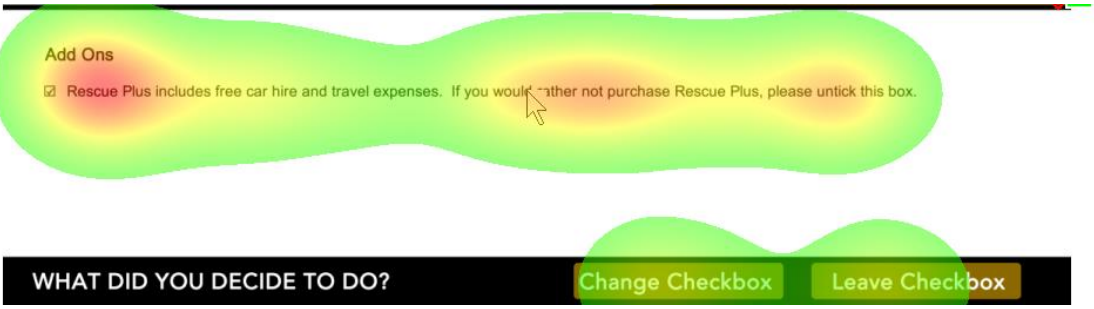

Figure 4 – Aggregated heat map for PSR

The aggregated heat map for un-selected rejection framing (USR) (see Figure 3) shows more focus on the instructional language in the construct than for pre-selected rejection framing (PSR). This suggests participants spent more time trying to decipher the text for USR than they did for the similarly framed PSR. Presumably the dichotomy of the un-selected checkbox and the negative framing in the USR caused confusion and required more effort to decipher for those who looked beyond the state of the checkbox for an indication of the construct type. While the pre-selected checkbox for the PSR suggests an opt-out to the participants, the rejection framing still led to confusion on the part of some participants, with many struggling to understand what it meant. The word 'not', in particular, caused difficulty for both USR and PSR, with one participant stating, "'not' threw me". Several participants believed both rejection framed constructs could easily induce users into making the wrong decision and inadvertently purchasing the item. They believed the construct was "confusing", "deceiving", "contradictory", "tricky" and "complicated".

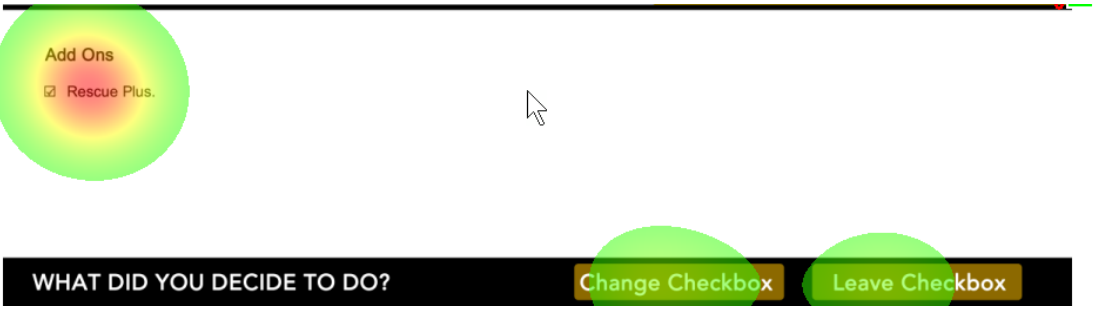

Figure 5 – Aggregated heat map for PSN

PSN (see Figure 5) had similar levels of error to PSR (24% versus 25%), an outcome that, at first glance, is surprising, given the brevity of the pre-selected neutral framing (PSN) in comparison to the PSR. However, the Cued RTAs indicated a clear division of opinion. Many liked its brevity and felt they were unlikely to make a mistake. However, others believed errors were more likely due to the lack of instruction in the construct. For those, the pre-selected nature of the checkbox seemed to add to the confusion, with one participant stating, "it shouldn't be ticked if you don't want it". Therefore, errors appear to have occurred due to an expectant belief that an action is required to purchase and, without instruction to the contrary, some mistakenly changed the checkbox.

5.2 Accuracy of perceived performance

Participants' perceived performance was examined in Section 4.2, and was further broken down by those who were successful and those who weren't. Cued RTAs and heat maps were used to shed light on the reasons behind the accuracy of participants' perceived performance in both groups.

5.2.1 Perceived performance for correct action

Accuracy of perceived performance for those who were successful in their interaction can be seen in Table 6. The high levels of confidence in performance for PSA in those who are successful in their interaction is supported by the Cued RTAs where participants commented positively on the construct. Many felt that the pre-ticked checkbox provided an implicit affordance that was consistent with the decision. As one participant stated: "the checkbox tells you what you need to know", an important observation that the checkbox was a coherent signal that coincided with their expectations. The wording of this construct was perceived to be clearer than for other constructs, with participants stating: "it is very clear" and that users are "more likely to get it right". The affordance of the ticked checkbox, when combined with the perceived clarity of the wording, resulted in participant confidence in their performance. However, although participants were more positive about this construct than the others, there was still strong negative sentiment that it was an opt-out. One participant said, "if you read it, you'd get it right", suggesting that he may not always read the text of constructs encountered. Others stated that they would prefer to make the selection themselves, as would be the case for an opt-in.

PSN had the highest rate of accuracy in perceived performance of those who were successful in their interaction. While many liked the concise nature of the construct and believed it to be clear, others felt the lack of instruction was confusing, particularly in light of the pre-selected nature of the construct. Some participants made their decision on the construct type by quickly looking at the checkbox and concluding a pre-selected checkbox was an opt-out. Others, however, were less sure as they believed instructions should be given for an opt-out construct, which is likely to have resulted in a lack of confidence in their performance.

The Cued RTA reflected the lack of confidence amongst participants interacting with rejection framed constructs. Their observations highlighted elevated levels of confusion and frustration. With the USR, comments indicated confusion in the use of an un-selected checkbox as an opt-out: "Normally you tick it to buy it". One participant, on initially seeing an un-selected checkbox said, "this is better", only after reading the text to slowly realize that it was not an opt-in but something more confusing. He concluded that he might be "prone to make a mistake". Another participant stated, "It is unticked but that [text] was confusing so I had to read the text over again." Yet another participant remarked that "Unticked, you'd think you're not subscribing, it should be…", trailing off to conclude he would be more likely to make a mistake.

For both USR and PSR, comments were universally negative with regards to clarity and language, with one participant stating it "takes more time to work your way through the sentence". In particular, many participants felt the word "not" meant they had to work harder to interpret the sentence. Comments included "that's not something you would expect to see", "I don't know why anyone would do this", "the 'NOT' was difficult", "the double negative was very difficult to comprehend". Participants spent considerable time reading and re-reading this construct. This confusion is likely to have contributed to their lack of confidence in their performance, despite the fact they got it right.

5.2.2 Perceived performance for incorrect action

Accuracy of perceived performance for those who were successful in their interaction can be seen in Table 7. Analysis of the Cued RTAs indicated that many participants who made an error in their interaction assumed this construct was an

opt-in due to the unticked checkbox and made their decision on how to act based on the state of the checkbox rather than spending time fully understanding the construct. This can be seen in the aggregated heat maps in Figure 6 and Figure 7, where it is clear that those who got it correct spent more time reading the text than those who got it incorrect. The heat map showing a single participant's interaction (see Figure 8) clearly shows the participant, who was incorrect in their interaction, did not even glance at the text and made their decision based solely on the checkbox. It was clear that some participants simply observed the checkbox, decided "you tick it to buy it", and proceeded without reading the text, thus erroneously believing they had engaged correctly with the construct, resulting in a false sense of confidence in their performance.

Figure 6 – Aggregated heat map for USR - correct selection

Figure 7 – Aggregated heat map for USR - incorrect selection

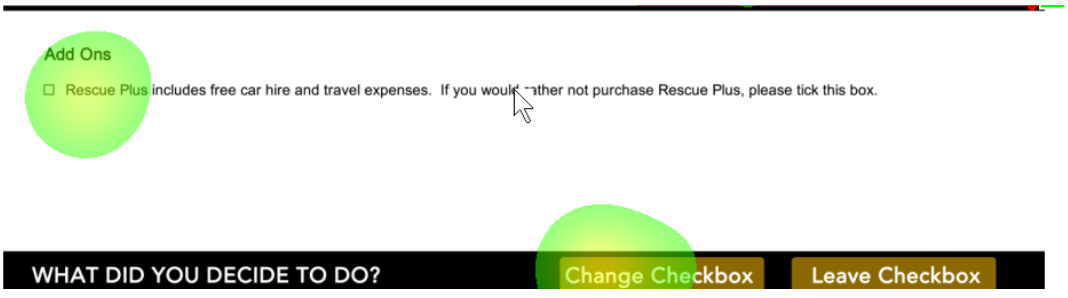

Figure 8 – Individual heat map for USR

5.3 Visual focus of attention

As can be seen in Table 9, eleven participants ignored the text for USR, while reading the text for the other constructs. The Cued RTAs indicated that many of these were likely to assume an un-selected checkbox was an opt-in as they believed an unticked checkbox indicated an opt-in ("you tick it if you want to get it"). They were, however, more meticulous for the pre-selected constructs, perhaps due to a general suspicion regarding opt-outs. Comments that follow typified such suspicions: "I wouldn't like that now because if you don't realize that it's ticked then you're automatically getting it"; "some people mightn't realize it's ticked or check, double-checking, and end up buying it"; and "[it's designed like that] so you're more likely to make a mistake".

The finding that visual focus of attention is impacted by construct type is supported by the Cued RTAs where participants repeatedly commented on the difficulty in interpreting and understanding the rejection framed constructs. The negative language associated with the word 'not' caused confusion, and presumably led to more attention being paid to the text in an effort to understand it, with one participant stating, "it takes more time to work your way through the sentence", while another stated they "had to think too much". Others stated the wording was 'confusing', 'a contradiction', 'deceiving' and 'tricky'. In contrast, comments on the wording of the PSA were more benign, with participants stating it was 'very clear', 'simple enough', and that they "were more likely to get this right", feelings that are likely to correspond with less effort and attention required to comprehend the text.

The Cued RTAs provided potential insight as to why visual focus of attention does not affect decision performance for some of the constructs. This was particularly the case for USR, where some participants assumed the un-selected nature of the checkbox indicated an opt-in and acted accordingly without much processing of the text, despite some cursory reading. Others spent considerable time deliberating over the meaning of the construct, but still believed it was an opt-in as "you tick it to buy it". Thus, some participants made an error by misinterpreting the construct whilst superficially interacting in a hurried manner, with consequent low levels of attention, while others deliberated for some time, with consequent higher levels of attention, but still made an error due to their inherent belief that action should be taken in order to purchase.

For PSR, similar confusion was apparent, with some participants commenting they had to read the text repeatedly to understand it. Some also commented on the difficulty in matching their intent with the language and checkbox pre-selection. For many, careful deliberation was required to determine the construct was an opt-out, but some still misunderstood, even after considerable focus on the meaning. Others simply glanced at the checkbox and assumed it was an opt-out ("the second sentence is not needed; the checkbox tells you this information"). This disparity in behavior indicates some participants interacted correctly very quickly, with low attention to the text, while others required more effort to process the text to interact correctly.

While the Cued RTA data for PSA was not as clear cut in its insight as to why the level of attention to the construct - as measured by mean fixation duration, fixation count and dwell time - are not predictors of errors, some insight was provided. Participants generally felt the language was clear and easy to understand. However, some participants still believed this to be an opt-in, with one stating you need to "make sure to leave the checkbox". It would appear that even though the language was clear, some participants instinctively associate action with purchasing a product and expect to make a change to the checkbox to purchase, rather than leaving it unchanged, as is the case for an opt-out. These participants were likely to exert more effort interpreting the construct.

This would explain the much higher error rate for USR as participants may have been swayed by the design and visual appearance of the construct, rather than its wording. However, the same assumptions regarding the checkbox would have applied to the both the PSR and PSA but the error rate was significantly higher for PSR. The main difference

between these two constructs was the framing and the frequency with which they are encountered. PSA is the most commonly encountered type of opt-out construct and so familiarity with that structure, coupled with the complexity of the language of the PSR, could explain the difference in error rates.

6 DISCUSSION AND CONCLUSIONS

A novel dimension of this study is that it employed a multi-method approach using both qualitative and quantitative data, thus gaining a deep and comprehensive perspective on user behavior. It investigated the impact of the design of opt-out decision constructs for micro-decisions on both error rate and the level of visual attention participants focus on the constructs. Participants' confidence in their performance was also examined, as were attitudes and emotional responses to the decision constructs.

Many of the findings in our study confirm prior research. Following on from Krug's assertion [53] that good design should minimize effort and uncertainty, our study clearly illustrates that the use of more complex decisions constructs (such as PSR and USR) is poor design as they require more thought and deliberation. Similarly, our findings that the opt-out construct is inherently problematic and holds the propensity for users to make an inadvertent choice, are consistent with the taxonomy that helped guide the framing of this study (see Section 2.2) [7].

Much research has been conducted in the use of opt-out decision constructs and how framing and defaults can be used to guide or nudge users towards the vendor's preferred choice. Studies have shown acceptance framing in a decision construct results in more users opting in [2, 54, 55, 56, 84], and that framing, coupled with the default value (i.e. ticked or unticked), impact on user selection [2, 12]. The results presented in this paper are differentiated from previous research in that they address the impact of framing and default value on the user's success or otherwise in achieving their intended course of action, rather than whether they have merely been nudged in a particular direction.

The decisions presented were all opt-outs and, while all were challenging to varying degrees, the un-selected rejection framing (USR) construct had a considerably higher error rate than the other constructs. The high error rate appears to be due to a combination of user assumption that an un-selected checkbox always represents an opt-in, and the confusing negative framing of the instruction. A novel finding of this study, which offers a significant additional contribution to the previous literature discussing the use of opt-outs, is that many users rely on partial information to identify constructs. Astonishingly, many users do not actually read the text of decision constructs and may decide which type of construct they have encountered based on the visual cue of the checkbox status (i.e. pre-selected or un-selected). The take-away here is that the use of an un-selected checkbox can trick a user into accepting an option they don't want as they are likely to have a false sense of confidence that they have rejected the option. This reinforces the temptation for designers to use ambiguous or dark patterns in designing decision constructs.

The framing of constructs, particularly rejection framing, had a real impact on the level of visual attention paid to the text of the constructs. A logical expectation, given previous research indicating higher levels of visual attention can indicate confusing language [34, 68, 73, 79], might be that higher levels of visual attention should lead to higher error rates. However, this was not the case and appears to be due to the different reasons that participants erred. Some made an error through haste and snap decisions. In many of these cases the participant barely glanced at the framing text, relying largely on the un-selected checkbox to erroneously conclude it was an opt-in construct. Others made an error through confusion and misunderstanding, despite considerable effort in reading and re-reading, whilst trying to unravel the construct. While this study has extended scholarship in the use of visual focus of attention, the results indicate a gap in the current literature and suggests further research is required to explore in more detail the causes and determinants of errors.

Dark patterns are a commonly used method of tricking users into making unintended decisions [59]. Previous research has examined the various styles of dark patterns [59], the prevalence of dark patterns on B2C websites [63] and the impact of dark patterns on user behavior [2]. The work herein builds on this research by examining user attitudes and reactions to the use of dark patterns on B2C websites. This examination of intentional use of dark patterns to trick users into inadvertent choices is of practical interest to users, developers and legislators (c.f. E.U. legislation regarding opt-outs, U.S. proposal to legislate against dark patterns). Users encounter micro-decisions in online transactions on a very frequent basis; indeed, many people encounter these constructs every day and may not realize that web designers are deliberately attempting to deceive them into making incorrect decisions. Over time, as users become accustomed to certain common tricks, designers respond by inventing new patterns. However, the underlying constructs remain essentially the same, so it is largely immaterial whether decision constructs (i.e. PSA, PSR, USR, PSA) are presented using checkboxes, toggle buttons or other means. We confidently expect that our findings will stand the test of time.

This study has examined the impact of a single type of dark pattern (trick questions) on micro-decision making on B2C websites. Brignull [15], who first coined the term 'dark patterns', created a taxonomy of dark patterns, all of which are designed in different ways to trick the user into making a specific decision. Other researchers have expanded on his work and provided additional taxonomies [36, 59]. However, a gap in this research could be filled using the methodology described herein. Repeating this study with each of the different types of dark pattern would provide additional insight into user performance, both in terms of decision outcome and in highlighting which parts of the pattern draw their attention. The additional insight into user attitudes from Cued RTAs can also provide valuable data on user attitudes. As such, the methodology used in this study is of practical use to researchers wishing to gain a deeper understanding of how and why dark patterns affect user decision making. In fact, this methodology would be suitable for researchers and practitioners interested in gaining a deep and holistic understanding of user interactions in a variety of contexts.

This study provides unique and original insights into user interaction with opt-out micro-decisions so frequently encountered in the transactional process. In previously cited research [10], it is asserted that firms may quite easily, and deliberately, design decisions to achieve self-serving outcomes. However, this can be a counterproductive approach. As evidenced by the attitudinal data revealed in the Cued RTAs and users' perceived performance, using complicated or unusual constructs may not necessarily achieve the desired result. Thus, this study has practical implications for managers and developers who are tempted to use dark patterns in decision constructs to nudge consumers towards increased sales or subscriptions. Undoubtedly, the use of dark patterns will confuse and potentially deceive the user and some who intended not to buy or subscribe will accidently do so. However, users who wish to purchase or subscribe are just as likely to be confused or tricked as those who do not, with a consequent loss of willing customers. Additionally, the mistrust and negative attitude of users who encounter these types of dark patterns may result in users going elsewhere to firms who offer choices in a clear, unambiguous manner and who will perhaps create loyal, returning customers as a result. While an appeal to adhere to ethical design may not work, an appeal to the bottom line may.

7 LIMITATIONS AND FURTHER RESEARCH

As is normal in empirical studies, there are a few limitations that must be acknowledged. Firstly, the research only examined opt-outs. Decision constructs can also take the form of opt-ins and must-opts [41]. The authors plan to extend the study by examining the use of all types of decision constructs and comparing the construct types. Additionally, the constructs were presented to the participants in isolation, rather than a more natural setting with multiple decision constructs presented to the user throughout the transactional process. It is intended that similar studies be conducted examining user interaction with decision constructs in a more natural setting with multiple encounters throughout the

interaction. These studies could also examine other types of micro-decision, such as acceptance of cookies, privacy settings and recurring subscriptions. Our work is also of relevance to related areas such as recommender systems [83].

The participants in this study were mainly postgraduate students doing Business or Information Systems courses, and all had extensive experience of engaging with B2C websites. Although there were a number of older and younger participants, the majority (72%) fell in the age range of 21 to 30 years. As such, the generalizability of the findings is limited. An older, less educated, less technically-adept user group may experience even more problems with opt-out constructs. It would therefore be interesting to replicate the study with a wider variety of participants. The population of interest for the purposes of our study was internet users who regularly engage in on-line purchase transactions. Although the use of student samples as surrogates for on-line consumers is not ideal, it has nevertheless been demonstrated to be quite reliable by a number of previous comparable studies [32, 76, 80].

While this research has answered some interesting questions, it also raises some additional questions that can be answered through further analysis of the data gathered. Although the heat maps provided valuable data on participants' focus, it did not illustrate the pattern of reading or whether participants re-read certain parts of the constructs. Gaze path analysis will be conducted to develop a more nuanced understanding of user reading patterns. In particular, the different reading patterns of those making errors and those getting it correct will be explored. This may provide more insight into why and how errors are being made.

Another potential avenue for further research is to examine in more detail how users feel about the use of deceptive dark patterns, and the extent to which this affects their continued willingness to transact business with online vendors who engage in such practices. Theories from microeconomics suggest that, all else being equal, rational consumers would shift allegiance away from such vendors if convenient substitutes are available. In the marketing and brand loyalty literature, there is a substantial body of prior work on trust, satisfaction and intention to re-use. A disgruntled consumer may decide to move away from a vendor that commits a "psychological contract violation" but this is dependent on a number of other influential factors, such as how satisfactorily the vendor deals with post-failure service recovery [58]. The extent to which dark patterns are normalized in a particular sector is also likely to be a factor; if the principal competitors are doing likewise, then neutralization theory suggests that such practices become more acceptable and almost expected. In recent years, there is growing public awareness and discontent about the use of personal data by digital marketing and social media companies, and the deceptive methods used to capture that data. This has led to calls for a new paradigm for online business [43, 90]. It will be interesting to observe if companies that adopt simpler, fairer, more transparent practices can attract custom away from those who continue to use dark patterns.

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