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## Dark Patterns: Effect on Overall User Experience and Site Revisitation

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# Dark Patterns: Effect on Overall User Experience and Site Revisitation



**Deon Soul Calawen**

A dissertation submitted in partial fulfilment of the requirements of  
Technological University Dublin for the degree of  
M.Sc. in Computer Science (Advanced Software Development)

**January 2022**

# Declaration

I certify that this dissertation which I now submit for examination for the award of MSc in Computer Science (Advanced Software Development), is entirely my own work and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

This dissertation was prepared according to the regulations for postgraduate study of the Technological University Dublin and has not been submitted in whole or part for an award in any other Institute or University.

The work reported on in this dissertation conforms to the principles and requirements of the Institutes guidelines for ethics in research.

*Signed:* 

*Date: 05 January 2022*

# Abstract

Dark patterns are user interfaces purposefully designed to manipulate users into doing something they might not otherwise do for the benefit of an online service. This study investigates the impact of dark patterns on overall user experience and site revisitation in the context of airline websites. In order to assess potential dark pattern effects, two versions of the same airline website were compared: a dark version containing dark pattern elements and a bright version free of manipulative interfaces. User experience for both websites were assessed quantitatively through a survey containing a User Experience Questionnaire (UEQ) and a System Usability Scale (SUS). Site revisitation i.e. users' willingness to revisit a website was assessed qualitatively through semi-structured interviews. Dark pattern awareness was also investigated through the survey and interviews. For the UEQ, a significant difference was observed for Attractiveness. There was no significant difference observed for the rest of the scales, namely Perspicuity, Efficiency, Dependability Stimulation and Novelty. Additionally, there was no significant difference between the SUS scores of the two sites. Thus, dark pattern application was found to have no significant effect on overall user experience. Despite this, the bright website was found to have a higher rating for all scales of the UEQ as well as for the average SUS score compared to the dark website. The semi-structured interviews revealed that dark pattern also had no effect on site revisitation. Lastly, questions assessing dark pattern awareness revealed that the majority of participants were moderately aware of dark patterns despite not knowing the term.

**Keywords:** Dark patterns, UX, site revisitation, manipulative design, HCI



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# List of Acronyms

<b>UX</b>	User Experience
<b>HCI</b>	Human Computer Interaction
<b>UEQ</b>	User Experience Questionnaire
<b>SUS</b>	System Usability Testing
<b>GDPR</b>	General Data Protection Regulation

# Chapter 1

## Introduction

### 1.1 Background

Dark patterns are user interface elements purposefully designed to manipulate users into doing something they might not otherwise do in order to benefit an online service. These deceptive designs can range from simple implementations such as using double negatives on checkboxes to confuse users (e.g. “Click here if you do not want to subscribe to our newsletter?”) to more complex ones such as interfaces that make the process of cancelling a subscription more difficult and convoluted for the user. Such interface designs have become increasingly pervasive in digital platforms including shopping websites (Mathur et al., 2019), social media (Mildner & Savino, 2021) and gaming (Zagal et al., 2013). Due to this, there has also been an increasing interest in dark patterns within the Human Computer Interaction (HCI) domain over the past few years. Such interest has resulted into the development of different taxonomies (Gray et al., 2018; Mathur et al., 2019) for classifying different dark patterns.

Additionally, there has been a surge of studies (Graßl et al., 2021; Mejtoft et al., 2021; Nouwens et al., 2020; Soe et al., 2020; Utz et al., 2019) analysing dark patterns in user

consent banners including their frequency, the most commonly used patterns as well as their effects on user acceptance or denial of consent. Despite this, research on dark patterns that exist beyond these consent banners i.e. dark patterns that exist when interacting with the website itself and particularly their impact on the user experience remain scarce. There has been some preliminary research analysing dark pattern effect on different aspects of the end user experience including perceived manipulation (Gray, Chen, et al., 2020) as well as perceived annoyance and brand trust (Voigt et al., 2021). However, there is hardly any research that investigate dark patterns effects on overall user experience and users' willingness for site revisitation. Thus, the present study aims to investigate dark pattern effects on these two aspects. To do so, the study will compare two versions of a mock website: a "dark" website which will contain dark pattern elements and a "bright" website which will be free of manipulative interface elements. The mock website that will be used for the study will be an airline website. In particular, an airline website is chosen for the study as these type of websites have been relatively under explored compared to retail shopping websites within the realm of dark pattern research. In addition, the use of a mock website will allow the research to accurately monitor the interactions of the users with the site.

## 1.2 Research Project

To investigate potential dark pattern effects, the resulting dark and bright airline websites will be compared in terms of the two comparison criteria mentioned previously. These are overall user experience and site revisitation. Overall user experience refers to users' feelings, impressions and attitudes when interacting with the website. This will be assessed based on the User Experience Questionnaire (UEQ) proposed by Laugwitz et al. (2008) which measures aspects such as product understandability, annoyance and efficiency across 7-point Likert scales. In addition, the System Usability Scale (SUS) created by Brooke (1995) will be employed as an additional measure of user experience. It measures usability aspects such as system effectiveness, efficiency

and satisfaction.

Meanwhile, site revisitation refers to users willingness to revisit or continue using a website. In the context of this study, it translates to users' willingness to continue using airline websites for subsequent bookings. Users' willingness to revisit will be assessed through semi-structured interviews. Participants will be asked to explain their response on whether they are likely or unlikely to continue using airline websites that employ dark patterns. The main aim of the interviews will be to explore whether dark pattern application has any effect on site revisitation based on participants' personal experiences and thoughts as well as their feelings towards dark patterns.

To this end, the present study aims to answer the following research questions:

*“Does the application of dark patterns on airline websites significantly affect users’ overall experience?”*

*“Does the application of dark patterns on airline websites affect users’ willingness to revisit those sites?”*

### 1.3 Research Objectives

#### 1.3.1 Analysis of Airline Websites

Prior to the implementation of the mock airline websites, popular airline websites in Europe and North America will be analysed to determine the types of dark patterns that are commonly employed. This will be achieved by screenshotting each page traversed when booking a flight for each airline website. Furthermore, the resulting screenshots will be annotated to highlight potential dark patterns that have been identified. Through this process, dark patterns that are applied will be identified and categorised using [Mathur et al.'s \(2019\)](#) taxonomy and then recorded. The identified

patterns will then be verified with the help of an expert to ensure their validity.

### 1.3.2 Mock Website Implementation

Following the analysis of the airline websites, two versions of a mock airline website will be implemented: a dark version containing dark pattern elements and a bright version which will be free of any manipulative interface. The dark patterns applied to the dark version will be based on dark patterns identified in the website analyses. Doing so allows the mock website to be modelled after real word examples. The mock websites will be implemented through React with HTML, CSS, Javascript and Bootstrap.

### 1.3.3 Survey Design, Testing and Analysis

After the mock websites have been implemented, an online survey will be designed to evaluate each version of the website. Two groups of participants will be surveyed; one for the dark version and one for the bright version. Both groups will be asked to complete a flight booking task and will then fill out a survey as they perceive it. The survey will assess user experience through a questionnaire based on Laugwitz et al.'s (2008) UEQ, as well as Brooke's (1995) SUS and their willingness to revisit the site. Demographic questions will also be asked in the survey including the participant's age, gender and digital literacy. First, the survey will be tested and be completed by a small number of participants. The survey will then be rolled out after successful testing. Upon the completion of the survey and interview, the resulting data will be analysed in order to answer the research questions.



## 1.4 Research Methodologies

The present study will employ a combination of primary and secondary research. The secondary research will comprise of a literature review of dark patterns research, synthesising and critically evaluating related research to provide the reader with an understanding of the context and relevance behind present study. In terms of primary research, the study will take a mixed-methods approach. Quantitative and qualitative data will both be collected from the online survey and follow-up interviews.

For the quantitative analysis, an independent samples t-test assuming unequal variance (or Welch's t-test) will be performed for calculated scales of the UEQ and the SUS scores. As for the qualitative analysis, thematic analysis will be employed to examine participants' responses for the open-ended questions from the survey. As for the follow-up interviews, transcripts from the interviews will also be analysed through thematic analysis. Results from these analyses will be used to understand results derived from the statistical analysis and to have a broader understanding of dark patterns effects on user experience and site revisitation based on the perspective of the end user.

## 1.5 Scope and Limitations

The mock website will be based solely on airline websites, limiting the study's generalisability since dark patterns on other types of e-commerce sites may have a different effect on the end user. Additionally, the mock website will primarily focus on the process of booking a flight and the dark patterns that may arise during that process, other typical features of airline websites such as hotel booking will be ignored.

## 1.6 Document Outline

Details of the upcoming chapters in this dissertation are presented below:

- **Chapter 2: Literature Review**

This chapter reviews various literature relevant to the research topic. The first part of the chapter covers the historical origins of dark patterns. The next section focuses on dark pattern research; starting with a review of different dark pattern definitions; a look at various dark pattern taxonomies; and finally an analysis of dark pattern research related to the present study.

- **Chapter 3: Airline Websites Analysis**

This chapter details the airline website analysis conducted. It describes the methodology of the analysis and its results. Next, a discussion of the results is presented along with some of the limitations of the analysis.

- **Chapter 4: Mock Airline Websites: Design and Implementation**

This chapter discusses the design and implementation of the two airline websites used by participants in the booking task. First, it describes the bright website including its layout and functionalities. Next, the dark version is described along with the dark patterns implemented to it.

- **Chapter 5: Online Experiment: Design and Methodology**

This chapter covers the design and methodology of the online experiment to evaluate the bright and dark websites implemented. It outlines the experimental procedures, details about the participants, contents of the questionnaire, structure of the follow-up interviews and analysis of the resulting data.

- **Chapter 6: Online Experiment: Results and Discussion**

This chapter presents the results of the online experiment conducted. It first describes the quantitative analysis of the UEQ and SUS. It then outlines the

qualitative analysis of the open-ended questions and the follow-up interviews. Finally it discusses the results and some of the limitations of the experiment.

- **Chapter 7: Conclusion**

This last chapter presents an overview of the research and the problem definition. Next, it summarises the design and experimentation of the study as well its evaluation and results. Lastly, the contributions and impact of the study as well as future work and recommendations are discussed.

# Chapter 2

## Literature Review

### 2.1 Introduction

This chapter reviews various literature relevant to the research topic. The initial section covers the historical origins of dark patterns; from deceptive designs in retail, nudging from the realm of behavioural economics and growth hacking in the field of marketing. The next section focuses on dark pattern research; starting with a review of different dark pattern definitions; then a look of various dark pattern taxonomies; and finally an analysis of dark pattern research related to the present study.

### 2.2 Deception by Design

Although dark patterns have recently emerged into mainstream awareness, they have been the result of three decade-long trends: deceptive practices from the world of retail; nudging from research and public policy; and growth hacking from the design community (Narayanan et al., 2020).

### 2.2.1 Deceptive Designs in Retail

Historically, different deceptive and manipulative practices have been employed in the retail industry. These range from normalised practices such as psychological pricing i.e. making the price slightly less than a round number (e.g. €49.99); to unlawful practices such as bait and switch car ads. There are also more complex practices such as the Gruen Effect which was originally applied in shopping mall design, intentionally providing users with a disorienting layout causing them to lose track of their original intentions and become more prone to impulse buying (Carah & Brodmerkel, 2012).

### 2.2.2 Nudging

In behavioural economics, the book *Nudge* by Thaler & Sunstein (2008) popularised designs that utilise psychological susceptibilities to alter one's behaviour. The default effect for example is a method which has been adopted by businesses, usually with malicious intents such as setting privacy-intrusive defaults (Lukoff et al., 2021). Many governments have used nudges which maintain freedom of choice but also steer people in a particular direction in policy making in areas such as consumer protection, health care, environmental protection, tax policy, poverty and retirement (Goyens et al., 2018).

### 2.2.3 Growth Hacking

The final trend which is growth hacking, is the one that most directly developed into dark patterns. In the field of marketing, growth hacking through A/B testing where subsets of users are presented with variants of web pages, designers began to uncover that even small changes to design elements can result into significant changes in user behaviour. Perhaps the best-known instance of growth hacking was one that was implemented by Hotmail when it launched in 1996. Instead of using traditional mar-

keting methods like billboard advertising, the founders employed a different strategy through which the service automatically added the signature, “Get your free email with Hotmail,” to every outgoing email, essentially getting users to advertise on its behalf, subsequently leading to viral growth (Narayanan et al., 2020).

## 2.3 Dark Patterns

### 2.3.1 Defining Dark Patterns

In 2010, when UX specialist Harry Brignull coined the term “dark pattern” on his [darkpatterns.org](http://darkpatterns.org) website, he described the phenomenon as “a user interface carefully crafted to trick users into doing things they might not otherwise do, such as buying insurance with their purchase or signing up for recurring bills” (Brignull, 2013). Since then, Brignull’s work has resulted into a surge of academic research that attempt to define and shed some light on dark patterns. However, as demonstrated by Mathur et al. (2021), such dark pattern research are not established on a singular, unified definition or concern. From their review of dark pattern related papers, Mathur et al. identified 19 definitions and discovered four aspects of dark pattern definitions.

The first aspect describes elements of the user interface affecting users. For instance, as cited by Mathur et al., some definitions refer to dark patterns as “tricks” (Brignull, 2013; Waldman, 2020), while others refer to them as “misleading” interface design (Bösch et al., 2016) or attribute them a set of properties such as being “coercing, steering, or deceiving” (Mathur et al., 2019) and having “obnoxious, coercive, or deceitful” behaviour (Gray, Chivukula, & Lee, 2020). The second aspect of definitions relates to the mechanism of effect for influencing users. Some definitions characterise dark patterns as undermining user intent (Bösch et al., 2016; Brignull, 2013; Waldman, 2020) or undermining user preferences (Bösch et al., 2016; Luguri & Strahilevitz, 2021; Mathur et al., 2019). The third aspect is concerned with the role of the user interface

designer. For example, some definitions mention designers abusing their knowledge of human behaviour such as behavioural and cognitive psychology (Gray et al., 2018; Lacey & Caudwell, 2019; Maier & Harr, 2020), while other definitions mention designers trying to achieve a goal (Gray, Chivukula, & Lee, 2020; Gray et al., 2018; Luguri & Strahilevitz, 2021; Zagal et al., 2013). Finally, the fourth aspect relates to the benefits and harms that result from a user interface design. For instance, some definitions characterise dark patterns as seeking to benefit an online service (Gray, Chivukula, & Lee, 2020; Mathur et al., 2019; Utz et al., 2019), while others mention harm to users (Gray et al., 2018; Waldman, 2020; Zagal et al., 2013).

Evidently, there is significant variation among the aspects derived from the definitions. Some definitions may characterise dark patterns with only one or some of the aspects outlined above. For instance, a definition may mention characteristics of user interface but not address the role of the user interface designer or elements of benefits and harm. To help address this lack of consistency and to develop a common vernacular, Mathur et al. (2021) drew out normative considerations from literature and categorised them into four normative lenses. In particular, these normative lenses offer different perspectives with which researchers can analyse dark patterns. The four normative lenses, as quoted from Mathur et al., pp. 13-19, are as follows:

- **Individual Welfare** — “Under this lens, a dark pattern is any interface that modifies the choice architecture to benefit the designer at the expense of the user’s welfare.”
- **Collective Welfare** — “Under this lens, a dark pattern is any interface that modifies the choice architecture to benefit the designer at the expense of collective welfare.”
- **Regulatory Objectives** — “Under this lens, a dark pattern is any interface that modifies the choice architecture to interfere with or undermine specific regulatory objectives.”

- **Individual Autonomy** — “Under this lens, a dark pattern is a user interface that undermines individual decision-making.”

The present study will be analysing dark patterns under the individual welfare lens. This lens describes how dark patterns decrease individual welfare, either through financial loss, invasion of privacy or cognitive burden. The consequence of suffering financial loss is common for shopping and travel websites which utilise different interfaces to push users into spending more money than they would have originally. Invasion of privacy is also another welfare consequence faced by users when a dark pattern subverts their privacy e.g. interfaces with privacy-invasive defaults that disclose user data. Finally, users suffer cognitive burden as a consequence when a dark pattern imposes cognitive tax on the users e.g. causing them to spend unnecessary amount of attention, time or energy to complete an action. Consequently, since the present study is primarily concerned with dark pattern effects on overall user experience for airline websites, research under the individual welfare lens is the most relevant out of the four normative lenses.

### 2.3.2 Categorising Dark Patterns

Just as there has been a variety of definitions in literature to define and describe dark patterns, different taxonomies have also been developed in order to describe and categorise various types of dark patterns. [Brignull \(n.d.\)](#) originally formulated twelve different types based on different e-commerce websites (see [Table 2.1](#)).

Following Brignull’s work, [\(Gray et al., 2018\)](#) considered a larger corpus of examples from online platforms including search engines like Google and Bing; social media sites such as Facebook, Twitter and Reddit; and commercial websites, identifying five primary dark patterns that seem to serve as strategic motivators for designers. They present a broader categorisation of Brignull’s original typology and collapsed some patterns into the following categories: Nagging, Obstruction, Sneaking, Inter-



face Interference and Forced Action. For instance, Sneaking refers to interfaces that attempt to hide, disguise or delay divulging information relevant to the user and includes Brignull's Forced Continuity, Hidden Costs, Sneak into Basket as well as Bait and Switch. A more recent proposed typology is that from [Mathur et al.'s 2019](#) study which identified 1800 dark pattern instances from an automated web crawl of around 11,000 shopping websites. They derived 15 types of dark patterns and 7 broader categories, using some of the dark pattern labels proposed by the previously mentioned taxonomies.

Type	Description
Trick Questions	While filling in a form you respond to a question that tricks you into giving an answer you didn't intend. When glanced upon quickly the question appears to ask one thing, but when read carefully it asks another thing entirely.
Sneak into Basket	You attempt to purchase something, but somewhere in the purchasing journey the site sneaks an additional item into your basket, often through the use of an opt-out radio button or checkbox on a prior page.
Roach Motel	You get into a situation very easily, but then you find it is hard to get out of it (e.g. a premium subscription).
Privacy Zuckering	You are tricked into publicly sharing more information about yourself than you really intended to. Named after Facebook CEO Mark Zuckerberg.
Price Comparison Prevention	The retailer makes it hard for you to compare the price of an item with another item, so you cannot make an informed decision.
Misdirection	The design purposefully focuses your attention on one thing in order to distract your attention from another.
Hidden Costs	You get to the last step of the checkout process, only to discover some unexpected charges have appeared, e.g. delivery charges, tax, etc.
Bait and Switch	You set out to do one thing, but a different, undesirable thing happens instead.
Confirmshaming	The act of guiltling the user into opting into something. The option to decline is worded in such a way as to shame the user into compliance.
Disguised Ads	Adverts that are disguised as other kinds of content or navigation, in order to get you to click on them.
Forced Continuity	When your free trial with a service comes to an end and your credit card silently starts getting charged without any warning. In some cases this is made even worse by making it difficult to cancel the membership.
Friend Spam	The product asks for your email or social media permissions under the pretence it will be used for a desirable outcome (e.g. finding friends), but then spams all your contacts in a message that claims to be from you.

**Table 2.1:** Brignull's n.d. Dark Pattern Taxonomy

Different dark pattern types and instances have also been identified in other contexts outside of e-commerce. [Zagal et al. \(2013\)](#) described seven different types of dark patterns employed by video game designers. The authors present temporal dark patterns such as Grinding which refers to performing repetitive and tedious tasks in order to progress in a game, consequently coercing players to spend unnecessary time solely in order to increase the game's duration. They also introduce monetary dark patterns such as Pay to Skip whereby players are pushed to pay in order to make progress in a game. This particular pattern often appears with Grinding in which players pay for the benefit of skipping it. [Bösch et al. \(2016\)](#) analysed dark patterns relating to privacy, presenting new patterns such as Forced Registration where account registration is required from the user in order to access a functionality; and Address Book Leeching where address books shared by the user are stored internally by the service provider and are maliciously processed for purposes such as profiling and tracking unregistered individuals.

### 2.3.3 Related Work

Growing interest in dark pattern research within the HCI domain has resulted in various studies that go beyond developing taxonomies for identifying dark patterns. Recently, there has been a flurry of studies investigating dark patterns in consent banners, especially after the adoption of the General Data Protection Regulation (GDPR) in May 2018. [Utz et al. \(2019\)](#) analysed the effect of cookie consent notices on users' behaviour and found that dark pattern practices in such banners relating to nudging, wording and positioning of elements substantially affected user behaviour. Furthermore, they found from scraping a sample of 1000 consent banners that more than half used dark patterns to select privacy-unfriendly options. Similarly, [Nouwens et al. \(2020\)](#) found dark patterns to be ubiquitous when they evaluated popular consent management platforms employed by 10,000 UK websites. In addition, their user study revealed that removal of the opt-out button from the first page of the banner

increased user consent while offering more granular options decreased user consent. Subsequent studies that have used manual methods of data collection as opposed to the automated website scrapes employed by [Utz et al.](#) and [Nouwens et al.](#) echo similar findings with regards to the pervasiveness of dark patterns in consent banners. In an analysis of 300 consent notices from online news outlets by [Soe et al.](#) (2020), almost all of them (297) employed dark patterns when eliciting user consent, with Obstruction and Interface Interference being the most dominant types. [Mejtoft et al.](#) (2021) who used a smaller sample of 50 cooking recipe websites found that more than half of the consent banners were non-GDPR compliant and that the majority of those that were compliant used some type of dark pattern such as Misdirection and Sneak into Basket. [Graßl et al.](#) (2021) focused more on dark and bright patterns effect on user consent and revealed that most users agreed to all consequent notices regardless of dark pattern nudges. When the experiment was reversed and the interface nudged users towards the privacy-friendly option (i.e. bright patterns), users effectively chose the privacy-friendly option.

Though there has been considerable work done on dark patterns in the context of consent banners, the impact of dark patterns that exist on websites beyond such consent banners remains understudied. There have been recent research investigating users' ability to recognise dark patterns. When [Di Geronimo et al.](#) (2020) asked users to watch videos of mobile application interfaces and identify instances of dark patterns, the majority were not able to spot such instances. However, they found that users can perform better in recognising dark patterns if they are informed about it. In a similar study conducted by [Bongard-Blanchy et al.](#) (2021) where users were instructed to spot dark patterns from a series of images from different interfaces, the majority of users were able to recognise at least five instances. Furthermore, the ability to recognise them was positively correlated with younger age (<40) and education levels higher than a high-school degree.

There has also been some preliminary research analysing dark pattern effect on aspects of end user experience including perceived manipulation ([Gray, Chen, et al.](#), 2020) as

well as perceived annoyance and brand trust (Voigt et al., 2021). However, there is little to no research that investigates the effect of dark patterns on overall user experience and user's willingness to revisit a site. Thus, the present study aims to investigate dark pattern effects on these two aspects.

## 2.4 Conclusion

This chapter has reviewed various literature relevant to the research topic. It covered the historical origins of dark patterns; from deceptive designs in retail, nudging from the realm of behavioural economics and growth hacking in the field of marketing. Different dark pattern definitions were reviewed along with various dark pattern taxonomies. Finally dark pattern research related to the present study was analysed to identify gaps in the literature.

# Chapter 3

## Airline Websites Analysis

### 3.1 Introduction

This chapter details the analysis conducted to identify and categorise dark pattern instances in different airline websites. It begins by describing the methodology of the analysis. Next, the results of the analysis are presented including some examples of the dark patterns identified. Finally, the results are discussed and the limitations of the analysis are outlined.

### 3.2 Methodology

The websites of 30 leading airlines in Europe and North America according to data from *statista.com* (Burgueño Salas, 2021; Mazareanu, 2021) were analysed in order to identify dark patterns. In particular, the analysis focused on identifying dark patterns that may arise in the flight booking process. For each airline website, dark pattern identification was conducted manually by screenshotting each page traversed in the booking process, starting from the destination and date selection up until the payment

page. When booking, the cheapest options (e.g. cheapest bundle/fare type, baggage and seats) were often selected to elicit dark patterns that may try to get users to spend more money. For comparison, the more expensive options were also selected to see if they would exhibit the same behaviour. Dark pattern instances identified were highlighted, annotated and then categorised using Mathur et al.'s 2019 dark pattern taxonomy (Table 3.1). Finally, they were verified with the help of a UX expert through a discussion.

CATEGORY	TYPE	DESCRIPTION
Sneaking	Sneak into Basket	Adding additional products to users' shopping carts without their consent.
	Hidden Costs	Revealing previously undisclosed charges to users right before they make a purchase.
	Hidden Subscription	Charging users a recurring fee under the pretence of a one-time fee or a free trial.
Urgency	Countdown Timer	Indicating to users that a deal or discount will expire using a counting-down timer.
	Limited-time Message	Indicating to users that a deal or sale will expire soon without specifying a deadline, thus creating uncertainty.
Misdirection	Confirmshaming	Using language and emotion (shame) to steer users away from making a certain choice.
	Visual Interference	Using style and visual presentation to steer users to or away from certain choices.
	Trick Questions	Using confusing language to steer users into making certain choices.
	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.
Social Proof	Activity Messages	Informing the user about the activity on the website (e.g., purchases, views, visits).
	Testimonials of Uncertain Origin	Testimonials on a product page whose origin is unclear.
Scarcity	Low-stock Message	Indicating to users that limited quantities of a product are available, increasing its desirability.
	High-demand Message	Indicating to users that a product is in high-demand and likely to sell out soon, increasing its desirability
Obstruction	Hard to Cancel	Making it easy for the user to sign up for a recurring subscription but cancellation requires emailing or calling customer care.
Forced Action	Forced Enrolment	Coercing users to create accounts or share their information to complete their tasks.

Table 3.1: Mathur et al.'s 2019 Dark Pattern Taxonomy

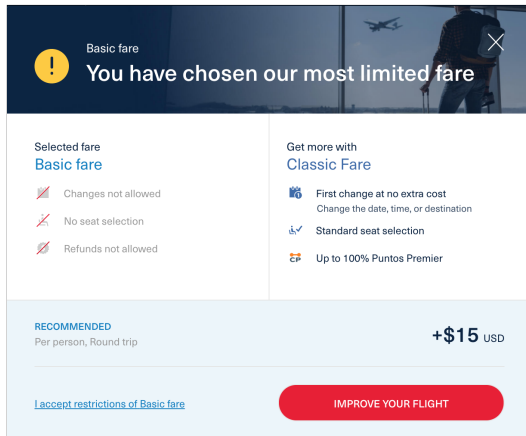
## 3.3 Results

Across the 30 airline websites analysed, 110 dark pattern instances were identified. These instances fall under the categories of Misdirection (N=74), Scarcity (N=25), Urgency (N=6), Social Proof (N=2), Forced Action (N=2) and Sneaking (N=1).

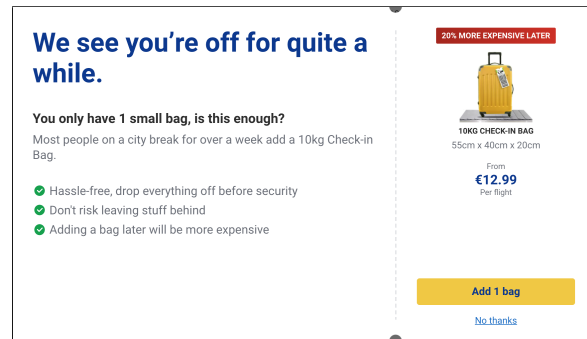
### 3.3.1 Misdirection

Misdirection was the most prevalent dark pattern category. These are dark patterns that use visuals, language or emotions in order to steer users towards or away a certain choice. It includes Pressured Selling, Visual Interference, Confirmshaming and Trick Questions. Pressured Selling involves preselection of more expensive versions of a product, or pressuring users to purchase more expensive versions of a product. From the analysis, 25 instances of Pressured Selling were observed. These mainly came in the form of pop-ups nudging users to upgrade to more expensive options of fare type, baggages or seats when the cheapest option is selected as well as preselection of the more expensive option (see Figure [3.1](#)).

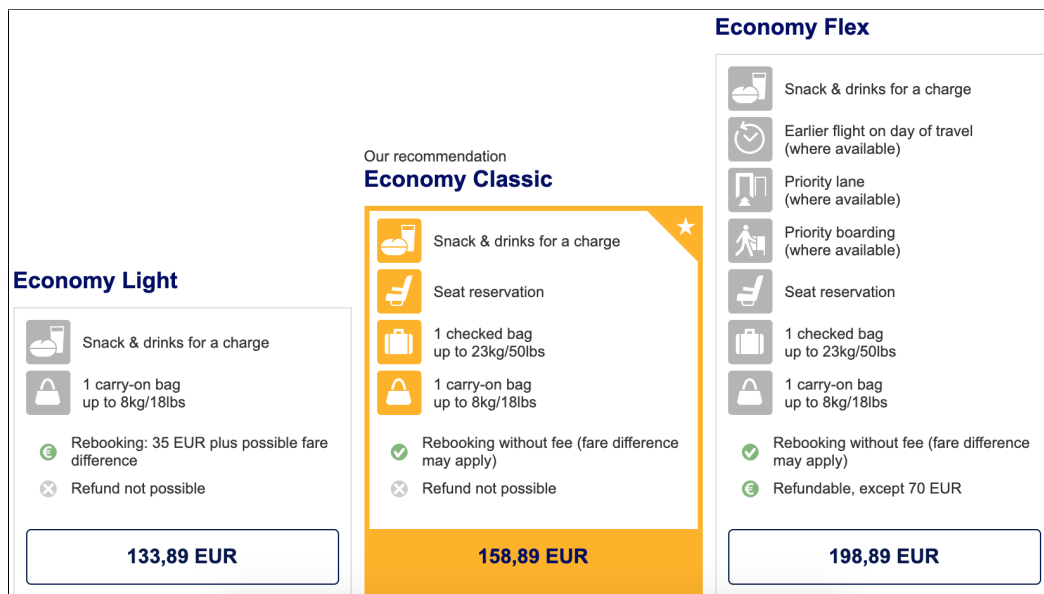




(a) Pressured Selling on aeromexico.com. Pop-up pushing user to upgrade to the Classic Fare when Basic Fare is selected.



(b) Pressured Selling on ryanair.com. Pop-up steering user to add additional baggage when no baggage is added.

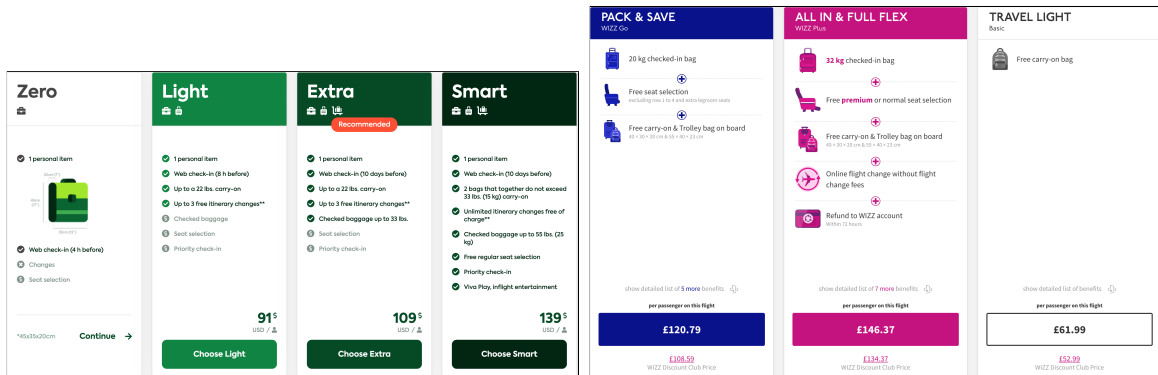


(c) Pressured Selling on lufthansa.com. The more expensive Economic Classic fare bundle is preselected for the user.

**Figure 3.1:** Instances of Pressured Selling

Visual Interference are dark patterns that employ style and visual presentation to steer users towards or away a particular choice. From the analysis, 34 instances of Visual Interference were identified. In some instances, airline websites use this dark pattern to make the action of choosing the more expensive fare types more visually

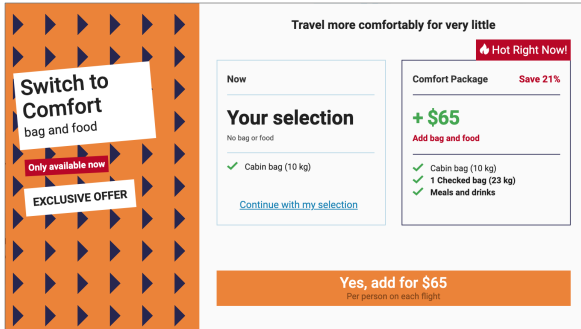
prominent than the cheapest fare type. For example, in Figure 3.2a the more expensive fare options are stylistically more prominent than the cheapest option. Similarly for Figure 3.2b, the more expensive bundles are highlighted and are more noticeable but the cheapest option is also placed on the far right where one would expect the most expensive bundle would be.



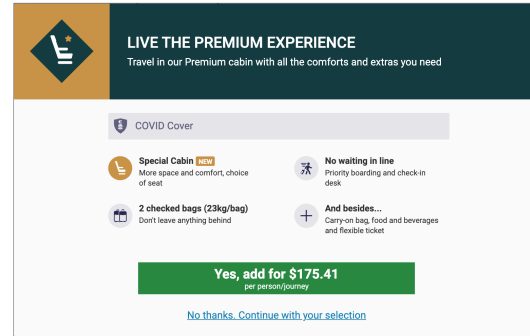
(a) Visual Interference on vivaaerobus.com. (b) Visual Interference on wizzair.com. More expensive options (Light, Extra and Smart) stand out more with colours and buttons compared to the Zero option. More expensive bundles are visually more prominent than the Travel Light bundle. Travel Light bundle is also located on the far right, which is where the most expensive option would normally be.

**Figure 3.2:** Instances of Visual Interference on Bundle Selection

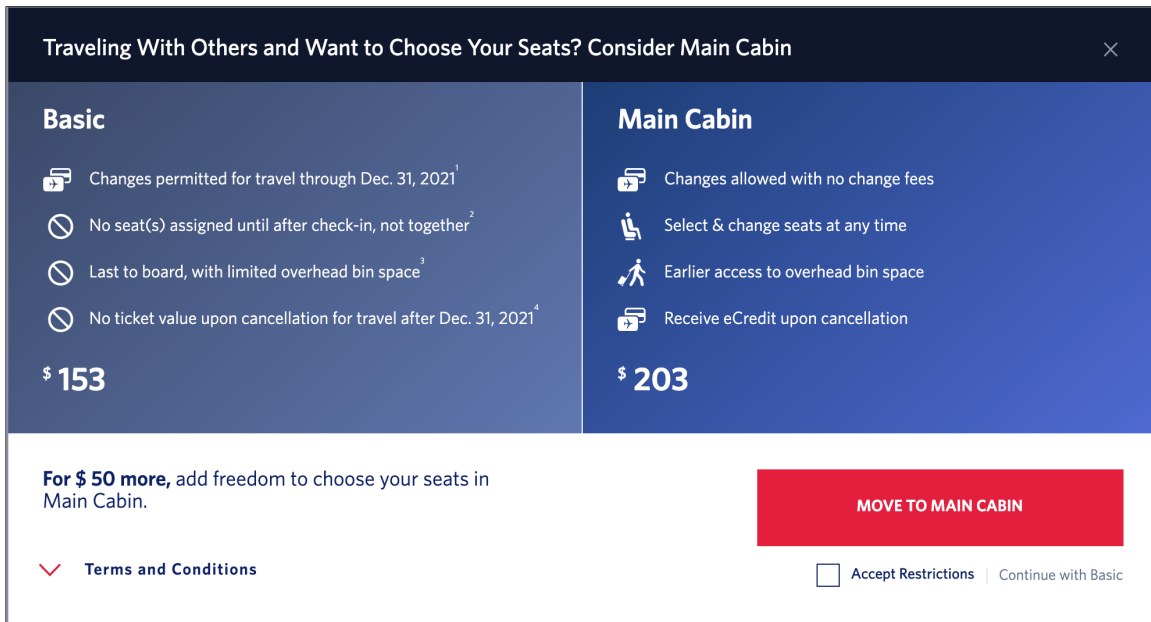
In other instances, Visual Interference is usually used in conjunction with Pressured Selling pop-ups in order to further push users to upgrade to the more expensive options. Figures 3.3a and 3.3b shows the common practice of using hyperlinks for the option of continuing with the less expensive option and using stylistically more prominent buttons for the upgrade option. Figure 3.3c shows requiring to perform an additional step of ticking a checkbox before continuing with the cheaper option.



(a) Visual Interference on flylevel.com. The option to continue with the Light bundle uses a hyperlink while the option to upgrade to Comfort bundle uses a more visually prominent button.



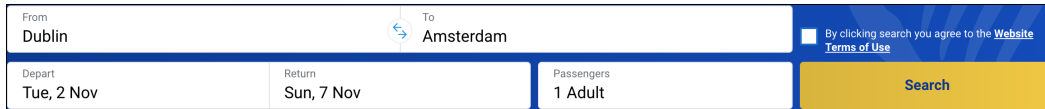
(b) Visual Interference on flylevel.com. The option to continue with the Comfort bundle uses a hyperlink while the option to upgrade to Premium bundle uses a more visually prominent button.



(c) Visual Interference on delta.com. Option for continuing with the basic option is greyed out and requires ticking an additional checkbox in order to be clicked. Upgrade option only requires one click.

**Figure 3.3:** Instances of Visual Interference on Bundle Upgrade Pop-ups

A more unique kind of Visual Interference is one where by simply searching for a flight, the user is also unknowingly agreeing to the Terms of Use. In Figure 3.4 the checkbox for agreeing to the Terms of Use appears above the search button in small text. However, in order to agree to this, the check box does not require to be ticked. By simply pressing search, the box is ticked automatically for the user.



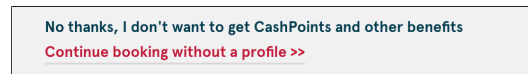
(a) Visual Interference on ryanair.com. By pressing Search the user is automatically agreeing to the Terms of Use.

**Figure 3.4:** Instance of Unique Visual Interference

Confirmshaming involves the use of language and emotion to steer users away from a particular choice. From the analysis, 10 instances of Confirmshaming dark patterns were observed. Figure 3.5 are some examples.



(a) Confirmshaming on alaskaair.com. Option for not purchasing flight insurance guilts user for not protecting their flight.



(b) Confirmshaming on norwegian.com. Option for not booking with a profile shames user for not wanting benefits.

**Figure 3.5:** Instances of Confirmshaming

Trick Questions are dark patterns which use confusing language to steer users into making a particular choice. This was the least common type of Misdirection with only two instances identified. Figure 3.6 shows an example where both opting in and opting out require checking the checkboxes.

I do not wish to receive any information about offers related to my booking (e.g. upgrades, flight-related services by the Lufthansa Group, feedback) You can object to this usage with future effect at any time.

Remember these contact details for the next booking

Yes, I would like to receive current offers, including **partner content**, and other service information from Deutsche Lufthansa AG via email newsletter. My data will be used solely for this purpose within the **Lufthansa Group**.

(a) Trick Question on lufthansa.com. The first option uses a double negative where opting out means ticking the checkbox. In the next options, ticking the checkbox means opting in.

**Figure 3.6:** Instance of Trick Question

Lastly, three instances of Misdirection were observed that did not fall under the four types mentioned. These were instances of preselection for email promotion services (Figure 3.7a) and saving the user’s credit card details (Figure 3.7b).

easyJet offers and updates  
As an easyJet subscriber we'll send you digital updates about our special offers, holidays and inspiring news on flights and easyJet travel products and even our exclusive Flight Club.

Yes  No ✓

(a) Opting in for the email promotion service is selected by default for easyjet.com

Save credit card for onboard refreshment purchases. ?

(b) Save credit card details for future onboard purchases is preselected for united.com

**Figure 3.7:** Instances of Uncategorised Misdirection Dark Patterns

### 3.3.2 Scarcity

Scarcity refers to the category of dark patterns which indicate that a product has limited availability or is in high demand, thus increasing its perceived value and desirability to the user. This category includes the types Low-stock Message and High Demand Message. In the data set, 21 out of the 30 airline websites analysed had at least one instance of Low-stock Message. In the context of airline websites, these are messages displaying precise quantities of seats left for a particular flight (Figure 3.8).

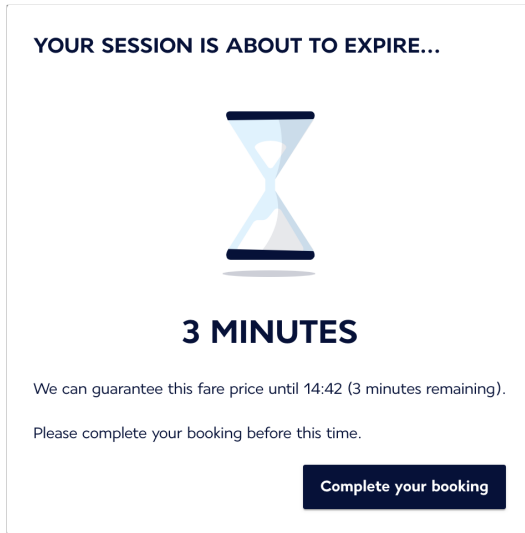
There was one instance of High Demand Message identified, implying that the flight bundle is in high demand using the label “Hot Right Now”.



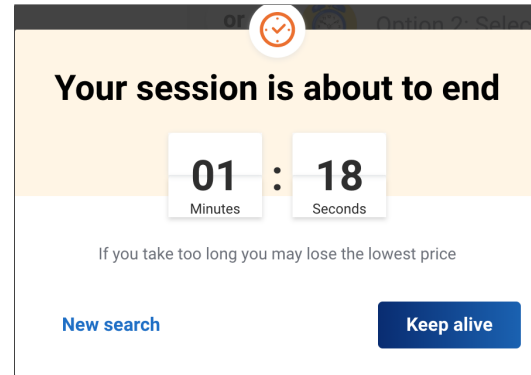
**Figure 3.8:** Instances of Scarcity

### 3.3.3 Urgency

Urgency refers to the category of dark patterns that impose a deadline on a sale or a deal, thus expediting the user decision-making process and purchases. Such dark patterns usually present themselves as either Countdown Timers or Limited-time Messages. In the data set, 6 instances of Countdown Timers were found. These countdown timers usually show up as pop-ups after a period of inactivity during the booking process, imposing a deadline to the user’s booking session.



(a) Countdown Timer on airfrance.com

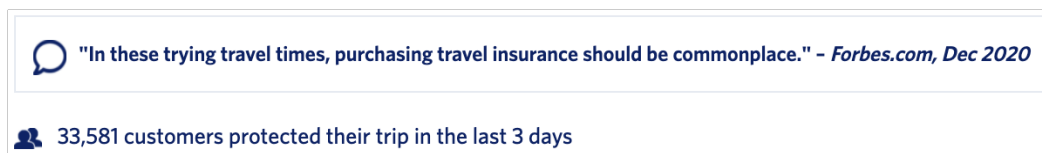


(b) Countdown Timer on ryanair.com

**Figure 3.9:** Instances of Urgency

### 3.3.4 Social Proof, Forced Action and Sneaking

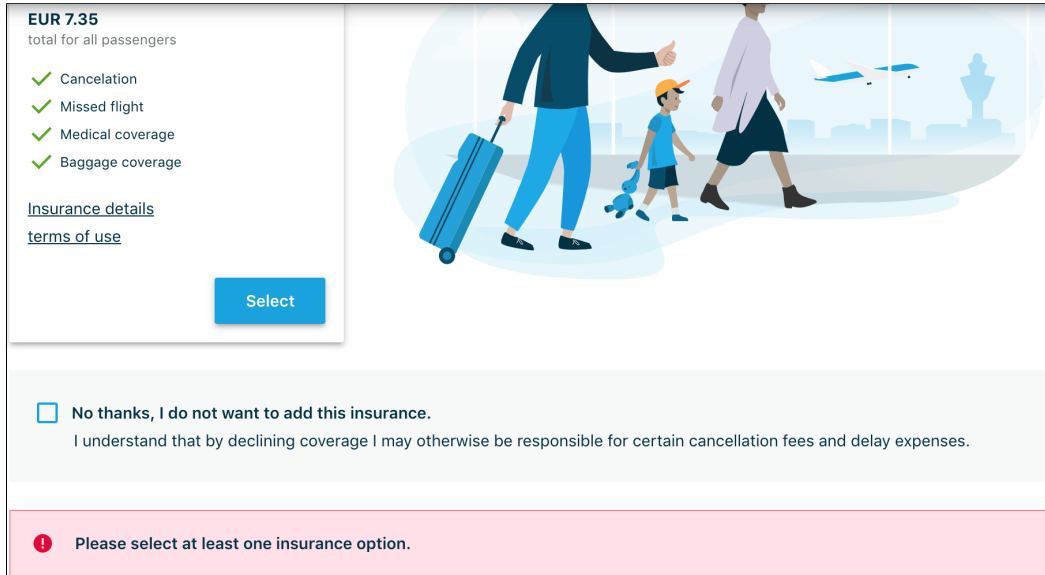
Though less common, instances of the Social Proof, Forced Action and Sneaking categories were also identified. The Social Proof category refers to dark patterns that influence users' behaviour by describing the experiences and actions of other users and can come in the form of Activity Messages or Testimonials of Uncertain Origin. Two instances of Activity Messages were observed in the analysis, both indicating the number of people purchasing travel insurance (Figure 3.10).



(a) Activity Message on delta.com. Message indicates number of users who bought travel insurance.

**Figure 3.10:** Instances of Social Proof

Meanwhile, Forced Action dark patterns are those which require users to perform a specific action to complete their task. Two instances of Forced Action were observed. Figure 3.11 shows an example where the user is forced to select an insurance option and where the non-selection option is visually more prominent than the select option.

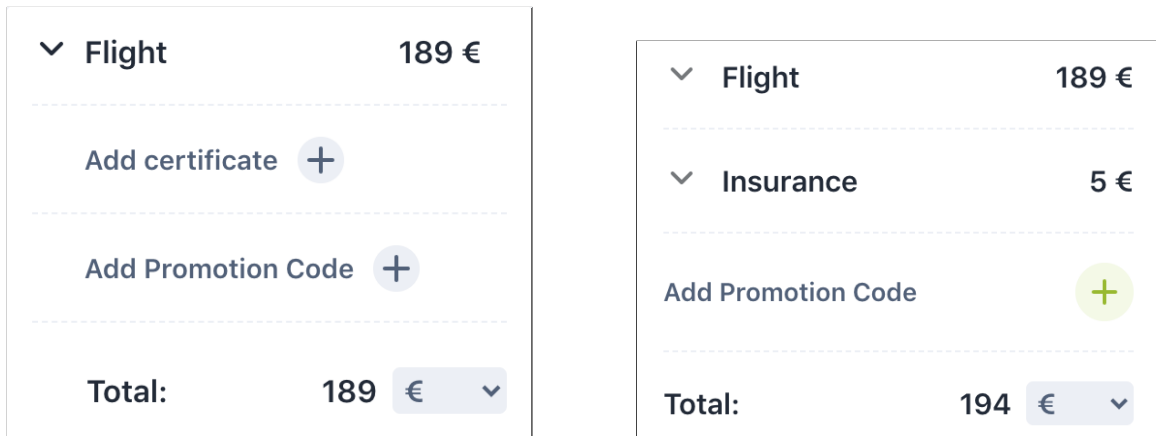


(a) Forced Action on klm.com. User is required to select an insurance option before continuing. The option to add insurance is also more visible than opting out.

**Figure 3.11:** Instance of Forced Action

Finally, Sneaking dark patterns refer to those that attempt to misrepresent user actions, or hide or delay information that, if made available to users, they would likely object to. It includes Sneak Into Basket, Hidden Costs and Hidden Subscription. One instance of Sneak into Basket was observed where an additional product was added to the shopping basket (Figure 3.12).





(a) Sneak Into Basket on s7.ru. Total before flight insurance is added automatically without the user's consent.

(b) Sneak Into Basket on s7.ru. Total after flight insurance is added automatically without the user's consent.

**Figure 3.12:** Instance of Sneaking

### 3.4 Discussion

Evidently, dark pattern application is pervasive among airline websites. Misdirection is the most common category observed, accounting for over half of the total instances identified. In particular, Pressured Selling and Visual Interference were the most prevalent types from this category. The main goal of these dark patterns and as well as the other types observed in general is to coerce the user into spending more money than they originally would have. One thing to note is that the dark patterns identified may be manipulative but not necessarily deceptive. Manipulation involves attempting to coerce the user into doing something that is not in their best interest. Meanwhile, deception involves claiming something that is not true. For instance, a message indicating the number of seats left for a particular flight price can be manipulative since they may cause a user to buy on impulse, however, if the message truly reflects the correct number of seats left available then they are not deceptive. Deception arises when the message does not reflect reality and instead is randomly

generated, thus, creating false scarcity. Besides potential financial loss, effects of the dark patterns identified to the user remains unclear. For instance, do application of such dark patterns negatively affect the users' overall experience and their willingness to continue using the airline website? Furthermore, are users aware of the existence of such manipulative practices when booking flights? In order address these questions, a user study is conducted.

### 3.5 Limitations

The website analysis conducted has several limitations. Firstly, the study analyses a relatively small corpus of 30 airline websites so the generalisability of the findings may be limited. Furthermore, the study only analysed direct bookings through the airline websites and did not analyse bookings through third-party travel agency websites such as *expedia.com*. Secondly, the identification of dark patterns were mainly based on examples from [Mathur et al.'s 2019](#) taxonomy and existing dark pattern literature. However, some of those identified may exist in a grey area and in such cases determining whether these instances are deliberately manipulative or not can sometimes be difficult to distinguish. Opinions as to what constitute as dark patterns can also vary among experts and users alike. Finally, dark patterns may also arise after payment which this analysis fails to capture since no payments for flights were made.

### 3.6 Conclusion

In this chapter, the airline websites analysis conducted was discussed. Websites of 30 leading airlines in Europe and North America were analysed to identify dark pattern instances. 110 dark pattern instances were recorded with the majority falling under the category of Misdirection. In general, the dark patterns observed try to push users into spending more money for their flight purchase. These dark patterns were usually

manipulative in nature but not necessarily deceptive.

# Chapter 4

## Mock Airline Websites: Design and Implementation

### 4.1 Introduction

This section details the design and implementation of the mock airline websites used for the booking task in the A/B testing. It describes the two mock airline websites implemented; the first is a bright version which is free of manipulative interfaces; the second is a dark version containing dark pattern elements. Both airline website versions were implemented using React with HTML, CSS, Javascript and Bootstrap.

The decision was taken to implement a new site rather than use a pre-existing commercial site, so as to monitor the interactions of the users with the pages. Particularly, the implementation of the dark website provides the opportunity for users to interact with an array of different dark patterns since one type of dark pattern may exist on one particular airline site but not on another. Furthermore, the implementation of the bright website provides the user with an interaction completely devoid of dark patterns or any manipulative artefacts. Lastly, by having two versions of the same site

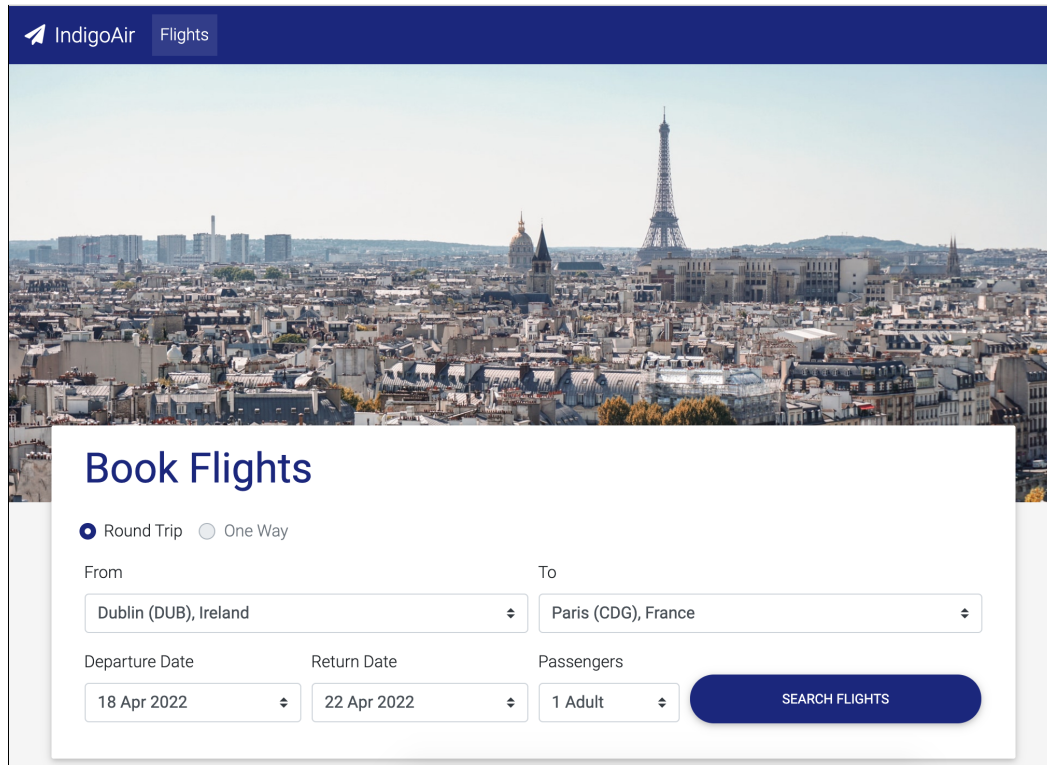
differing only in the dark pattern application for the dark version, allows the research to solely focus on the potential effects of the dark pattern variable and not on any other factors.

## 4.2 Bright Airline Website

The airline website, IndigoAir, consists of six main pages: Home Page, Outbound Flight Selection, Return Flight Selection, Passenger Information, Additional Services and Payment. Each of these pages is traversed during the flight booking process. These pages are described below.

### 4.2.1 Home Page

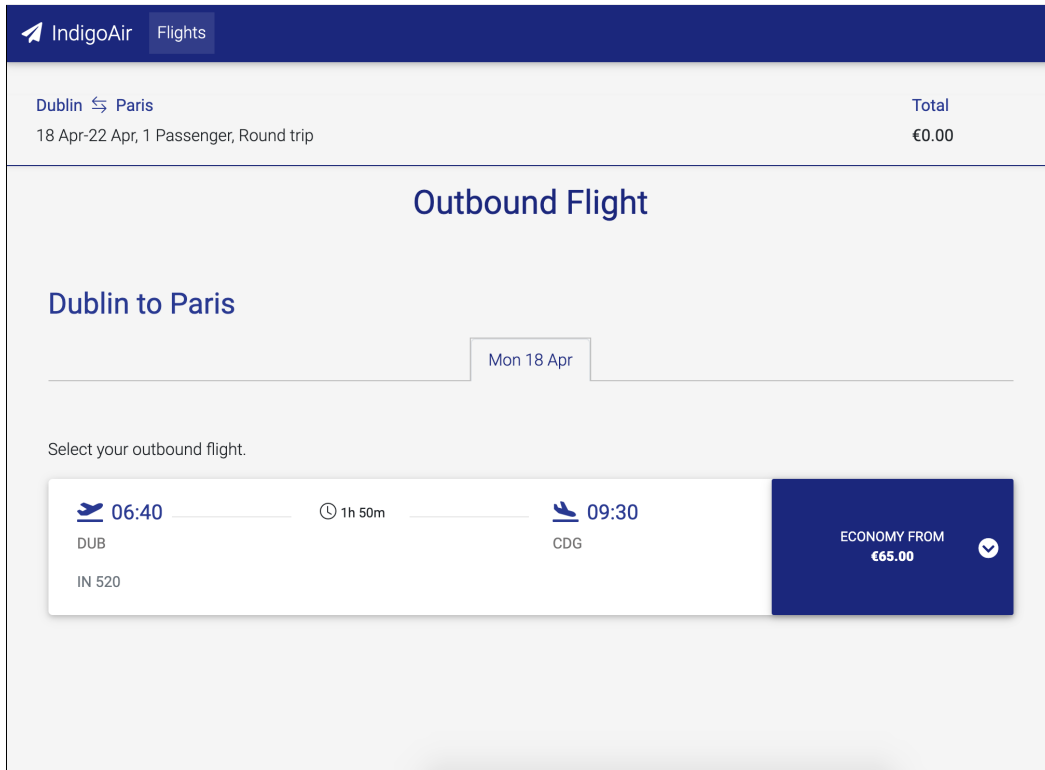
The home page, displayed in Figure [4.1](#), consists of the flight origin and destination selection; departure and arrival date selection; and passenger number selection. The flight origin, destination, dates and number of passengers were preselected in order to keep it consistent for each participant when doing the booking task. These were Dublin, Paris, 18 Apr 2022 to 22 Apr 2022 and 1 Adult Passenger respectively.



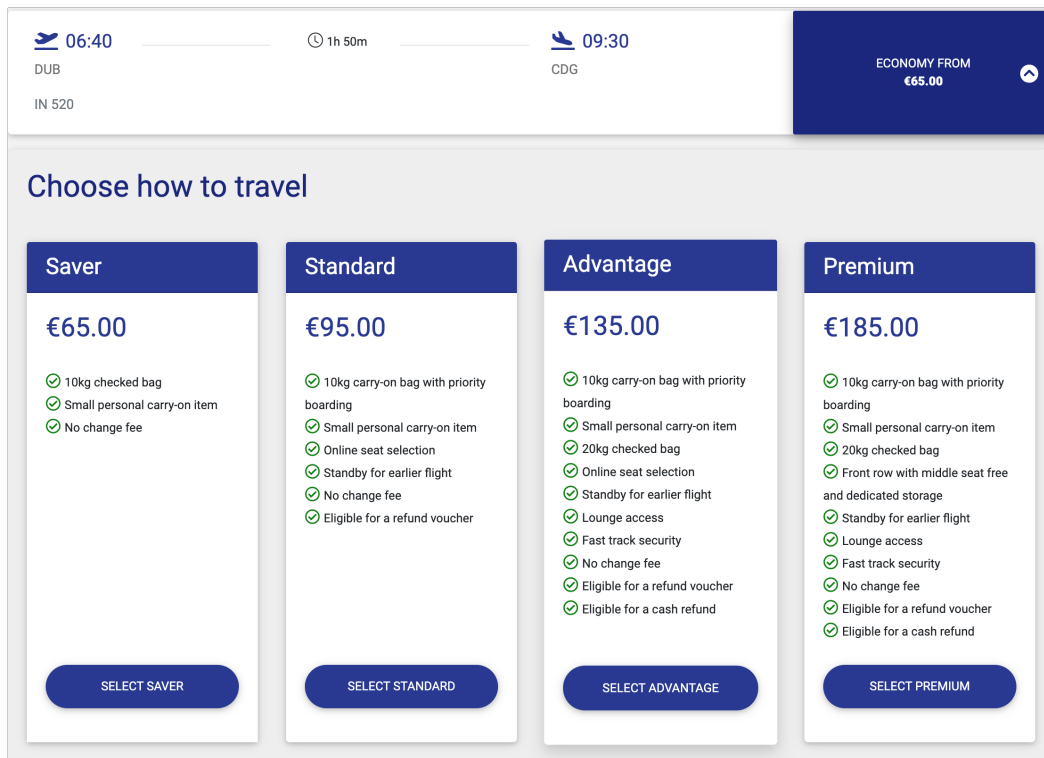
**Figure 4.1:** Home Page

## 4.2.2 Outbound Flight Selection

The outbound flight selection page, shown in Figure [4.2](#), provides a single flight option for the outbound flight. Clicking on the flight option prompts the user to select a bundle type. There are four bundle types: Saver, Standard, Advantage and Premium; each one offering different features.



(a) Outbound flight option

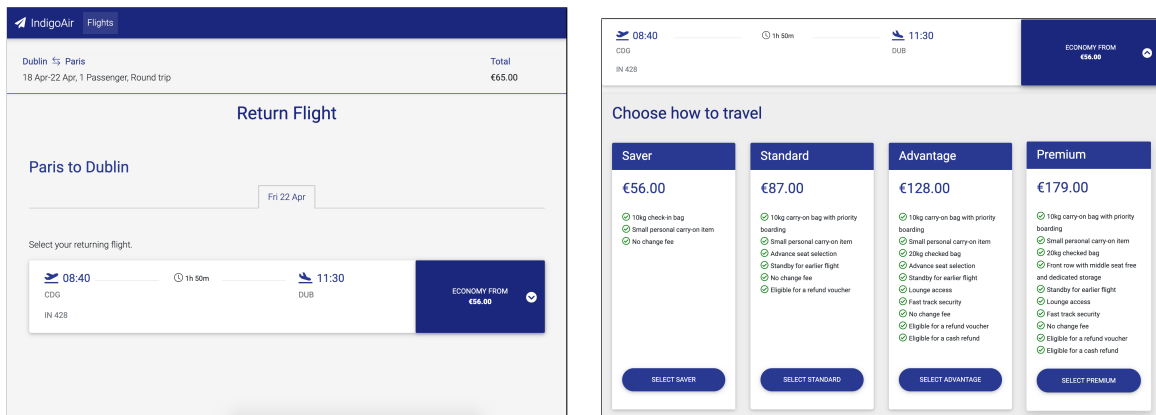


(b) Bundle selection for outbound flight

Figure 4.2: Outbound Flight Selection Page

### 4.2.3 Return Flight Selection

Similarly, the return flight selection page, illustrated in Figure 4.3, provides a single flight option for the return flight. Clicking on the flight prompts the user to select a fare type. The same four fare types are provided.



(a) Return flight option

(b) Bundle selection for return flight

Figure 4.3: Return Flight Selection Page

### 4.2.4 Passenger Information

The passenger information page, shown in Figure 4.4, prompts the user to input passenger details and contact information. This page also includes travel insurance selection. The passenger details and contact information forms were included to make the booking process relatively realistic. However, any details inputted by the user are not recorded or saved in any database. This was done in order to protect any participant's personal information when performing the booking task.



IndigoAir Flights

Dublin ↔ Paris Total  
€121.00

18 Apr-22 Apr, 1 Passenger, Round trip

## Passenger Information

Complete the fields requested below.

**Adult 1**

Please make sure your first and last names match your passport as these cannot be changed.

Title	First Name	Last Name
- ▾	<input type="text"/>	<input type="text"/>

Special Assistance

Check this box if you require any special assistance for your trip.

(a) Passenger details

**Contact Information**

This information will be used to keep you updated about your trip.

Email Address


Check this box if you want to receive emails about our latest offers.

Phone Number

Country Code	Local Number
IE (+353) ▾	<input type="text"/>

(b) Passenger contact information

## Travel Insurance



**Protect your trip and travel with peace of mind**

We protect you when:

- ✔ **Cancellation.** Refund up to €4500 in case of injury, sickness  
Covid-19 included
- ✔ **Delayed Departure.** Get compensated up to €280
- ✔ **Medical.** Medical expenses refund, medical repatriation etc.
- ✔ **Personal Possession.** Compensation up to €2,500, for  
baggage stolen, damaged, or lost

Price Per Adult	€ 16.37
<small>Prices are inclusive of tax</small>	
<hr/>	
<b>Total</b>	<b>€ 16.37</b>

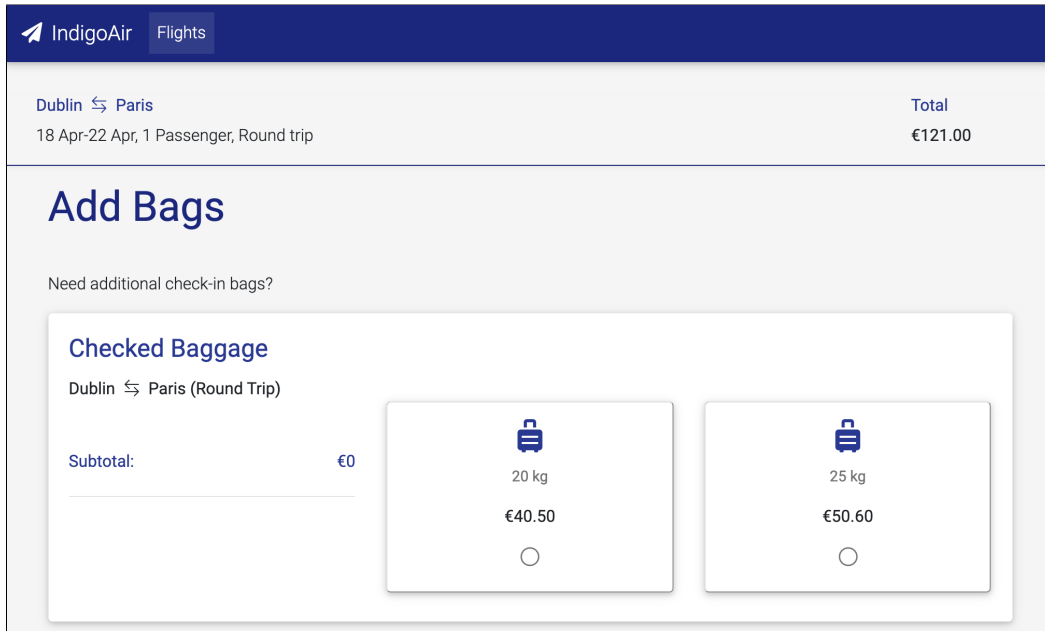
Yes, add trip protection

No, thanks

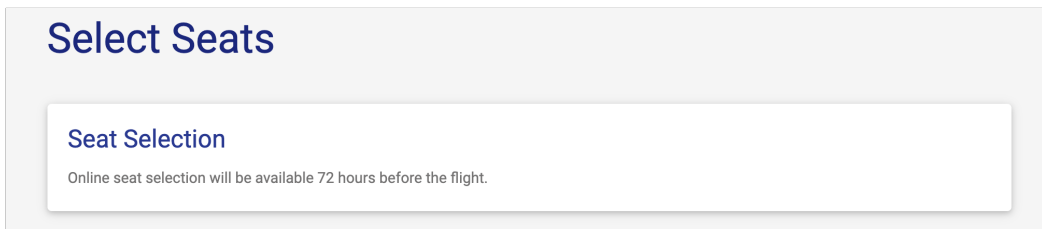
(c) Travel insurance selection

### 4.2.5 Additional Services

The additional services page, displayed in Figure 4.5 provides the user the option to add checked bags and provides seat selection information.



(a) Add checked bags option



(b) Seat selection information

**Figure 4.5:** Additional Services Page

### 4.2.6 Payment

The payment page consists of the trip summary and the price summary, see Figure 4.6. The trip summary details the flights selected while the price summary provides a breakdown of the flight booking total. A payment form asking for the user's credit

card information which is typically present on airline websites at the end of a booking was excluded from this page to protect participants' personal information.

The screenshot shows the IndigoAir Flights page with a 'Trip Summary' section. It details two flights:

- Dublin to Paris:** Departure at 06:30 from DUB, arrival at 09:40 at CDG, duration 1h 50m, on Mon, Apr 18 2022, Flight IN 520, Economy Saver.
- Paris to Dublin:** Departure at 08:40 from CDG, arrival at 11:30 at DUB, duration 1h 50m, on Fri, Apr 22 2022, Flight IN 428, Economy Saver.

(a) Trip summary

The screenshot shows the 'Price Summary' section with a 'BOOKING TOTAL' table. Below the table is a 'Complete Booking' button.

BOOKING TOTAL		
Click on details to show more information.		
Flights	DETAILS ▾	€121.00
Additional Bags	DETAILS ▾	€0.00
Travel Extras	DETAILS ▾	€0.00
<b>Amount Due</b>		<b>€121.00</b>

[Complete Booking](#)

(b) Price Summary

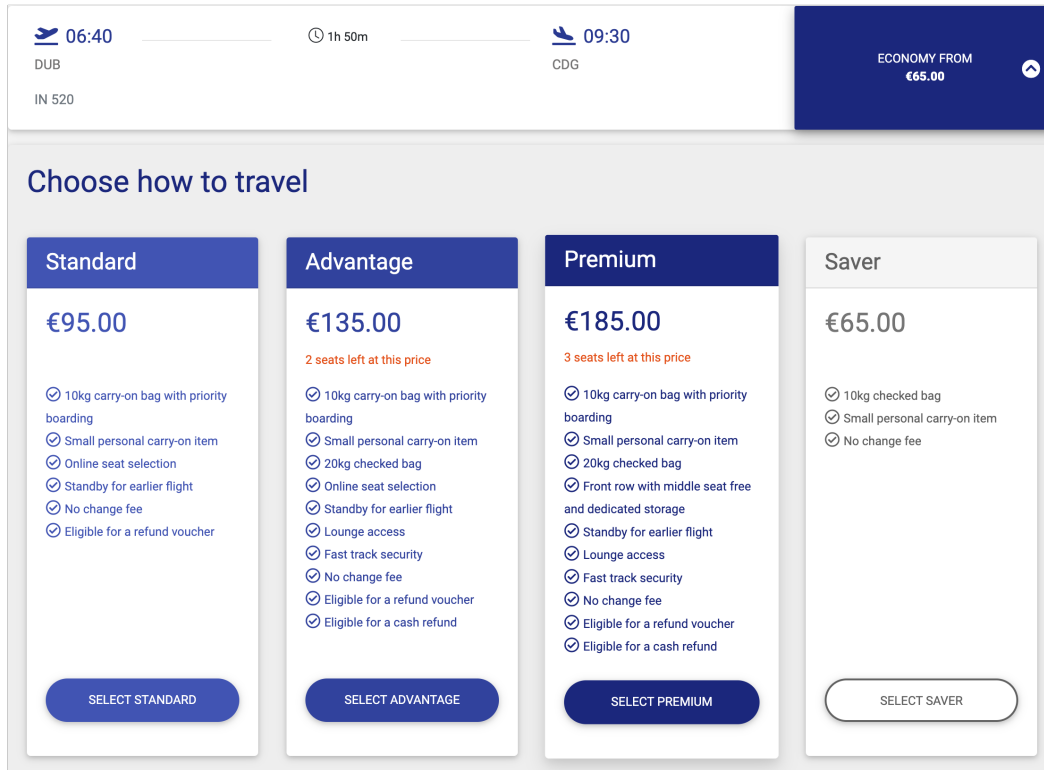
Figure 4.6: Payment Page

## 4.3 Dark Airline Website

The dark version of the airline website is identical to the bright airline website previously described, except on the pages where dark pattern elements are applied. The dark patterns implemented are all based on the dark pattern instances identified in the airline websites analysis.

### 4.3.1 Outbound Flight Selection

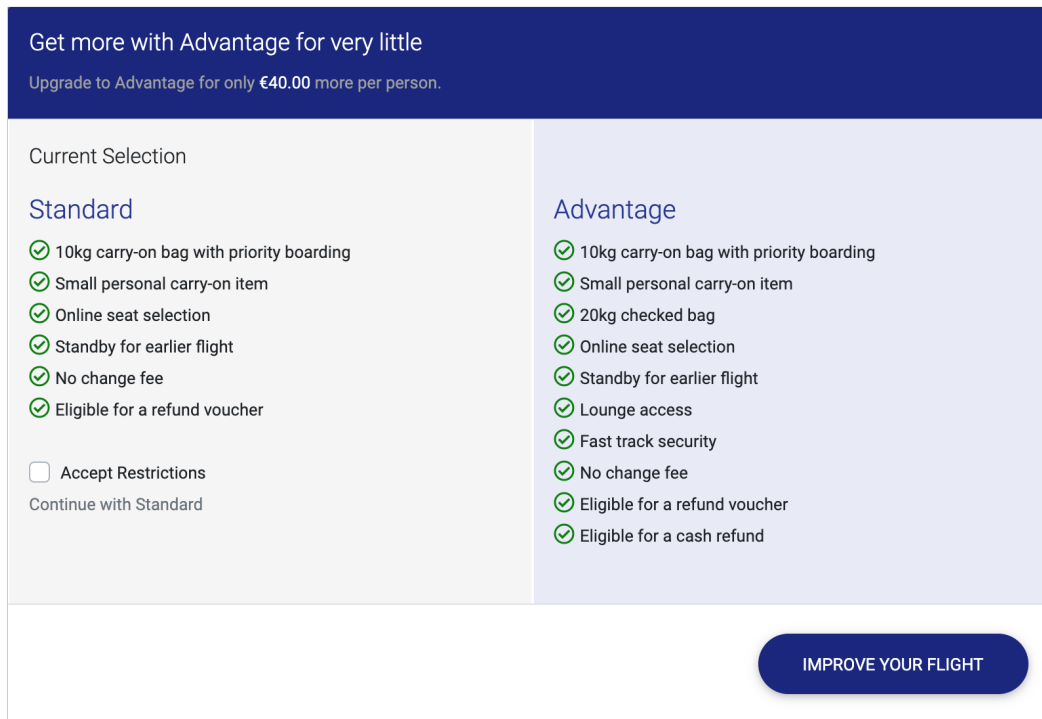
For the outbound flight selection page, several types of dark patterns were applied. These were a combination of Visual Interference, Pressured Selling and Low Stock Message. Visual Interference was applied in the bundle selection by making the more expensive bundles (Standard, Advantage, Premium) and their respective buttons more prominent and colourful compared to the cheapest bundle (Saver). Additionally, the Saver bundle is positioned on the far right where the most expensive option would usually be. Lastly, a Low Stock Message was applied to the Standard and Advantage bundles. Figure [4.7](#) shows the application of these dark patterns.



**Figure 4.7:** Outbound flight bundle selection with Visual Interference and Low Stock Message

Pressured Selling was implemented through a pop-up pushing the user to upgrade their current bundle selection to the more expensive bundle. As illustrated in Figure 4.8 for example, if the user has selected the Standard bundle then a pop-up asking the user to upgrade to the Advantage bundle will appear when the user tries to continue to the next page. The pop-up appears for all bundle types except for the most expensive bundle which is Premium.

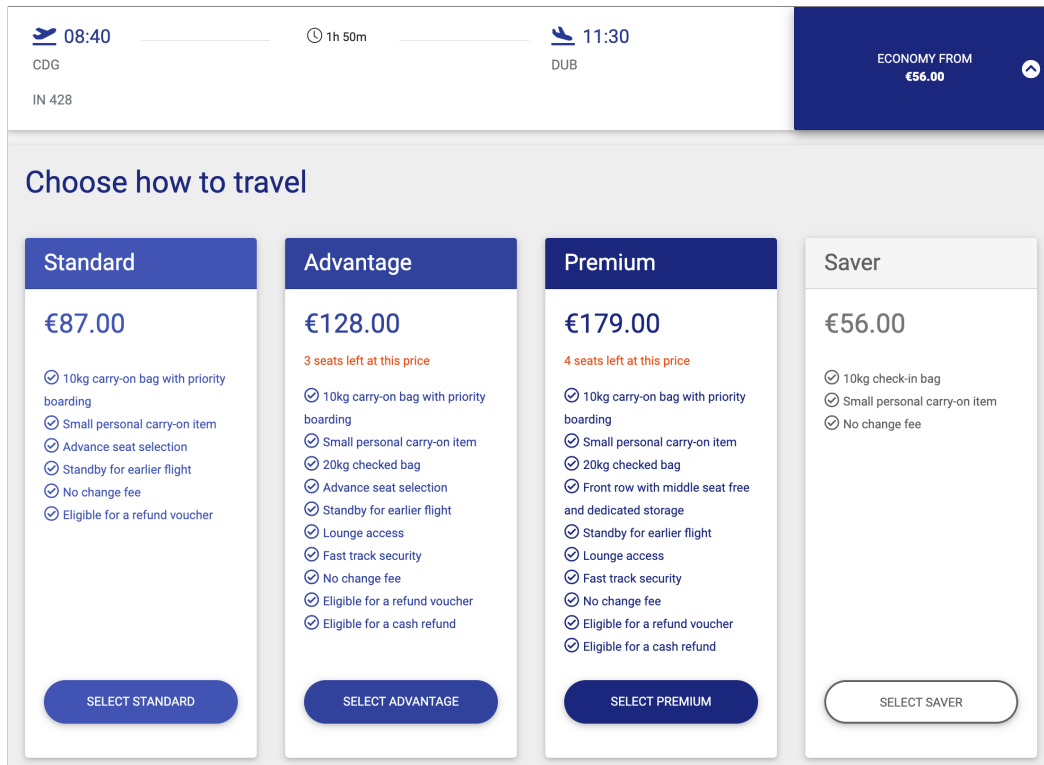
Visual Interference was also implemented within the pop-up to further push the user in to upgrading. The upgrade button i.e. the “*Improve Your Flight*” button is designed to be visually more noticeable and requires only one click. Meanwhile, the option for continuing with the current selection is greyed out and requires ticking the “*Accept Restrictions*” checkbox in order for it to be clicked.



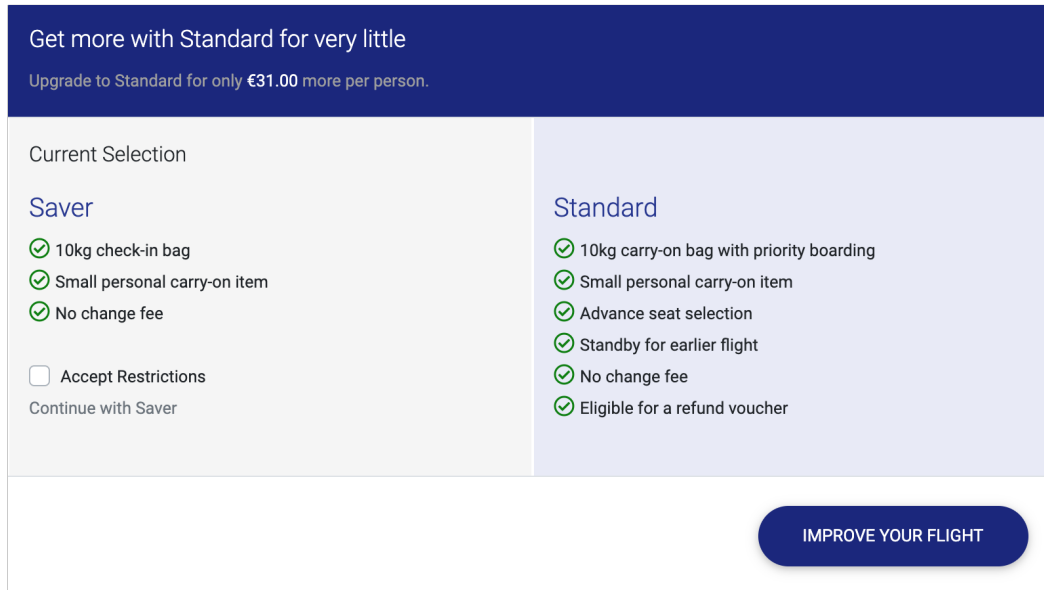
**Figure 4.8:** Pressured Selling pop-up in the outbound flight selection page. Standard is the current selection and Advantage is the upgrade option.

### 4.3.2 Return Flight Selection

The same dark patterns from the outbound flight selection page were applied to the return flight selection page, as shown in Figures 4.9 and 4.10.



**Figure 4.9:** Return flight bundle selection with Visual Interference and Low Stock Message.

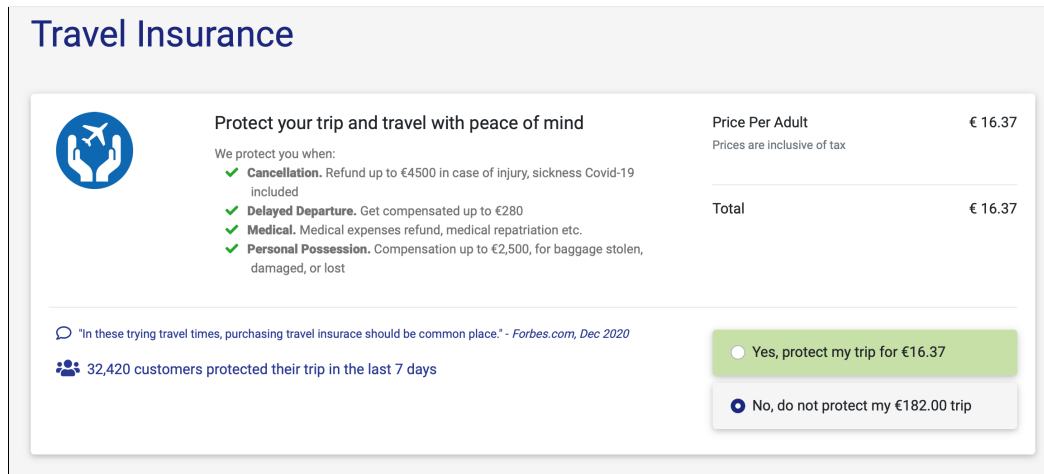


**Figure 4.10:** Pressured Selling pop-up in the return flight selection page. Saver is the current selection and Standard is the upgrade option.

### 4.3.3 Passenger Information

In the passenger information page, dark patterns were applied to the travel insurance selection. Confirmshaming was added to shame the user for not adding travel insurance. Visual Interference was also added to make the “*Yes protect my trip for ...*” option more visible. Finally, Social Proof was applied by describing the number of customers that added travel insurance to their trip within the last week. Figure [4.11](#) illustrates the application of these dark patterns.

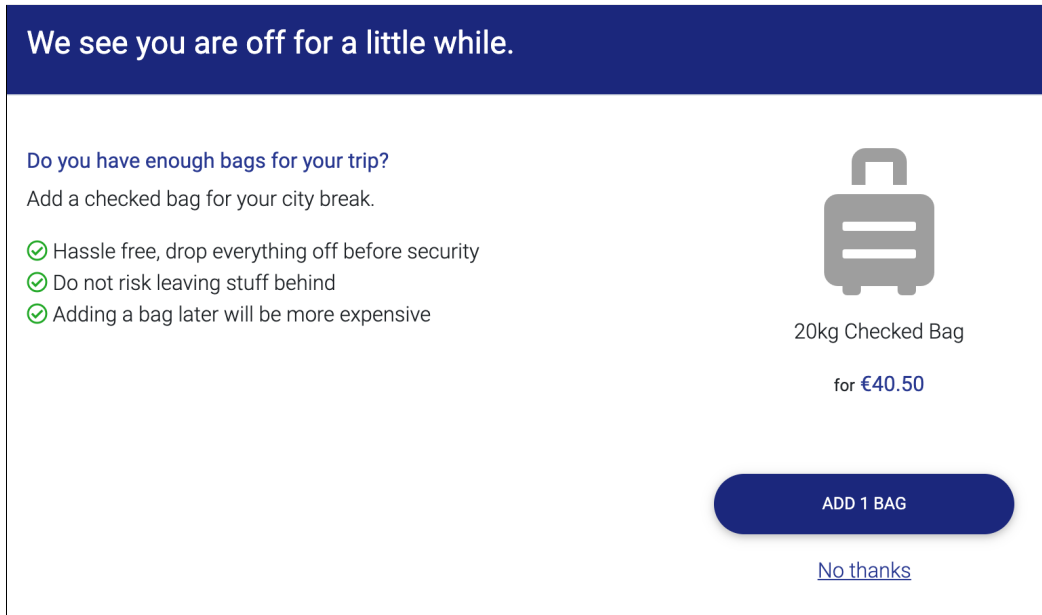




**Figure 4.11:** Travel insurance selection with Confirmshaming, Visual Interference and Social Proof

#### 4.3.4 Additional Services

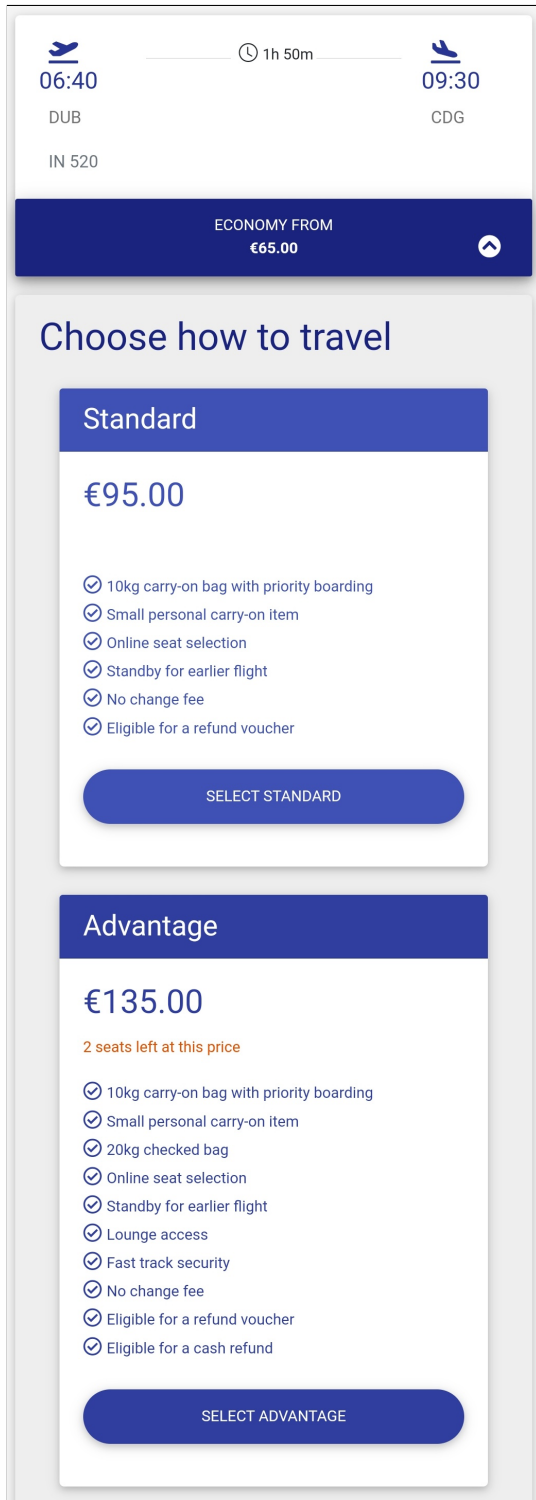
Pressured Selling was implemented in the additional services page through a pop-up which tries to steer the user into adding a checked bag. The pop-up, shown in Figure 4.12, appears when no additional checked bag is selected from the bag options. Visual Interference is also applied to the pop-up by using a more prominent button for the “Add 1 Bag” option and a hyperlink for the “No thanks” option.



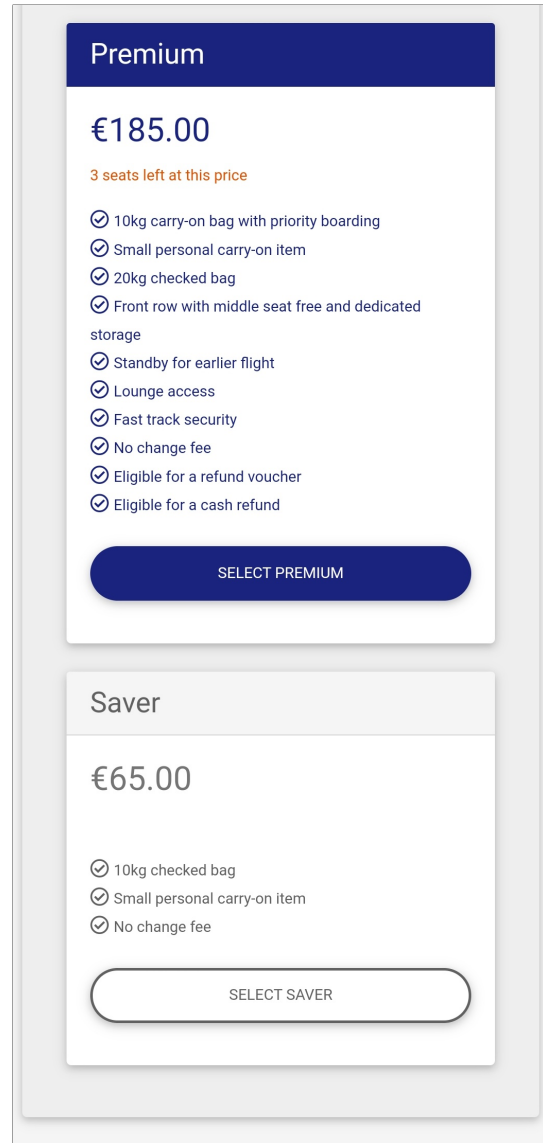
**Figure 4.12:** Pressured Selling pop-up in the additional services page with Visual Interference

## 4.4 Mobile Compatibility

Both the bright and dark airline websites were designed to be responsive thus making them compatible with desktop, tablet and mobile browsers. By doing so, the websites are accessible to the user, regardless of what type of device they use when performing the booking task. For the most part, the websites appear the same whether it is opened through a desktop browser or a mobile browser. However, there are slight differences in how some elements appear on a mobile browser. In particular, the bundle cards in the bundle selection appear vertically rather than horizontally. This means that the Saver bundle appears at the very bottom on a mobile browser, as opposed to appearing horizontally on the far right in a desktop browser (see Figure [4.13](#)). Other than this, the pages and other elements such as the pop-ups appear almost identical for both types of browsers.



(a) Bundle selection



(b) Bundle selection continued

Figure 4.13: Dark airline website bundle selection on a mobile browser

## 4.5 Conclusion

In this chapter, the design and implementation of the bright and dark mock airline websites used for the booking task were described. Both websites consists of six main pages: Home Page, Outbound Flight Selection, Return Flight Selection, Passenger Information, Additional Services and Payment. The dark airline website is identical to the bright airline website, except on the pages where dark pattern elements are applied. The dark patterns applied are all based on the dark pattern instances identified in the airline websites analysis. Such dark patterns include Visual Interference, Pressured Selling, Confimshaming and Social Proof. Both websites are made compatible with desktop, tablet and mobile browsers. Thus, making them accessible to the participant when performing the booking task, regardless of what type of device they use to access it.

# Chapter 5

## Online Experiment: Design and Methodology

### 5.1 Introduction

This chapter details the design and methodology of the online experiment conducted to evaluate the bright and dark airline websites implemented. It discusses the procedures of the experiment, details about the participants, the online questionnaire and follow-up interviews as well as how the resulting data was analysed.

### 5.2 Experimental Procedures

The experiment was conducted in the form of an online survey. Before participation, each participant was presented with a participant information sheet and consent form providing them with general information about the study and what taking part involves. Consenting participants were then asked to complete a flight booking task using either the bright version or dark version of the airline website, IndigoAir. Thus,

participants were divided into two groups; those that completed the booking task using the bright version; and those that completed the booking task using the dark version. After completing the booking task, each participant was redirected to a Google Forms survey in which they were asked to evaluate their experience when using the particular version of the airline website they were presented with. The survey includes a User Experience Questionnaire, a System Usability Scale questionnaire, some additional user experience questions and demographic questions. At the end of the survey, participants were also asked if they were willing to participate in a post-survey interview in which they would be asked further user experience related questions regarding dark patterns in airline websites as well as their potential effects on site revisitation. A full version of the survey can be found in the appendix.

Prior to the study, the online survey was first tested with two participants, one for each version of the airline website. Upon successful testing, the survey was then distributed through personal contacts of the author. Participants who have completed the survey were also asked if they could share the survey to their own personal contacts. The goal was to target “every day users” who have experience of booking flights on airline websites.

### 5.3 Participants

A total of  $n = 51$  participants completed the online experiment, of whom  $n_{dark} = 31$  used the dark and  $n_{bright} = 20$  used the bright version of the airline website. To gather additional information about the participants, demographic questions were asked. This includes, gender, age, if english is their first language, self-rated level of digital literacy, how often they book flights and their main means when booking flights.

Gender identity distribution of participants was as follows: female (n=28; 55%) and male (n=23; 45%). Age distribution of participants was as follows: 18-24 yrs (n=13)

25-34 yrs (n=33), 35-44 yrs (n=4), 45-54yrs (n=1). The average age of participants was 27.55 years, with a standard deviation of 5.85 years. 67% (n=34) of the participants had English as their first language while the remaining 33% (n=17) did not.

The participants were substantially digital literate; when asked to rate their ability in using digital technologies on a scale of Very Poor, Poor, Acceptable, Good and Very good, 63% (n=32) of the participants rated their ability as Very good, 35% (n=18) as Good and 2% (n=1) as Acceptable. Participants had a relatively high level of experience with booking flights online; when asked how often they booked flights online when travelling, 43% (n=22) of the participants responded with Always, 25% (n=13) with Often, 24%(n=12) and 8% (n=4) with Rarely. Lastly when booking flights, the majority of the participants (n=41; 80%) usually book their flights direct through the airline website while the rest (n=10; 20%) book using online travel agencies.

## 5.4 User Experience Questionnaire

The first section of the survey involves the participant completing a User Experience Questionnaire (UEQ). The UEQ, which can be easily applied, is a reliable and valid measure of user experience than can be utilised in conjunction with data from other methods of evaluation using subjective quality ratings (Laugwitz et al., 2008). As shown in Figure 5.1, the UEQ contains 26 items. Each item is presented as a semantic differential i.e. two opposing terms. The order of the items are randomised with half of the items starting with the positive term and the other half starting with the negative term. Using a seven-stage scale, the items are scaled from -3 to +3. This means -3 represents the most negative answer, 0 a neutral answer and +3 the most positive answer.

	1	2	3	4	5	6	7		
annoying	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	enjoyable	1
not understandable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	understandable	2
creative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	dull	3
easy to learn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	difficult to learn	4
valuable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	inferior	5
boring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	exciting	6
not interesting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	interesting	7
unpredictable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	predictable	8
fast	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	slow	9
inventive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	conventional	10
obstructive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	supportive	11
good	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	bad	12
complicated	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	easy	13
unlikable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	pleasing	14
usual	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	leading edge	15
unpleasant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	pleasant	16
secure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	not secure	17
motivating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	demotivating	18
meets expectations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	does not meet expectations	19
inefficient	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	efficient	20
clear	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	confusing	21
impractical	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	practical	22
organized	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	cluttered	23
attractive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	unattractive	24
friendly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	unfriendly	25
conservative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	innovative	26

Figure 5.1: English version of the UEQ (Schrepp et al., 2017, p. 104)

### 5.4.1 Scale Structure

The 26 items of the UEQ are grouped into six scales that encompass a comprehensive impression of user experience. As defined in Schrepp's UEQ handbook (2015, p. 2), the six scales are:



- **Attractiveness** - Overall impression of the product. Do users like or dislike the product?
- **Perspiciuity** - Is it easy to get familiar with the product? Is it easy to learn how to use the product?
- **Efficiency** - Can users solve their tasks without unnecessary effort?
- **Dependability** - Does the user feel in control of the interaction?
- **Stimulation** - Is it exciting and motivating to use the product?
- **Novelty** - Is the product innovative and creative? Does the product catch the interest of users?

Attractiveness is a pure valence aspect; Perspiciuity, Efficiency and Dependability are considered pragmatic quality aspects (goal-directed); while Stimulation and Novelty are regarded as hedonic quality aspects (non goal-directed) (Schrepp, 2015). The Attractiveness scale consists of six items while all the other scales have four items. Figure 5.2 illustrates the assumed structure of the UEQ and the items within each of the six scales.

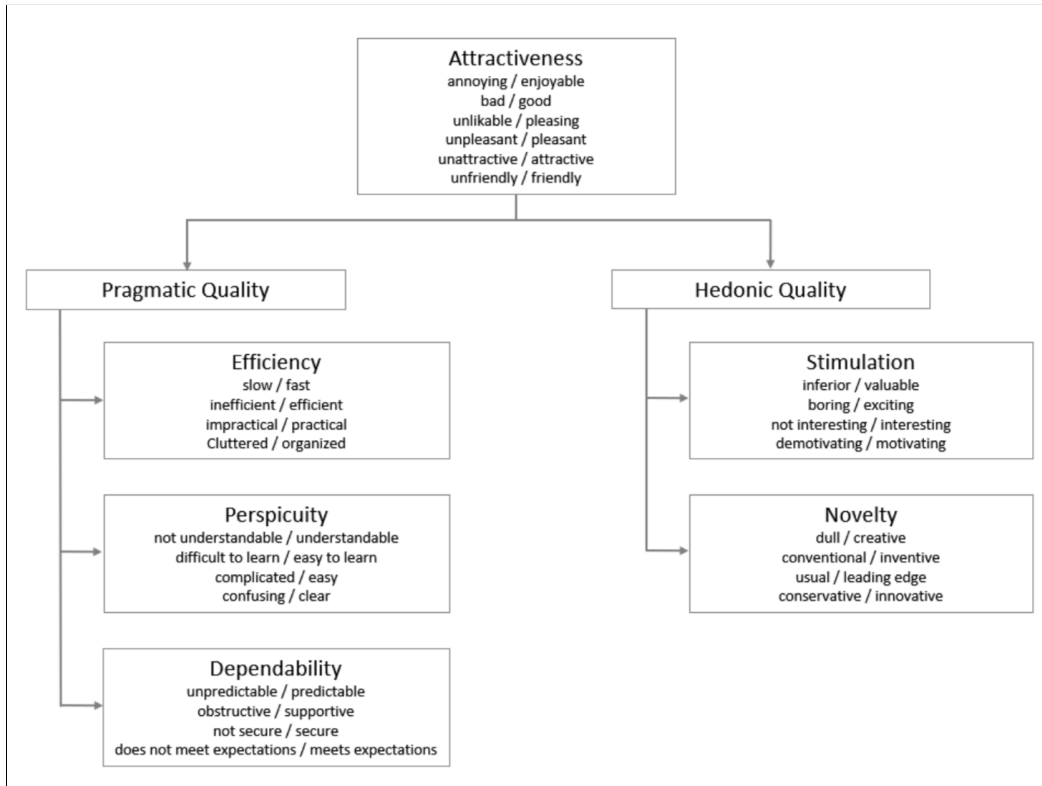


Figure 5.2: Assumed structure of the UEQ (Schrepp, 2015, p. 3)

### 5.4.2 UEQ Data Analysis

The results of the UEQ from the bright and dark groups were analysed using the data analysis tool provided by Schrepp et al. (n.d.). The tool applies an independent samples t-test assuming unequal variances (also referred to as Welch’s t-test), to check if the scale (i.e. Attractiveness, Perspicuity, Efficiency, Dependability, Stimulation and Novelty) of two measured products differ significantly. The two measured products in this case are the bright and dark version of the airline website. The alpha-level for the t-test was set to 0.05 ( $\alpha = 0.05$ ).

In order to get a better understanding of the quality of the bright and dark airline websites, a benchmark provided by the data analysis tool was also applied. The benchmark compares the measured experience of the bright and dark airline websites

to results of other established products. According to Schrepp's UEQ handbook (2015, p. 6), the benchmark classifies a product into 5 categories per scale:

- **Excellent** - In the range of the 10% best results.
- **Good** - 10% of the results in the benchmark data set are better and 75% of the results are worse.
- **Above average** - 25% of the results in the benchmark are better than the result for the evaluated product, 50% of the results are worse.
- **Below average** - 50% of the results in the benchmark are better than the result for the evaluated product, 25% of the results are worse.
- **Bad** - In the range of the 25% worst results.

### 5.5 System Usability Scale

After completing the UEQ, the participants were then asked to fill out a System Usability Scale (SUS) questionnaire. The SUS is a simple ten-item scale providing an overall view of subjective assessments of usability (Brooke, 1995). The SUS uses 5-point Likert scale for each of the items. Thus, participants rank each statement made from 1 to 5 based on how much they agree or disagree with the statement, see Figure 5.3.

	Strongly disagree				Strongly agree
1. I think that I would like to use this system frequently	1	2	3	4	5
2. I found the system unnecessarily complex	1	2	3	4	5
3. I thought the system was easy to use	1	2	3	4	5
4. I think that I would need the support of a technical person to be able to use this system	1	2	3	4	5
5. I found the various functions in this system were well integrated	1	2	3	4	5
6. I thought there was too much inconsistency in this system	1	2	3	4	5
7. I would imagine that most people would learn to use this system very quickly	1	2	3	4	5
8. I found the system very cumbersome to use	1	2	3	4	5
9. I felt very confident using the system	1	2	3	4	5
10. I needed to learn a lot of things before I could get going with this system	1	2	3	4	5

**Figure 5.3:** The System Usability Scale (Brooke, 1995, p. 4)

When conducting the SUS for the study, the word “*system*” which is used in each of the ten statements, was replaced with “*airline website*”. For instance, instead of the statement “*I think that I would like to use this system frequently*”, the statement “*I think that I would like to use this airline website frequently*” was used.

### 5.5.1 SUS Scoring

The SUS produces a single number which represents a combined measure of the overall usability of the system being evaluated (Brooke, 1995). The scores for the individual items provide no meaning on their own.

In order to calculate the SUS score, first add the score contributions from each item. Each item's score contribution will range from 0 to 4. For the odd items i.e. statements 1, 3, 5, 7 and 9, the score contribution is the scale position subtracted by 1. For the even items i.e. statements 2, 4, 6, 8 and 10, the score contribution is 5 subtracted by the scale position. The sum of the scores is then multiplied by 2.5 to obtain the SUS score. SUS scores range from 0 to 100. It is important to note however that this score is not a percentage. Figure 5.4 shows an example of the calculation.

The respective mean SUS score for the dark and bright airline website were then calculated in order to compare their level of usability. The average SUS score is 68, meaning a system with an SUS score higher than 68 can be considered above average while a score less than 68 can be considered below average (Lewis & Sauro, 2018). Like in the UEQ, a Welch's t-test was conducted to check if the SUS scores of the dark and bright airline website differ significantly. The same alpha-level of 0.05 ( $\alpha = 0.05$ ) was applied for the t-test.

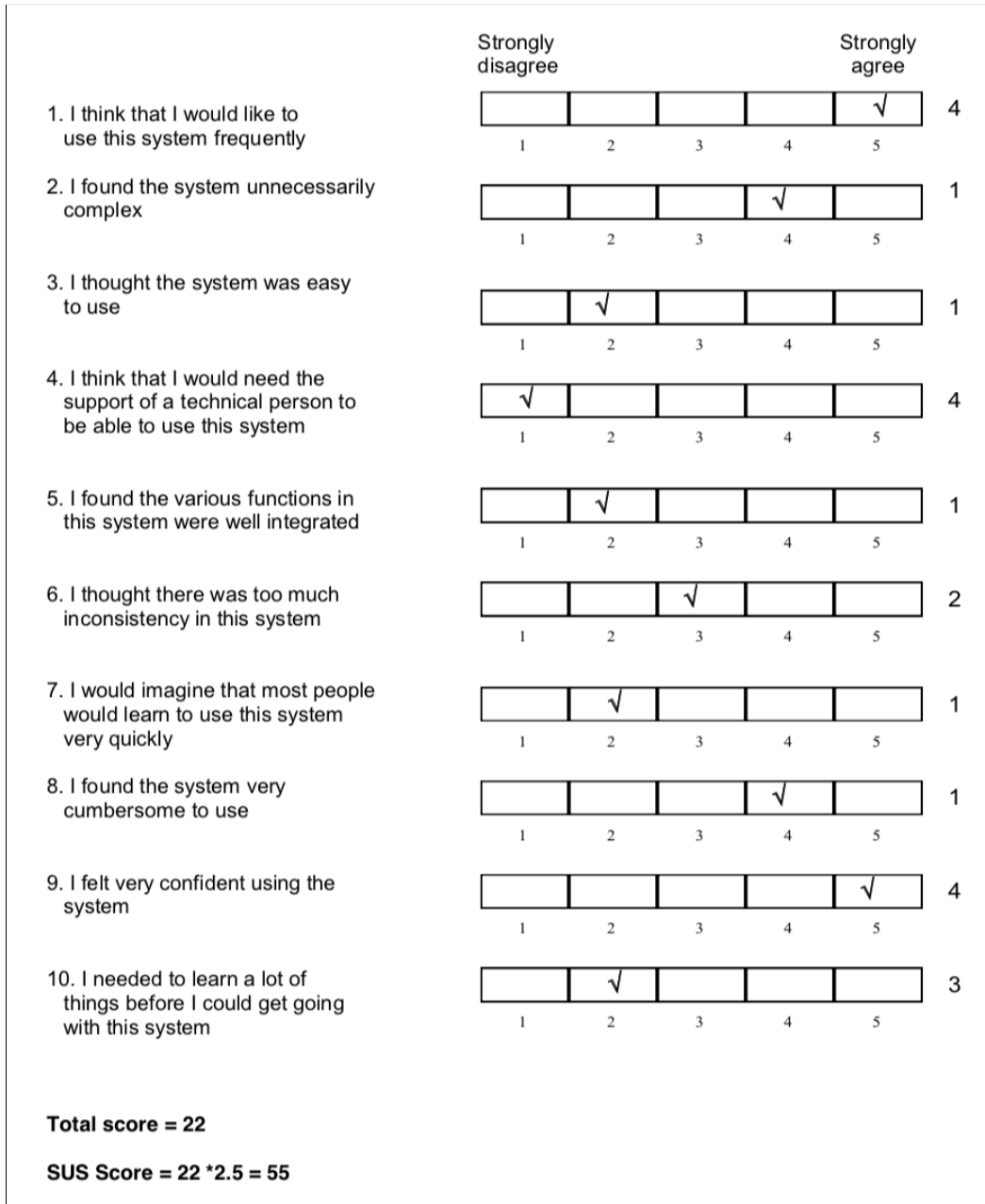


Figure 5.4: Example of an SUS score calculation (Brooke, 1995, p. 6)

## 5.6 Additional Questions

After completing the UEQ and SUS, participants were also asked open-ended questions for more insight regarding their impressions of the airline website, their potential

annoyance and their dark pattern awareness:

- What are your impressions of the airline website?
- What, if anything, did you find annoying about the airline website while booking the flight?
- Did you notice anything that would try to get you to spend more money while booking? If yes, please describe them?

Responses to these questions were analysed through thematic analyses.

## 5.7 Follow-up Interview

At the end of the survey, participants were asked to share their contact information if they were willing to participate in a follow-up interview. The goal of the interview was to further explore users awareness and their overall thoughts regarding dark patterns. More importantly, it was conducted to investigate whether dark pattern application has any effect on site revisitation i.e. a users willingness to revisit or reuse a website.

A total of five participants participated in the post-survey interview. Each participant was made aware that the interview audio will be recorded and each one was asked for their consent. For each participant, a semi-structured online video interview roughly lasting 10 to 15 minutes was conducted. First, each participant was asked the question *Have you ever heard of the term dark patterns?* If they were not aware of the term, they were given an explanation and were presented with different dark pattern examples in airline websites. Following the explanation and examples, the rest of the interview was guided by the subsequent main questions:

- Have you ever encountered any of the dark patterns shown in the examples before?

- What are the first things that come to mind when you think about these dark patterns?
- Do they negatively affect your experience when using an airline website at all?
- Do the application of these dark patterns on an airline website ever stop you from using that particular website? Why or why not?
- Do you think knowing about the existence of dark patterns or being aware about them is helpful to users in any way?

Note that at times these questions were slightly reformulated. Additionally, some follow-up questions were asked after the main questions in order to maintain the flow of the interview as well as to broaden the conversation. Audio during the interviews were recorded. The audio recordings were then manually transcribed to text. Finally, the transcriptions were then assessed using thematic analysis.

## 5.8 Conclusion

In this chapter the design and methodology of the online experiment conducted was discussed. A total of  $n = 51$  participants partook in the online experiment, of whom  $n_{dark} = 31$  used the dark and  $n_{bright} = 20$  used the bright version of the airline website to complete a flight booking task. Upon task completion, each participant was presented with a questionnaire in order to assess their overall user experience. This included a UEQ and an SUS as well as more open-ended questions relating to user experience, annoyance and dark pattern awareness. Finally, follow-up interviews were conducted for willing participants to further investigate dark pattern effects on user experience, moreover, their effect on users' willingness to revisit a website and users' dark pattern awareness.



# Chapter 6

## Online Experiment: Results and Discussion

### 6.1 Introduction

This chapter covers the results from the online experiment conducted. It details quantitative data analysis results for the UEQ and SUS as well qualitative data analysis results from the questionnaire's open-ended questions and the follow-up interviews. Next, it discusses the results in relation to the research questions. Finally, the limitations of the study are outlined.

### 6.2 Quantitative Analysis

#### 6.2.1 User Experience Questionnaire

A Welch's t-test was performed between the dark and bright airline website for each of the six scales of the UEQ. The results show a significant difference between the

two versions for Attractiveness. However, for the rest of the scales i.e. Perspicuity, Efficiency, Dependability Stimulation and Novelty, there was no significant differences observed (see Figure [6.1](#)).

	Dark	Bright	p-value
$M_{Attractiveness}$	1.01	1.74	< 0.05
$SD_{Attractiveness}$	1.55	0.92	
$M_{Perspicuity}$	1.88	2.01	> 0.05
$SD_{Perspicuity}$	1.25	0.86	
$M_{Efficiency}$	1.58	1.81	> 0.05
$SD_{Efficiency}$	1.37	0.81	
$M_{Dependability}$	1.19	1.33	> 0.05
$SD_{Dependability}$	1.12	0.75	
$M_{Stimulation}$	0.59	0.79	> 0.05
$SD_{Stimulation}$	1.20	0.93	
$M_{Novelty}$	-0.22	-0.09	> 0.05
$SD_{Novelty}$	0.87	0.77	

**Table 6.1:** Differences between the dark and bright version of the airline website concerning the six scales of the UEQ.

As illustrated in Figure [6.1](#), the dark version had lower mean values for all the scales compared to the bright version. Scale means for both versions were all positive except for Novelty. Furthermore, when the scale means of both versions were set in relation to existing values from a benchmark data set, the dark and bright version had the same rating for Efficiency, Dependability, Stimulation and Novelty. These were Good, Above Average, Below Average and Bad respectively. The bright website had slightly better Perspicuity rating of Excellent compared to the dark website which was rated Good. Notably, the websites differed the most in Attractiveness with the bright and dark version being rated Good and Below Average respectively. Table [6.2](#) summarises

these benchmark ratings.

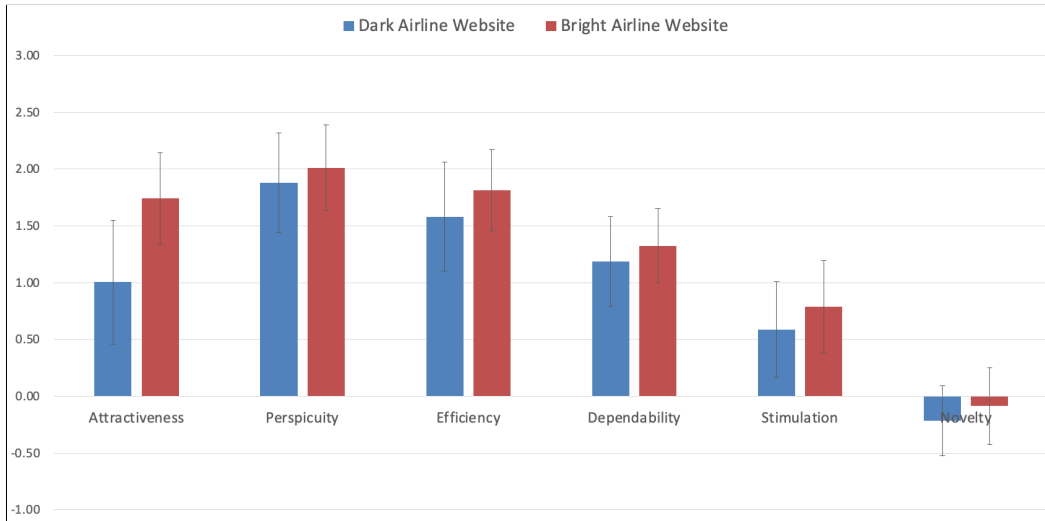


Figure 6.1: Comparison of scale means.

	Dark	Bright
Attractiveness	Below Average	Good
Perspicuity	Good	Excellent
Efficiency	Good	Good
Dependability	Above Average	Above Average
Stimulation	Below Average	Below Average
Novelty	Bad	Bad

Table 6.2: Comparison of both dark and bright version to benchmark data.

### 6.2.2 System Usability Testing

A Welch t-test was conducted to compare the SUS scores of the dark and bright airline websites. The results show no significant difference in the SUS scores between the dark version ( $M = 77.5$ ,  $SD = 17.31$ ) and the bright version ( $M = 80.75$ ,  $SD = 13.6$ ),  $p > 0.05$ . In terms of usability, both websites have an above average rating i.e. more

than 68. The bright version fairs slightly better with an average SUS score of 80.75 compared to the dark version which yielded an average SUS score of 77.5.

## 6.3 Qualitative Analysis

### 6.3.1 Open-ended questions

#### Airline Website Impression

When asked about their impression of the airline websites, the bright website garnered strictly positive responses. The majority of the comments touched on the ease of use of the bright website e.g. *“straight forward and easy to use”*, *“simple and easy to understand”*, *“fairly easy to use and relatively effective”*, *“clear, organized”*. Other positive comments simply described the participants’ affinity with the website e.g. *“I like it”*. In comparison, the dark website yielded more mixed responses with the majority being positive, some negative and some neutral. Similar to the bright websites, most of the positive comments from the dark website mention ease of use to some degree e.g. *“quick and easy to use”*, *“easy to navigate”*, *“very clear layout and colour”*, *“functions were straightforward”*. The majority of the negative comments relate to the website pushing the participant into spending more for their booking e.g. *“very clearly trying to encourage the purchase of the premium options”*, *“had a lot of pop-ups”*, *“tries to trick users into paying more”*, *“money grabbing”*. Lastly, neutral responses included comments such as *“it’s okay”* and *“it’s very normal, nothing different”*.

#### User Annoyance

When asked if they found anything annoying about the airline website, responses from the bright and dark version were vastly different. Participants in the bright group

mostly responded with “no”, one participant commented “*a lot of words*” and another responded with “*the baggage is confusing*”; the rest had no response. Comparatively, in the dark group the majority of the participants had a comment in relation to some of the dark patterns applied e.g. “*constant pop-ups asking me to upgrade*”, “*a bit pushy to pay for a bag*”, “*how difficult it was to pay the minimum*”, “*everything is monetised and ask you as second time to spend more money*”, “*lowest price was hidden*”.

### Dark Pattern Awareness

When participants in the dark group were asked if they noticed anything that pushed them to spend more money, 71% of them (n=22) noticed something relating to the dark patterns implemented, the rest (29%; n=9) did not notice anything. Pressured Selling was the most commonly identified dark pattern with the majority of the comments mentioning the pop-ups e.g. “*pop-ups asking to upgrade fares or add more bags*”, “*asking if I want to improve flights*”, “*asked me a couple of times if I wanted to add another luggage*”. Next is Visual interference with some participants mentioning those applied e.g. “*Saver package was located at the end of the page*”, “*cheapest price into grey*”, “*continuing with your selection is hard to see*”. Very few participants mentioned Confirmshaming e.g. “*suggesting insurance*”. One person mentioned something regarding Social Proof: “*persuasive as they have included statistics of how many people are flight protected*”. There was no mention of the Low Stock Messages.

### 6.3.2 Follow-up Interviews

Responses from the semi-structured interviews were grouped into three main themes. These are dark pattern awareness, dark pattern effects on user experience and dark pattern effects on site revisitation. The five participants of the interview henceforth will be referred to as P1, P2, P3, P4 and P5.

### Dark Pattern Awareness

None of the participants were familiar of the term dark patterns. However, all were aware of their existence and have “*always*” (P2 & P5) encountered them when booking flights. Though most of the participants were aware of the more blatant types of dark patterns like Pressured Selling in the form of pop-ups, some were unaware of more subtle types such as visual presentation like “*using colour*” (P4) or Sneak into Basket: “*I never like check if they add insurance without you ever knowing*” (P4). Furthermore, some were unaware of their manipulative nature prior to the interview: “*you assume that it’s normal but it’s actually not, that they’re actually psychologically making your decisions for you*” (P2). The participants all agreed that knowing more about dark patterns is beneficial to the user since they would be “*more careful*” (P1). For instance, “*reading everything*” (P1 & P3) when booking.

### Effects on User Experience

The participants had different attitudes towards dark patterns. Some of the participants find that dark patterns negatively affect their experience when booking flights. In particular, some users find them “*annoying*” (P2 & P4) and “*a bit of a hassle since there’s too many pages*” (P3) and “*you have to click no no no*” (P2) when “*it really should be straightforward*” (P4). One participant expressed “*it always makes me quite anxious when I’m booking a flight for myself because they have so many popups*” (P5). In contrast, a participant expressed that due to familiarity, dark patterns do not significantly affect their experience when booking: “*I think I’m just so used to seeing them*” (P1).

### Effects on Site Revisitation

When the participants were asked if dark pattern application ever stopped them from revisiting or reusing a particular airline website, all of the them responded with “no”. One of the main reasons they outlined is the cheap price of flights of some websites that use dark patterns: *“no because for like Ryanair, their flights are very cheap”* (P1 & P2) and *“they have some good deals”* (P4). Participants expressed that they would be more bothered by other aspects regarding an airline: *“I think it’s more on their terms and conditions”* (P1), *“I think I’m more turned off by an airline if I did get a personal horrible experience on the flight”* (P4). One participant explained that they were not deterred by dark patterns in airline websites since they are technologically competent: *“I’m more tech educated ... I can easily click on which one I actually want and not fall into the trap”* (P3). Finally, one user mentioned that dark patterns do not necessarily put them off using a website because they are so ubiquitous: *“they’re always gonna want you to spend more money, I don’t think there’s avoiding that anywhere, so instead of avoiding that I want to be more aware of it so that I know how to navigate through it”* (P5).

## 6.4 Discussion

Results from the quantitative analysis for the UEQ show that between the bright and dark airline website, a significant difference was only observed for the Attractiveness scale. The Attractiveness scale in particular considers six items from the UEQ, namely, annoying/enjoyable, bad/good, unlikable/pleasing, unpleasant/pleasant, unattractive/attractive, unfriendly/friendly. Considering these items, the contribution of dark pattern application towards participants’ annoyance may constitute the significant difference in Attractiveness. Notably, when users were asked to identify elements they found annoying when completing the booking task, the majority of participants from the dark group referenced at least one of the dark patterns implemented. Compara-

tively, the majority in the bright group did not find anything annoying with the bright website.

As previously mentioned, with the exception of the Attractiveness scale, no significant difference between the bright and dark version was found for the other five scales of the UEQ . Furthermore, results from the SUS analysis show no significant difference between the two versions in terms of usability. Thus, with regards to the first research question, dark pattern application has no significant effect on overall user experience. However, it is worth noting that the bright version was ranked higher in all the six scales of the UEQ and in terms of mean SUS score compared to the dark version.

Similarly, responses from the follow-up interviews reveal that dark pattern application had no effect on site revisitation. Participants expressed that they were willing to revisit or continue using airline websites with dark patterns mainly since such websites usually offer cheap flights. Being digitally competent and being familiar with dark patterns were also reasons mentioned by participants in continuing to use such websites since they are easily able to navigate through dark patterns.

Though not one of the principal goals of the study, the participants' dark pattern awareness was also assessed. Most of the participants are aware of dark patterns even though they are not familiar with the term. Besides the omnipresence of dark patterns in airline websites, perhaps the participants' high level of digital literacy has some contribution to this awareness.

### **6.5 Limitations**

The online experiment conducted has some limitations. Firstly, the participants are lacking in terms of age diversity with more than half falling under the 25-34 range. Similarly, most of the participants have a self-rated digital literacy of either Good or Very Good. Furthermore, the post-interview only involved five participants. Thus the



generalisability of this study may be limited by the characteristics of the participants. Finally, the study solely investigates dark patterns within the context of airline websites, also limiting the study's generalisability since dark patterns present on other types of e-commerce websites may have a different effect on the end user.

## 6.6 Conclusion

This chapter evaluated and discussed the results of the online experiment conducted. For the UEQ, a significant difference between the dark and bright airline website was observed only for the Attractiveness scale; with the dark version being considered significantly less attractive than the bright version. Regarding usability, the SUS showed no significant difference between both versions. Dark patterns were also shown to have no impact on users willingness to revisit a site. In terms of the research questions, dark pattern application was found to have no significant effect on overall user experience. Similarly, it had no effect on site revisitation.

# Chapter 7

## Conclusion

### 7.1 Research Overview

Dark patterns are interfaces carefully designed to manipulate users into doing something they might not otherwise do for the benefit of an online service. This study investigated the impact of dark patterns on overall user experience and site revisitation in the context of airline websites. In order to assess potential dark pattern effects, two versions of the same airline website were compared: a dark version containing dark pattern elements and a bright version free of manipulative interfaces. User experience for both websites were assessed quantitatively through a survey containing User Experience Questionnaire (UEQ) and a System Usability Scale (SUS) questionnaire. Site revisitation i.e. users' willingness to revisit a website was assessed qualitatively through semi-structured interviews. Dark pattern awareness was also investigated through the survey and interviews.

## 7.2 Problem Definition

Although there has been considerable work done on dark pattern in the context of consent banners, the impact of dark patterns that exist on websites beyond such consent banners i.e. dark patterns that exist when interacting with the website itself and particularly their impact on the user experience remain scarce. There has been some initial research analysing dark pattern effect on aspects of end user experience including perceived manipulation as well as perceived annoyance and brand trust in online shopping websites. However, there is little to no research that investigates the effect dark patterns on overall user experience and user's willingness to revisit a site, especially in the context of airline websites. Thus, the present study aims to investigate dark pattern effects on these two aspects.

## 7.3 Design & Experimentation

First, an analysis of airline websites was conducted to determine dark patterns that are commonly employed. Two versions of a mock were implemented; a dark version containing dark pattern elements based on the airline websites analysis conducted; and a bright website free of manipulative elements. The choice to create a mock website meant that more careful monitoring of the users' interactions was possible. One group used the dark version and another group used the bright version to complete a booking task. Upon completion, both groups completed a questionnaire containing the UEQ and SUS to assess their user experience. Willing participants performed a follow-up interview to investigate dark pattern effects on site revisitation. Dark pattern awareness was also assessed through the survey and interviews.

## 7.4 Evaluation & Results

For the UEQ, a significant difference was observed for Attractiveness. There was no significant difference observed for the rest of the scales, namely Perspicuity, Efficiency, Dependability Stimulation and Novelty. Additionally there was no significant difference between the SUS scores of the two sites. Thus, dark pattern application was found to have no significant effect on overall user experience. Despite this, the bright website was found to have a higher rating for all scales of the UEQ as well as for the average SUS score. The structured-interviews revealed that dark pattern also had no effect on site revisitation. Lastly, questions probing dark pattern awareness revealed that the majority of participants were fairly aware of dark patterns although not knowing the term.

## 7.5 Contributions and impact

This study contributes to the growing body of research regarding dark patterns. It investigates dark patterns in a relatively under explored area, that is, airline websites as majority of dark pattern research have focused on consent banners and online shopping websites. The study identifies and categorises common dark patterns applied in airline websites. Moreover, it provides a better understanding of how the application of such dark patterns affects the experience of the end user. The study also shares more information to users who may have encountered dark patterns but were not fully aware of their manipulative nature. Thus, the study also raises dark pattern awareness.

## 7.6 Future Work & recommendations

The present study can be improved in a number of ways. First the context can be expanded to online travel agencies, since according to the survey, a number of participants also use such means for booking flights. The age demographic could also be widened in order to increase the study's generalisability. Doing so, one could also further assess dark pattern awareness and user experience effects based on age groups. Similarly, since most of the participants in the present study had a high levels of digital literacy, future studies could also include those that are less digitally literate. Furthermore, a more robust measure of digital literacy could be applied instead of a self-rated scale.

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# Appendix A

## Online Survey

### A.1 Participant Information Sheet

#### Participant Information Sheet

You are invited to participate in a study which will be exploring user experiences in airline websites.

##### Who am I?

My name is Deon Calawen, an MSc Computer Science student of TU Dublin. This study is being conducted as part of my dissertation.

##### Why have I been invited to take part in the study?

There is no particular reason why you have been chosen for this study. This study accepts any willing participant that is 18 years old or over.

##### What will taking part involve?

If you decide to take part in the study, you will simply be asked to complete a flight booking task and fill out an online questionnaire.

##### How long will my part in the study take?

The booking task and questionnaire is not likely to require more than 12 minutes of your time.

##### Do I have to take part?

Participation is completely voluntary. It is entirely up to you to decide whether or not you will take part in the study. If you do decide to take part you will be asked to agree to a Consent Form indicating that you are willing to take part. You are free to refuse any question and withdraw at any time without any consequences whatsoever.

##### Who should I contact for further information?

If you want any additional information or answers to questions about the study and your participation in the study, you can email me using the following email address: [d20123738@mytudublin.ie](mailto:d20123738@mytudublin.ie)

## A.2 Consent Form

### Consent Form

**Declaration:**

- I am 18 years or older
- I understand that I may refuse to answer any question and that I may withdraw at any time without penalty.
- I understand that my participation is fully anonymous and that no personal details about me will be recorded.
- I agree that my data is used for scientific purposes and I have no objection that my data is published in scientific publications in a way that does not reveal my identity.
- I freely and voluntarily agree to be part of this research study, though without prejudice to my legal and ethical rights.

Clicking on the **Agree** button below indicates that:

- You agree to all the above declarations
- You have read the above information
- You voluntarily agree to participate in the study.

If you **do not** wish to participate in the study, please decline participation by simply exiting from this website or closing your browser.

**AGREE**

## A.3 Booking Task Instructions

### Instructions

Thank you for agreeing to participate in this study. The following study will involve completing a flight booking task and a questionnaire. Please read the following instructions carefully.

---

#### Flight Booking Task

- First, you are asked to book a flight through an airline website.
- The destination, dates and number of passengers for this flight will be pre-selected.
- To simply start the booking process, click the **Search Flights** button, which you will see after you click **Start** from this page.
- Please complete the booking process as if you are booking a real flight.
- At the end, keep the final page of the booking task open as you will need it to answer a question in the questionnaire.
- The booking task should only be completed once.

#### Questionnaire

- Completing the booking task will open a link to an online questionnaire in which you will be asked some questions about the booking task.
- More general user experience questions and demographic questions will also be asked.

---

**Note:** At some point in the booking process, you will be asked to input some personal information normally asked when booking a flight, however, none of this information is recorded. If you wish, you can use pseudonyms.

If for any reason you decide you want to withdraw from participating, you can exit the booking task or questionnaire by navigating away or by closing your web browser.

Press **Start** to begin.

**Start**

## A.4 UEQ Instructions

### Airline Website Evaluation

In the next set of questions, you will be evaluating the airline website (IndigoAir) used in the booking task.

The questions consists of pairs of contrasting attributes that may apply to the airline website. The circles between the attributes represent gradations between the opposites. You can express your agreement with the attributes by ticking the circle that most closely reflects your impression.

Please decide spontaneously. Don't think too long about your decision to make sure that you convey your original impression.

Sometimes you may not be completely sure about your agreement with a particular attribute or you may find that the attribute does not apply completely to the airline website. Nevertheless, please tick a circle in every line.

It is your personal opinion that counts. Please remember: there is no wrong or right answer!

Example: in the image below, the response would mean that you rate the website as more attractive than unattractive.

Example

attractive	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	unattractive
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## A.5 UEQ

	1	2	3	4	5	6	7		
annoying	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	enjoyable	1
not understandable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	understandable	2
creative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	dull	3
easy to learn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	difficult to learn	4
valuable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	inferior	5
boring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	exciting	6
not interesting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	interesting	7
unpredictable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	predictable	8
fast	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	slow	9
inventive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	conventional	10
obstructive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	supportive	11
good	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	bad	12
complicated	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	easy	13
unlikable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	pleasing	14
usual	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	leading edge	15
unpleasant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	pleasant	16
secure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	not secure	17
motivating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	demotivating	18
meets expectations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	does not meet expectations	19
inefficient	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	efficient	20
clear	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	confusing	21
impractical	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	practical	22
organized	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	cluttered	23
attractive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	unattractive	24
friendly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	unfriendly	25
conservative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	innovative	26

## A.6 SUS

	Strongly disagree				Strongly agree
1. I think that I would like to use this system frequently	1	2	3	4	5
2. I found the system unnecessarily complex	1	2	3	4	5
3. I thought the system was easy to use	1	2	3	4	5
4. I think that I would need the support of a technical person to be able to use this system	1	2	3	4	5
5. I found the various functions in this system were well integrated	1	2	3	4	5
6. I thought there was too much inconsistency in this system	1	2	3	4	5
7. I would imagine that most people would learn to use this system very quickly	1	2	3	4	5
8. I found the system very cumbersome to use	1	2	3	4	5
9. I felt very confident using the system	1	2	3	4	5
10. I needed to learn a lot of things before I could get going with this system	1	2	3	4	5

## A.7 Demographic Questions

### Participant Questions

This last section will be asking some questions about you.

What is your age? \*

Your answer \_\_\_\_\_

What best describes your gender? \*

Male

Female

Prefer not to say

Other: \_\_\_\_\_

Is English your first language? \*

Yes

No

How would you rate your ability to use digital technologies e.g. the Internet? \*

- Very poor
- Poor
- Acceptable
- Good
- Very good

How often do you book flights online through airline websites when travelling? \*

- Never
- Rarely
- Sometimes
- Often
- Always



When booking flights online, I usually book my flights \*

- Direct e.g. through [ryanair.com](http://ryanair.com), [aerlingus.com](http://aerlingus.com) etc.
- Through online travel agencies e.g. [expedia.com](http://expedia.com), [lastminute.com](http://lastminute.com) etc.
- Other: \_\_\_\_\_

A second part of the study involves a short online interview asking more user experience related questions. If you would like to participate, please leave your email address below, otherwise, leave it blank.

Your answer \_\_\_\_\_

## A.8 Links to Bright and Dark Websites

**Bright:** <https://flight-booking-br.herokuapp.com/home>

**Dark:** <https://flight-booking-dr.herokuapp.com/home>