Have mobile eCommerce websites become too dependent on the hamburger menu?

Navigation for mobile eCommerce websites

A thesis

submitted in partial fulfilment

of the requirements for the degree

of

Masters of Design

at

The University of Waikato

by

PAIGE AMY WYATT

THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

2022

Abstract

Mobile phones have become a ubiquitous element in modern-day society, with many people using their mobile devices for online shopping. Mobile eCommerce websites specifically offer users the ability to view or purchase a product without entering a physical shop.

With the added implications of the COVID-19 pandemic, mobile eCommerce websites play a more prevalent role in consumerism than in the past. Given the popularity of mobile devices and extensive research into eCommerce design, it was surprising to see little research into navigation menu for mobile eCommerce websites.

The navigation positioning, type of navigation, and user experience are areas investigated within this thesis. This research's main goal was to look into navigation menus on mobile eCommerce websites and learn which approach offers the most optimal solution for a successful navigation experience.

We learned that the hamburger menu in the top left-hand corner is the most commonly used form of navigation through a case study. We also identified that the hamburger menu in the top left-hand corner might not be the optimal solution. We then conducted a user study to investigate user preferences concerning navigation options on mobile devices. We used the case study findings and developed a secondary navigation option to test against the top-left hamburger menu. This secondary option was a menu bar navigation, with a hamburger incorporated on the bottom right. Results showed that in general users preferred the layout and experience that the bottom bar navigation option offered.

We could recommend the inclusion of a bottom bar navigation option in the development of mobile eCommerce websites. The research suggested that a bottom bar navigation option would offer a more user-friendly mobile eCommerce website experience. Finally, we identified the limitations of the study, as well as future work surrounding the topic.

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1 Introduction

The research introduced in this thesis aimed to understand and evaluate navigation for mobile eCommerce websites. This study focused on shoppers who used mobile eCommerce platforms to browse or purchase a product. In Chapter 2, we delved into the existing literature on the topic to begin our findings and discovered what user experience is, how users manoeuvre throughout websites and the ergonomics of mobile device interfaces. Here we also investigated the existing design solutions for navigation options. The information reviewed highlighted a gap in the literature surrounding navigation on mobile eCommerce websites.

To address the literature gap, we compared a series of navigation options via a case study in Chapter 3. The cases study also investigated the current navigation for mobile eCommerce websites to understand this.

Based on the case study, we then looked into whether the hamburger menu was the optimal solution and conducted a user study comparing two navigation options in Chapter 4. The user study comparing these options helped determine which was more optimal for mobile eCommerce websites. The study also helped us learn if one of the options provided a more advanced user experience for the participant. Chapter 5 is where the results were presented, and conclusions drawn from the study. Chapter 6 discusses the research questions, future work, and study limitations.

1.1 Motivation

Smartphones have become ubiquitous in our everyday lives, as technology advances, these devices are becoming omnipresent. In 2016, 2.5 billion smartphone users existed; by 2018, this had increased to 2.9 billion. In 2021, it was forecasted that there would be approximately 3.8 billion smartphone users worldwide (Statista, 2020).

With the popularity of smartphones increasing, mobile Commerce (mCommerce) is a medium whose rapid growth has no apparent end. Along with the increase in smartphones, the prevalence of mobile shopping and the digital economy has flourished. Meola (2022) discusses how mCommerce has continued to develop rapidly, as demonstrated in their graph*, Figure 1: Business Insider - US Retail mCommerce Sales, 2019-2025.* As smartphone technology evolves rapidly, more people have switch out the household computer for mobile devices, specifically smartphones. Already, It is common for smartphones to be more powerful than most people's ageing computers (Samsung for Business, 2021).

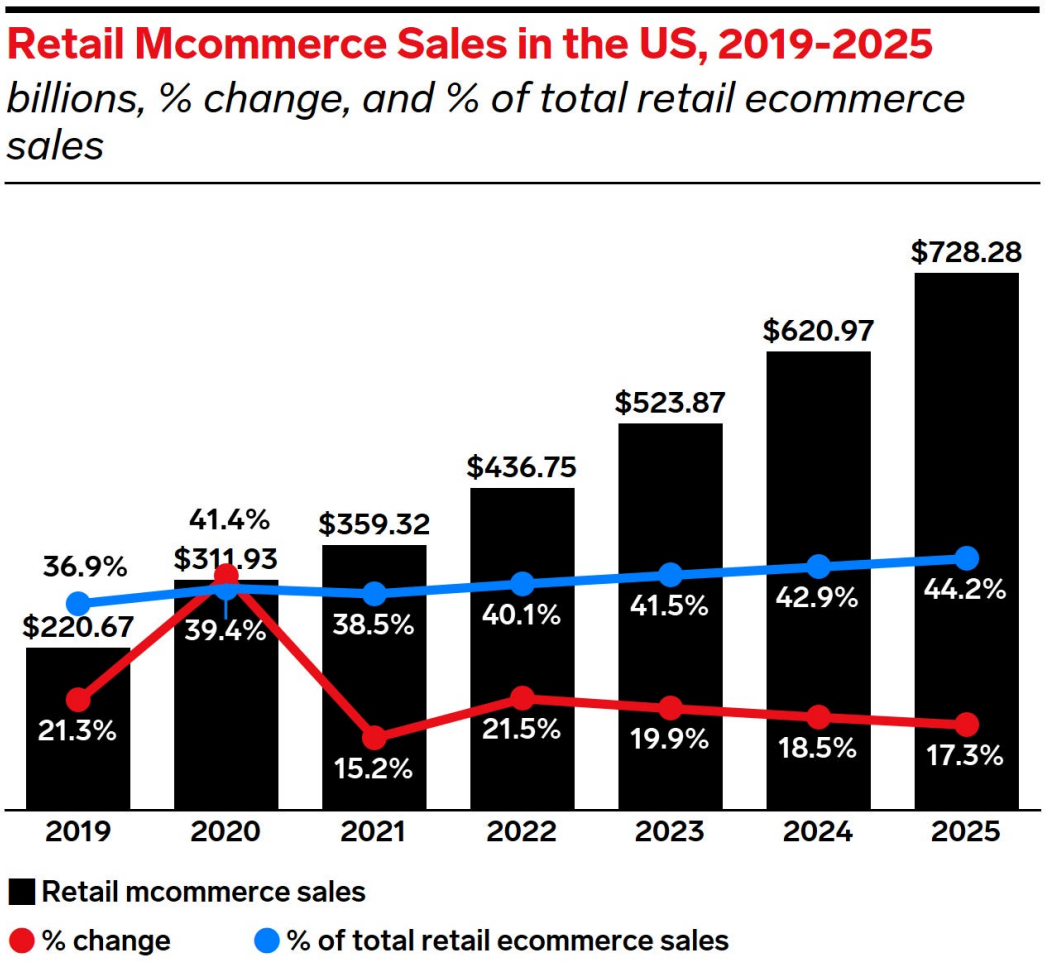


Figure 1: Business Insider - US Retail mCommerce Sales, 2019-2025

The users of a website can manoeuvre around using the navigation option. One example of navigation could be a hamburger menu in the top left-hand corner of the device. Information's presentation directly affects users' perception and buying decisions (Blanco et al., 2010; Fu et al., 2018; Liao et al., 2016).

Navigation menus are an essential and often overlooked visual feature of mobile eCommerce websites. Menus help the user in manoeuvring throughout the site and discovering the information required. These navigation menus often prove difficult to navigate and provide users with issues that prevent them from having the user experience desired.

For this thesis, we specifically investigated navigation for mobile eCommerce websites, searching for an optimal navigation menu. One potential by-product of an advanced and

more refined navigation could have been a more developed and satisfying user experience whilst navigating mobile eCommerce websites.

1.2 Research questions

Four research questions will get discussed in this thesis. These are:

RQ1: What can affect a user's ability in the navigation of a mobile eCommerce website?

RQ2: What is the current state of the art navigation for mobile eCommerce websites?

RQ3: What design interventions can be developed to help the user manoeuvre more successfully throughout a mobile eCommerce website?

RQ4: Can an adapted and refined navigation menu improve a user's experience on mobile eCommerce websites?

RQ1 researched and analysed the related work on the topic. The research needed to highlight any issues or barriers users commonly face whilst manoeuvring throughout mobile eCommerce websites. The Literature review began to address the answer to RQ1; this was further discussed in Chapter 5.

RQ2 researched and analysed the related work on the topic. This investigated the navigational design solutions currently in use for mobile eCommerce websites. RQ2 was further developed in the case study. The case study took the knowledge discovered through the literature review and built on it, investigating the navigation of a set of successful pre-existing mobile eCommerce websites. Doing this highlighted the current state of the art navigation for mobile eCommerce websites and, in turn, began to address the answer to RQ2; this was further deliberated in the discussion chapter of this thesis.

RQ3 introduced a case study. The case study investigated what improvements could get made to the navigation of mobile eCommerce websites. Improvements were implemented to two navigation prototypes that were developed for a user study. These prototypes aided in answering RQ3 and RQ4.

RQ4 conducted a user study to develop a clear and concise answer. The user study developed and compared two prototypes. A comparison of the prototypes helped to learn which navigation was more desired. Whether this is the defined state of the art navigation, or the secondary option developed. This specifically looked at navigation in the context of mobile eCommerce websites.

1.3 Hypothesis

The hypothesis of this study was **the ordinarily used hamburger menu in the top left-hand corner of modern smartphones is a sub-optimal navigation option for the general navigation of eCommerce Website's categories and products.** When in the top left-hand corner, the hamburger menu may not provide the most auspicious encounter for a user manoeuvring throughout mobile eCommerce websites. The top left-hand corner of a mobile device can be challenging to reach for the average right-handed user.

The hamburger menu could instead get positioned in a more accessible location. However, this top left-hand corner could be more suited for the settings menu.

1.4 Thesis structure

This thesis was split into six main chapters. Chapter 1: Introduction, Chapter 2: User experience and mobile devices. Chapter 3: case study of mobile navigation solutions, Chapter 4: User study of two navigation prototypes developed and conducted, Chapter 5: Discussion and Chapter 6: Conclusions. An outline of the remainder of the thesis is discussed here.

Chapter 1: Introduction introduced the thesis and the topics discussed throughout. Chapter 1 also highlighted the hypothesis and research questions.

Chapter 2: user experience and mobile devices introduced and discussed related works to understand mobile eCommerce websites, users manoeuvring throughout mobile eCommerce websites, and navigations currently in use. Chapter two began to answer *RQ1, what can affect a user's ability in the navigation of a mobile eCommerce website?* And *RQ2, what is the current state of the art navigation for mobile eCommerce websites?* This was completed by assessing the existing material on the topic.

Chapter 3: Case study of mobile navigation solutions introduced and presented a case study that looked at ten existing mobile eCommerce websites' navigation. This case study helped answer *RQ2: What is the current state of the art navigation for mobile eCommerce websites? And RQ3: What design interventions can be developed to help the user manoeuvre more successfully throughout a mobile eCommerce website?* The case study also helped learn what the optimal navigation options for mobile eCommerce websites could be. The findings of this case study also enabled us to proceed and develop prototypes for user testing.

Chapter 4: User study of two navigation prototypes developed and conducted presented our methodology for a user study of two prototypes. The two prototypes were developed following the case study analysis that investigated ten different websites' navigation. This chapter helped answer *RQ4: Can an adapted and refined navigation menu improve a user's experience on mobile eCommerce websites?* The user study was split into two main sections, section A and section B. Section A covered an observation of users completing four tasks on two different navigation prototypes, and a *User Experience Questionnaire* (UEQ) got completed. Section B consisted of a semi-structured interview that aided the researcher in gaining qualitative information from the participants. Throughout the user study, the researchers discussed how the user study proceeded and the participants' demographics that took part in the study. Difficulties that arose throughout the study also got investigated.

Chapter 5: Discussion discussed the results of the user study. The chapter analysed the four tasks completed in the user study and discussed these in-depth. We then evaluated the UEQ conducted and the interviews that occurred. Finally, we answered all four of our research questions outlined in section 1.2 Research questions.

Chapter 6: Conclusions concluded our thesis. Here we summarised and reemphasised the most critical findings. Chapter 6 discussed the findings, research questions, future work, and study limitations.

2 User experience and mobile devices

This chapter first analysed responsive web design before moving onto investigating user interface design and user experience design. We then delved into mobile devices, their design consideration, and the ergonomics of mobile devices in the context of design. Next, we examined eCommerce websites. Finally, we outlined current design solutions for navigation menus on mobile.

We aimed to understand the related work around the topic to help identify any potential gaps in the literature that required investigation. We highlighted a need for additional research to determine the usability of the hamburger menu in a modern mobile setting.

This chapter begun to answer RQ1, *What can affect a user's ability in the navigation of a mobile eCommerce website?* and RQ2: *What is the current state of the art navigation for mobile eCommerce websites?*

2.1 Responsive web design

Responsive web design is the development and design of websites to adapt and function on many devices, rather than just being optimised for one particular platform (Babich, 2020a). Responsive web design layouts typically include breakpoints and the use of grids to ensure an authentic experience across different possible devices (*Responsive UI - Layout*, n.d.).

2.2 User interface design

User interfaces are the visual source where interaction occurs between the user and the product (Babich, 2019). Good user interface design takes into consideration the actions a user takes and ensures a layout with ease of use (Garrett, 2011; Suzanne Martin, n.d.); *User Interface Design Basics*, 2014).

2.3 User experience design

A user's experience is an essential component of the interaction with a product. Leaving a positive impression on users in online shopping scenarios is vital (Fu et al., 2018). User experience encompasses the experience of interactions that take place between a user and an interface (Babich, 2019). Co-founder of the Nielsen Norman group Don Norman first used the term user experience in the 1990s (Babich, 2020b).

According to Nielsen and Norman (2014), "user experience encompasses all aspects of the end-users interaction with the company, its services, and its products." Nielsen and Norman (2014) mentioned some sound user experience requirements. These include the ability of the target user to achieve the required task and keeping things as simplistic as possible.

User experience deals with the form of a page or object, how content is displayed, and its function. Doing that helps provide optimal performance to a user where minimal confusion and difficulties are required to complete a task or interact with the object.

Garrett (2011) discussed user experience in his book *"The elements of User Experience",* stating that "user experience design often deals with the context" (Garrett, 2011).

Karr (2015) describes user experience as "*a continuum*—between a role and a process. On the far left, we find UX research, and on the far right, we find UX/UI design". Karr (2015) then discusses how user experience situates itself in the centre of this band. Karr's findings demonstrate that user experience is the design, the look and functionality that affect users' needs and their end interaction.

2.4 User experience vs customer experience

Customer experience and user experience are two very similar facets. Customer experience looks at user interactions with the company, whereas user experience focuses on digital interactions (Flahertry, 2019). Spool (2019) stated that they are the "same language, different dialects", with customer experience being mainly quantitative-based, dealing with marketing and selling products and what customers think they want. On the other hand, user experience is primarily qualitative-based, focusing on a user's behaviour and interaction with a product.

2.4.1 User Experience design principles

In the book *"the elements of user experience",* Garrett (2011) introduced a five plane diagram, defining the elements that go into user experience design, see *Figure 2: The Elements of User Experience (Garrett, 2011, p. 29)*. This diagram split up the many aspects of user experience into five easy to follow planes, each with a specific goal. *Table 1: The Elements of User Experience Planes Defined* brakes down the planes.

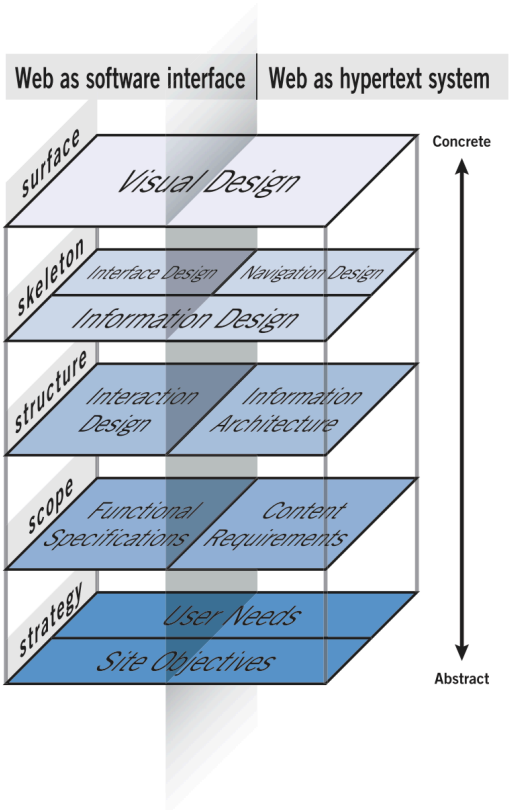


Figure 2: The Elements of User Experience (Garrett, 2011, p. 29)

Table 1: The Elements of User Experience Planes Defined

Plane		Description
1.	strategy	What are our users and we aiming to achieve?
2.	scope	Requirements to function and for the required content.
3.	structure	Puts a plan in place of how everything will come together.
4.	skeleton	Improves on the structure already defined to develop further and advance.
5.	surface	Moves from a more abstract wireframe to something with visual aesthetics and style.

The first plane, strategy, introduced two questions to be asked before proceeding too far into the design process *"What do we want to get out of the product? and What do our users want to get out of it?"* (Garrett, 2011). These questions demonstrated how the more we understand a product and user needs, the more successful a product could be.

Garrett (2011) introduced the second plane, scope. The scope identified requirements based on the product and user needs previously identified. These functional and content-related requirements help ensure everyone is all on the same page.

The third plane, structure, helped to fit the puzzle together. This structure helped define an outline of how the site would go together. Garrett (2011) explained how structure plays a part in switching from the abstract to concrete.

The fourth plane, skeleton, discussed by Garrett (2011) takes the abstract structure developed previously and cultivates this further to improve the functional aspects. The

skeleton is where the interface, information, and navigation combine to form an initial wireframe.

Finally, Garrett (2011) discussed the fifth plane, surface. The surface takes the wireframe formed in the skeletal phase and develops the site's visual aesthetic. This aesthetic takes the rational layout already designed and applies a visual style to organise the page elements.

2.5 Ecommerce websites

eCommerce websites are online platforms for selling and purchasing goods (eCommerce Guide, 2022). Mailchimp (2021) discussed how eCommerce allows people to purchase physical goods and services without venturing to a physical shop. This thesis focused on navigation for selling physical goods on eCommerce websites.

2.5.1 mCommerce websites

For this thesis, we specifically looked at mobile eCommerce websites, often referred to as mCommerce. mCommerce is like typical eCommerce websites; however, designed for mobile devices. More specifically, these are online platforms designed for on the move with mobile devices where a transaction may take place or get considered (Clemens et al., 2012; Liang, Huang, Yeh, & Lin, 2007).

2.6 Mobile devices

Mobile devices have been researched thoroughly in the context of design. This section discusses what mobile devices are, mobile device interface considerations, and ergonomics concerning design for mobile devices.

In recent years, mobile device screen sizes have rapidly increased, with a standard mobile screen size now sitting around six to seven inches wide (Statista, 2021). This gets featured in *Figure 3: Smartphone unit shipments worldwide by screen size from 2018 to 2022 (in millions) retrieved from Statista (2021).*

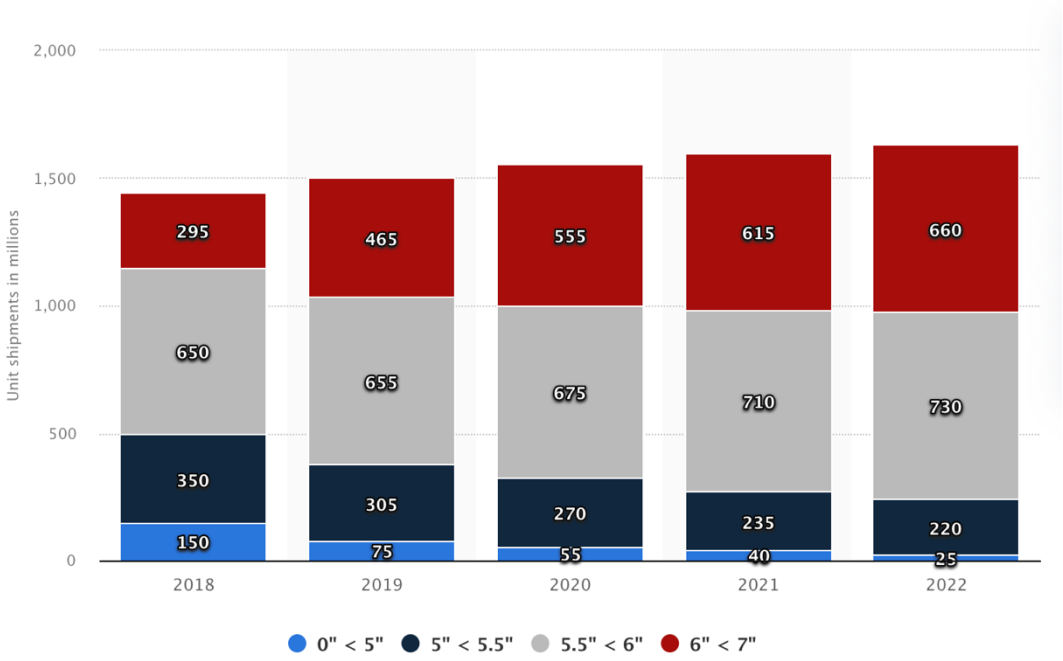


Figure 3: Smartphone unit shipments worldwide by screen size from 2018 to 2022 (in millions) retrieved from Statista (2021)

2.6.1 What are mobile devices

This thesis defined mobile devices as hand-held touch screen smartphone gadgets currently available on the market. These devices usually featured Android, Windows, or IOS operating systems; however, other alternate operating systems are becoming more apparent. Designing for these smaller mobile devices incorporates different attributes compared to their more evolved older sibling, the computer.

2.6.2 Mobile device interface considerations

This section introduced and discussed mobile interface design principles. The principles discussed are

1. Stick to a simple design (Ahmad, Rextin, & Kulsoom, 2018; Garcia-Lopez, Garcia-Cabot, de-Marcos, & Moreira-Teixeira, 2021; Garcia-Lopez, Garcia-Cabot, Manresa-Yee, De-Marcos, & Pages-Arevalo, 2017; Lobo, Kaskaloglu, Kim, & Herbert, 2011; Shitkova, Holler, Heide, Clever, & Becker, 2015)
2. Keep the inputs basic (Blanco et al., 2010; Liao et al., 2016)
3. Have a mobile-specific design (Clemens, Cata, & Hackbarth, 2012; Lobo et al., 2011)
4. Native apps and mobile websites both have their uses (Lobo et al., 2011; Nielsen, 2012)
5. Simplistic Navigation (Ahmad et al., 2018; Clemens et al., 2012; Garcia-Lopez et al., 2017; Lobo et al., 2011; Shitkova et al., 2015)

1. Stick to a simple design. As graphic designers, one of our key objectives is to ensure that the designs we are creating are kept straightforward and serve a purpose to the user.

Slower internet and smaller screens are two of the factors of mobile devices that make it imperative to stick to a simple design (Lobo et al., 2011). Easily identifiable iconography and emphasis on important information are highly beneficial, helping users see and recall something instead of searching for the required content (Garcia-Lopez et al., 2017; Shitkova et al., 2015). Nielsen (2011) stated that users will often leave web pages in 10 seconds; However, webpages containing a clear message often can gain a more extended attention period.

It is essential to ensure messages get communicated whilst keeping information to a minimum, making sure things are "brief and specific" (Ahmad et al., 2018). Interfaces of mobile devices should be kept simple and straightforward with minimal clutter, fancy flashy content, and double-ups no unneeded content that does not add to the message (Garcia-Lopez et al., 2021; Lobo et al., 2011; Shitkova et al., 2015).

2. Keep the inputs basic. Ahmad et al. (2018) discussed the importance of ensuring the number of touches to reach something should be kept to a minimum. The lack of real estate on mobile devices makes displaying a full-sized menu and large amounts of information difficult. Lobo et al. (2011) explained how using the search function to find the needed products can provide itself as a barrier, and the options of scrolling and browsing a site are much more engaging for users.

3. Have a mobile-specific design. With desktop and laptop computers being largely different in orientation and screen size to modern mobile devices, mobile-specific website design has proved to be essential for displaying content on mobile devices (Lobo et al., 2011). Clemens et al. (2012) identified that one of the critical issues in mCommerce design is scaling the desktop version of a site down to the size of a mobile device where the same vast array of information is not necessarily accessible to the user. Vanderschantz and Sijnja (2020) discussed product galleries on mobile devices. They identified that when webpages are not designed with a mobile device in mind, it can be challenging to achieve the required action.

The style and layout of a desktop website may not necessarily work when doing a mobile-specific design, so aspects such as font size and margins must often be reconsidered (Clemens et al., 2012). Clemens et al. (2012) discussed how the flow of information can and often needs to be separated out and often displayed over multiple pages. The aim is to minimise the amount of information displayed on mobile devices. The need to adapt the information displayed and re-define how it flows on a page at different scales is key to an exemplary user interface and experience (*Responsive UI - Layout*, n.d.).

4. Native apps and mobile websites both have their uses. Nielsen (2012) discussed the difference between native applications and mobile websites. Generally, A mobile application offers a more significant user experience than a mobile website due to having the opportunity to optimise the app depending on the device used. Nielsen discussed how there will be a shift away from this in the future, leading towards mobile websites. In the case of mCommerce, mobile websites got found to provide a better experience (Lobo et al., 2011).

The journal article *"Online retailing across e-channels and e-channel touchpoints: Empirical studies of consumer behavior in the multichannel e-commerce environment",* discussed that users view websites optimised for mobile use as having better ease of use and being more practical (Wagner et al., 2020).

5. Simplistic Navigation is highlighted as something important when it comes to the design of mobile interfaces. With screen space being considered extremely valuable, it is essential to optimise the navigations use of this to keep it to a minimum (Ahmad et al., 2018; Lobo et al., 2011). Another critical aspect of simplicity is ensuring that the navigation is kept consistent. Consistency ensures that users can easily recognise and navigate their way, minimizing the need for re-learning tasks (Ahmad et al., 2018).

Ahmad et al. (2018) discussed how at times, having multiple methods to reach the same destination can be beneficial as users with different experiences and backgrounds may use different methods to reach a destination. Clemens et al. (2012) supported this, stating that "Menus must be intuitive and the amount of browsing time reduced".

Shitkova et al. (2015) highlighted minimising the number of clicks it takes to reach each page and using single-level navigation as critical navigation components. It is also suggested that the menu gets kept to a minimum, avoiding options that get deemed unnecessary. To avoid scrolling and ensure ease of use, four to eight items are considered the maximum number of items within the navigation (Shitkova et al., 2015).

As smartphones have gotten bigger, navigational options have not considered this. In Tsiodoulos (2016) study, one of the participants identified issues on the 5" smartphone used. The participant determined that it was hard to effectively reach that top left-hand corner to access the version of navigation being used, in this case, a hamburger menu in the top left-hand corner. The participant was "afraid the phone would slip, as I like using the phone with one hand" and also stated that "It was challenging to reach the top left side" (Tsiodoulos, 2016). The research by Shitkova et al. (2015) supported this comment, stating that buttons should be positioned "on the right side of the screen."

2.6.3 Ergonomics and mobile devices

Ergonomics refers to the arrangement of items to suit the purpose and people they get designed. In the context of mobile devices, this is about the user, their hand, and the mobile device. Coursaris and Kim (2011) discussed the importance of considering the physical limitations of future devices throughout the design process.

Karlson and Bederson (2007) identified that people habitually prefer single-handed interaction with mobile devices. Using one hand enables users to complete supplementary tasks with their free hand*. Figure 4: Thumb Zone Map Retrieved from Hurff (2019),* published initially by Clark (2015) in his book "*designing for touch*"; identified the most commonly accessed locations on a phone screen; this image is based on Hoobers (2013) research. The readily accessible areas on a smartphone screen are green, and the hardest to access points are shown in red. The information presented here supports the statement made in the research by Nguyen (2015) noted previously, identifying that one of the participants in the study found reaching the top left-hand corner of the 5" device challenging.

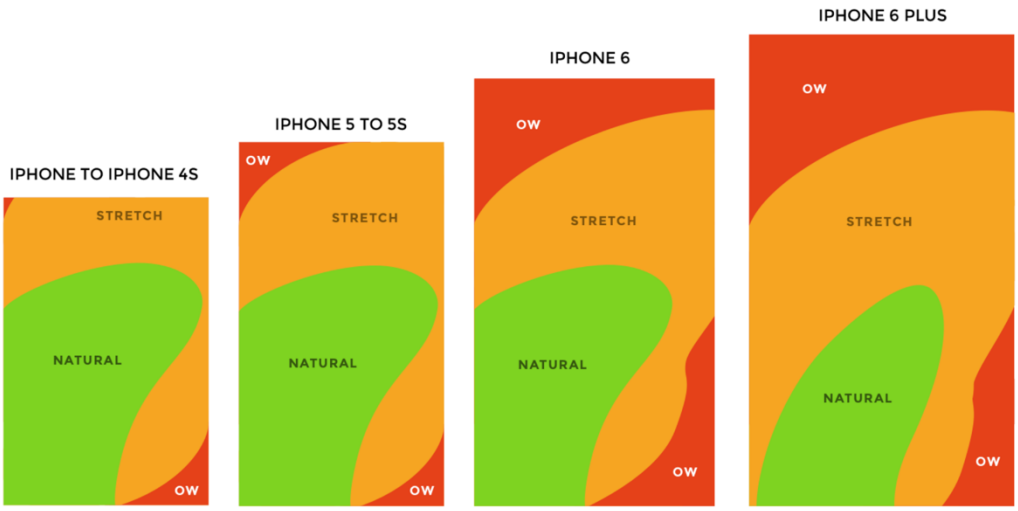


Figure 4: Thumb Zone Map Retrieved from Hurff (2019)

Nguyen (2015) discussed the importance of designing for both left and right-handed users. Nguyen demonstrated that modern interface designs need much improvement in the layout of items on a screen for single-handed interaction. When designing for small screen interfaces such as mobile devices, it is vital to consider this single-handed accessible area of the thumb. Areas similar to the top left-hand corner can be challenging to assess when holding the device with only the right hand (Wroblewski, 2011).

Ingram (2016) wrote an article titled "The Thumb Zone: Designing For Mobile Users" that further explored these ideas. In this article, Ingram defined easy-to-reach, hard-to-reach, and in-between areas. Ingram (2016) discussed the importance of designing with the thumb zone in mind. As technology evolves and device sizes change, the thumb zones will be something that remains crucial when it comes to designing for mobile devices. Katzenbach (2019) emphasised how the most challenging location to reach on a mobile device is the top left-hand corner.

2.7 Navigational design solutions

The following section discusses the design-related navigational solutions for mobile eCommerce websites. The bottom bar navigation menu, top bar navigation menu and hamburger menu are all forms of navigation discussed.

2.7.1 Bottom bar menu

A bottom bar menu is a form of navigation considered exposed navigation (Katzenbach, 2019). Exposed navigation means that users can see the navigation options without entering a menu.

Bottom navigations typically display three to five destinations to allow quick and straightforward movement between crucial areas of a website. As stated in Google Material Designs (n.d.), the bottom bar navigation is efficient because it is ergonomic and easily accessible, appears consistently throughout a website, and all navigation options are equally important.

Tsiodoulos (2016) completed a study comparing the bottom bar menu to the hamburger menu on a 5" device. Tsiodoulos (2016) discovered that although the results were very similar, users' experienced a marginally higher efficiency with the bottom bar menu, even though this was considered a relatively 'new' form of navigation to some of the users. As we have highlighted from Statista (2021), smartphone screen sizes have increased by approximately 20% since this study was completed.

2.7.2 Top bar menu

The top bar navigation typically presents information to the user related to the information a user is currently seeing on the screen. Google Material Designs (n.d.) talked about the top bar menu being visible at first sight and disappearing on the scroll, and having consistent content. It is common in top bar navigation to also have an overflow menu. This functions as a hamburger menu and holds the information that the top bar menu could not display efficiently.

2.7.3 Hamburger menu

The hamburger menu is a navigation solution commonly featured on either the top left or top right-hand side of the screen. This solution hides the navigation options of the screen until the user interacts with the icon. The menu then displays the options to the user (Garczarek-Bąk, 2016). The hamburger menu is aptly named because it takes the form of a hamburger; this gets featured in *Figure 5: The Hamburger Menu* below. When navigating mobile websites, the hamburger is a form of navigation that is commonly seen. The Hamburger menu is often referred to as a "hidden" navigation form (Katzenbach, 2019).

Figure 5: The Hamburger Menu

According to Campbell-Dollaghan (2014), the hamburger menu was first introduced in the early 1980s through the Xerox star's personal workstation; an early graphical user interface (GUI). Xerox's designer at the time was Norm Cox. Norman was responsible for the design of the navigation. Cox created the icon to signify that a list gets hidden behind this icon to a user. Campbell-Dollaghan (2014) contacted Norm Cox to enquire about this and find out more. Cox stated that:

> *Its graphic design was meant to be very "road sign" simple, functionally memorable, and mimic the look of the resulting displayed menu list. With so few pixels to work with, it had to be very distinct, yet simple. I think we only had 16x16 pixels to render the image. (or possibly 13x13... can't remember exactly).*

In contrast to the popularity of the hamburger menu, there has been previous concern about how it performs from a user experience standpoint. Abreu (2014) stated that "what's out of sight is out of mind". Katzenbach (2019) also discussed the use of hidden navigation compared to partially or fully exposed navigation. She identified that 86% of people will use a combo navigation option compared to 57% who use hidden navigation.

2.8 Summary

This chapter has begun to help address RQ1, *What can affect a user's ability in the navigation of a mobile eCommerce website?* and RQ2: *What is the current state of the art navigation for mobile eCommerce websites?*

The literature has shown us that there has been research completed on the user experience of mobile eCommerce websites. A key finding from the literature discussed user experience and customer experience and the user experience design principles. The literature has also shown that research has been completed on mobile devices and navigation surrounding these. Key findings from here were the application of thumb zones on mobile devices, mobile device interface design considerations, and navigational design solutions on eCommerce websites. Discussions surrounding the navigation on mCommerce are beginning to occur. Investigation into the literature has highlighted that additional research is required to determine the usability of navigation menus within a modern mobile setting.

Ergonomics have demonstrated to be an essential part of designing for mobile devices. Thumb zones proved to be an aspect of this that is relevant to modern and future design when designing for mobile devices (Ingram, 2016). Because people prefer single-handed interaction on mobile devices (Karlson & Bederson, 2007), it is crucial to consider the hard to reach screen areas when designing for mobile.

The research presented by Tsiodoulos (2016) discovered that users experienced a marginally higher efficiency when using the bottom bar menu compared to the hamburger menu. As we have highlighted from Statista (2021), smartphone screen sizes have increased by approximately 20% since this study was completed. Navigation options were further investigated, but further research was needed into navigation for mobile devices due to technological advances.

2.8.1 Beginning to answer RQ1

RQ1, *What can affect a user's ability in the navigation of a mobile eCommerce website?*

We identified ergonomics as a significant factor in the navigation of mobile eCommerce websites. We have learnt that previous research has helped us gain insight into ergonomics and navigation on mobile devices. Technological advancements have been made in recent years that could affect this.

2.8.2 Beginning to answer RQ2

RQ2: *What is the current state of the art navigation for mobile eCommerce websites?*

Our research into the related work investigated the navigational design solutions currently used for mobile eCommerce websites. Three main navigation options were identified, the bottom bar menu, the top bar menu, and the hamburger menu. Further research is required to develop this topic and identify the current state of the art option in navigation for mobile eCommerce websites.

3 Case Study of mobile navigation solutions

This chapter details a case study that analysed the navigation options of ten mobile eCommerce websites' navigations. This case study aimed to understand the different mobile navigations on these websites and learn the most used design solution. This was completed using a set of navigation questions and Nielsen's usability heuristics to assess the usability. These findings also help us investigate what improvements could be made to mobile eCommerce website navigation options to provide a more optimal user experience.

The findings help us answer *RQ2: What is the current state of the art navigation for mobile eCommerce websites?* and *RQ3: What design interventions can be developed to help the user manoeuvre more successfully throughout a mobile eCommerce website?*

The case study also helped us to define improvements which could be made to mobile eCommerce navigation options. These improvements were then implemented in a prototype which is discussed further in chapter 4.

3.1 Methodology

We conducted a case study that investigates ten mobile eCommerce websites. This case study focused primarily on the navigation of these websites.

First, we analysed each of the navigation in detail. Specifically, we discussed any notable features that differ within the navigation from the case study and the deficits of the navigation design. To assess whether the websites followed a set of usability principles, a heuristic valuation got conducted (Nielsen, 1994b). The researchers then compared the usability of the navigation options discovered in the case study against Nielsen's usability heuristics to learn if there were any usability issues.

Our literature review in Chapter 2 has demonstrated that very few studies identify the state-of-the-art menu for the navigation of mobile eCommerce websites. Because of that, this case study was designed to fill that gap. We will also answer *RQ2: What is the current state of the art navigation for mobile eCommerce websites?* This research question must get answered before identifying how navigation options could be improved to help the user manoeuvre throughout a mobile eCommerce website.

As well as identifying the state-of-the-art navigation, the case study also investigated the requirements for the navigation prototypes. These prototypes were developed in section 4.1. The prototypes then were tested in the user study completed in chapter 4.

3.1.1 Mobile eCommerce website selection

To select the mobile eCommerce websites used in this case study, we investigated the top 10 eCommerce websites in New Zealand based on net sales. Statista (2019) identified the following shops as the most popular ten online stores in 2018 based on net sales.

- Countdown - *countdown.co.nz*
- The Warehouse - *thewarehouse.co.nz*

- Mighty Ape - *mightyape.co.nz*
- Noel Leeming - *noelleeming.co.nz*
- PB Tech - *pbtech.co.nz*
- Farmers - *farmers.co.nz*
- Bunnings - *bunnings.co.nz*
- Mitre 10 - *mitre10.co.nz*
- Kmart - *kmart.co.nz*
- NZ Sale - *nzsale.co.nz*

See *Figure 6: Most popular online stores in New Zealand in 2018 by e-commerce net sales retrieved from Statista (2019)*, for a further breakdown of these websites' ranking. These websites contained a range of online-only eCommerce shopping and traditional stores with eCommerce websites to support them. Many of the brands investigated also have a mobile app available. It would be interesting in future to investigate whether this mobile application contains a better user experience when it comes to navigation; however, that was outside of the scope of this study.

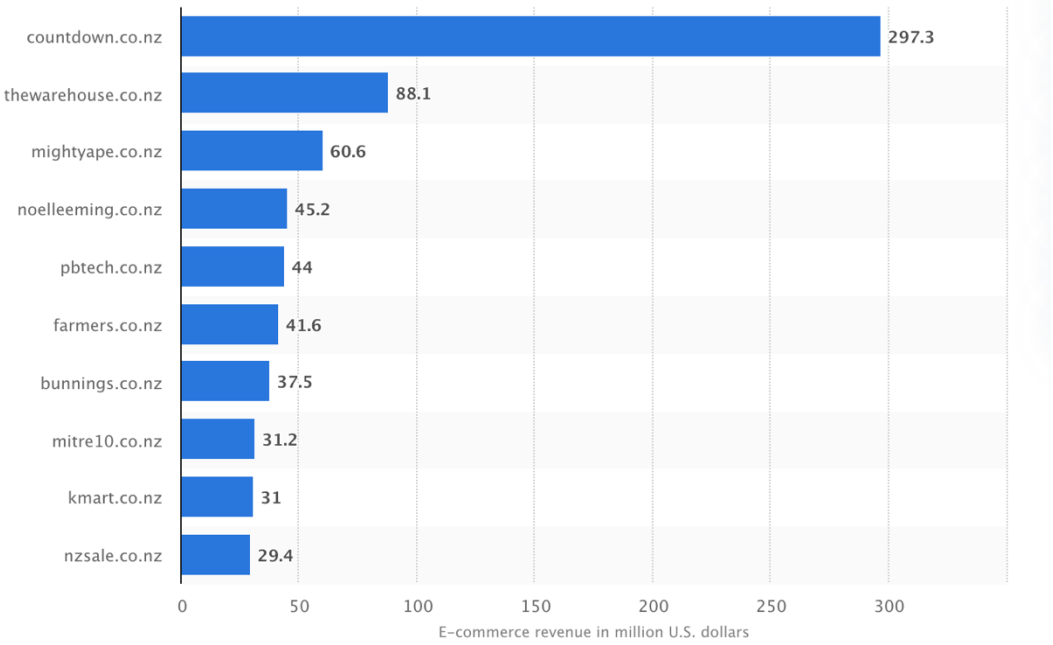


Figure 6: Most popular online stores in New Zealand in 2018 by e-commerce net sales retrieved from Statista (2019)

3.1.2 Testing platform

A mobile device was used for testing the websites in this case study. This device was a 5.1" Huawei P10 smartphone released in 2017. The device operated on a stock Android operating system. It was factory reset before testing to ensure that nothing pre-installed on the device could influence how these mobile eCommerce websites functioned.

3.1.3 Analysis guidelines and questions

When looking into the navigation of the mobile eCommerce websites listed above, we considered multiple aspects. During the case study, the questions asked about each mobile eCommerce website are featured in *Table 2: Questions asked in the Case Study.*

The answers to these questions are displayed in *Table 5: Mobile Website Navigation comparison*. Alongside this base set of questions, we will also delve into depth on the navigations visual and functional key features.

Table 2: Questions asked in the Case Study

Question Number	Questions
1	What was the navigation used?
2	What is the positioning of the navigation?
3	What visuals are associated with this navigation?
4	Was the navigation fully functioning?

Analysis Q1: What was the navigation used? This question aimed to determine and identify which navigation options were used on the specific mobile commerce website. Understanding which navigation were used in each website allows us to gather knowledge surrounding the trends for the most common ones and variations of different navigations. This also allowed us to discover which navigation methods identified in our literature review currently get used in successful mobile eCommerce websites.

Analysis Q2: What is the positioning of the navigation? The positioning of the navigation can have a significant influence around overall usability. This question helped us in gaining an understanding of what positioning gets used commonly for navigation options.

Analysis Q3: What visuals are associated with this navigation? This question looked at what the user sees when interacting with the navigation on a mobile eCommerce website. The specific visuals of the navigation that we discovered are a good indicator of what users are used to seeing as prompts for their navigation experience.

Analysis Q4: Was the navigation fully functioning? This question gave us the ability to gauge whether the options tested on the websites were fully functioning and bug-free or if they had issues affecting how the user interacted with the specific option.

3.1.4 Heuristic evaluation method

Nielsen's heuristics were selected as a guide in analysing the usability of each of the navigations investigated in this case study. To guide the analysis of the navigation, Nielsen's nine usability heuristics were applied. Nielsen (1994a) compared seven existing sets of usability heuristics to develop a refined set of nine usability heuristics. Nielsen (2020) then added the tenth heuristic to this. These ten heuristics apply to real-world interfaces and are outlined *in Table 3: Nielsen's Ten Usability Heuristics*. A further breakdown of these heuristics in relation to the ten mobile eCommerce websites we are looking at in this case study is featured in *Table 4: Nielsen's Heuristics in relation to our study*.

Table 3: Nielsen's Ten Usability Heuristics

	Heuristic	Description
1	Visibility of system status.	Provide feedback to the user based on the received information and any tasks that have been undertaken. Features of the interface can be seen adapting as the user interacts, and any feedback is promptly provided.
2	Match between the system and the real world.	Speaks the users' language while following real-world conventions. The interface uses any existing background knowledge that the user may have.
3	User control and freedom.	Undo and Redo actions are supported with clearly marked exits. Tasks have forgiveness and allow the user freedom to do what they want.
4	Consistency in standards.	Consistency expresses the same thing in the same way. Commands are universal. Information is displayed in similar ways throughout.
5	Error prevention.	Errors do not occur in the first place.
6	Recognition rather than recall.	Minimising the users' memory load. Instead of remembering, the user receives visual see-and-point reminders.
7	Flexibility and efficiency of use.	The physical interaction with the system feels natural to the user. The user can initiate and control actions and can re-order or cancel tasks. Shortcuts are available to help speed up dialogue.
8	Aesthetic and minimalistic design.	The interface should be aesthetically pleasing.
9	Helping users recognise, diagnose and recover from errors.	Error handling methods are in place to help the user recognise, diagnose and recover from errors.
10	Help and Documentation	If required, help and documentation should be supplied to the user.

Table 4: Nielsen's Heuristics in relation to our study

	Heuristic	Evaluation Details
1	Visibility of system status.	Feedback is provided to the user.
2	Match between the system and the real world.	The navigation utilises the existing background knowledge the user has. The language used in the navigation is that the user can understand.
3	User control and freedom.	Navigation tasks have forgiveness and allow the user freedom to do what they want. Undoing an action is supported.
4	Consistency in standards.	Consistency within the navigation. Universal commands get used. Similar information gets displayed in consistent locations on the device screen.
5	Error prevention.	The navigation prevents errors from occurring in the first place.
6	Recognition rather than recall.	The layout of the navigation utilises visuals and iconography. The layout of the navigation enhances the user's recognition of the interface. Interface relays to the user what they have selected to this point.
7	Flexibility and efficiency of use.	The user has multiple ways to complete tasks. The physical interaction with the navigation feels natural to the user. The placement of the navigation enhances the completion of tasks.
8	Aesthetic and minimalistic design.	The design features a minimalistic approach. The aesthetics enhance the completion of tasks. Mobile screens get considered in the design of the navigation.
9	Helping users recognise, diagnose, and recover from errors.	The user is provided with help when necessary.
10	Help and Documentation.	Understandable and simple documentation is supplied when applicable.

3.2 Study structure

The study was carried out over multiple days with all the images of the navigation being captured on Tuesday 7th July 2020. We first investigated the most used eCommerce websites in New Zealand. Once the websites to study were identified, we then completed the analysis by asking four main questions. These are outlined previously in *Table 2: Questions asked in the Case Study*. We also completed a heuristic evaluation based on Nielsen's Heuristics; these can be seen in relation to our study previously in *Table 4: Nielsen's Heuristics in relation to our study.* The analysis of each website was completed using a 5.1" Huawei P10 smartphone released in 2017. When offered an app and a mobile site, the mobile site was used.

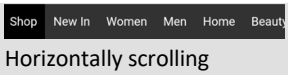
3.3 Results

In this section, we detail the results of the case study. The results cover the overall mobile eCommerce website analysis. This includes the visual design of the navigation and the functionality of these. Following this, we discuss a heuristic evaluation.

3.3.1 Mobile eCommerce website analysis

This section details the navigation styles featured in the ten websites identified. *Table 5: Mobile Website Navigation comparison* lists the top 10 eCommerce websites in New Zealand as stated by Statista (2019) and answers the case study questions outlined in *Table 2: Questions asked in the Case Study.*

Table 5: Mobile Website Navigation comparison

ID	Mobile Website	Navigation Type	Navigation Position	Navigation Visuals	Fully Functional
1	Countdown.co.nz	Hamburger	Top Left		Yes
2	Thewarehouse.co.nz	Hamburger	Top Left		Yes
3	Mightyape.co.nz	Hamburger	Top Left		Yes
4	Noelleeming.co.nz	Hamburger	Top Right		Yes
5	Pbtech.co.nz	Hamburger	Top Left		Yes
6	Farmers.co.nz	TopBar Menu	Top of the page, below the logo and search bar		Yes
7	Bunnings.co.nz	Hamburger	Top Right		Yes
8	Mitre10.co.nz	Hamburger	Top Left		Partially
9	Kmart.co.nz	Hamburger	Top Left		Yes
10	Nzsale.co.nz	TopBar Menu	Top of the page below the logo	 Horizontally scrolling	Yes

A notable point from *Table 5: Mobile Website Navigation comparison* is that website eight, *Mitre10.co.nz* lacks full functionality. This created difficulties for users navigating the website. The navigation in this website would often load the content for the top-level category selected rather than showing the user the subcategories that would sit under it.

The hamburger menu was popular in the websites investigated through the case study. This demonstrated that the hamburger is the most used navigation on mobile eCommerce websites.

The hamburger made up 80% of the sample in this case study, highlighted in *Table 5: Mobile Website Navigation comparison*. Of these eight, five of the menus were in the traditional top left-hand corner, with only three located in the website's top right-hand corner. *Figure 7: Case study websites with a Hamburger Menu* display the sites' screenshots using hamburger menus. All hamburger menus have very similar functionality regarding the features. The only significant difference between all eight is the positioning.

In all instances of the hamburger menu, the user was initially presented with the top-level or main categories when it first opened. The user could select one, and its subcategories would then appear to help the user be more specific in their category selection. There were some differences in how these subcategories got revealed. This is covered in the analysis of the individual websites following.

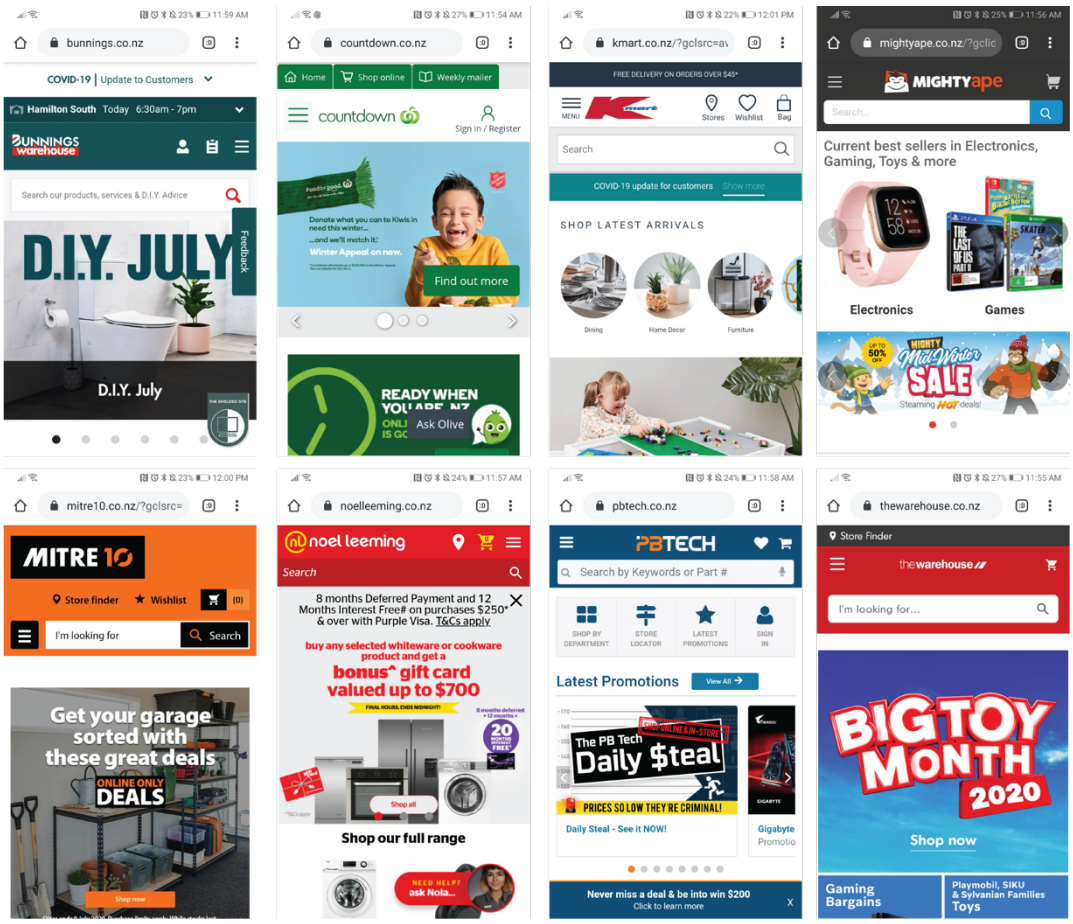


Figure 7: Case study websites with a Hamburger Menu

We then analysed each of the navigation styles in detail. Specifically, we will discuss any notable features that differ within the navigation from the case study, the benefits of the navigation design, and the deficits of the navigation design.

3.3.1.1 *Countdown analysis*

The Countdown navigation pictured in *Figure 8: Countdown Navigation*, was relatively simple featuring the hamburger in the top left-hand corner of the device.

The Countdown navigation used a single level of options where the user simply selects the website's area. With no further filtering or subcategories needed, they then get taken there. From the literature reviewed in chapter 2, a bottom bar navigation could potentially have worked better in this circumstance to minimise the number of clicks it takes for a user to navigate to their desired destination. Countdown is the only website from this case study with this feature.

After the case study, it was noted that the shopping options here get located under the shop online tab. This was overlooked in the case study and highlights that the discoverability of the navigation on mobile websites is an essential aspect in preventing this from happening.

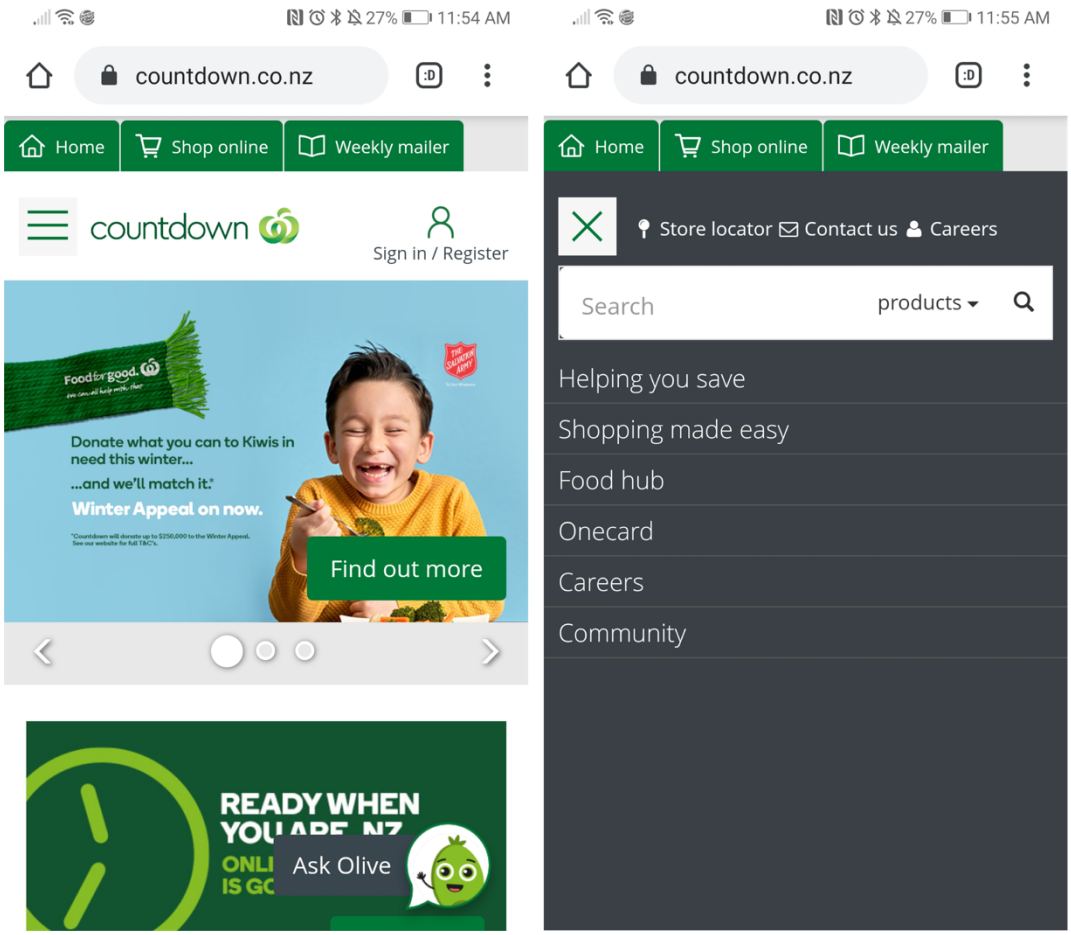


Figure 8: Countdown Navigation

3.3.1.2 *The Warehouse analysis*

The navigation used on *thewarehouse.co.nz* can be seen in *Figure 9: The Warehouse Navigation.* The Warehouse featured a hamburger menu in the top left with multiple levels so that the user can narrow it down to the specific category that they require.

The Warehouse clearly showed the user where they are in the navigation by giving the category a dark grey background.

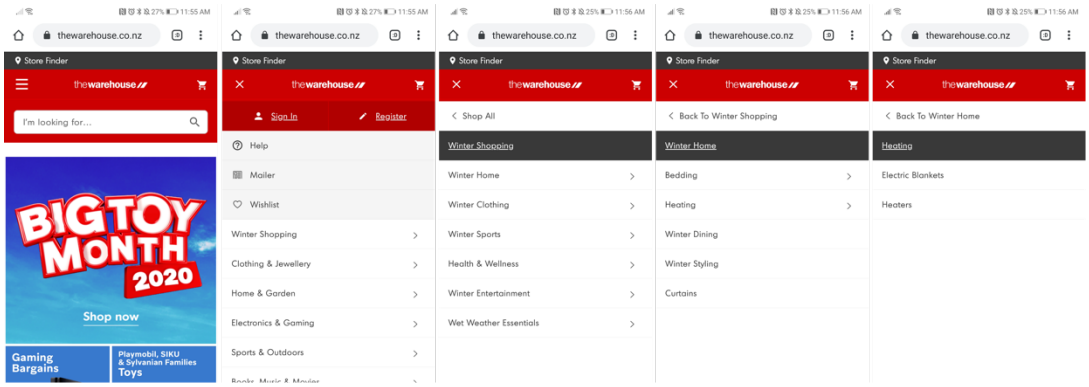


Figure 9: The Warehouse Navigation

3.3.1.3 *Mighty Ape analysis*

The Mighty Ape navigation is featured in *Figure 10: Mighty Ape Navigation.* The icons were helpful when testing for the case study as they added a heavily visual element to help picture what exactly will be in that final category. The Mighty Ape navigation featured a standard hamburger menu in the top left-hand corner of the screen. One difference from many other navigations is how it gets the user to select their destination. Once the user chooses their category in the Mighty Ape navigation, they are taken to a separate screen to select their destination (shown in the screen on the far right of *Figure 10: Mighty Ape Navigation*).

The Mighty Ape navigation featured iconography within the navigation option. These icons prove helpful and aid in quickly visualising what each of the categories within the option are available.

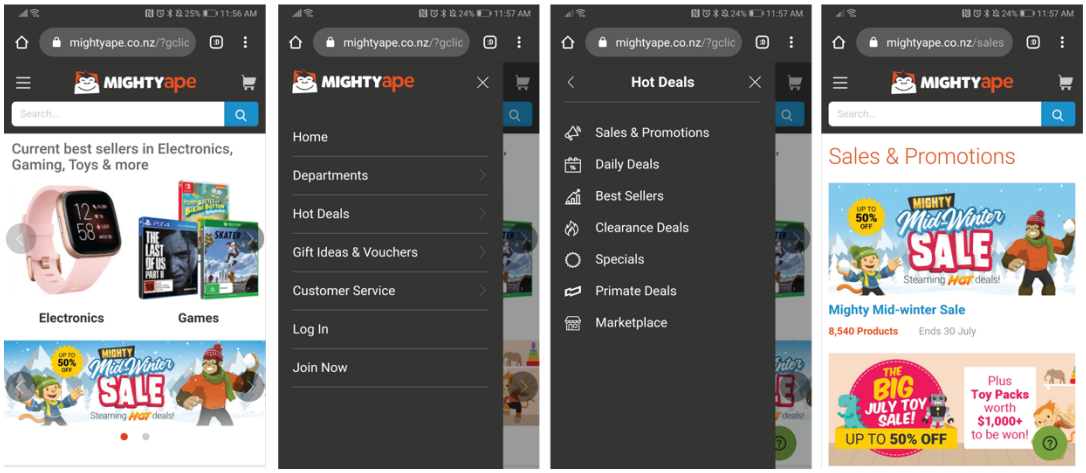


Figure 10: Mighty Ape Navigation

3.3.1.4 Noel Leeming analysis

The Noel Leeming navigation featured in *Figure 11: Noel Leeming Navigation* was the first of our navigations to utilise the hamburger menu in the top right-hand corner of the screen. This differs from the navigations previously seen in the top left. The benefit of this being in the top right is that it is in a slightly more advantageous position for the user to access; however, as identified in our literature review, it is still out of reach for many people on modern smartphones. The Noel Leeming navigation also dropped down to show the user the lower-level categories rather than loading a new page; this improved the workflow and streamlines the user's process by preventing the need to relearn the content on the page. During testing, this helped the researcher recognise precisely where they were in the navigation. It also meant that they could easily see where they had been previously and view other options.

The navigation could have been more transparent in showing the structure. This could have aided eye flow when glancing at the navigation to learn where you are at speed.

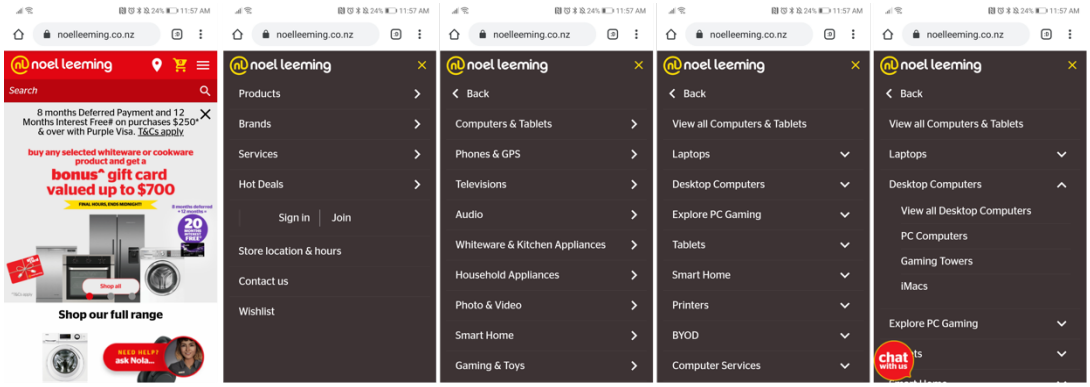


Figure 11: Noel Leeming Navigation

3.3.1.5 PB Tech analysis

The PB Tech navigation had similar functionality to Mighty Ape. The PB Tech navigation uses a hamburger menu in the top left-hand corner of the screen and gets featured in *Figure 12: PB Tech Navigation*. The user is taken to a separate page (shown in the third section of *Figure 10: Mighty Ape Navigation*) to help select their destination. Again, this iconography is proven helpful as it gives the user visual cues to recognise where the user intends to go next.

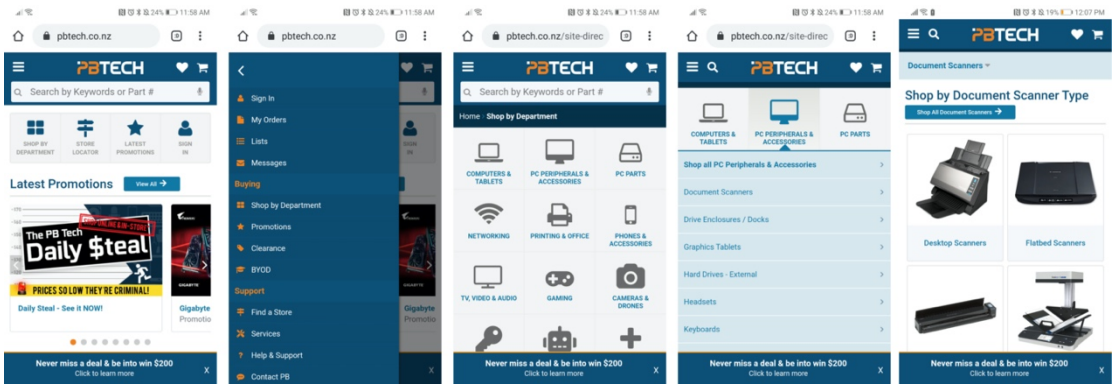


Figure 12: PB Tech Navigation

3.3.1.6 *Farmers analysis*

The Farmers website was the first in this case study to use top bar navigation. This can be seen in *Figure 13: Farmers Navigation*. The top bar navigation used by Farmers is an effective way of manoeuvring throughout the website. The navigation incorporated iconography that aids in relating the category to the real-world items they represent. The icons add a visually recognisable element to each category.

The one major downfall to this navigation option was that there were still specific buttons on the far left of the top bar that was difficult to reach.

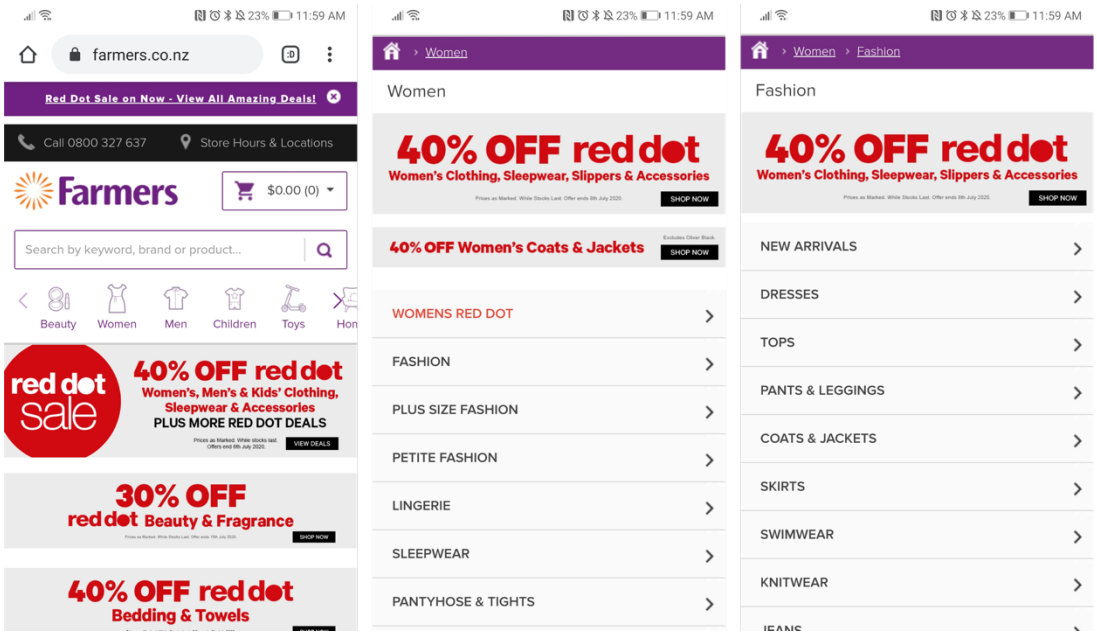


Figure 13: Farmers Navigation

3.3.1.7 *Bunnings analysis*

The Bunnings navigation can be seen in *Figure 14: Bunnings Navigation*. Like many of the navigation seen so far, Bunnings used a hamburger menu; however, it is the second example to consider the knowledge learnt from section 2.4. Bunnings positions the hamburger menu in the top right-hand corner so that it is a more accessible section of the screen. This navigation location could again be improved by taking larger smartphones into account and moving to a position closer to the bottom of the screen.

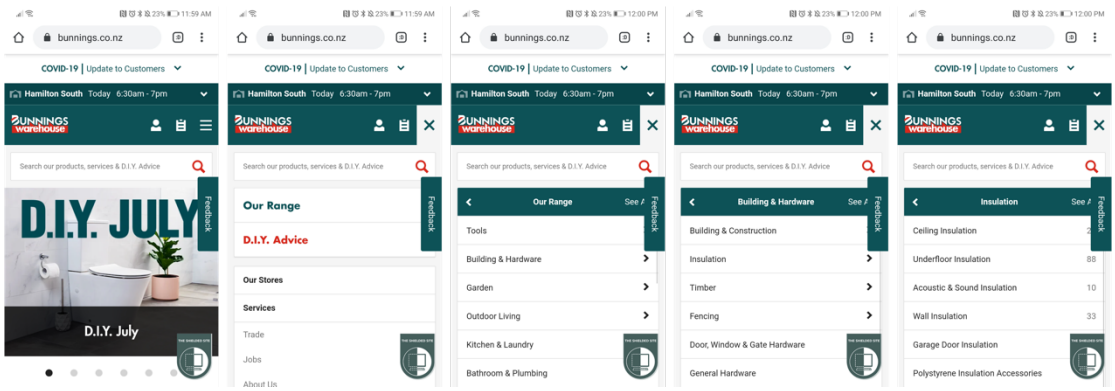


Figure 14: Bunnings Navigation

3.3.1.8 Mitre 10 Analysis

The Mitre 10 navigation gets featured in *Figure 15: Mitre 10 Navigation.* Mitre 10 used a very similar navigation option with their hamburger menu internals to that seen in Noel Leeming; however, it highlights the most necessary navigational element in a tone to highlight the most critical item to the user.

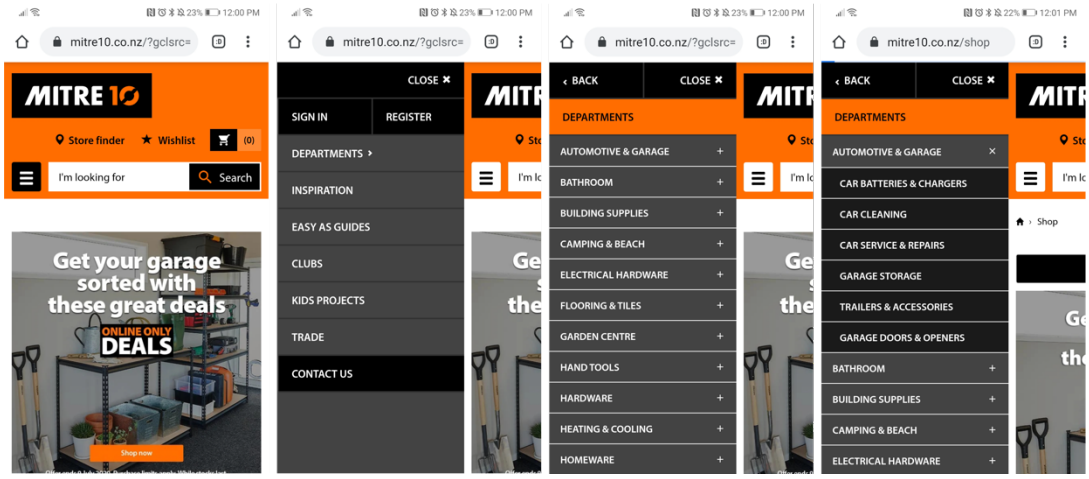


Figure 15: Mitre 10 Navigation

3.3.1.9 Kmart analysis

The Kmart navigation option can be seen in *Figure 16: Kmart Navigation*. Kmart's navigation used a hamburger menu located in the top left-hand corner. The information within the hamburger is exceptionally alike to that seen in both Mitre10 and Noel Leeming.

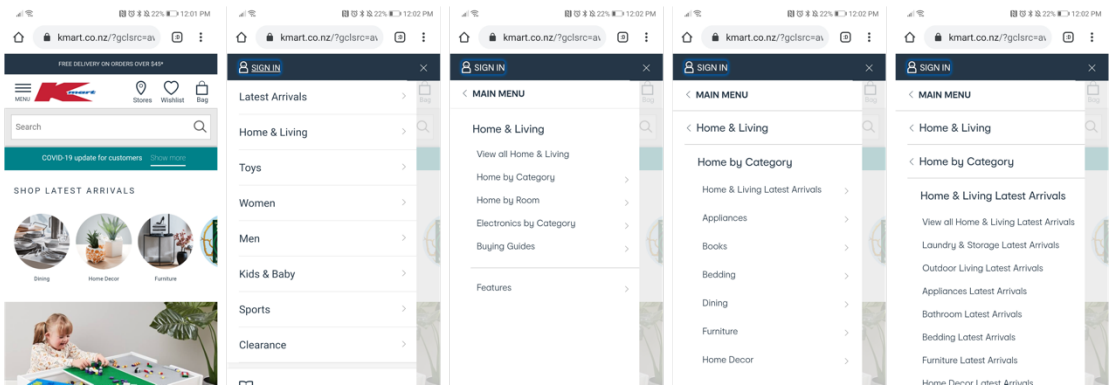


Figure 16: Kmart Navigation

3.3.1.10 NZ Sale analysis

A Topbar was the navigation used for the *nzsale.co.nz* website; this gets featured in *Figure 17: NZ Sale Navigation*. Users were able to browse sections by reading the labels. The visual design for the NZ Sale navigation felt lacking in information due to the loss of the recognisable symbols featured previously on the Farmers navigation *in Figure 13: Farmers Navigation*.

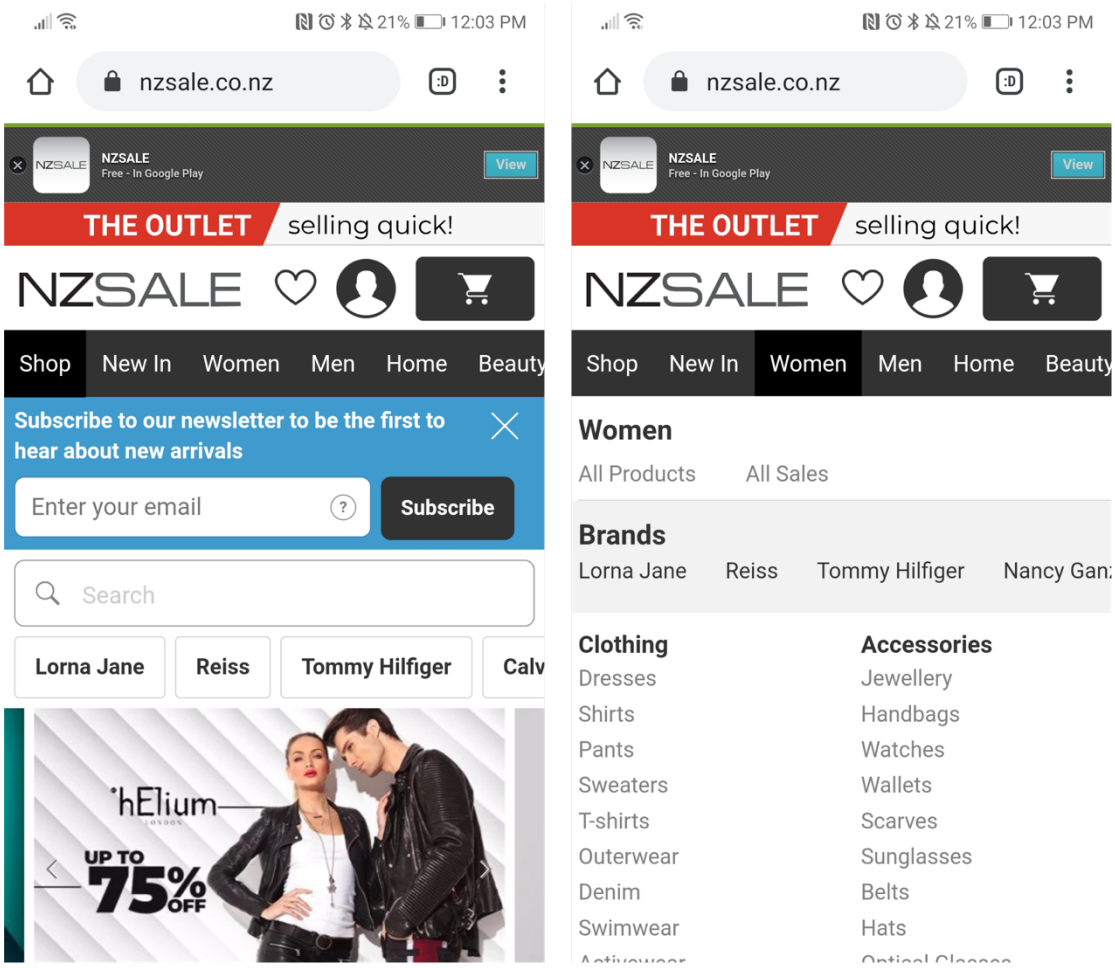


Figure 17: NZ Sale Navigation

3.3.2 *Answering analysis questions*

Here we answer the questions set out in *Table 2: Questions asked in the Case Study.* To recap, these questions were

1. What was the navigation used?
2. What is the positioning of the navigation?
3. What visuals are associated with this navigation?
4. Was the navigation option fully functioning?

The answers addressed below are summarised in *Table 5: Mobile Website Navigation comparison.*

Answering Analysis Q1: What was the navigation used? This question aimed to determine and identify which navigation gets used on the specific mobile commerce website. We learnt that only two of the navigation identified in our literature review are used on the ten mobile eCommerce website studies, the hamburger, and the top bar navigations. Eight of the ten websites used the hamburger menu, and the remaining two used the top bar menu.

Answering Analysis Q2: What is the positioning of the navigation? The positioning of the navigation can have a significant influence surround overall usability. Of the eight websites studies using the hamburger menu; six were in the top left-hand corner, and

two were in the top right. The two navigations that used the top bar menu had them positioned at the top of the page.

Answering Analysis Q3: What visuals are associated with this navigation? The primary form of navigation experience was the hamburger menu icon. Additionally, buttons and iconography also were used to indicate an option or navigational functionality.

Answering Analysis Q4: Was the navigation fully functioning? This question gives us the ability to gauge whether we were fully functioning and bug-free or if it had issues that would affect how the user interacted with the specific navigation. Nine of the ten websites identified in the case study were fully functioning and bug-free.

3.3.3 Heuristic evaluation

This section reviews a heuristic evaluation that compares each navigation option to Nielsen's nine usability heuristics. An outline of Nielsen's usability heuristics can be seen in *Table 3: Nielsen's Ten Usability Heuristics*. These heuristics are then further outlined in relation to this case study in *Table 4: Nielsen's Heuristics in relation to our study.* This heuristic evaluation has demonstrated that the heuristics set out by Nielsen (1994a) are still relevant in analysing the navigation options on mobile eCommerce websites.

As seen in *Table 6: Heuristic Evaluation,* for the most part, the website's studies met the heuristic guidelines set out by Nielsen (2020). When a website failed a heuristic, this usually fit into the *User Control and Freedom*, *Error Prevention, Consistency in Standards, Recognition Rather than Recall or Flexibility* and *Efficiency of use heuristics.* All the websites that we investigated performed well in terms of *Visibility of system status, Match between the system and the Real World, Aesthetic and Minimalistic design* and *Helping users Recognise Diagnose and Recover from errors.* Many of the heuristics were evident in numerous navigations, which allowed them to confine to Nielsen's heuristics.

One website had an issue where the function of selecting an item within the navigation would often load the content for the top-level category selected rather than showing the user the subcategories that would sit under it. The lack of full functionality caused difficulties as a user navigated the website.

Table 6: Heuristic Evaluation

	Countdown.co.nz	Thewarehouse.co.nz	Mightyape.co.nz	Noelleeming.co.nz	Pbtech.co.nz	Farmers.co.nz	Bunnings.co.nz	Mitre10.co.nz	Kmart.co.nz	Nzsale.co.nz
Visibility of system status.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Match between the system and the real world	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
User control and freedom.	✓	✓	✗	✓	✓	✗	✓	✓	✓	✓
Consistency in standards	✓	✓	✗	✓	✗	✓	✓	✓	✓	✗
Error prevention.	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓
Recognition rather than recall.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗
Flexibility and efficiency of use.	✗	✗	✗	✓	✗	✓	✗	✗	✗	✗
Aesthetic and minimalistic design.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Helping users recognise, diagnose and recover from errors	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Visibility of system status. Feedback is offered to the user regarding where and what they have selected within the navigation.

Match Between the system and the real world. The language used throughout the navigation was what the user would use in real-life situations. There was a slight variation between some websites; however, all language, both textual and visual icons, always ensured that the user could quickly determine what the term meant.

User control and freedom. Most of the websites performed well here, providing users with the opportunity to go back within the navigation hierarchy they felt they needed to. Websites that failed this heuristic tended to be because they did not support more flexible navigation, allowing users to browse through the categories seamlessly.

Consistency in standards. Many of the navigation investigated had a consistent and well-defined style and guidelines for their navigation. There were no unforeseen surprises as the user navigated through, which meant they had to re-learn the options. There were navigation options that did not confine to this consistent layout and standard. Usually this occurred when the initial navigation would be a standard hamburger menu and then progressed to a radically changed imagery-based navigation. PB tech is an excellent example of this in *Figure 18: PB Tech Hamburger*, which shows the hamburger menu used initially in the PB Tech Navigation option. *Figure 19: PB Tech Product Menu* demonstrates the radical change in this navigation to a more natural product-focused imagery later in the users' interaction.

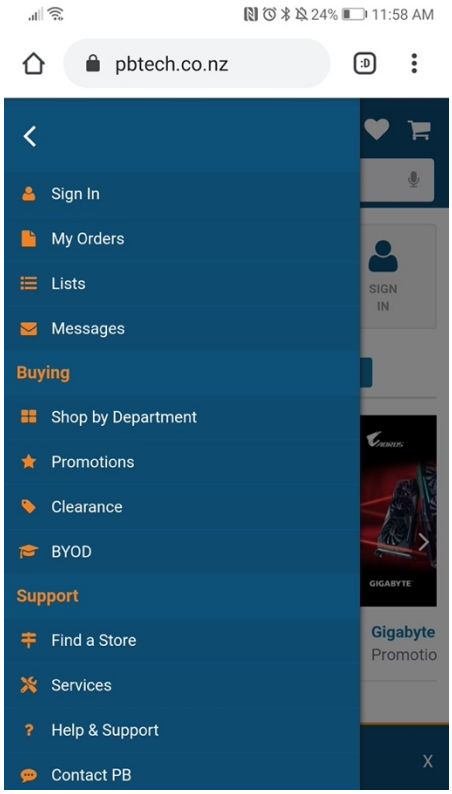


Figure 18: PB Tech Hamburger

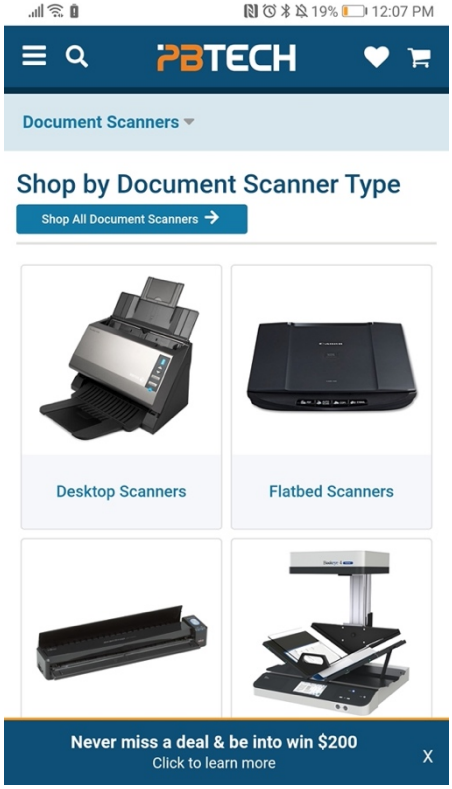


Figure 19: PB Tech Product Menu

Error Prevention. All but one navigation was designed to fully function, and users had the full opportunity to complete the tasks required with the navigation. The only navigation that did not meet this particular heuristic was Mitre10. As we discussed

earlier, the Mitre10 navigation was not fully functioning and had bugs that meant the user could often not adequately complete the required task error-free.

Recognition Rather than Recall. Although not all websites used visual iconography in their navigation, all but one navigation option met this heuristic. This was because the options fulfilled the requirements. All layouts utilised aim to enhance the user's recognition of the interface. The interface relayed the information on previous actions to get to the current point. During the study, websites that excelled in this heuristic incorporated visual iconography within the navigation. This allowed users to have a more visual experience than reading each item on the screen.

Flexibility and Efficiency of Use. Not all navigation options offered flexibility when it came to completing tasks. This led to users having to assess and work out how exactly the option wanted the job to get completed. The navigation location was also not always positioned so that it was easily accessible to the user and able to be interacted with naturally.

Aesthetic and Minimalistic Design features a minimalistic approach, avoiding unnecessary clutter. Aesthetic and minimalistic design refers to the consideration of mobile-friendly design for the overall navigation. All navigations took this into account and had a mobile-friendly style.

Helping Users Recognise Diagnose and Recover from Errors. All navigation methods provided the user with the necessary tools to recover from errors. Although not always built into the navigation, all navigations worked with the back functionality standard on mobile browsers that acted as an escape route for the user when needed.

3.4 Discussion

By analysing ten highly-rated mobile eCommerce websites' navigation options, we have discovered one main navigation style that is the most commonly used, the hamburger menu. The second style that we found frequently applied was the top bar menu.

We found eight out of the ten websites using the hamburger menu. We hypothesise that this is a common and well-known option for navigation that often gets implemented because of users' familiarity with the navigation. The two remaining websites implemented the top bar menu, proving a practical navigation option. Although not commonly seen, this option provided to be straightforward, although at times felt lacking in different categories that users could need within the navigation.

Each option had downfalls that compromised the experience; many of these issues were addressed in other navigations investigated in the case study. The researcher identified that all navigations were placed at the top of the device screen. Our literature review discussed previously identified the top of the screen as one of the most challenging locations to reach, in this study that factor was observed and enforced. The researcher, a right-handed user, struggled to reach the navigation throughout the study, especially in the device's top left-hand corner. The struggles led to having a negative experience with this aspect of navigation. The researcher identified a factor that led to a more positive and streamlined experience: the inclusion of iconography within the navigation.

Icons proved to be paramount when quickly recognising a category as there was the opportunity to scan the options quicker.

It was noticeable that websites using the hamburger menu had a similar navigation layout. The content and the branding in the navigation were one of the major differentiating factors. More differences were noticeable surrounding whether websites placed the navigation in the top left- or right-hand corner and how the navigation's hidden content dropped down. However, the overall layouts and styles were similar. Whether this is to aid in familiarity mentioned previously or the commonality of use is hard to say. There are reasons outside the scope of this study that could come into this.

3.5 Summary

This case study testing different navigation options identifies the hamburger menu as the predominant navigation option for mobile eCommerce websites, specifically in the top left-hand corner. Because of this, we will carry the hamburger menu in the top left-hand corner to Chapter 4: User study of two navigation prototypes developed and conducted. We will develop a second navigation menu to help form a comparison to learn if the hamburger menu in the top left-hand corner is the most effective navigation form. This navigation will focus on a bottom bar navigation option; however, it will expand to include fixes to some of the issues identified with the navigation in this case study.

Going forward into Chapter 4: User study of two navigation prototypes developed and conducted, develop two prototypes to test and outline the methodology for a user study based on these two prototypes.

3.5.1 Answering research question 2.

Research question two was, *What is the current state of the art navigation for mobile eCommerce websites?*

From this case study, we have identified that the hamburger menu in some form makes up 80% of the eCommerce websites in the case study. Specifically, we have discovered that the common navigation on mobile eCommerce websites is a hamburger menu in the top left-hand corner of a mobile device's screen. In this case study, the menu in the top left-hand corner of the device made up 50% of the navigation options investigated in the study and accounted for 75% of all hamburger menus featured in the websites discussed.

From this, we can conclude that the hamburger menu located in the top left-hand corner of a mobile website is a frequent navigation option selected for mobile eCommerce websites.

4 User study of two navigation prototypes developed and conducted

This chapter outlines prototype development and a user study methodology that looked at two different navigation options on mobile eCommerce websites. The study delved into what optimal navigation would be. This user study aimed to help identify the ideal navigation for mobile eCommerce websites and presents how different options affect users' experiences.

This chapter then detailed a user study procedure looking at two different navigation options on mobile eCommerce websites. This user study aimed to help identify the ideal navigation option for mobile eCommerce websites and how different navigations affect users' experiences. This user study aids us in answering *RQ1: What can affect a user's ability in the navigation of a mobile eCommerce website?, RQ3: What design interventions can be developed to help the user manoeuvre more successfully throughout a mobile eCommerce website?* And *RQ4: Can an adapted and refined navigation improve a user's experience on mobile eCommerce websites?*

In total twenty-four studies were conducted. These studies took place over six weeks, from 30th August to 8th October 2020. Each of these studies took approximately half an hour.

4.1 Prototype design decisions and considerations

It was concluded in chapter 3 that the bottom bar navigation functioned optimally. The most frequent navigation was identified as the hamburger in the top left-hand corner of the device. The researchers developed two prototypes based on these. This section discusses the design of the two prototypes.

To complete the user study following, two prototypes were developed. Prototype A is a standard hamburger navigation in the top left-hand corner of the device. Prototype B featured a navigation that consisted of a hamburger menu in the bottom right-hand corner of the device and an adapted bottom bar menu based on the *nzsale.co.nz* and *farmers.co.nz* websites.

4.1.1 General aesthetics

Both Prototype A and Prototype B were designed using adobe XD and were inspired by the Google Material Designs (n.d.) guidelines. It is important to note that both prototypes were designed around the same website. The site category was a gender-neutral, outdoors-focused website with the fictional name of Yaba. Apart from the navigation, nothing else changed within the site tested in each prototype

The typeface used stayed consistent throughout both prototypes. The leading and kerning were kept standard, with no significant adjustments to ensure consistency and familiarity. The sole typeface selected for the prototype was Source Sans Pro. Source sans pro was selected as a sans-serif typeface that is highly recognisable among users. Source sans pro is also the typeface recommended through Google Material Designs and is, therefore, one commonly used on websites.

The iconography also stayed consistent between the prototypes. These icons were mainly selected from the Font Awesome database (*Font Awesome*, n.d.). A second set was used where font awesome did not have the required icon on hand for either of the prototypes. This second set of icons followed the same base style; however, it was purchased and licensed through creative market for use in the two navigation prototypes.

4.1.1.1 Language and imagery

As outlined in Nielsen's heuristics, using the user's language is an integral part of any interface design. Because of this, standard eCommerce language was used throughout both prototypes.

We ensured that both prototypes used the language and phrasing constantly to help consistency further. This consistency also helped ensure that it could not influence the users' navigation preferences in the testing phase.

All lifestyle imagery for the prototype were sourced from pexels.com under a Creative Commons 0 License. Product imagery was retrieved from other various sources.

4.1.2 Design decision implementation

This section will cover the implementation of the design considerations outlined in section 4.1

4.1.2.1 Developing prototype A

Prototype A is standard hamburger menu in the top left-hand corner of the device. Prototype A was based on the navigation option location featured in the five eCommerce websites studied with their hamburger navigation in the top left-hand corner; ID numbers one, two, three, five, eight and nine. The hamburger menu's internal organisation was based on the websites with ID numbers four, eight and nine.

The only significant difference from the navigation option identified in the case study was that we decided to move the prototype's search button. This was done to be more subtle; furthermore, emphasis could be made on the navigation itself getting tested rather than the other elements in the prototype.

4.1.2.2 Developing prototype B

To help learn whether the hamburger menu in the top left-hand corner featured in prototype A is the most effective navigation form, we needed to present a comparison. Therefore, we also developed a second navigation option; prototype B. Prototype B again incorporates a hamburger menu; the hamburger was identified as a valid form of navigation in the literature review and the case study.

Alongside using the hamburger menu in prototype B, it also incorporates the bottom bar navigation. Although the bottom bar navigation did not get featured in the case study, the literature review's information has indicated that it is likely the easiest to use navigation option for mobile devices.

This bottom bar navigation was based on the top bar navigation featured on the *farmers.co.nz* website. The top bar navigation by Farmers proved to be an effective way

of manoeuvring throughout the site. The symbols used in the navigation matched the real-world items they represented, adding a visually recognisable element to each category. We will be bringing the idea for these symbols forward into our bottom bar navigation prototype. Although the top bar navigation was an effective way of manoeuvring throughout the website, it was still tedious to select some of the navigation buttons along the screen's top; we have opted to use the bottom bar navigation.

The literature review highlighted the bottom bar navigation as an effective navigation solution. However, this navigation had downfalls surrounding its ability to perform when there are many categories. By incorporating the hamburger menu into this bottom bar navigation and calling out critical categories alongside it, we should remedy this rather than calling out the full range as the Farmers website does.

4.1.3 Design summary

The prototype website 'Yaba' was designed as a unisex website to test the navigation options. Yaba aimed to present the standard functionality of a mobile e-commerce website, including the requirements for the navigation option set out previously in section 4.1.2.1.

The prototype getting tested was located locally on the researcher's device and was not something that the participant could gain access to outside of testing. Chapter 3 introduces this same testing device in the case study.

There were two navigation options presented on the prototypes; prototype A and prototype B. The hamburger menu positioned in the top left-hand corner of the device (the identified status quo) was labelled as Prototype A. This complied with the guidelines we set out based on the state-of-the-art navigation. A bottom bar menu that also featured a hamburger menu on the far-right hand side down the bottom was labelled prototype B. Prototype B implemented the suggestions made in section 4.1.2.2 and were offered as the second prototype in the user study testing.

The hamburger menus for prototype A and prototype B are featured in *Figure 20: Prototype A* and *Figure 21: Prototype B* respectively.

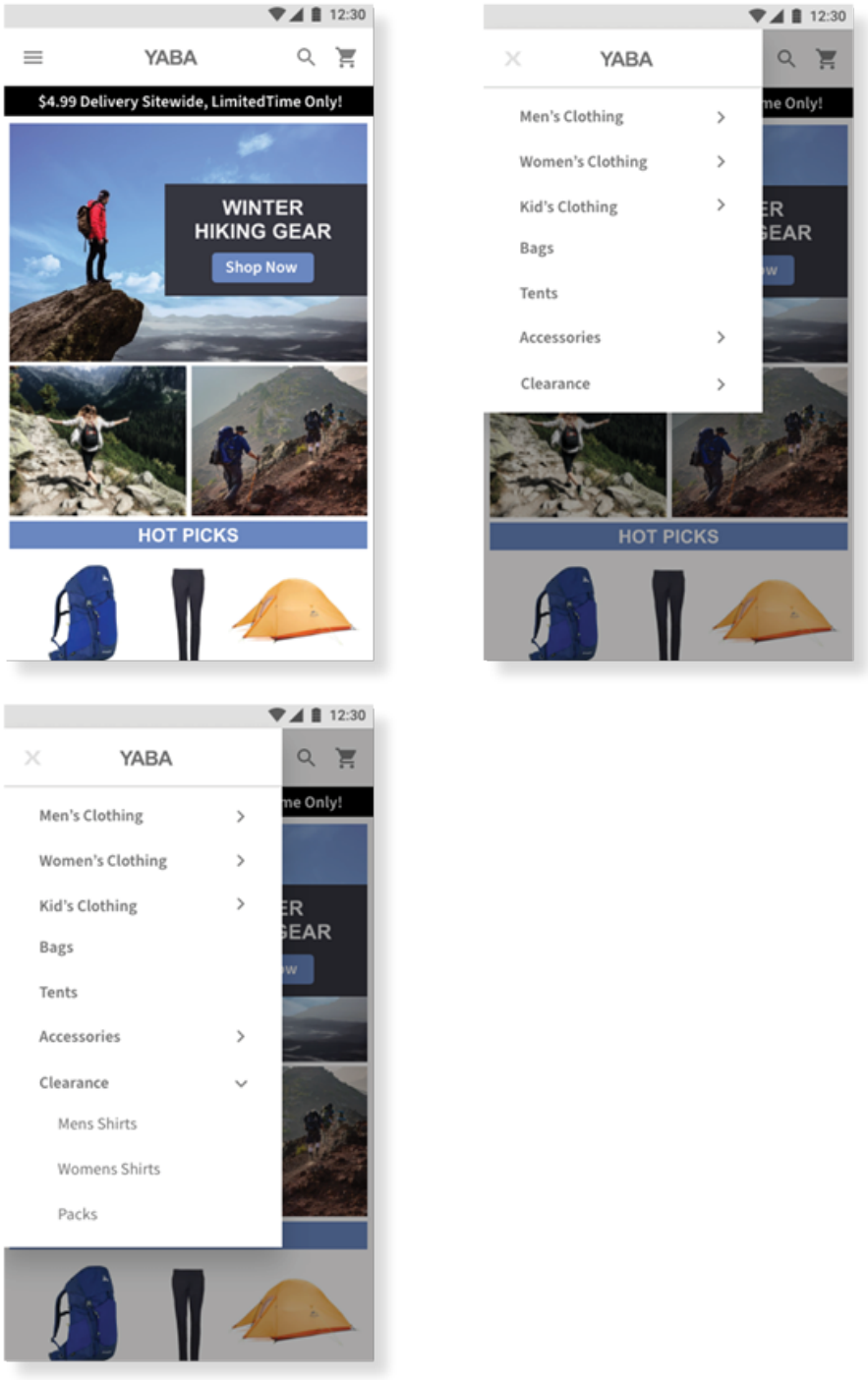


Figure 20: Prototype A

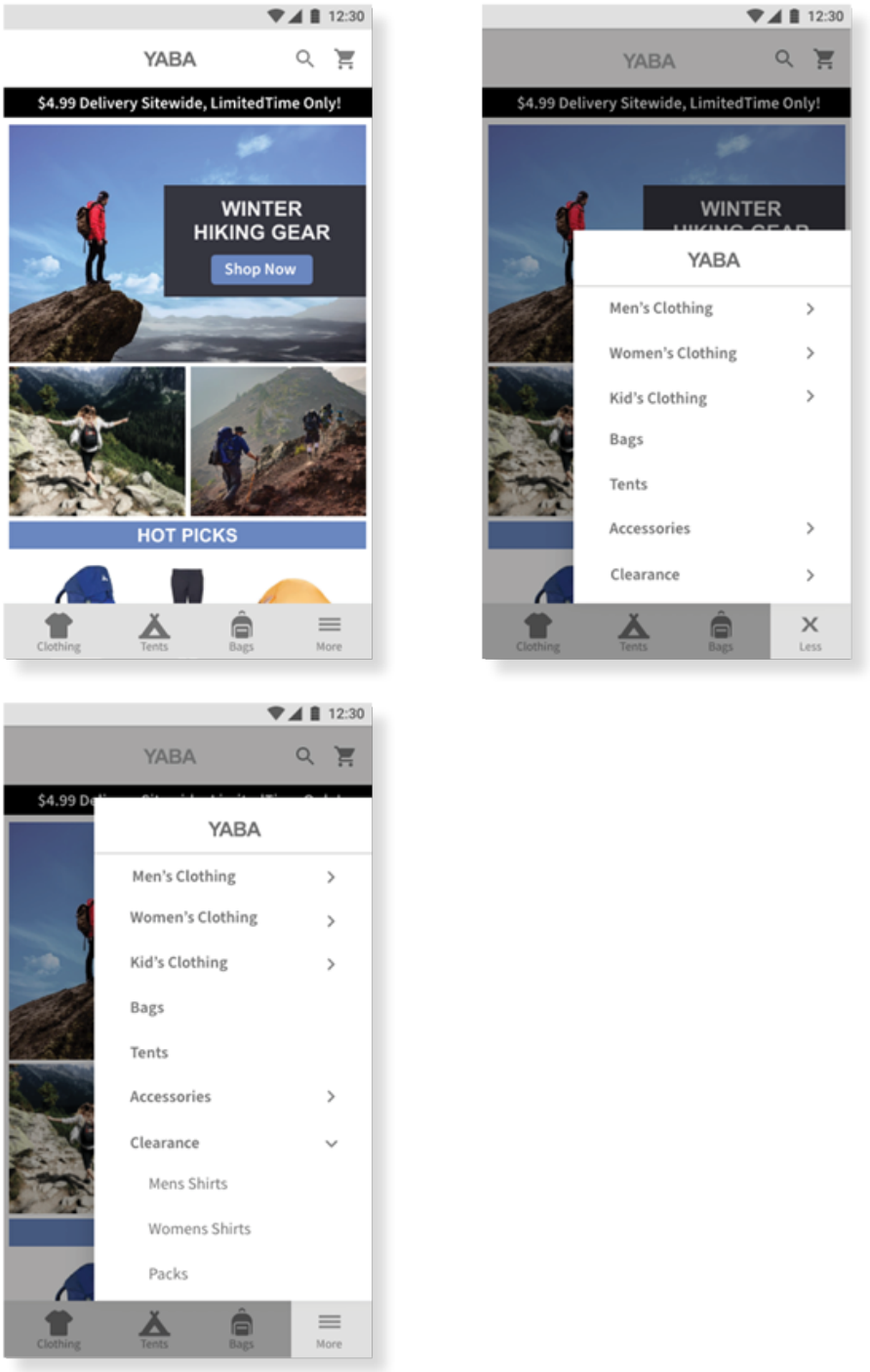


Figure 21: Prototype B

Three key category icons are featured on prototype B. These helped the user to have a more direct path to their specific locations. These three categories were identified as being the most popular to navigate to on the website designed for the prototype. Bags and tents send the user directly to the category removing one step and simplifying the proses for the user on commonly used options. This is demonstrated in *Figure 22: Prototype B - Bags and Tents.*

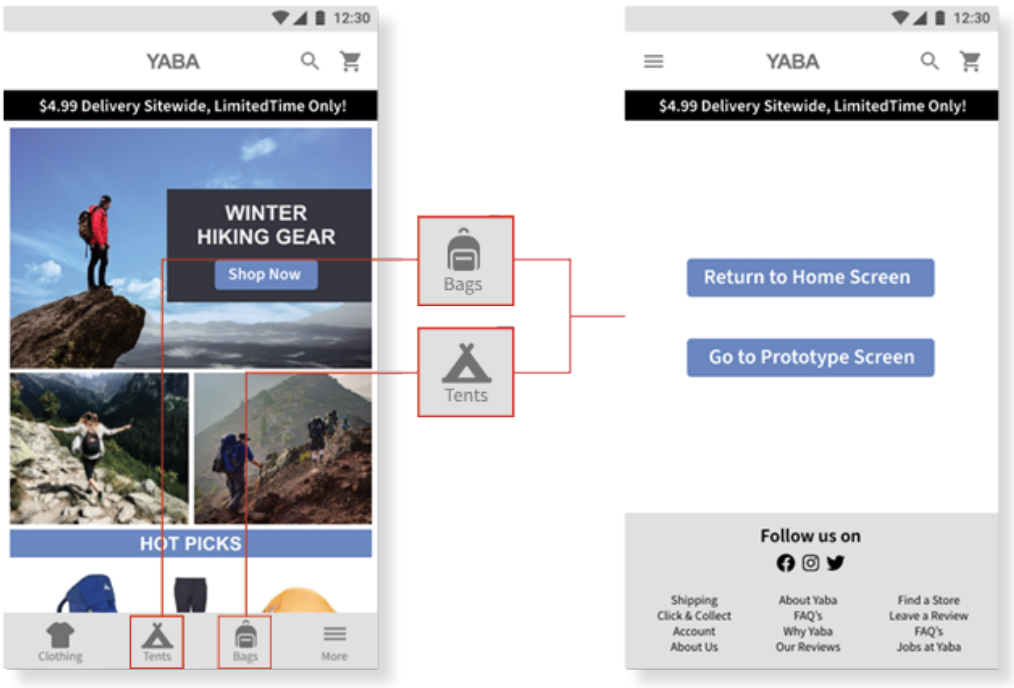


Figure 22: Prototype B - Bags and Tents

The clothing icon sends the user to a separate clothing screen that displays all of the options. The icon removed the need to manoeuvre through multiple dropdowns within the navigation that was featured in *Figure 23: Prototype B - Clothing Via Hamburger Menu*. The option to go through the hamburger menu in the bottom right-hand corner was still available to the user if this is how they would prefer to navigate.

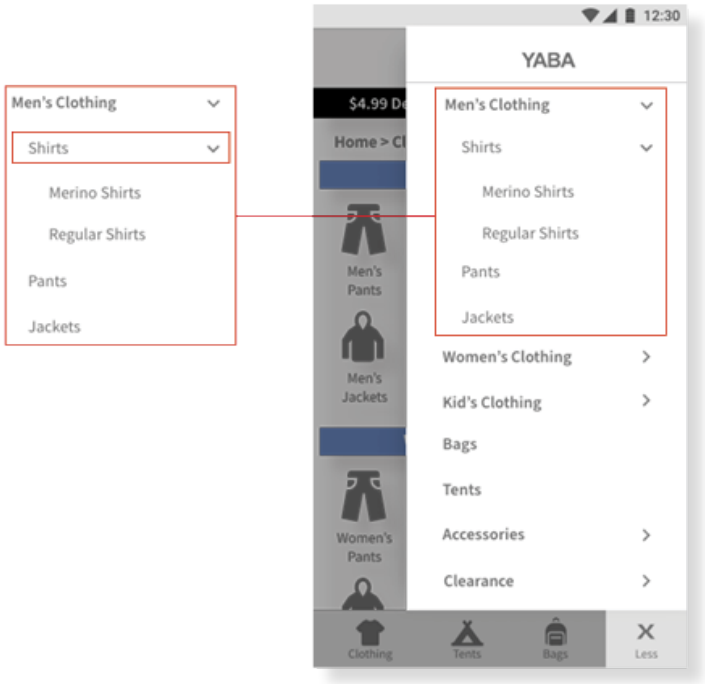


Figure 23: Prototype B - Clothing Via Hamburger Menu

The clothing screen for the alternate navigation method can be seen *in Figure 24: Prototype B – Clothing*. This removed the need to navigate via stacked dropdowns within the hamburger menu. The clothing page adds a visual aid to a section of the website with many options. The visual use of the icons is to aid the recognition of categories, and to provide a visual match between the word and an actual item representative of it.

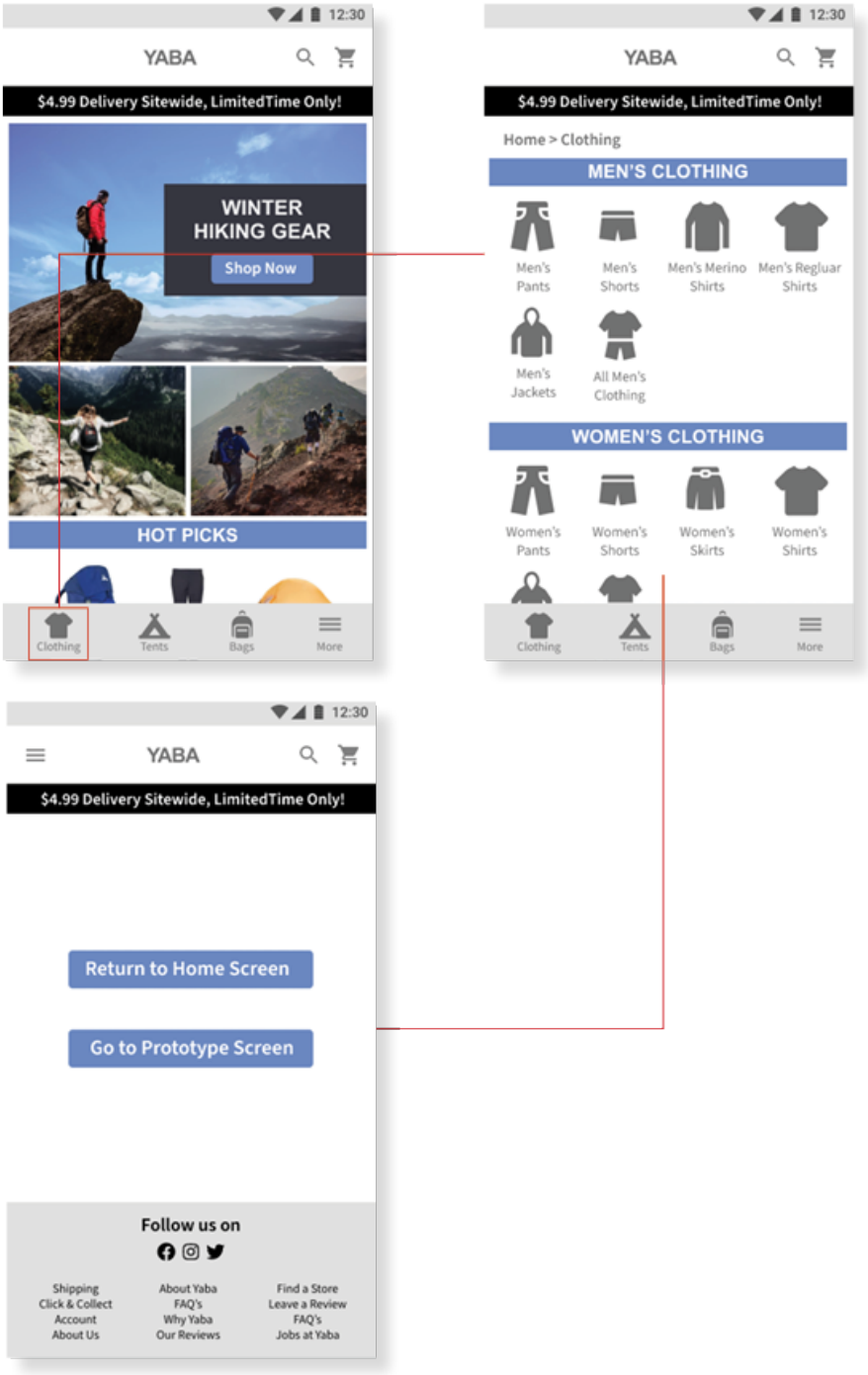


Figure 24: Prototype B – Clothing

4.2 Methodology

The user study contains two main sections. The first; section A, focused on an observation and two questionnaires. The second; section B, focused on a semi-structured interview. Doing this helped us to gather both quantitative and qualitative information. We explored users' preferences in navigation options on mobile eCommerce websites and understood each navigations user experiences. A flow of the overall structure can be seen in *Figure 25: User testing flow chart.*

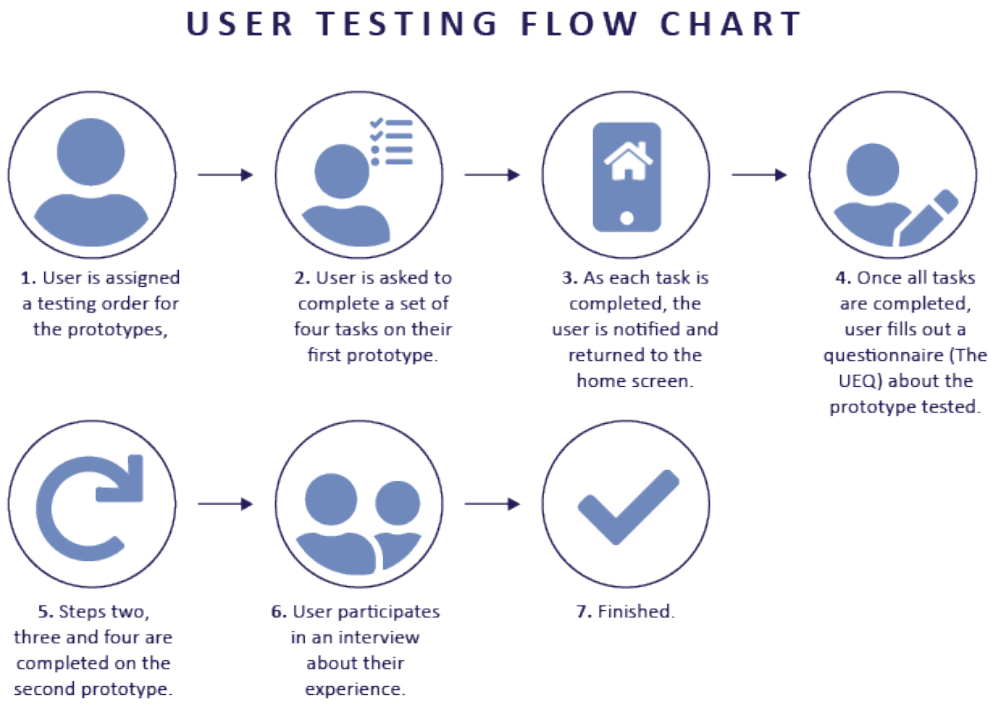


Figure 25: User testing flow chart

Ethics were applied for and approved through the HECS department at The University of Waikato prior to the study occurring. The ethical approval letter for this study is featured in *Appendix A.*

There were twenty-four participants in total. The studies ran over six weeks, from the 30th of August to the 8th of October 2020. These studies took approximately half an hour each. All participants were from NZ and spoke fluent English.

4.2.1 Section A

Section A of the user study observed the following structure. An overview of this structure can be seen in *Figure 26: User testing flow - Section A.*

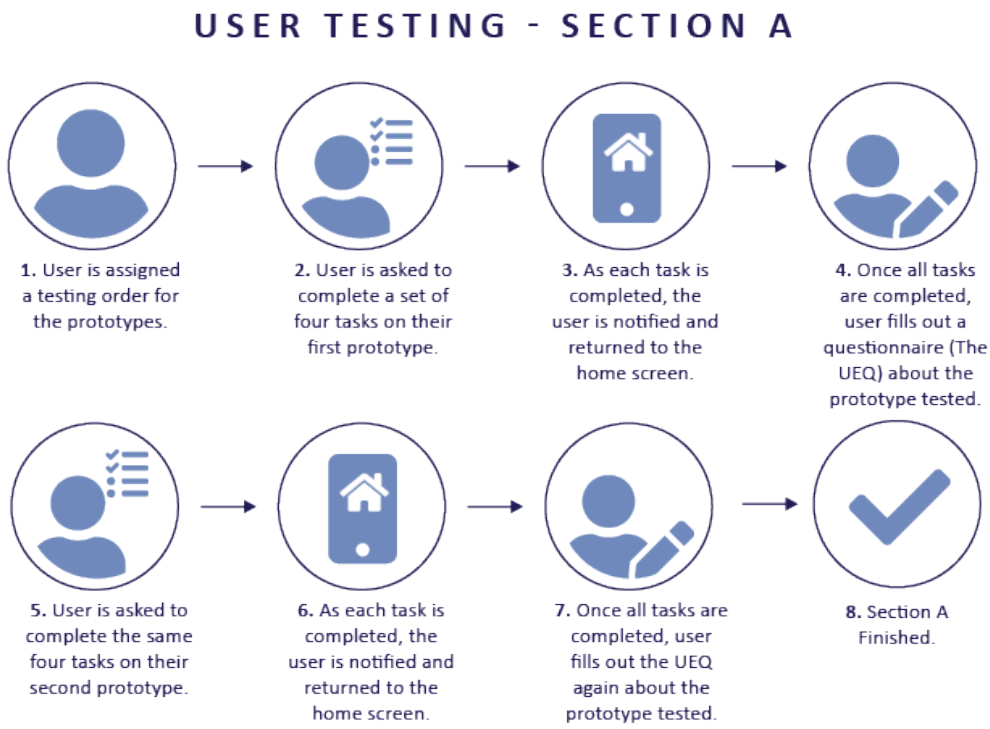


Figure 26: User testing flow - Section A

The participant was presented with two navigation options. The hamburger menu in the top left and the bottom bar navigation. These is featured in *Figure 27: Prototype A - Hamburger menu in the top left* and *Figure 28: Prototype B - Bottom bar navigation.* Before interacting with them, the researcher demonstrated how the prototype works and the navigation options to build familiarity. The participants were then asked if the overview of the two navigations was evident. If any confusion occurs, it was rectified before the testing device could be received.

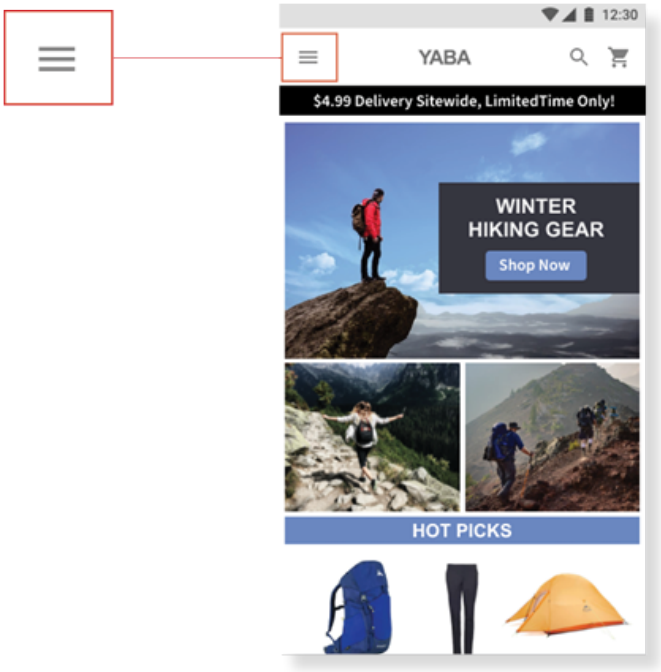


Figure 27: Prototype A - Hamburger menu in the top left

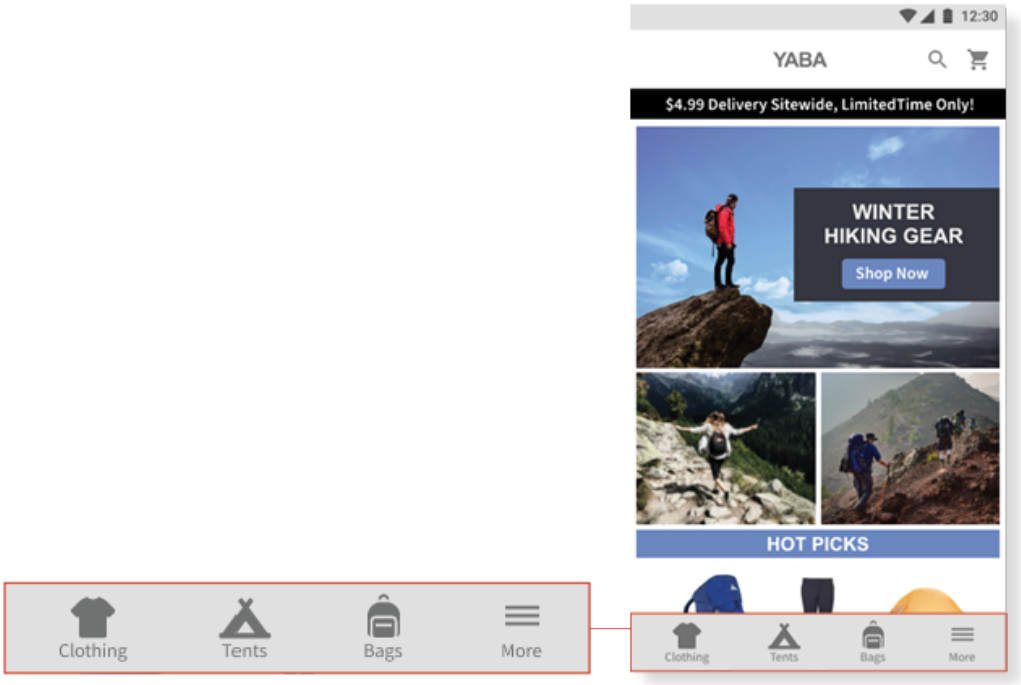


Figure 28: Prototype B - Bottom bar navigation

Once handed the testing device, the participant was informed whether assigned to testing order A or testing order B. Participants were asked to select the first prototype to test from the initial landing page. This is featured in *Figure 29: Initial Prototype landing page.*

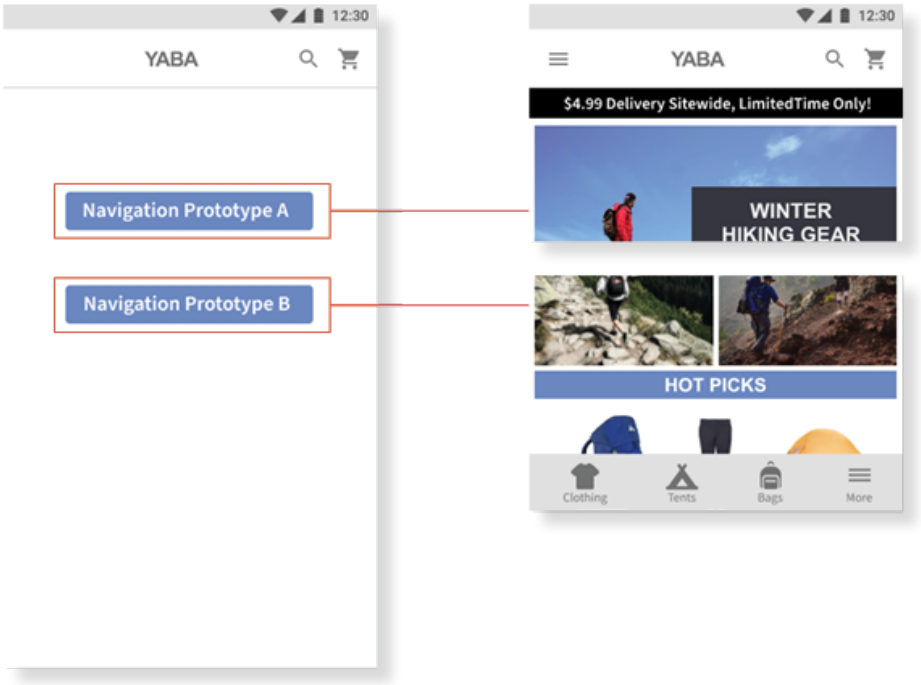


Figure 29: Initial Prototype landing page

Users were asked to complete four tasks, one after the other. On completion of the task, the user was asked to return to the homepage of Yaba before having the next task explained to them. Upon completing the final tasks, the user was asked to return to the main prototype screen and put down the testing device. The researcher then introduces a questionnaire that gets filled out surrounding this interaction. The user then repeats the process, completing the same four tasks on the remaining prototype. After completing the four tasks, the user again immediately filled in the questionnaire. After the study's observational stage, the user took part in a semi-structured interview to help the researcher gain qualitative information surrounding their interaction. This is explained in section 4.2.2.1

4.2.1.1 Testing questionnaire structure

The objective was to observe participants testing two navigation prototypes and have them attempt to complete four pre-set tasks on each of the prototypes. This helped to assess their experience with the navigation options. While observing, the researcher took down notes. These notes consisted of the participants completing the task, the hand used, and how the user completed the tasks. Anything the participant said, aspects that looked relatively easy or difficult, and any other notable points that arose also were noted.

Each participant attempts four tasks on prototype A and the same four tasks on Prototype B. The order of the tasks and prototypes is assigned to each participant, altering between order one, see *Figure 30: Prototype Testing Order 1*; and order two, see *Figure 31: Protype Testing Order 2*. The two testing orders get further shown in

Table 7: Prototype Testing Order 1 and *Table 8: Prototype Testing Order 2*. Changing the task order avoids any influence the testing order could have on the results. All

participants are seated at a table for both navigations throughout the testing. On average, completing the four tasks on one of the prototypes takes less than five minutes. The tasks completed influenced these questions and the findings from the case study in Chapter 3.

The device used to test is a 5.1" Huawei P10 smartphone, released in 2017. This is the selected device as it is identical to the previous device in the Case Study.

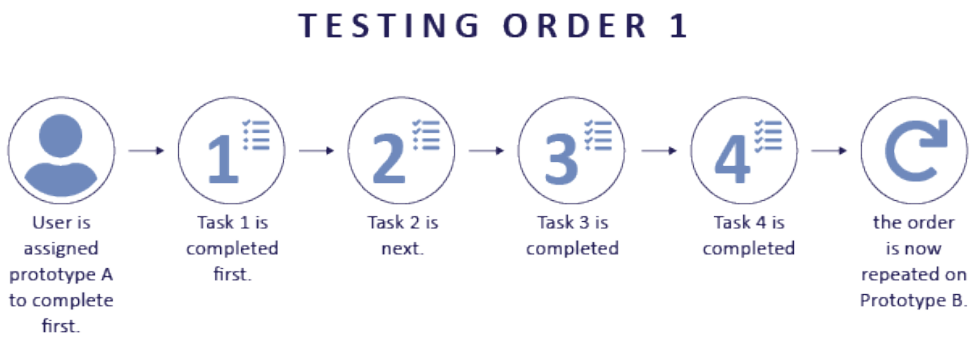


Figure 30: Prototype Testing Order 1

Table 7: Prototype Testing Order 1

Task Number	Prototype A
1	Using your primary hand, navigate to the category Men's Merino shirts.
2	Using both hands to hold the phone, navigate to the Tents section.
3	Again using your primary hand, navigate to the bags section.
4	Using both hands again, navigate to the men's shirts that are in the clearance section of the website.
Task Number	**Prototype B**
1	Using your primary hand, navigate to the category Men's Merino shirts.
2	Using both hands to hold the phone, navigate to the Tents section.
3	Again using your primary hand, navigate to the bags section.
4	Using both hands again, navigate to the men's shirts that are in the clearance section of the website.

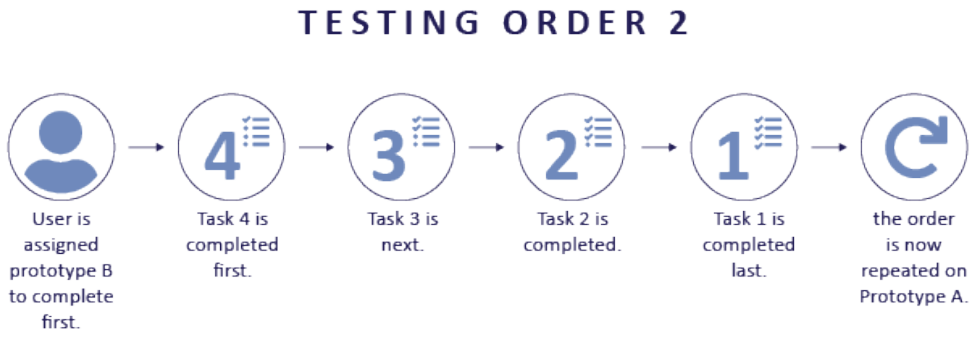


Figure 31: Protype Testing Order 2

Table 8: Prototype Testing Order 2

Task Number	Prototype B
4	Using both hands, navigate to the men's shirts that are in the clearance section of the website.
3	Using your primary hand, navigate to the bags section.
2	Again, using both hands to hold the phone, navigate to the Tents section.
1	Using your primary hand, navigate to the category Men's Merino shirts.
Task Number	**Prototype A**
4	Using both hands, navigate to the men's shirts that are in the clearance section of the website.
3	Using your primary hand, navigate to the bags section.
2	Again, using both hands to hold the phone, navigate to the Tents section.
1	Using your primary hand, navigate to the category Men's Merino shirts.

4.2.1.2 User Experience questionnaire structure

The User Experience Questionnaire (UEQ) was used in this phase. The UEQ was chosen to help gather quantitative data to compare the user's experience with tested navigation options. The UEQ can be seen below in *Figure 32: User Experience Questionnaire.* The complete questionnaire, along with the covering information, is featured in *Appendix B.*

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

Figure 32: User Experience Questionnaire

The UEQ is a scale developed by Laugwitz, Held, and Schrepp (2008), consisting of 26 Likert scales. These scales rate from one to seven, with each of these scales containing two terms with opposing connotations at either end. The seven-stage Likert scale gets ranked in a range of -3 (the extreme negative) to 3 (the extreme positive). The 26 scales get divided into six subcategories that are measured. These are Attractiveness, Efficiency, Perspicuity, Dependability, Stimulation and Novelty. *Table 9: UEQ Subcategory Definitions in relation to our study* shows a breakdown of the definitions of these subcategories in relation to the user study that we will be completing. These definitions were adapted around those set out in *Figure 33: Assumed scale structure of the UEQ,* retrieved from Schrepp (2019, p. 3), also shows a further breakdown of these subcategories and the questionnaire item each falls beneath.

Table 9: UEQ Subcategory Definitions in relation to our study

Term	Definition
Attractiveness	The users' overall impression of the navigation option. Does it appeal to the users, or does it not.
Efficiency	Ease of use. Is getting familiar with the navigation option a difficult task? How simple is it for a user to learn their way around?
Perspicuity	Does it require unnecessary work for a user to complete a task,i.e. navigate somewhere?
Dependability	When navigating, does the user feel as if they are in control?
Stimulation	Is using the navigation option an exciting experience? Is the user motivated to use the navigation?
Novelty	Does the navigation option capture the users' attention? Is it both innovative and creative?

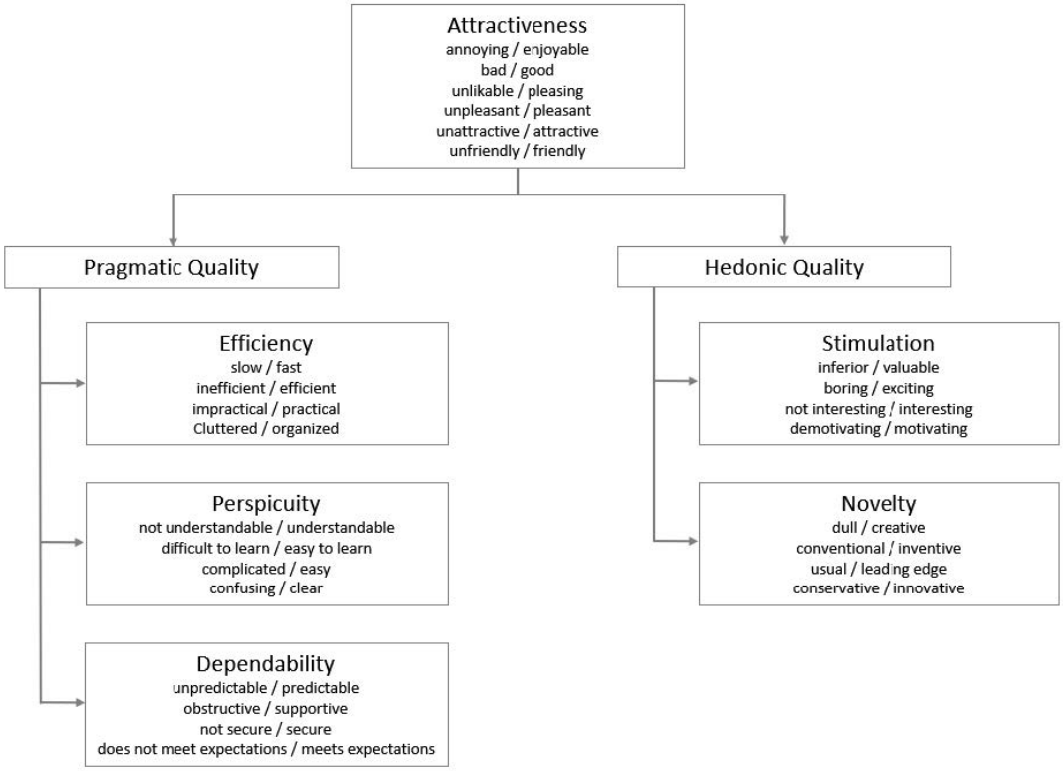


Figure 33: Assumed scale structure of the UEQ

Users each completed two UEQs. The first questionnaire was completed directly following the interaction with the first navigation option. The following questionnaire was completed following the second testing round—the completing of the questionnaires immediately after the interaction aids in ensuring fair and consistent results. The direct conduction of the UEQ following users' interaction with each of the prototypes, rather than at the end after a discussion about the options, was to gather uninfluenced information regarding the options. This immediate gathering of the quantitative data ensures that the prototype is fresh in the user's mind. The UEQ results then got used to statistically compare one another and provide accurate comparative user experience results for each of the options.

4.2.2 Section B

Section B of the user study conducted a semi-structured interview. Immediately following section A of the study, the user gets asked to participate in this interview. The interview helped the researcher gain qualitative information surrounding the user's interaction with each of the prototypes. The flow of section B gets featured in *Figure 34: User testing flow - Section B.*

Figure 34: User testing flow - Section B

4.2.2.1 Interview structure

The researcher's objective was to gather qualitative information about the participants' history with navigation options on mobile eCommerce websites and gain further insight into their experience with the two prototypes' navigation pattern throughout the testing process.

Each interview lasted approximately 10 minutes. The interview followed a semi-structured process, questions asked in the interview can be seen in Table 10: Interview Questions. Responses were recorded through note-taking during the interview. For research purposes, the interviews are also audio-recorded. Participants could opt out of the audio recording if they pleased. The Interview answer sheet that the researcher filled in during each of the interviews can get found in *Appendix C.*

Table 10: Interview Questions

Interview Questions
Gender: Male, Female, other, prefer not to specify.
Left or right-handed?
Age Bracket: >20, 20-29, 30-39, 40-49, 40-54, 55+, Prefer not to specify
Mobile Platform: Android, IOS, windows, other.
How often do you use mobile eCommerce websites?
Do you ever find yourself experiencing problems navigating mobile eCommerce websites?
Try to remember the last time you were navigating an eCommerce website on your mobile. How was this experience?
What were your first impressions for Prototype A?
What were your first impressions for Prototype B?
How did you find the Navigation system on Prototype A?
How did you find the Navigation system on Prototype B?
Did you find any of the tasks easier on one prototype over the other?
Did you find anything particularly challenging on either of these prototypes?
Did you find anything particularly easy on either of these prototypes?
Was there anything that you found surprising about these prototypes or aspects that didn't do what you expected them to?
Which of these two prototypes did you like the most? Why?
Which of these two prototypes did you like the least? Why?
Would you look forward to using either of these systems again? Why?
Do you think that either of these navigation systems could be presented in a more effective or relevant way?
Is there anything else that you would like to add?

4.2.3 *Methodology summary*

The user study that has been discussed looks at two different navigation styles on mobile eCommerce websites. The study focuses on what the optimal navigation could be. The user study aims to help identify the ideal navigation options for mobile eCommerce websites and how different navigation options affect users' experiences. The user study will also help us answer *RQ1: What can affect a user's ability in the navigation of a mobile eCommerce website? RQ3: What design interventions can be developed to help the user manoeuvre more successfully throughout a mobile eCommerce website?* And *RQ4: Can an adapted and refined navigation improve a user's experience on mobile eCommerce websites?*

The user study has two main sections, section A, and section B. These ran direct succession to each other. Section A handled the observation and questionnaires. Section B handled the semi-structured Interview. In the following sections, we will discuss the conduction of the user study and the demographics of the participants. Difficulties or limitations that came up throughout the user study are also mentioned.

4.3 Observation: section A

The first section of the user study, section A was focused on a user observation. Users were asked to complete four tasks on two prototypes for the study's observation portion. The testing took place; all participants were seated at a flat-topped table that felt comfortable and natural. The researcher demonstrated the two navigations to the user before their interaction so that they understood both prototypes. Participants

performed four tasks on each prototype using the 'Yaba' prototype. Once a task had been completed successfully, the participant was notified and asked to return to the home screen to begin the next task. Upon completing the final task, the participant was notified that they had completed the required interaction with that prototype.

During the observation, each of the participants were closely observed. This allowed the researcher to understand their decisions and see how they interacted with the navigation. The researcher took notes on what hand the user was primarily using, how they were using the navigation and any difficulties the participant faced. In prototype B, where two options we available to the user to complete a task, the route taken was equally noted for reference.

The process of Section A has been visualised previously in *Figure 26: User testing flow - Section A.*

4.4 Questionnaires: section A

Section A of the study also utilised questionnaires as stated in the methodology section. The questionnaire used for this study was the *User experience Questionnaire* (UEQ). The participants completed two questionnaires each, directly following each navigation prototype's interaction. The questionnaires were filled out before any discussion around the navigation that was tested. This was to ensure that no discussion would influence the questionnaire results and that the content was still fresh to the participant. The UEQ was filled out in a printed format by all participants. After the participant had completed the study, the researcher transcribed these results into a spreadsheet.

4.5 Interview: section B

The second portion of the study, Section B, involved the users taking part in an interview. The interviews were all conducted as semi-structured interviews with a pre-defined set of base questions featured in *Table 10: Interview Questions*. The interviews were also audio-recorded; however, two of the twenty-four participants opted out. The researcher digitally transcribed the audio recording for each interview.

The participants again were situated seated upright in a comfortable position at a flat-topped table for the interview. This was the same table and location the participant was seated at for section A of the study.

The process of section B has been visualised previously in *Figure 34: User testing flow - Section B.*

4.6 Participants: section B

Twenty-four participants were recruited from people whom the researcher already knew and had relations. Initial contact regarding potential participation in the study was made in person. Some participants were also contacted via social media and direct messages. Everyone approached to partake in the study had no obligation and participated of their own will. None of the twenty-four participants decided to opt out once the study had begun.

Each participant completed four tasks on prototype A and the same four tasks on prototype B. The order of the tasks and prototypes is assigned to each participant altered between order one and order two. Twelve participants completed the study in order A, and the other twelve completed the study in order B. The two testing orders get shown in

Table 7: Prototype Testing Order 1 and *Table 8: Prototype Testing Order 2.*

This section outlined the demographics of the participants. There were eleven female and thirteen male participants taking part in the study. *Table 11: Participant Demographics* shows the details of the participants from the study. We will now go on to discuss these further.

Table 11: Participant Demographics

ID	Gender	Primary Hand	Age Bracket	Mobile Platform	Mobile Ecommerce website usage	Problems with Mobile eCommerce website
P01	Female	Right	20-29	Android	Multiple times a week	Sometimes
P02	Male	Right	20-29	Android	Once a Month	Yes
P03	Female	Right	20-29	IOS	Once a Week	Yes
P04	Female	Right	20-29	Android	Twice Daily	yes
P05	Female	Right	20-29	Android	Daily	Sometimes
P06	Female	Right	20-29	Android	Daily	Sometimes
P07	Male	Right	55+	Android	Daily	Yes
P08	Male	Right	20-29	IOS	Twice Daily	Sometimes
P09	Female	Right	50-54	IOS	Once a Week	yes
P10	Female	Right	20-29	Android	Daily	yes
P11	Male	Right	20-29	Android	Once a Week	No
P12	Female	Left	20-29	IOS	Weekly	Yes
P13	Male	Right	20-29	Android	Once a Month	Yes
P14	Female	Right	20-29	Android	Multiple Times Daily	No
P15	Female	Right	20-29	Android	Daily	Yes
P16	Male	Right	20-29	Android	Multiple Times a Month	No
P17	Female	Right	20-29	Android	Once a Month	Yes
P18	Male	Left	20-29	Android	Daily	Sometimes
P19	Female	Right	20-29	IOS	Multiple times a week	Yes
P20	Male	Ambide xtrous	20-29	Android	Daily	Yes
P21	Male	Right	20-29	Android	Rarely	No
P22	Male	Right	50-54	Android	Multiple Times Daily	Yes
P23	Male	Right	20-29	Android	Multiple times a week	yes
P24	Female	Right	20-29	IOS	Multiple times a week	Yes

4.6.1 Participant primary hand

For interview question two, participates were asked which was their primary hand. Twenty-one participants identified their right-hand as their primary hand, while only two identified primarily using their left-hand. One participant reported that they were ambidextrous. These findings are presented in *Figure 35: Primary Hand.*

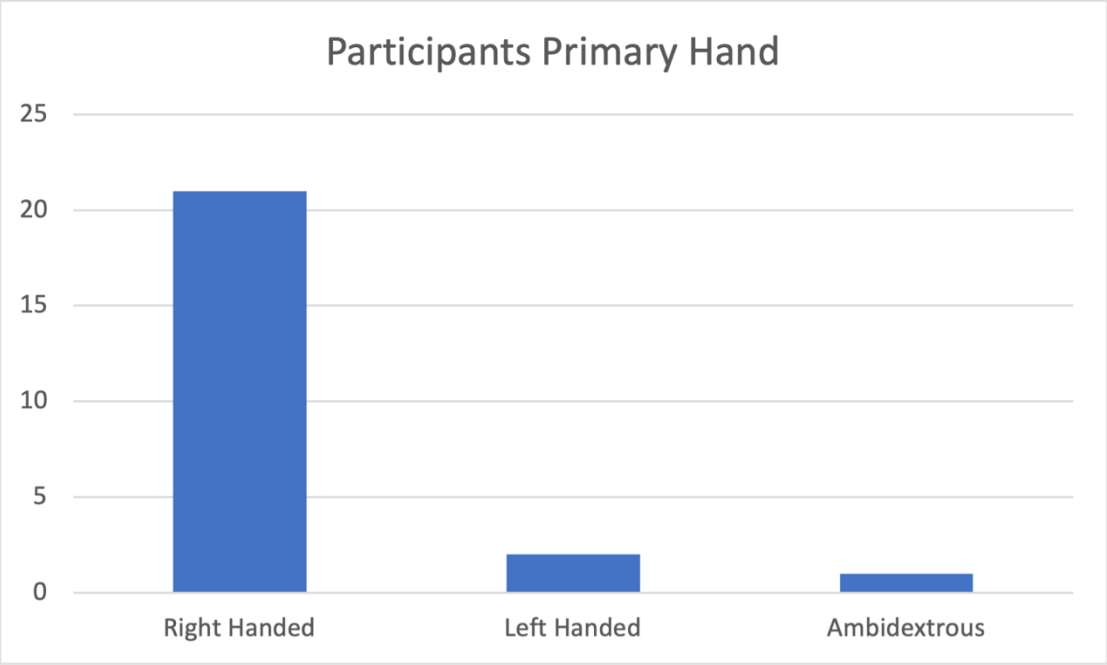


Figure 35: Primary Hand

4.6.2 Participant age

Interview question three asked participants to specify which age band they fit into. There were Six bands: >20, 20-29, 30-39, 40-49, 40-54 and 55+. Alongside these bands, participants had the option of 'Prefer not to specify'. None of the participants selected this band. *Figure 36: Age Bracket*, shows the results for the number of people in each band.

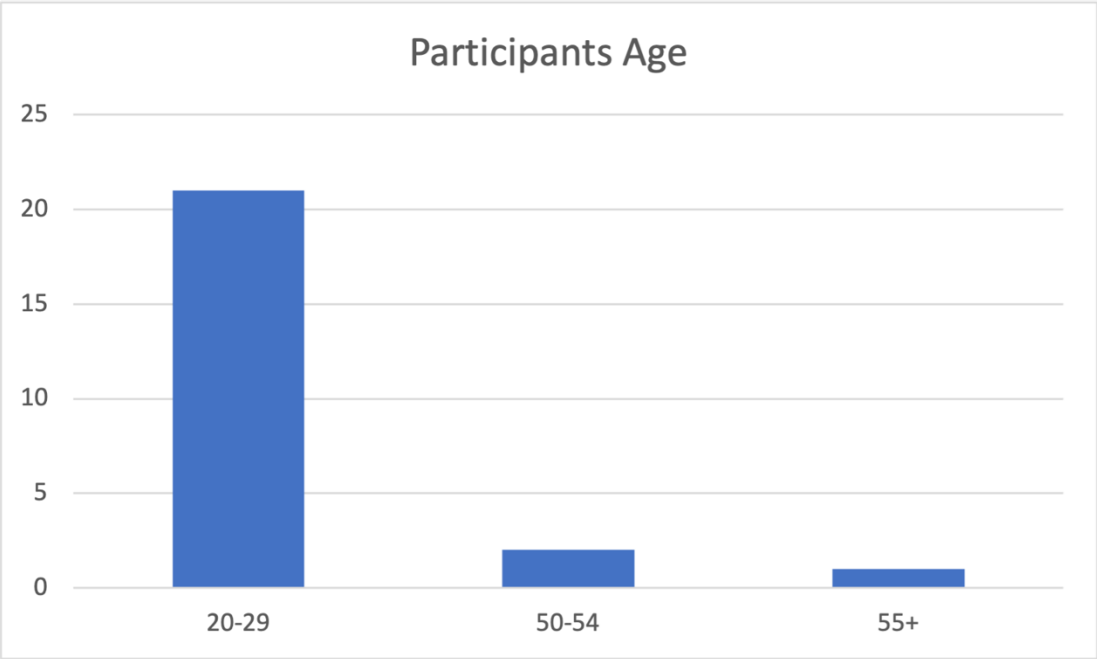


Figure 36: Age Bracket

Of the twenty-four participants in the study, only three of the participants were over the age of 29. The remaining twenty-one of the participants all fitted into the millennial or 20-29 age bracket.

4.6.3 Primary mobile platform

All participants had previous experience with mobile devices; this was asked in interview question four. Eighteen participants currently owned an android device, with only six currently having an IOS device. These findings get presented in *Figure 37: Mobile Platform used by participants.*

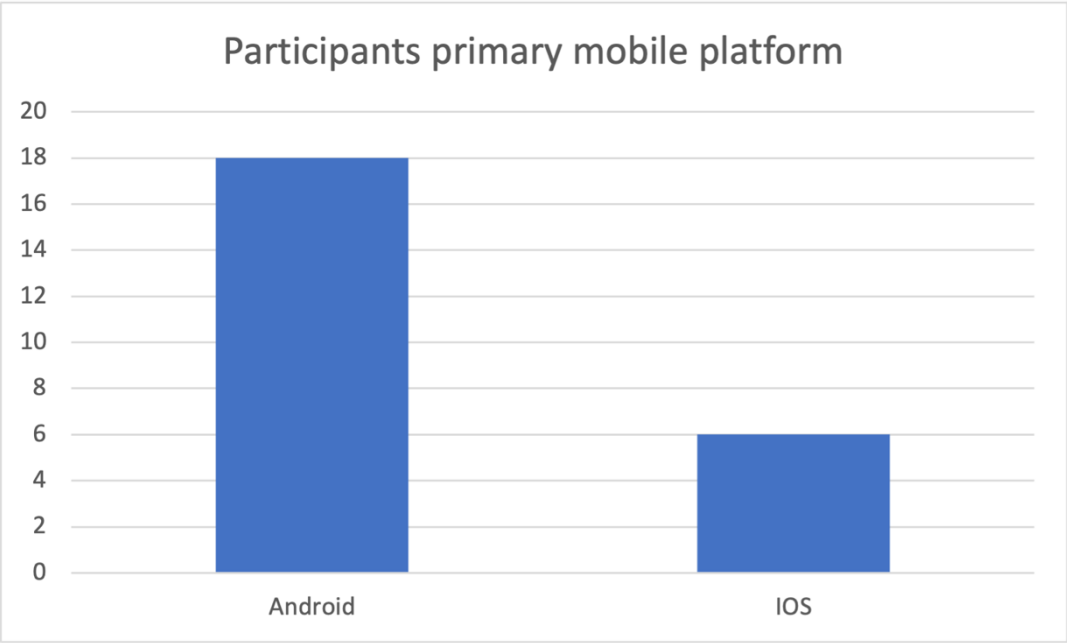


Figure 37: Mobile Platform used by participants

4.6.4 E-commerce website usage

Interview question five asked about eCommerce website usage. The participants were each asked how often they would find themselves using mobile eCommerce websites. Figure 38: eCommerce Website usage demonstrates how often participants identified using mobile eCommerce websites.

Figure 38: eCommerce Website usage

Most participants used Commerce websites daily. All participants identified with having used mobile eCommerce websites before, with only one of the twenty-four participants stating that they rarely use mobile eCommerce websites. Three participants stated that they only used mobile eCommerce websites once a month. One person stated that they only used mobile eCommerce websites multiple times a month, but less often than once every week. The remaining nineteen of the twenty-four participants all identified using eCommerce websites at least once a week.

4.6.5 E-commerce website problems

For interview question six, we asked people if they ever experience problems when navigating mobile eCommerce websites. This question assessed issues the participant would encounter during navigation and classify as a problem rather than giving them a setlist of issues. This was conducted due to the multitude of navigation options, websites, and issues that any participant could encounter. These findings are presented below in *Figure 39: eCommerce Website Problems*.

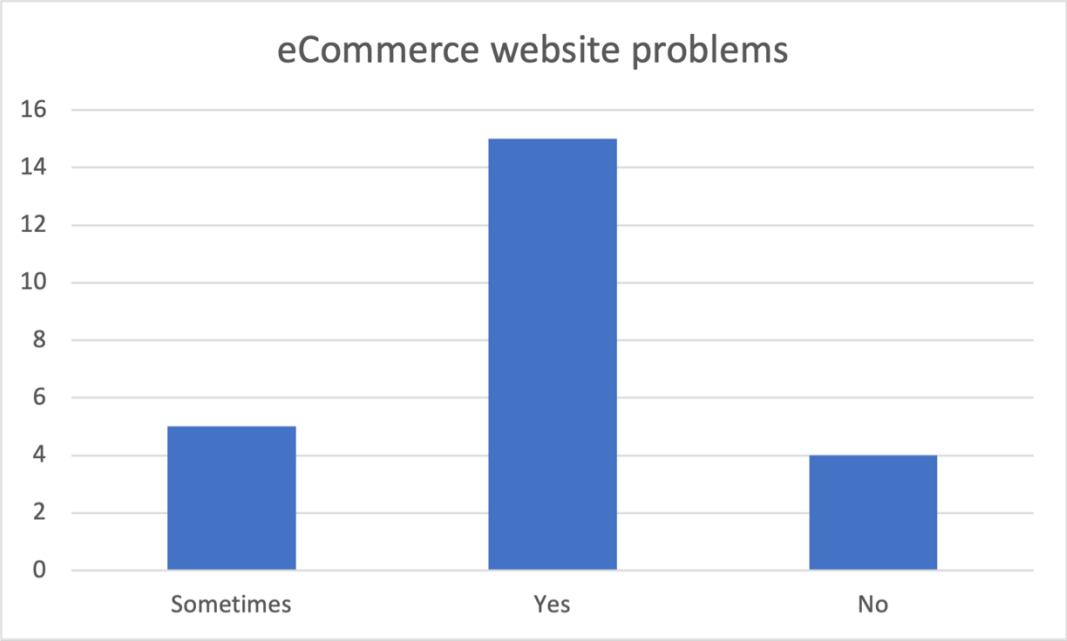


Figure 39: eCommerce Website Problems

Of the twenty-four participants, only four identified as not having problems navigating; the remaining twenty had all experienced issues.

Five of the participants identified issues navigating at times. The remaining fifteen participants stated that issues frequently occurred whilst navigating mobile eCommerce websites.

4.7 Difficulties

One limitation of this study would have been the recruitment of participants. Due to the COVID-19 pandemic prevalent throughout this study, some potential participants were apprehensive and therefore did not participate where they otherwise may have. The pandemic also meant that caution had to get taken throughout the study. No aspect of the user study went against the COVID-19 level restrictions in place in Hamilton, New Zealand, at the time. The device was also sanitised thoroughly to prevent contamination alongside the pen provided to the user to fill in the questionnaire.

4.8 Summary

For this study, the researcher conducted twenty-four user studies over six weeks. These participants all had varying demographics. All participants had experience with mobile devices and used mobile eCommerce websites on at least a monthly basis. Most participants had issues except for four. These four participants stated that they did not have issues with sites' navigation. Of the twenty-four participants, there were eleven female and thirteen males. All participants were over the age of 20, with most participants being between 20-29 years old. The participants tested were a majority right-handed, with three identifying as being either left-handed or ambidextrous. Eighteen of the twenty-four participants currently owned an android device, and only six currently have an IOS. Going forward into chapter 5: Discussion, we will discuss the user study results.

5 Discussion

This section introduces and discusses the findings from the observation, questionnaire and interviews of the user study discussed previously in Chapter 4: User study of two navigation prototypes developed and conducted

This section discusses results from the observation, questionnaires, and interview. Participants' demographics that took user in the user study have been outlined previously in section 4.6.

5.1 Observation results

This section reported on the results observed from the testing phase of the user study. Any related interview questions will also get reported in this section.

Table 14: Participants assigned each testing order featured in *Appendix D* demonstrated the number of participants that were assigned to each of the two testing orders, testing order A and testing order B. An even 50/50 split of 12 participants were assigned to testing order A and 12 to testing order B in the user study. The only difference between the two study variations was the order in which the prototypes were tested the questions were asked. All participants had the opportunity to complete the same tasks on each prototype.

Interview questions twelve asked participants which tasks they found easier to complete on which prototypes. A summary of the results for this interview question gets presented in *Table 15: Interview Question Twelve Answers* featured *in Appendix D.* These results will now be delved into in more depth.

5.1.1 Task 1: primary hand - men's merino shirts

This section addresses explicitly *Task 1: Using your primary hand, navigate to the category men's merino shirts.* For participants completing the testing in order one, this was the first task they completed, for participants assigned to testing order two, this was the final task they undertook.

This task asked the participants to hold the phone in one hand (their primary hand). Whilst holding the phone and using just this one hand to navigate to the men's merino shirts section of the website. This task could only be completed in one way on prototype A. On prototype B, users had two options to navigate there using. Option One was via the hamburger menu, and option two was through the clothing icon and menu via the direct links in the bottom bar.

Most participants stated that they found this task easier to complete on bottom bar navigation (prototype B) over the hamburger menu in the top left (prototype A). Only one-person preferred prototype A for this task, twenty-one preferred prototype B and the remaining two were impartial. These findings from task one gets presented below in *Figure 40: Task 1, preferred navigation prototype*.

Participants mentioned that having visual elements and the larger buttons within the clothing landing page ensured that they selected the right product; this also minimised the reading required. Specifically, P23 Stated that *"I appreciated the key callouts down*

the bottom, it really made it faster. I also appreciated the big buttons under the clothing menu. It made it easier to select them and gave less chance of missing them" in reference to Prototype B.

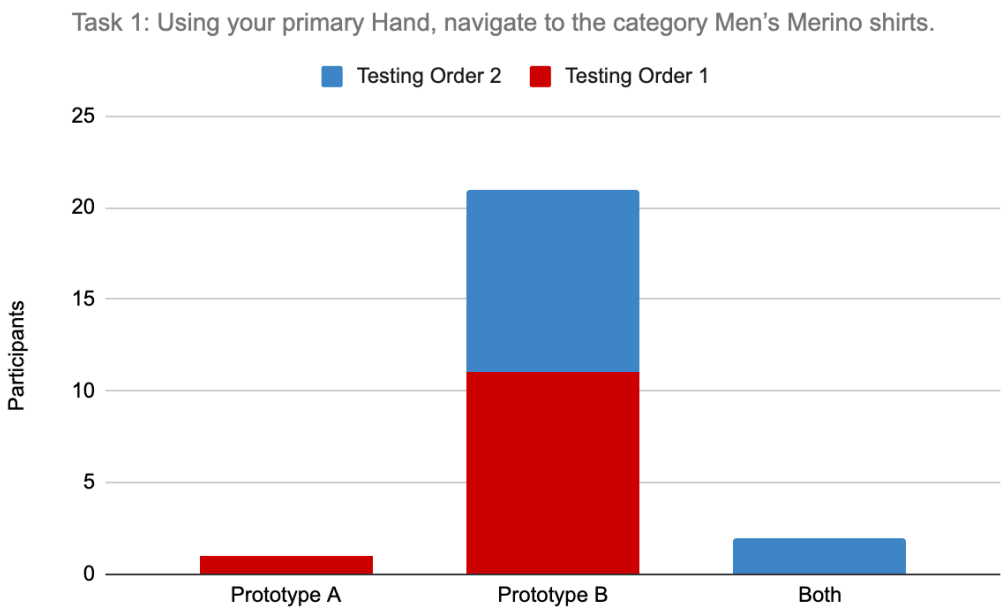


Figure 40: Task 1, preferred navigation prototype

5.1.2 Task 2: both hands - tents

This section explicitly addresses *Task 2, Using both hands to hold the phone, navigate to the tents section.* For participants completing the testing in Order one, this was the second task they completed, for participants assigned to testing order two, this was the third task they undertook.

This task asked participants to hold the phone with two hands in a natural way. The participant was then required to navigate to the tents section using the navigation while holding the phone with two hands. This task could only get completed one way on Prototype A; however, it could get completed one of two ways on prototype B. The completion methods on prototype B were again the bottom hamburger menu or via the tent icon on the bottom bar menu. Using the tent icon meant that unnecessary interaction with the navigation got reduced for the user.

Like Task 1, most participants stated that they found this task easier to complete on bottom bar navigation (Prototype B) over the hamburger menu in the top left (Prototype A). Eighteen participants preferred prototype B for this task, two preferred prototype A and a further four participants were impartial. These findings from task two are presented below in *Figure 41: Task 2, preferred navigation prototype.*

Participants stated that, they generally preferred to complete the tasks with shortcuts on prototype B as it reduced the number of steps that had to be taken to reach a category. Specifically, P03 stated that they found the tasks with highlighted categories easier on *"prototype B because it was way faster and the icons also helped".*

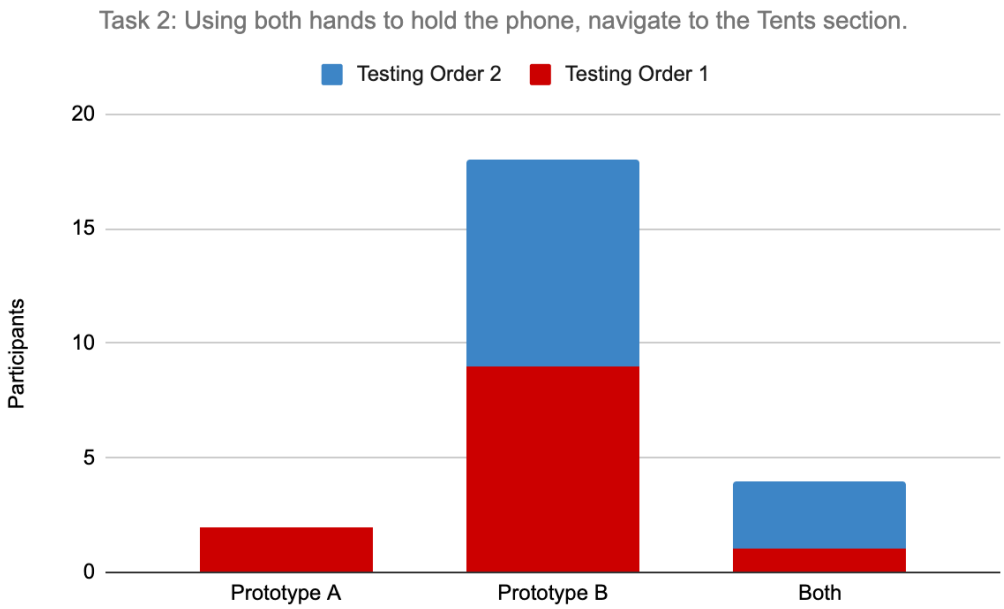


Figure 41: Task 2, preferred navigation prototype

5.1.3 Task 3: primary hand - bags

This section explicitly addresses *Task 3: Using your primary hand, navigate to the bags section.* For participants completing the testing in order one, this was the third task they completed. For participants assigned to testing order two, this was the second task they undertook.

This task asked the participants to hold the phone in one hand (their primary hand). Whilst holding the phone and using just this one hand, navigate to the website's bags section. Again, this task could only get completed in one way on Prototype A; however, it could be completed one of two ways on prototype B. Like the previous task, the methods of completion on prototype B were again the bottom hamburger menu or via the icon on the bottom bar menu, in this case a bag icon.

Most participants stated that they found this task easier to complete on bottom bar navigation (Prototype B) over the hamburger menu in the top left (Prototype A). Twenty-two of the twenty-four participants preferred prototype B when it came to completing this task, only one participant found this to be easier on prototype A, and a further one participant was again impartial between the two prototypes. The findings from task three are presented below in *Figure 42: Task 3, preferred navigation prototype.*

Further to the statements made by participants on previous tasks, again, this was in general found to be easier on prototype B due to the shortcuts available. P15 found this task easier on Prototype B, they stated that it was *"So much easier to navigate with one hand on Prototype B"* and that *"Using one hand on prototype A it was a little hard to reach that top left-hand corner".* These were comments that were also bought up elsewhere in the user study interviews.

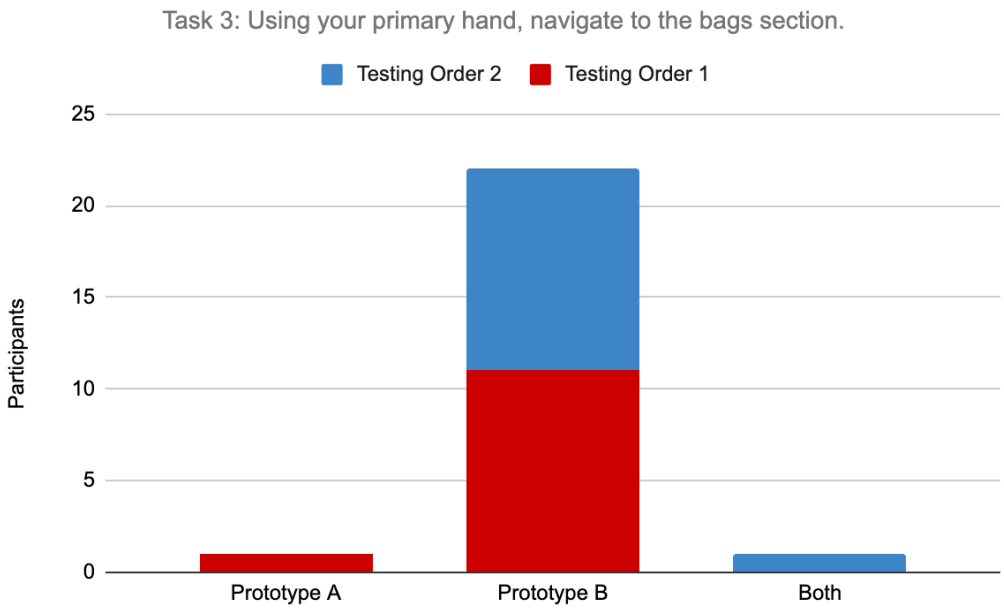


Figure 42: Task 3, preferred navigation prototype

5.1.4 Task 4: both hands - clearance men's shirts

This section addresses explicitly *Task 4: Using both hands, navigate to the men's shirts that are in the clearance section of the website.* For participants completing the testing in order one, this was the final task they completed, for participants assigned to testing order two this was the first task they undertook.

This task asked participants to again hold the phone with two hands in a natural way. Whilst holding the phone with two hands, the participant was then required to navigate to the clearance section and select the men's shirts using the navigation. This task was the only one of the four tasks that could only get accessed in one way on each of the prototypes. Accessing the men's clearance shirts on each prototype was done via the hamburger menu.

Eleven of the twenty-four participants stated that they were impartial regarding a preference in completing this task. When it came down to the two prototypes, we can see that eight participants preferred prototype B again, with only five preferring prototype A. The findings from task four get presented below in *Figure 43: Task 4, preferred navigation prototype.*

From the interviews, we learned that participants found that the hamburger menu in the top left-hand corner was not as difficult to reach when they could use two hands. Participants also identified that because of this, and that you must go through the hamburger menu for the clearance items on either prototype, there was not a massive difference in completing the tasks between the two prototypes.

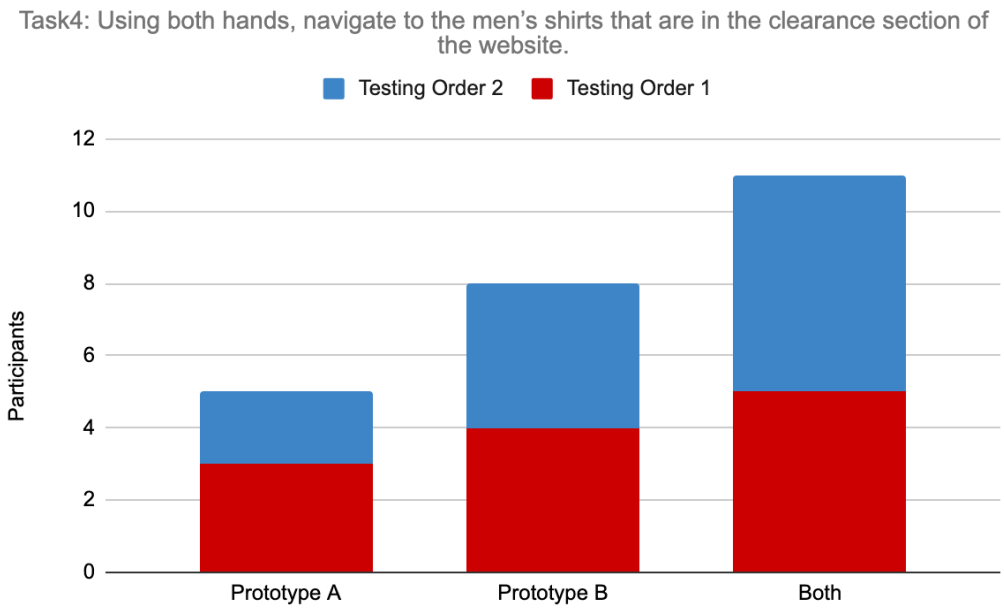


Figure 43: Task 4, preferred navigation prototype

5.2 Questionnaire results

This section will report on the results received in the questionnaire phase of the user study. We will first touch on the reliability of the UEQ Scale. After this, we will go on to cover the results of the UEQ. Once we develop a consensus on the results, we will then discuss the findings concerning each of the six scales, Attractiveness, Perspicuity, Efficiency, Dependability, Stimulation and finally Novelty.

5.2.1 UEQ reliability

The UEQ is a highly accurate scale used commonly in user experience testing; however, to ensure this accuracy, we will also be testing the correlation of each scale to check reliability. To do this, we will be using Cronbach's Alpha-Coefficient from the UEQ evaluation tools that are readily available. Glen (2014) discusses how Cronbach's Alpha-Coefficient measures the overall accuracy. It considers *"hidden or unobservable variables like: a person's conscientiousness, neurosis or openness" (Glen, 2014)*.

A Cronbach's Alpha-Coefficient of ≥ 0.7 is considered sufficient in studies using Likert scale type evaluations. This can be seen below in *Table 12: Scale Accuracy using Cronbach's Alpha-Coefficient.* This demonstrates that results for Attractiveness, Efficiency, and Novelty should be considered accurate; however, the results received in the remaining are not necessarily accurate. Although not undoubtedly accurate, the results received were still reported.

Table 12: Scale Accuracy using Cronbach's Alpha-Coefficient

Scale Accuracy		
Using: Cronbach's Alpha-Coefficient		
Scale	**Prototype A Coefficient**	**Prototype B Coefficient**
Attractiveness	0.89	0.85
Perspicuity	0.84	0.61
Efficiency	0.80	0.70
Dependability	0.79	0.42
Stimulation	0.66	0.72
Novelty	0.70	0.83

The findings of the UEQ, in general, will now get further discussed.

5.2.2 *UEQ results*

The UEQ made use of a T-Test to analyse the data received. The two-sample T-Test assuming unequal variances surrounding the six categories also outlines if there is a significant difference. This difference is calculated in the mean values of the scales measured between the two questionnaires.

This t-test identified that there is a significant difference in four of the six scales: Attractiveness, Efficiency, Stimulation and Novelty. These significant differences identify the bottom bar navigation (prototype B) as the preferred option. This T-Test utilised a standard alpha level or significance level of 0.05. This information is presented below in *Table 13: T-Test Results.* Further to this*, Figure 44: Comparison of UEQ Scale means* shows the scale means and the corresponding 5% confidence intervals concerning the user study from the UEQ information.

Table 13: T-Test Results

Two sample T-Test assuming unequal variances		
Alpha Level: 0.05		
Scale	**Value**	**Difference**
Attractiveness	0.0021	Significant Difference
Perspicuity	0.5413	No Significant Difference
Efficiency	0.0083	Significant Difference
Dependability	0.7993	No Significant Difference
Stimulation	0.0000	Significant Difference
Novelty	0.0000	Significant Difference

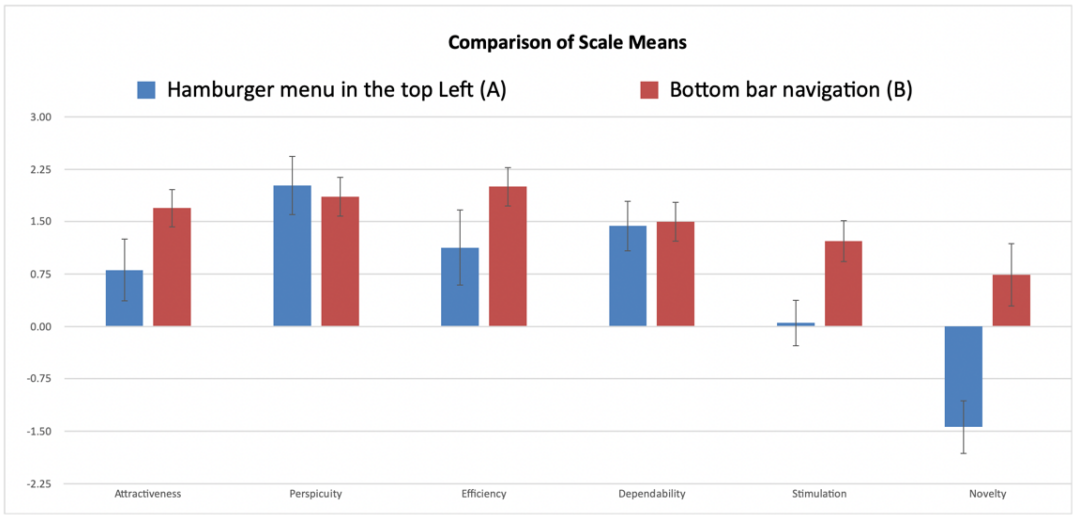


Figure 44: Comparison of UEQ Scale means

The findings of the UEQ now get discussed concerning each scale, Attractiveness, Perspicuity, Efficiency, Dependability, Stimulation and novelty.

5.2.2.1 Attractiveness

The T-test conducted based on the UEQ questionnaire identified a significant difference in Attractiveness. This difference favoured the bottom bar navigation (prototype B). Our alpha coefficients, outlined in *Table 12: Scale Accuracy using Cronbach's Alpha-Coefficient*, support this statement's accuracy.

The results demonstrated that users' overall impression of the bottom bar navigation (Prototype B) was more positive than the hamburger menu on the top left (prototype A). Participants had a more pleasant, enjoyable, and user-friendly experience in their interaction with the Prototype B navigation.

5.2.2.2 Perspicuity

The UEQ questionnaire identified no significant difference in Perspicuity between the two navigation prototypes tested. Our alpha coefficients, outlined *in Table 12: Scale Accuracy using Cronbach's Alpha-Coefficient*, have demonstrated that these results do not necessarily have a high level of accuracy.

If accurate, this demonstrates that familiarity with the navigation option does not differ between the two prototypes tested on the Yaba website. Even though users had previous experience with the status-quo option, the hamburger menu in the top left, they were still required to gain familiarity with the Yaba website; therefore, the barrier still existed. Furthermore, this demonstrates that ease of use is another barrier that is not increased in participants learning to use the new option. Learning to use prototype B and navigate around the Yaba website was no more difficult, confusing, complicated, or hard to understand than the same tasks on the standard navigation option.

5.2.2.3 Efficiency

The T-test conducted based on the UEQ questionnaire identified a significant difference in Efficiency. This difference favoured the bottom bar navigation (prototype B). Our

alpha coefficients, outlined in *Table 12: Scale Accuracy using Cronbach's Alpha-Coefficient,* support this statement's accuracy.

The UEQ results demonstrated that efficiency was significantly increased for the participants when completing the testing on the bottom bar navigation (prototype B) over the hamburger menu in the top left (prototype A). This shows that the bottom bar navigation came through as being perceived as a faster, more efficient, practical, and organised navigation to navigate manoeuvre through.

5.2.2.4 Dependability

The UEQ Questionnaire identified no significant difference in dependability between the two navigation prototypes tested. Our alpha coefficients, outlined in *Table 12: Scale Accuracy using Cronbach's Alpha-Coefficient,* have demonstrated that these results do not necessarily have a high level of accuracy. These prototypes do, however appear to be the only results that show equal.

If accurate, this demonstrated that being puissant over the navigation options tested on the Yaba website did not differ between prototypes. Participants felt that their ability to pre-empt changes, control the option, and have their expectations met did not get compromised through either prototype

5.2.2.5 Stimulation

The UEQ questionnaire identified a significant difference in Stimulation, favouring the bottom bar navigation (prototype B). Our alpha coefficients outlined in *Table 12: Scale Accuracy using Cronbach's Alpha-Coefficient*, has demonstrated that these results do not necessarily have a high level of accuracy. However, the coefficients are close to being so.

If accurate, this information demonstrates that participants were more excited to interact with the bottom bar navigation (prototype B) than the alternative provided in prototype A. Prototype B proved to have more excitement, interest, and value being more motivating to the participant.

5.2.2.6 Novelty

The T-test conducted based on the UEQ questionnaire identified a significant difference in Novelty. This difference favoured the bottom bar navigation (prototype B). Our alpha coefficients, outlined in *Table 12: Scale Accuracy using Cronbach's Alpha-Coefficient,* support this statement's accuracy.

The results demonstrate that participants found the bottom bar navigation (prototype B) both more exciting and innovative to interact. Participants found Prototype B to be the most cutting-edge, original, and inventive.

5.3 Interview results

This section will report on the results received in the interview phase of the user study. As some of the interview questions have been reported previously in this thesis's observation results section, these results will not get reintroduced here.

5.3.1 Previous experience navigating mobile eCommerce websites (Question Six: Do you ever find yourself experiencing problems navigating mobile eCommerce websites? And Questions 7: Try to remember the last time you were navigating an eCommerce website on your mobile, how was this experience?)

Interview Questions six and seven gave us a baseline in understanding some of the issues users encountered in navigating mobile eCommerce websites. Furthermore, it helped us understand what a standard navigation experience could be. In this section, we will cover the answers to these interview questions.

Previously, we have outlined a breakdown of how often users experience issues navigating mobile eCommerce websites, the data for this can be seen previously *in Figure 39: eCommerce Website Problems.* Further to the information provided on interview question six in section 4.6.5 E-commerce website problems, we will now cover some of the issues identified by participants in the interview. The answers to interview question six are outlined in *Table 16: Interview Question Six Answers* featured in Appendix D.

Interview Questions seven then asked users to try and remember when they were navigating a mobile eCommerce website and explain this interaction. The answers to this interview question get outlined in *Table 17: Interview Question Seven Answers* which are featured in Appendix D.

Based on the answers that we received from participants during the interviews, we can assume that most users experience problems navigating mobile eCommerce websites at some stage. Specifically, P04 stated that when encountering mobile eCommerce websites' problems, the *"Problems are always navigational".*

Many participants also identified that navigation options are often a barrier to using mobile eCommerce websites. P13 stated that *"I find using mobile slower than on the computer, so I usually try and do it on the computer instead".* Furthermore, P23 also stated *"Overall I use a PC or a computer rather than every mobile phone since they work neater. The navigation design can be a bit of barrier to use on mobile"* supporting previous statements.

5.3.2 First impressions of prototype A (Question Eight: What were your first impressions of Prototype A)

Interview Questions eight then asked participants what their first impression of prototype A was. These results get presented in *Table 18: Interview Question Eight Answers* that is featured in Appendix D.

A common theme amongst participants for this question was that prototype A was more of a standard and expected navigation option. Specifically, P05 stated that it was *"Pretty standard, it's what you see on a lot of websites",* and P02 described it as being *"Standard. The normal menu you see".* However, participants did mention, even in this

stage of the interview, that it was difficult to use. P17 stated that *"With using my right hand it being up in the far corner of the device is difficult. Also with a larger phone these days it could be an issue."*

From the answers received in the interview, we can assume that participants expected to see the navigation presented in prototype A, the hamburger menu in the top left. The expectation of the hamburger was a well-known factor and commonly encountered by participants. However, the hamburger is not a navigation option that is well known for its merits.

5.3.3 First impressions of prototype B. (Question Nine: What were your first impressions of prototype B)

Interview Questions Nine then asked participants their first impression of prototype A. These results get presented in Table 19: Interview Question Nine Answers. This table is featured in *Appendix D.*

A common theme amongst participants when it came to their first impressions of prototype B was that it was not a navigation option that they had expected to see when it came to navigation and that it was somewhat unexpected. Although unexpected, this navigation was still a pleasant surprise to many. P09 stated that *"I found it unexpected. I liked the fact it was down the bottom, it was different and stood out."* Likewise. P02 also said *it was "*Unconventional", but they were *"Excited to use it. The system peaked my interest."*

From this interview question, we learned that prototype B was perceived as being different, more accessible, and faster to use. P13 stated that *"It was a bit different but once I saw what you do it was pretty easy, and I could use it one-handed a lot easier. Was probably even better than A".*

5.3.4 Experience with prototype A (Question Ten: How did you find the navigation system on Prototype A

Interview Questions Ten then asked participants what their experience with the navigation option on prototype A was. These results get presented *Table 20: Interview Question Ten Answers.* This table is featured in *Appendix D.*

When talking about their experience with prototype A, participants, in general, found it to be more difficult to reach, particularly one-handed. Furthermore, it was stated that this is not only an issue that has been encountered with the navigation option tested; however, something that participants have encountered elsewhere. P05 said:

> *Having to reach up, particularly just my primary hand to open it was difficult. This is something that I notice more on other website now that mobile screens have gotten larger. Even if the hamburger menu Is in the top right it is still quite a stretch.*

5.3.5 Experience with prototype B (Question Eleven: How did you find the navigation guideline on Prototype B)

Interview question eleven then asked participants their experience with the navigation on prototype A. These results get presented in *Table 21: Interview Question Eleven Answers.* This table gets featured in Appendix D.

At first, some participants found the prototype B navigation slightly confusing due to its different layout. After a brief period, most of these worries had cleared up, and these participants came to prefer the navigation featured in prototype B.

About their experience with prototype B, participants found it to be a more streamlined and fluid process. Participants particularly liked the callout icons down the bottom. They found them to be more accessible and a faster method to get to some of the key categories on a website they would be going to more often. They also appreciated that the hamburger navigation was still included meaning there was a familiar way to access other website sections. p14 Stated that *"I preferred it to prototype A, especially with the mixture of getting straight to the category down the bottom and then the menu. Just the combined methods of the one touch and specific menu was good."*

An interesting comment bought up by P10 was around general accessibility for people less able. P10 stated that *"The callouts with the symbolism would be good for people that struggle with words or are dyslexic. It reaches a larger target audience".* This could be an element of the design worth further exploration.

5.3.6 Challenges with the prototypes (Question Thirteen: Did you find anything particularly challenging on either of these prototypes?)

Interview questions thirteen asked participants if they found anything challenging on either of the prototypes. The answers to this question get presented in *Table 22: Interview Question Thirteen Answers.* This table is featured in *Appendix D.*

When asked, the main challenge that participants encountered was reaching the hamburger menu in the top left-hand corner of prototype A. Of the twenty-four participants who took part in the study, one participant stated that they struggled to get their thumb to the correct location on Prototype B. Eight participants stated experiencing challenges with prototype A. The remaining participants did not state any challenges with either of the prototypes for this interview question.

5.3.7 Simplicities of the prototypes (Question Fourteen: Did you find any of the tasks easier on one prototype over the other?)

Interview questions fourteen asked participants if they found anything particularly easy on either of the prototypes. The answers to this can be seen in *Table 23: Interview Questions Fourteen Answers.* This table gets featured in *Appendix D.*

When asked what participants found easy about the navigation options tested, prototype B was the most common answer. Participants liked the smooth process of prototype B and the fact that it was accessible for use with one hand. Participants also

appreciated the fact that on prototype B, they had the iconography that aided them in seeing which category was which; this took an aspect of reading away from the navigation that made it easier for multiple users. This is supported by P12 stating that *"The shortcuts on prototype B were handy as the icons were self-explanatory. Really liked the visuals".*

5.3.8 Surprises of the prototypes (Question Fifteen Was there anything that you found surprising about these prototypes or aspects that didn't do what you expected them too?)

Interview questions fifteen asked participants if there was anything that they found surprising about either of the prototypes, or aspects that did not do what they expected them to do. The answers to this interview question is featured in *Table 24: Interview Questions Fifteen Answers.* This table is featured in *Appendix D*

When asked what participants found surprising about the navigations tested, having no surprises or challenges was by most common answer to this question, with 62.5% of participants answering this way. When a participant identified a surprise, it was usually surrounding the layout of prototype B due to its unexpected nature. This surprise to prototype B was also usually followed up with praise regarding the design's ease of use. Specifically, P15 stated that they were *"Surprised by how much I liked the Prototype B. Especially because that is not a layout you normally see or use"*, furthermore; P09 mentioned that it was *"Surprising that the navigation was down the bottom on prototype B, but I actually ended up preferring it and it was easier to use".*

5.3.9 Prototype preference

Interview questions sixteen and seventeen went on to ask the participants about their preference for the two prototypes. User preference helped us learn which of the two prototypes participants liked the most and which of the two prototypes participants liked the least.

The following sections break this analysis down to identify which of the two prototypes was the preferred option for navigation on mobile eCommerce websites.

5.3.9.1 Preferred prototype (Question Sixteen: Which of these two prototypes did you like the most? Why?)

Interview question sixteen asked participants which of the two prototypes they liked the most. From this interview question, we have identified twenty participants preferred navigating with prototype B. These findings are presented in *Figure 45: Preferred Prototype*. P08 noted that *"As far as user experience goes, prototype B had a far better UX, like functionality wise. By having dedicated buttons to key callout categories it let me activate them easier".* This was further supported by P17, stating that *"If prototype B was used more, I feel like it would be so much more effective, I also like the categories included too"*

Accessibility was noted as being something important when it came to the user experience of navigation options. This accessibility was highlighted as being superior in prototype B also. Specifically, P18 stated *"Being left-handed, having it down the bottom*

was more accessible for me, the top left was actually a little harder to reach". The visual elements for the key categories were also noticed by participants that helped improve the accessibility of different website sections.

The answers to interview question sixteen can be seen *in Table 25: Interview Question Sixteen Answers*. Appendix D shows this table.

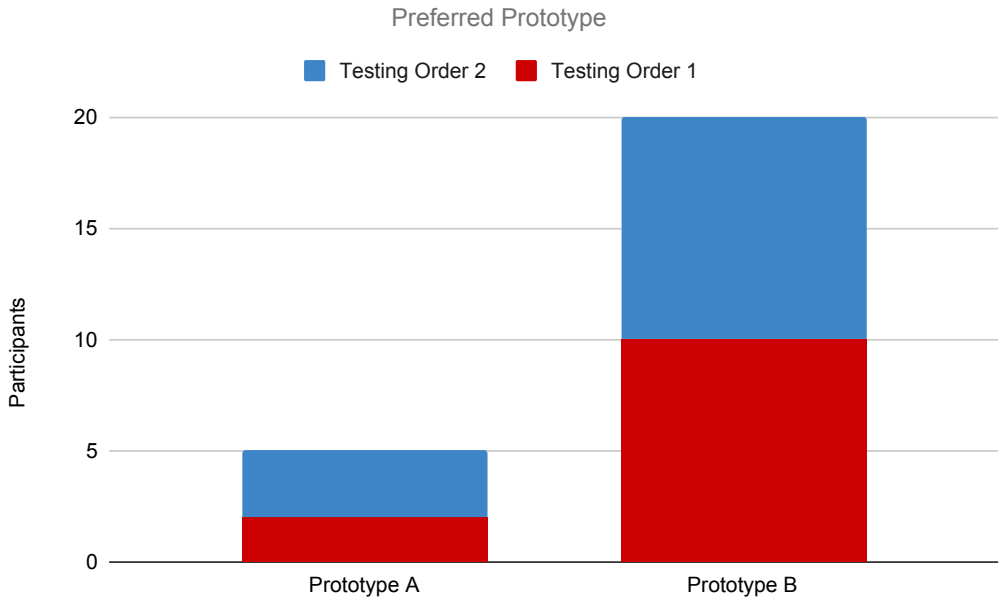


Figure 45: Preferred Prototype

5.3.9.2 Least preferred prototype (Question Seventeen: Which of these two prototypes did you like the least? Why?)

Interview question seventeen asked participants which of the two prototypes that they liked the least. This identified nineteen of the twenty-four participants also identified prototype A as being their least preferred option to navigate. Four participants found Prototype B to be their least preferred. Only one participant stated that they didn't necessarily dislike either of the prototypes. This participant believed that they both have their merits; however, they did identify prototype B as being their preferred to navigate via these findings are presented in *Figure 46: Least Preferred Prototype*. The most common reason for prototype A being least preferred was the difficulty participants had when it came to manoeuvre the navigation with a single hand. P20 states that *"Prototype A was physically not as easy to use".*

Another reason for prototype A being the least preferred method of navigation was the constant filtering through the single button and the lack of visual cues that prototype B had for the participants. This caused participants to have to put a more significant focus on finding the correct category for prototype A, whereas for many tasks on B, they were able to select the category directly via the visual buttons at the bottom of the screen. P08 summarises this well stating that *"The more things a single button does the less it will do well",* with P19 also mentioning that they *"did not like the constant filtering for each section. There was too much reading",* in regards to prototype A.

The answers to interview question seventeen can be seen in *Table 26: Interview Question Seventeen Answers*. Appendix D shows this table.

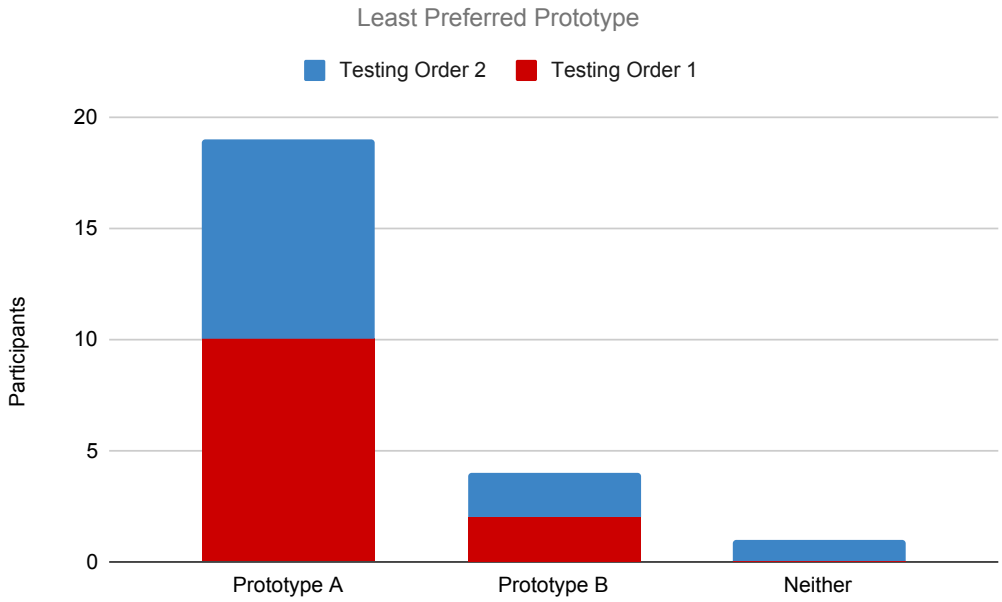


Figure 46: Least Preferred Prototype

5.3.9.3 *Like to use again (Question Eighteen: Would you look forward to using either of these systems again)*

Interview question Eighteen asked participants if they would like to use either of the two prototypes again. The answers to this research question can be seen in *Table 27: Interview Question Eighteen Answers*. Appendix D shows this table.

A common theme amongst participants for this question was that Prototype B was the preferred prototype for selecting one that they would like to use again. Prototype B was highlighted as the most appropriate here due to the location's ease of reach, the positive experience participants had with the prototype and the simplified workflow of the navigation. Specifically, P24 states that when it came to using the porotypes again, they would like to use *"Prototype B mostly, mainly because it was easier to reach and use. The key category callouts play into this too because it was a lot faster to use".*

5.3.10 *Participant suggestions (Question Nineteen: Do you think that either of these navigation systems could be presented in a more effective or relevant way?)*

Finally, in interview question Nineteen, participants were asked if they had any suggestions around changes that could get made to the navigation or things that could be improved upon to make a better experience. The results for this interview question get presented in *Table 28: Interview Question Nineteen Answers.* This table gets featured in Appendix D.

The definitive answer from participants when it came to this particular interview question was that they had no suggestions or improvements or changes that could get made to the navigation. P22 makes a good point stating that *"there is room for improvement in every system"* before speaking on prototype B being their preferred navigation method.

Suggestions were made around the hamburger menu placement in prototype A. P04 suggested that perhaps the top right-hand corner could be more appropriate. This was investigated in the literature review previously and was proven less effective than alternative navigation options. In future, this could be something worth further investigation.

5.4 Summary

The UEQ has identified that in all three of the categories where Cronbach's Alpha-Coefficient had a fair value to ensure reliability, the bottom bar navigation (prototype B) was superior. These categories were Attractiveness, Efficiency, and Novelty.

Through the user study tasks and interview questions related to these, we can conclude that participants found tasks easier to complete on prototype B over prototype A, especially when it came to the tasks that required users to navigate with their primary hand.

Based on the interview questions, we found that participants had a more optimal experience when interacting with prototype B. In general, participants stated that prototype B was their preferred method of navigation of the two and would be the method they would like to use again in the future.

Based on the information discovered via this user study, it can be concluded that the preferred navigation option was the bottom bar navigation presented in prototype B.

6 Conclusions

This section discusses a summary of the thesis presented. This includes the critical elements discovered in the literature review, the results from the case study and findings from the user study. Here we will also answer our four research questions set out earlier in the thesis. Limitations of the thesis will also be discussed, along with future work around the area of investigation.

6.1 Overview

We went into this thesis intending to understand and evaluate navigation options for mobile eCommerce websites.

This thesis was split into six main chapters. Chapter 1: Introduction, Chapter 2: User experience and mobile devices. Chapter 3: Case Study of mobile navigation solutions, Chapter 4: User study of two navigation prototypes developed and conducted, Chapter 5: Discussion and Chapter 6: Conclusions.

Chapter 1: Introduction introduced the thesis and the topics discussed throughout. Chapter 1 also highlighted the hypothesis and research questions.

Chapter 2: User experience and mobile devices discussed the related works to understand mobile eCommerce website, users manoeuvring throughout mobile eCommerce website, and alternative navigations currently in use. Chapter two begun to answer *RQ1, What can affect a user's ability in the navigation of a mobile eCommerce website?* And *RQ2, What is the current state of the art navigation for mobile eCommerce websites?*

Chapter 3: Case Study of mobile navigation solutions introduced and presented a case study that looks at ten existing mobile eCommerce websites' navigation. This case study helps answer *RQ2: What is the current state of the art navigation for mobile eCommerce websites? And RQ3: What design interventions can be developed to help the user manoeuvre more successfully throughout a mobile eCommerce website?* The case study helped learn what the optimal navigation options for mobile eCommerce websites could be. The findings of this case study also aid us to go forward and develop prototypes for user testing.

Chapter 4: User study of two navigation prototypes developed and conducted presented the methodology for a user study; this study was based on two prototypes that were developed after the analysis of the case study. This chapter helped us answer *RQ4: Can an adapted and refined navigation improve a user's experience on mobile eCommerce websites?* It also aided in answering RQ3: *What design interventions can be developed to help the user manoeuvre more successfully throughout a mobile eCommerce website?*

The user study compared these two navigations and helped us determine which was more optimal for mobile eCommerce websites. The study also helped us learn if one of the options provided a more advanced user experience for the participant. The first navigation was based on what we identified as the most common form of navigation in

use, the hamburger menu in the top left-hand corner of the device. This was defined as Prototype A and can be seen previously in *Figure 20: Prototype A*. We developed the second navigation prototype based on several navigation options' standout factors investigated via the case study. This prototype used a bottom bar menu incorporating a hamburger menu in the bottom right-hand corner, iconography, and labels. This prototype is referred to as prototype B. Prototype B can be seen previously in *Figure 21: Prototype B.*

The user study was split into two main sections, section A and section B. Section A covers an observation of users completing four tasks on two different navigation prototypes, and a user experience questionnaire (UEQ) was filled in. Section B consists of a semi-structured interview that aids the researcher in gaining qualitative information from the participants. Throughout the user study, we discuss how the user study proceeded and the participants' demographics that took part in the study. We also investigated difficulties that arose throughout the study.

Chapter 5: Discussion went on to discuss the results of the user study. The chapter analysed the four tasks completed in the user study and discussed these in-depth. Chapter 5 evaluates the UEQ that was conducted and interviews that also took place. Finally, we answer all four of our research questions outlined in section 1.2 Research questions.

Chapter 6: Conclusions concludes our thesis. Here we summarise and reemphasise the most critical findings from the thesis. The research questions presented initially are answered. Future work and limitations of the study are presented.

6.2 Answers to research questions

This section summarises four research questions defined previously in this thesis. These research questions were:

RQ1: What can affect a user's ability in the navigation of a mobile eCommerce website?

RQ2: What is the current state of the art navigation for mobile eCommerce websites?

RQ3: What design interventions can be developed to help the user manoeuvre more successfully throughout a mobile eCommerce website?

RQ4: Can adapted and refined navigation improve a user's experience on mobile eCommerce websites?

6.2.1 Research question one

Research Question one asked *What can affect a user's ability in the navigation of a mobile eCommerce website?*

We identified ergonomics as a significant factor in navigating mobile e-commerce websites. We have learnt that previous research has helped us gain insight into ergonomics and navigation on mobile devices. In the years since then, technological advancements have been made that could affect this.

In the user study, we observed that all twenty-four participants attempted to complete the tasks with no significant issues in most circumstances. The problems that did arise through this user study were surrounding the positioning of the hamburger in prototype A. This was addressed with the design and development of prototype B, which also got tested.

6.2.2 Research question two

Research Question two asked *What is the current state of the art navigation for mobile eCommerce websites?*

We will now answer this question. The case study conducted in Chapter 3 demonstrated that the hamburger menu in some form makes up 80% of the eCommerce websites investigated in the case study period. We discovered that the navigation most used on mobile eCommerce websites is a hamburger menu unambiguously in the mobile device's top left-hand corner. This top left-hand corner menu represented 50% of the navigation options investigated in this case study and accounted for 75% of all hamburger menus featured.

We can conclude that the hamburger menu in the top left-hand corner of a mobile website could be a frequent navigation option selected for mobile eCommerce websites.

6.2.3 Research question three

Research Question three asked *What design interventions can be developed to help the user manoeuvre more successfully throughout a mobile-eCommerce websites?*

Based on the case study, we developed navigation options that could provide a more optimal experience for users when it came to manoeuvring successfully throughout a mobile eCommerce website. Testing of this in the user study provided further insight into the effectiveness of this navigation.

6.2.4 Research question four

Research Question four asked *Can an adapted and refined navigation improve a user's experience on mobile eCommerce websites?*

In the user study, we learnt that the adapted and advanced navigation labelled prototype B could provide a better experience for the study participants. Among all tasks, prototype B proved it could be the most effective. Prototype B also proved potentially superior when it came to Attractiveness, efficiency and novelty (all three UEQ categories with adequate values to ensure reliability).

6.3 Limitations

Covid-19 provided to be a significant limitation when it came to the user study presented in this thesis. The user study included twenty-four participants. This allowed for results to be gathered given the circumstances surrounding covid-19. We could expand these results with a more extensive and more varied user study group.

Device size is also a limitation concerning the information gathered. It would be beneficial to replicate the user study on various device sizes to ensure the navigation

guideline tested was usable across various devices. Also, learning if the findings are relevant to larger touchscreen devices such as iPads and tablets.

6.4 Future work

Future work surrounding this thesis could investigate Asian sites vs NZ/western sites. Specifically, look into the way we read and if that affects standardised positioning of navigation options and the most effective approach for that circumstance. This leads us to discuss whether the findings from this thesis are applicable elsewhere in the world.

Another investigation area could be navigation option preferences when it comes to older users using mobile eCommerce websites.

Participants made suggestions around the hamburger menu placement in Prototype A. P04 suggested that perhaps the top right-hand corner could be more appropriate. This was something investigated in the literature review previously and proven less effective than alternative options. However, this could be something worth exploring further in future.

It would be worth investigating navigation options with accessibility for less abled people in mind and the potential benefit of a bottom bar menu in this situation. Regarding interview question eleven, P10 commented on this. P10 stated that *"The callouts with the symbolism would be good for people that struggle with words or are dyslexic. It reaches a larger target audience".* This highlights a different exploration area around an adapted navigation solution that could provide a more optimised experience for people with disabilities.

Different positioning of the bottom bar menu could also be a point of future work and ways to hide this navigation bar and have it display on an action that the user completes.

It was not the scope of the research to discuss both mobile websites and native applications; however, there are often solid relationships and interdependence between these. A topic of further investigation would be to explore these relationships and interdependences concerning the research presented.

Finally, it would be worth investigating the use of this navigation option and other alternate options on different devices such as tablets and X-Large phones that have started to make an appearance in the market in recent years.

6.5 Insights

The aim of the presented research was to investigate whether **the ordinarily used hamburger menu in the top left-hand corner of modern smartphones is a sub-optimal navigation option for the general navigation of eCommerce Website's categories and products.** The results from the user study and information learnt elsewhere have potentially proven this.

According to the research conducted, positioned in the top left-hand corner, the hamburger menu may not provide the most auspicious encounter for a user

manoeuvring throughout mobile eCommerce websites. The top left-hand corner of a mobile device could be difficult to reach for the average right-handed user. The hamburger menu might instead get positioned in a more accessible location.

This thesis concluded that a bottom bar navigation option could be the preferred navigation option for mobile eCommerce websites.

This gets demonstrated by the UEQ. The UEQ identified prototype B, the bottom bar navigation as the standout navigation in the three categories where we were able to ensure reliability. These were Attractiveness, Efficiency and Novelty.

The user study interviews also demonstrated that participants identified prototype B as not only their preferred option to use but potentially found tasks easier to complete on this navigation.

Based on the information presented in this thesis, we could recommend using bottom bar navigation. This bottom bar navigation would incorporate labels and icons alongside text to design mobile eCommerce websites in the future.

7 References

Abreu, L. (2014). *Why and How to Avoid Hamburger Menus*. Lmjabreu. https://lmjabreu.com/post/why-and-how-to-avoid-hamburger-menus/

Ahmad, N., Rextin, A., & Kulsoom, U. E. (2018). Perspectives on usability guidelines for smartphone applications: An empirical investigation and systematic literature review. *Information and Software Technology*, *94*, 130–149.

Babich, N. (2019). UI vs. UX Design: The Similarities & Differences | Adobe XD Ideas. *Ideas*. https://xd.adobe.com/ideas/process/ui-design/ui-vs-ux-design-understanding-similarities-and-differences/

Babich, N. (2020a). Deciding Between Responsive Web or Native Apps | Adobe XD Ideas. *Ideas*. https://xd.adobe.com/ideas/principles/web-design/responsive-web-or-native-app/

Babich, N. (2020b). What Is UX Design? User Experience Definition | Adobe XD Ideas. *Ideas*. https://xd.adobe.com/ideas/career-tips/what-is-ux-design/

Blanco, C. F., Sarasa, R. G., & Sanclemente, C. O. (2010). Effects of visual and textual information in online product presentations: Looking for the best combination in website design. *European Journal of Information Systems*, *19*(6), 668–686. https://doi.org/10.1057/ejis.2010.42

Campbell-Dollaghan, K. (2014). *Who Designed the Hamburger Icon?* Gizmodo. https://gizmodo.com/who-designed-the-iconic-hamburger-icon-1555438787

Clark, J. (2015). *Designing for touch*. A Book Apart New York.

Clemens, B., Cata, T., & Hackbarth, G. (2012). Mobile device considerations for supply chain and ERP related systems. *Communications of the IBIMA*, *1*.

Coursaris, C. K., & Kim, D. J. (2011). A meta-analytical review of empirical mobile usability studies. *Journal of Usability Studies*, *6*(3), 117–171.

eCommerce Guide. (2022, February 28). *What is Ecommerce? Definitions, Examples, And The Origin of Online Shopping*. ECommerce Guide. https://ecommerceguide.com/guides/what-is-ecommerce/

E-commerce Websites: What They Are & How to Build One | Mailchimp. (2021). Mailchimp. https://mailchimp.com/marketing-glossary/ecommerce-website/

Flahertry, k. (2019). *User Experience vs. Customer Experience: What's the difference?* https://www.nngroup.com/articles/ux-vs-cx/

Font Awesome. (n.d.). Retrieved May 9, 2022, from https://fontawesome.com/

Fu, Y., Zhang, D., & Jiang, H. (2018). *Comparison of Users' and Designers' Differences in Mobile Shopping App Interface Preferences and Designs*. 31–32.

Garcia-Lopez, E., Garcia-Cabot, A., de-Marcos, L., & Moreira-Teixeira, A. (2021). An Experiment to Discover Usability Guidelines for Designing Mobile Tourist Apps. *Wireless Communications and Mobile Computing*, *2021*.

Garcia-Lopez, E., Garcia-Cabot, A., Manresa-Yee, C., De-Marcos, L., & Pages-Arevalo, C. (2017). Validation of navigation guidelines for improving usability in the mobile web. *Computer Standards & Interfaces*, *52*, 51–62.

Garczarek-Bąk, U. (2016). Trends in website development based on the chosen functionalities in qualitative aspect. *Studia Oeconomica Posnaniensia*, *4*(10).

Garrett, J. J. (2011). *The elements of user experience: User-centered design for the Web and beyond* (2nd ed.). Berkeley New Riders.

Glen, S. (2014). *Cronbach's Alpha: Definition, Interpretation, SPSS*. Statistics How To. https://www.statisticshowto.com/probability-and-statistics/statistics-definitions/cronbachs-alpha-spss/

Google Material Designs. (n.d.). *Material Design*. Material.Io. Retrieved April 12, 2022, from https://material.io/design

Hoober, S. (2013). *How Do Users Really Hold Mobile Devices? : UXmatters*. UX Matters. https://www.uxmatters.com/mt/archives/2013/02/how-do-users-really-hold-mobile-devices.php

Hurff, S. (2019). *How to design for thumbs in the Era of Huge Screens*. https://www.scotthurff.com/posts/how-to-design-for-thumbs-in-the-era-of-huge-screens/

Ingram, S. (2016). *The Thumb Zone: Designing For Mobile Users*. Smashing Magazine. https://www.smashingmagazine.com/2016/09/the-thumb-zone-designing-for-mobile-users/

Karlson, A. K., & Bederson, B. B. (2007). *ThumbSpace: Generalized one-handed input for touchscreen-based mobile devices*. 324–338.

Karr, A. (2015). UX research vs. UX design. *Interactions*, *22*(6), 7–7. https://doi.org/10.1145/2834964

Katzenbach, F. (2019, February 14). *Bow to the Thumb—Rethinking Navigation for Bigger Screens in 2018* [Medium.com]. https://medium.com/the-ecommerce-thinkship/bow-to-the-thumb-rethinking-navigation-for-bigger-screens-in-2018-7a0a2e1457a5

Laugwitz, B., Held, T., & Schrepp, M. (2008). *Construction and evaluation of a user experience questionnaire*. 63–76.

Liang, T., Huang, C., Yeh, Y., & Lin, B. (2007). Adoption of mobile technology in business: A fit-viability model. *Industrial Management & Data Systems*.

Liao, C., To, P.-L., Wong, Y.-C., Palvia, P., & Kakhki, M. D. (2016). The impact of presentation mode and product type on online impulse buying decisions. *Journal of Electronic Commerce Research*, *17*(2), 153.

Lobo, D., Kaskaloglu, K., Kim, C. Y., & Herbert, S. (2011). Web usability guidelines for smartphones: A synergic approach. *International Journal of Information and Electronics Engineering*, *1*(1), 33–37.

material.io. (n.d.). *Bottom navigation*. https://material.io/components/bottom-navigation

Meola, A. (2022). *Rise of Mcommerce: Mobile Ecommerce Shopping Stats & Trends in 2022*. Business Insider. https://www.businessinsider.com/mobile-commerce-shopping-trends-stats

Nguyen, P. (2015). *A study of one-handed interaction of large smartphones: GUI changes for better ergonomics*.

Nielsen, J. (1994a). *Enhancing the explanatory power of usability heuristics*. 152–158.

Nielsen, J. (1994b). *Usability inspection methods*. 413–414.

Nielsen, J. (2011). *How Long Do Users Stay on Web Pages?* Nielsen Norman Group. https://www.nngroup.com/articles/how-long-do-users-stay-on-web-pages/

Nielsen, J. (2012). *Mobile Sites vs. Apps: The Coming Strategy Shift*. Nielsen Norman Group. https://www.nngroup.com/articles/mobile-sites-vs-apps-strategy-shift/

Nielsen, J. (2020). *10 Usability Heuristics for User Interface Design*. Nielsen Norman Group. https://www.nngroup.com/articles/ten-usability-heuristics/

Nielsen, J., & Norman, D. (2014). *The definition of user experience (UX)*. https://www.nngroup.com/articles/definition-user-experience/

Norman, D. (2013). *The Design of Everyday Things: Revised & Expanded Edition*. Basic Books.

Responsive UI - Layout. (n.d.). Material Design. Retrieved May 4, 2022, from https://material.io/archive/guidelines/layout/responsive-ui.html#

Samsung for Business. (2021, August 19). Your phone is now more powerful than your PC. *Samsung Business Insights*. https://insights.samsung.com/2021/08/19/your-phone-is-now-more-powerful-than-your-pc-3/

Schrepp, M. (2015). User experience questionnaire handbook. *All You Need to Know to Apply the UEQ Successfully in Your Project*.

Shitkova, M., Holler, J., Heide, T., Clever, N., & Becker, J. (2015). *Towards Usability Guidelines for Mobile Websites and Applications.* 1603–1617.

Spool, J. M. (2019). *UX and CX: Same Language; Different Dialects.v.* https://articles.uie.com/ux-and-cx-same-language-different-dialects/

Statista. (2019). *Most popular online stores in New Zealand in 2018, by e-commerce net sales*. S. O'Dea. https://www.statista.com/forecasts/1014511/top-online-stores-new-zealand-ecommercedb

Statista. (2020). *Number of smartphone users worldwide from 2016 to 2021*. S. O'Dea. https://www.statista.com/statistics/330695/number-of-smartphone-users-worldwide/

Statista. (2021). *Global smartphone shipments by screen size 2018-2022*. Statista. https://www.statista.com/statistics/684294/global-smartphone-shipments-by-screen-size/

Suzanne Martin. (n.d.). *Designing Effective User Interfaces*. Retrieved May 4, 2022, from http://web.cs.wpi.edu/~matt/courses/cs563/talks/smartin/int_design.html

Tsiodoulos, D. (2016). *Comparison of hamburger and bottom bar menu on mobile devices for three level navigation*.

User Interface Design Basics. (2014, May 21). Usability.Gov; Department of Health and Human Services. https://www.usability.gov/what-and-why/user-interface-design.html

Vanderschantz, N., & Sijnja, N. (2020). *Swipe, Scroll, Add-To-Cart: A case study of e-commerce gallery designs for small screen devices*.

Wagner, G., Schramm-Klein, H., & Steinmann, S. (2020). Online retailing across e-channels and e-channel touchpoints: Empirical studies of consumer behavior in the multichannel e-commerce environment. *Journal of Business Research*, *107*, 256–270.

Wroblewski, Luke. (2011). *Mobile first*. A Book Apart.

8 Appendix A

The University of Waikato
Private Bag 3105
Hamilton, New Zealand, 3240
0800 WAIKATO (924 528)

HECS Human Ethics Committee
Hecs-ethics@waikato.ac.nz

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

22 July 2020

Paige Wyatt

Re: HECS Ethics Approval of Application HREC(HECS)2020#15 "Navigation Systems for Mobile ECommerce Websites"

Dear Paige:

Thank you for submitting your amended application HREC(HECS)2020#15 for ethical approval.

We are pleased to provide formal approval for your project, including the following activities:

- You will undertake a user study with approximately 30 participants testing the navigation systems of two prototype mobile applications.
- Participants will be invited to participate in an audio-recorded interview, User Experience Questionnaire, and user observation of their use of prototypes on a supplied mobile device.
- Users will be able to withdraw from the study and refuse to answer any questions and that all participants identities will be anonymised in your thesis and any resulting publications.

Please contact the committee by email (hecs-ethics@waikato.ac.nz) if you wish to make changes to your project as it unfolds, quoting your application number with your future correspondence. Any minor changes or additions to the approved research activities can be handled outside the monthly application cycle.

We wish you all the best with your research.

Kind regards,

Dr. Nicholas Vanderschantz

HECS Human Ethics Committee
University of Waikato

The University of Waikato
Private Bag 3105
Hamilton, New Zealand, 3240
0800 WAIKATO (924 528)

HECS Human Ethics Committee
Brett Langley
Telephone +64 77 838 4060
Hecs-ethics@waikato.ac.nz

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

24 August 2020

Paige Wyatt

Re: HECS Ethics Approval of Application HREC(HECS)2020#15 "Navigation Systems for Mobile ECommerce Websites"

Dear Paige:

Thank you for submitting your amended application HREC(HECS)2020#15 for ethical approval.

We are pleased to provide formal approval for your project, including the following activities:

- You will undertake a user study with approximately 30 participants testing the navigation systems of two prototype mobile applications.
- Participants will be invited to participate in an audio-recorded interview, User Experience Questionnaire, and user observation of their use of prototypes on a supplied mobile device.
- Users will be able to withdraw from the study and refuse to answer any questions and that all participants identities will be anonymised in your thesis and any resulting publications.

Please contact the committee by email (hecs-ethics@waikato.ac.nz) if you wish to make changes to your project as it unfolds, quoting your application number with your future correspondence. Any minor changes or additions to the approved research activities can be handled outside the monthly application cycle.

We wish you all the best with your research.

Kind regards,

Brett Langley, PhD
Chairperson
HECS Human Ethics Committee
University of Waikato

9 Appendix B

Participant ID: Prototype Order:

Please make your evaluation now.

For the assessment of the product, please fill out the following questionnaire. The questionnaire consists of pairs of contrasting attributes that may apply to the product. 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.

Example:

attractive	○	⊗	○	○	○	○	○	unattractive

This response would mean that you rate the application as more attractive than unattractive.

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 particular product. Nevertheless, please tick a circle in every line.

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

Participant ID: Prototype Order:

Please assess the product now by ticking one circle per line.

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

10 Appendix C

Participant ID: Prototype Order:

Gender: Male Female Other: Prefer not to specify

Left or Right handed: Left Right Both

Age Bracket
>20 20-29 30-39 40-49 55+ Prefer not to specify

Mobile Platform Android IOS Windows Other:

How often do you use mobile eCommerce websites?

Do you ever find yourself experiencing problems navigating mobile eCommerce websites?

Try to remember the last time you were navigating an eCommerce website on your mobile, how was this experience?

1

Participant ID: Prototype Order:

What were your first impressions for Prototype A?

What were your first impressions for Prototype B?

How did you find the Navigation System on Prototype A?

Participant ID: Prototype Order:

How did you find the Navigation System on Prototype B?

Did you find any of the tasks easier on one prototype over the other?

Did you find anything particularly challenging on either of these prototypes?

Did you find anything particularly easy on either of these prototypes?

Participant ID: Prototype Order:

Was there anything that you found surprising about these prototypes or aspects that didn't do what you expected them too?

Which of these two prototypes did you like the most? Why?

Which of these two prototypes did you like the least? Why?

Participant ID: Prototype Order:

Would you look forward to using either of these systems again? Why?

Do you think that either of these navigation systems could be presented in a more effective or relevant way?

Is there anything else that you would like to add?

11 Appendix D

Table 14: Participants assigned each testing order

Testing Order	Number of Participants
Testing Order A (Prototype A, followed by Prototype B)	12
Testing Order B (Prototype B, followed by Prototype A)	12

Table 15: Interview Question Twelve Answers

ID	Answer
P01	It was pretty even between the two, Shirts and bags were easier on b, the other tasks were easier on A.
P02	Bags and tents, easier on B.
P03	Men's clearance shirts on A, The reset of the tasks on prototype B because it. Was way faster and the icons also helped.
P04	Prototype B easier with one hand, both the exact same with both hands.
P05	Prototype B, the called out categories had one step less. You could just click on the category callout.
P06	Hamburger easier cause you know where it is and everything is in there.
P07	Prototype A, knew what I was doing.
P08	Prototype B.
P09	Prototype B was better, it had easier hand movements to access the menu and items.
P10	Prototype B, all of the tasks. I think it was faster.
P11	Prototype B was easier with the callout categories because it took away the step of having to go through the hamburger menu.
P12	Finding the tents, and bags was easier on B because of the shortcuts. But I feel like A would be more seamless because of how often you see them.
P13	Yea, it was probably easier on prototype B as I could use one hand for everything and didn't have to stretch over the screen to reach the menu.
P14	Prototype B was easier for all of the tasks.
P15	So much easier to navigate with one hand on Prototype B.
P16	Prototype A, finding the clearance section was maybe a bit easier.
P17	All of the tasks were physically easier on Prototype B. Things being in an accessible place was definitely one thing that I initially noticed.
P18	Prototype B for all of the tasks.
P19	All tasks were easier in Prototype B, especially with less steps.
P20	The tasks were easier on Prototype B apart from the clearance one.
P21	Some of the tasks were easier on Prototype B because of the shortcuts down the bottom.
P22	All of the tasks were easier on Prototype B.
P23	Prototype B was faster using those key category callouts down the bottom.
P24	Prototype B the callouts.

Table 16: Interview Question Six Answers

ID	Issues	Comment
P01	Sometimes	Mobile can be very different to PC. Can be taken to unexpected places.
P02	Yes	In terms of navigating, it is definitely more annoying using website eCommerce than a mobile app.
P03	Yes	Hard when there is no direct link to somewhere. I don't necessarily know that I have to go through somewhere to get to another location that I want. Frustrating when you have to think too much to find things/places.
P04	yes	Yes. Button Size. Problems are always navigational.
P05	Sometimes	Usually when the navigation is quite small.
P06	Sometimes	Getting given too much information at first glance. When there's a heap in the menu it can be difficult.
P07	Yes	Some are much better than others.
P08	Sometimes	Usually on mobile websites that don't offer thee right experience.
P09	yes	Websites not having what they say they do.
P10	yes	Depending on how the menu is set out, if I want to find something specific, having to scroll down and things being in a weird order can make it difficult.
P11	No	Don't think so.
P12	Yes	More on categorisation and not know what it is in categories. Especially things not being where I expect them to be.
P13	Yes	I find using mobile slower than on the computer, so I usually try and do it on the computer instead.
P14	No	Normally just things being slow and since I have small hands, I click on things that I don't mean to.
P15	Yes	A lot of the times things have things behind it so you can't see what you're looking for, so they just seem to break a lot. You push a button, and nothing happens (slow response times).
P16	No	Don't often have problems.
P17	Yes	Not too bad with some of the more popular brands. The problems I experience are potentially why I don't use mobile websites as often. I do tend to pick some website over others specifically because I can't navigate them appropriately.
P18	Sometimes	Can't figure out how the navigation works. Navigation errors. Too many screens to go through.
P19	Yes	Layouts of menus can be frustrating at times. I find that website navigation can be easier to use so I often us that, even on my phone sometimes.
P20	Yes	There is no unified way, everyone does it by their own method. If you go from one. Bike seller to another, they will be completely different. You expect that from different areas of retail, but not the same people.
P21	No	No issues.
P22	Yes	I have problems navigating every time. I find that phones can be slow and difficult to navigate with as they don't seem to have the depth of data that you can get on the computer.
P23	yes	Overall I use a PC or a computer rather than a mobile phone since they work netter. The navigation design can be a bit of barrier to use on mobile.
P24	Yes	Very confusing when three is a tonne of stuff and I can't necessarily find a certain item or category. If there is too much to take in, you cant really tell the difference between things.

Table 17: Interview Question Seven Answers

ID	Answer
P01	Yesterday, I already knew the website well and knew where I was intending on going.
P02	Menu was annoying, hard to reach and the buttons were too small.
P03	This morning, it was pretty straightforward, I was just browsing through the site.
P04	Today, It was a good experience as it was clean and there was not to much going on.
P05	The actual hamburger menu was quite small on the mobile layout, so you had to be verry specific with where you selected to actually get it to open.
P06	It was pretty good.
P07	I was capable of getting around, but I did struggle.
P08	Good, they were on AliExpress and it was verry conservative, they actually didn't have a hamburger menu at all on the website.
P09	It was good, they always look at the new product first, it would be nice if these were called out and easier to get to.
P10	Annoying, too many headings, had to scroll too much to find what was required. Quick links would have been more effective.
P11	Average had to remember what was on the previous menu page which made it difficult. Had to scroll through lots of different options as well.
P12	Good, used the website a lot before and was familiar with their layout.
P13	Fine, pretty standard.
P14	No big complaints, but. Feel like the more popular a website is, the easier it is to navigate.
P15	Frustrating. The menu wouldn't work so I had to use the search function. Would have preferred to be able to go into a menu and just select things.
P16	OK, could have been better. Didn't have an actual menu and just called out categories.
P17	Struggled, not intuitive to use.
P18	Already knew the website so it was pretty good.
P19	Cannot recall.
P20	All right.
P21	Predictable and what I expected it to be, can't remember the navigation.
P22	Difficult because I couldn't find the product that I wanted.
P23	Difficult, couldn't tap on the items, I think it could have been faulty. The fact that the website navigation was hard to use is a barrier in going back .
P24	Enjoyable, found what I was looking for even though I didn't know the website. I did have someone that knew the website really well with me though.

Table 18: Interview Question Eight Answers

ID	Answer
P01	Understandable and often used.
P02	Standard. The normal menu you see.
P03	Predictable, bot unusual at all. Quite familiar with that function.
P04	Difficult, easy with both hands, difficult with the right hand alone. If they were doing something in the house and they were browsing with on hand it definitely would not be easy, it would be. A strain on the thumb.
P05	Pretty standard, it's what you see on a lot of websites.
P06	Quite generic, many of the sites do follow that kind of format.
P07	Typical, normal, easy.
P08	Traditional, simple and I knew how to use it straight away.
P09	Standard and boring.
P10	It was all right. It was familiar. I liked that it was in the top corner.
P11	It was basic and classic.
P12	First impressions were good. I liked how it was kind of all together and you could find everything under the one menu. My only real concern around it was the fact that it was at the top of the. Screen. My thumb had to stretch to get to the top.
P13	It's what you expect normally on a website. It was pretty straightforward.
P14	Kind of threw me off a bit, because I have small hands and doing it one handed. I was kind of scared of dropping the phone. I feel like that's where menus normally are on websites.
P15	It was a more traditional layout. Kind of like android.
P16	Pretty standard, easy as. About what ide expect from a menu on a website.
P17	Seems like the usual go to for everyone. With using my right hand it being up in the far corner of the device is difficult. Also with a larger phone these days it could be an issues. I feel like some phones are even bigger than this one. I find that a lot of websites in general are difficult to select things when using my right hand.
P18	Had to click to many times to get where you wanted, there were also no visuals which made it difficult.
P19	I felt like there were too many steps required to get to where I needed to go.
P20	It was easy to use, everything was displayed all at once when you clicked on the menu.
P21	I found it a bit difficult to use with just my primary hand.
P22	It was nowhere near good as Prototype B.
P23	Very Conventional. I feel like it's how everyone else does it these days.
P24	I found it was more similar to what is out there currently but I found that I was tapping more times for things and having to take up more time searching. So I think I liked it less than the other. It was also a bit harder to use in the sense that I had to reach over. I think it's just what is out there currently.

Table 19: Interview Question Nine Answers

ID	Answer
P01	Looked at the top for the menu first.
P02	Unconventional, Excited to use it. The system peaked my interest.
P03	Not unexpected, but it was unpredictable and more interesting. Still felt familiar to use.
P04	It was good, because I'm right handed, it was not a strain on their thumb. It was good and easy to reach. You text like that too so it. Was easy to tap with one hand, both hands etc.
P05	Felt quite natural to use. It was a lot easier to actually interact with. I didn't have to stretch as far, being right handed the hamburger menu in the top left means I have to stretch the entire screen. Having the key categories meant I also didn't have to go into the menu for a lot of things.
P06	Looked very specific and straight to the point. Thought it would be potentially hard one handed because of what we are used to seeing around. Found it weird to look at the bottom of the screen at first for prototype B because we are not necessarily used to that layout.
P07	Couldn't get there with thumbs.
P08	For some key categories it was most definitely faster, but it did clutter the screen more.
P09	I found it unexpected. I liked the fact it was down the bottom, it was different and stood out. It also didn't get in the way well looking around.
P10	I was unsure about it being down the bottom, but then it functioned a lot better, could have preferred it even more if the set up was at the top?
P11	I liked the menu at the bottom because you could actually touch it with your right hand, especially when you're a bit bigger.
P12	It was good, I liked the shortcut icons, but I guess it was a little bit confusing when I had to go through the menu to get the clearance section. Wasn't too much of an extra step, I'd definitely get used to it with more frequent use.
P13	It was a bit different but once I saw what you do it was pretty easy and I could use it one handed a lot easier. Was probably even better than A.
P14	I found that weird, I'm not used to seeing menus down the bottom, normally up the top I the left or right had corner. I found it quite strange, but yeah it was good. I also found. The icons for like going to the tents and stuff a nice easy feature.
P15	All I could think of was the apple layout. But then it was so much easier to us with one hand especially.
P16	More what I expect out of an app than a website, but overall I still think it worked well.
P17	Very accessible down the bottom.
P18	Liked the imagery down the bottom, it was very intuitive.
P19	I think that it was easy enough to Understand. I like that it had highlighted the three most popular categories I would be going onto that website for.
P20	A lot easier to use, and a lot easier to reach to but things are in two different areas.
P21	I found it much faster to use and it felt more comfortable.
P22	Prototype B was much easier and friendly to use. Firstly because I could hold my phone with one hand, and secondly because it had the bar across the bottom with the more common categories. The imagery also helped here.
P23	I often use thee one handed mode on my phone cause I have a small hand so that I don't have to reach so far. So I really liked not having to reach right up. I hate having to reach to the top left hand corner of the phone, I tend to drop my phone doing this.
P24	I found it unexpected. I liked that one. At first I thought it was a little bit different, but once I started using it I found it very easy to user, like it was a lot less pressing and everything was right where I wanted it to be as a right handed person holding the phone.

Table 20: Interview Question Ten Answers

ID	Answer
P01	Straightforward and predictable.
P02	Annoying to use with one hand, but was fine with two hands.
P03	Easy.
P04	Good, structured, nothing major wrong with it. Everything was together on one place.
P05	Having to reach up, particularly just my primary hand to open it was difficult. This is something that I notice more on other website now that mobile screens have gotten larger. Even if the hamburger menu Is in the top right it is still quite a stretch.
P06	Quite Easy.
P07	Good.
P08	Perfectly Adequate.
P09	Fine, worked how you would expect, pretty standard menu.
P10	It was allright, but after doing prototype B it seemed a bit tedious to get through the menu. It was not as functionable as the other prototype.
P11	It was a bit clumsy using your right hand.
P12	Pretty easy, I liked how when you were going to the men's merino shirts it was like clothing, men's, shirt, all step by step and nicely organised.
P13	I found it fine.
P14	I felt like I was missing something and the process to get to certain things was kind of quite long but also it made sense where I was filtering through all of the different categories to get to something specific. You had to work to get to what you actually wanted.
P15	It was clear and simple.
P16	Pretty easy to use, simple and clear.
P17	Straightforward, no questions as to where anything would be.
P18	Felt like I was clicking through a million different tabs and it took ages. Clicking on the hamburger menu in the top right didn't feel very. Intuitive either.
P19	Thought it was a lot more reading and scanning down.
P20	Straightforward, its how everyone does it.
P21	I thought it was fine, but using my one hand to navigate was a bit difficult. I had to stretch quite a bit.
P22	Fine with two hands. Couldn't really do it with one hand though.
P23	It was fine, I feel like cause its normal its kind of self-explanatory.
P24	More difficult and I had to take longer to learn where things were. There was also more to do motion wise with one hand than in Prototype B.

Table 21: Interview Question Eleven Answers

ID	Answer
P01	Unpredictable and different.
P02	Confusing sometimes having 2 separate navigation options within the one area.
P03	Really easy, and then one part of it was really difficult. Took a moment to realise that all of the items were not highlighted in the bottom bar. Once this was learnt it was straightforward though.
P04	Really easy to use, a couple of the icons were a bit confusing at first as they could be accessed in the menu too.
P05	Could seem confusing initially if you are not sure where something falls under, but if you are familiar with how a website goes about categorises products I think it could be quite efficient for someone to uses.
P06	Easy as well especially for the called out categories.
P07	Awkward.
P08	More inventive. For going to things like clothing it was most definitely faster; but I'm not sure how it would effect things like using the website outside of navigation. Actions could be taken alongside the navigation system to have it hide or display with particular movements within the website.
P09	Simple, the callouts in the menu made things so easy when you were looking for those categories. Could even call out the new ranges and other things like that down the bottom too.
P10	The callouts with the symbolism would be good for people that struggle with words or are dyslexic. It reaches a larger target audience. Prototype B was easy to use.
P11	Easy, it was right where my finger was.
P12	Prototype B was really good, I think I navigated it quicker because of the shortcuts, like the tents and stuff.
P13	I found it fine, if not easier than Prototype A because of the one handed thing. If I didn't see how to use it first it could have taken a couple seconds to get it going and work out how to use it to begin with.
P14	I preferred it to prototype A, especially with the mixture of getting straight to the category down the bottom and then the menu. Just the combined methods of the one touch and specific menu was good.
P15	More enjoyable. Simply because it had the stuff down the bottom where it broke it down into the categories in a slightly different way.
P16	Again, pretty simple.
P17	Initially because it's not the normal menu it took a second for my head to get around. Potentially the key categories could be adjusted based on what people use often. I did like the key categories down the bottom though.
P18	Well laid out, just one press and I could get to where I wanted most of the time.
P19	Felt like the process was a lot quicker. The icons used made it easy to identify without necessarily reading.
P20	Got confused between the key callouts and the menu when looking for the clearance section.
P21	A lot more fluid and comfortable. It was a lot easier to reach the navigation down the bottom.
P22	Much easier and more simple. The bar across the bottom with the main categories made it fast.
P23	It was equally easy to use. I appreciated the key callouts down the bottom, it really made it faster. I also appreciated the big buttons under the clothing menu. It made it easier to select them and gave less chance of missing them.
P24	I found this prototype easier and it was very clear. For someone that didn't know where things would be I think they would find it easier to use. Especially a first time user. It was easy to use and get the hang of.

Table 22: Interview Question Thirteen Answers

ID	Answer
P01	It was pretty even between the two, Shirts and bags were easier on b, he other tasks were easier on A.
P02	Bags and tents, harder on A. Harder to do them with one hand as you had to reach up, their phone was even bigger as well so it would be even more of an issue there.
P03	No.
P04	No, easy to navigate.
P05	Nothing challenging, just an annoyance to reach up to the hamburger menu in the top left.
P06	Not really.
P07	Thumb Moving on Prototype B.
P08	No.
P09	No
P10	Prototype A was more challenging to get around.
P11	Not really.
P12	I wouldn't say anything was challenging.
P13	Not really.
P14	Yea, just my small hands-on prototype A, reaching over with one hand, two handed it wasn't an issue at all though.
P15	Using one hand on prototype A it was a little hard to reach that top left-hand corner.
P16	No.
P17	Reaching across the phone to get to the menu on Prototype A.
P18	No.
P19	The Hamburger menu got difficult to read through with no visuals.
P20	No.
P21	No.
P22	Using one hand on Prototype A was very difficult.
P23	No.
P24	Finding men's merino shirts on prototype A, I had to scan through the hamburger menu more in comparison to prototype B just having them there.

Table 23: Interview Question Fourteen Answers

ID	Answer
P01	Know what to use on B.
P02	Reaching bags and tent with one hand .
P03	Prototype B, getting to the clothing tents and bags was super easy.
P04	Finding the tents on Prototype B.
P05	Reaching to interact with prototype B was really easy because you don't have to stretch as much and you are able to use just your primary hand for that. You don't have to be supporting the phone.
P06	The easiest thing was in prototype B, the icons were easy to just click on and go straight there. Whereas the hamburger you had to click into it and kind of go through it.
P07	Prototype A was easier
P08	They were both fairy easy to understand, prototype A was very traditional and to be fair so was the other one, it was more of a button choice movement than anything else. The icons were good and clear.
P09	Prototype B was easier for all of the tasks
P10	Symbols on prototype B made the tasks super easy.
P11	Navigation was easier on Prototype B
P12	The shortcuts on prototype B were handy as the icons were self-explanatory. Really liked the visuals.
P13	Prototype A would be exactly what you'd expect opening a website just because tis following website standards I guess. To begin with tasks were easier on Prototype A but after a bit it was easier on prototype B using one had etc.
P14	Prototype B easier to use one handed and easier to get to what I was wanting.
P15	Prototype B, just using one hand. Things felt like they came naturally using two hands on prototype B too.
P16	Both pretty easy to use in general.
P17	Reaching down the bottom on Prototype B. it was easier to just click on a category as well, there were less steps to go through to get to each of those sections.
P18	Shortcuts on B made it really easy.
P19	The hamburger menu was identifiable as a menu so I knew where to go straight away. I like that the tabs on Prototype B took you to more of a homepage to the clothes rather than having to sort through lots of different subcategories.
P20	Easier to reach with one. Hand down the bottom on Prototype B, even though I have big hands.
P21	No.
P22	Prototype B was easier as you could do it one handed. It also came back to the clarity of what you could see.
P23	Everything felt quite intuitive on both of the prototypes.
P24	Prototype B was a lot easier to find the main things, especially with the images.

Table 24: Interview Question Fifteen Answers

ID	Answer
P01	No.
P02	Clothing button, having the content under the symbol as well as the menu surprised them on Prototype B.
P03	No, not really.
P04	No, everything was very expected.
P05	Everything did what I expected. At first I wasn't sure how I felt about having the category callouts in B, whether it would make it confusing or whether you would make mistakes. But I didn't actually have any problems with that.
P06	No.
P07	How awkward B was to use.
P08	No.
P09	Surprising that the avigation was down the bottom on prototype B, but I actually ended up preferring it and it was easier to use.
P10	No.
P11	No not really.
P12	No.
P13	How hard it was using one hand, I guess I never really realised. Prototype B was heaps easier.
P14	The only thing that surprised me was Prototype B being down the bottom at first. But everything seemed to make sense and do what it should do.
P15	Surprised by how much I liked the Prototype B. Especially because that's not a layout you normally see or use.
P16	No not particularly, pretty much what you would expect from either of those layouts.
P17	No, Prototype B was unexpected but. It was definitely a pleasant surprise.
P18	All of the drop downs in Prototype A were a bit surprising.
P19	Didn't expect the tents to not have a filter/lower level category.
P20	No.
P21	No.
P22	No.
P23	No not really.
P24	I was surprised at how boaring I found Prototype A as its just the same as everything else. At first I was surprised when I saw prototype B and I thought I wasn't going to enjoy it, but I ended up enjoying that one and finding it the easiest and most enjoyable to use.

Table 25: Interview Question Sixteen Answers

ID	Answer
P01	Prototype A.
P02	Prototype B once. It had been. Used a little bit. Mainly because it was easier to use with one hand.
P03	Prototype B because of the icons.
P04	Prototype B because I like it down the bottom. Easier to reach with hand position. It is also familiar with android, texting etc.
P05	Prototype B, mostly because it felt easier and quicker to use. If there is a category that people are going to use often it makes it quicker.
P06	Prototype B, I found it more engaging and interesting to use. The main icons made it all quite self-explanatory as well.
P07	Prototype A.
P08	As far as user experience goes, prototype B had a far better UX, like functionality wise. By having dedicated buttons to key callout categories it let me activate them easier.
P09	Prototype B, I liked the thumb movements and the fact that I didn't have to read as much.
P10	Prototype B because it was quicker and easier to navigate.
P11	Prototype B because it was where I could reach my fingers.
P12	Prototype A, I just liked how everything was in the same place and it was the one that you saw everywhere
P13	Prototype B as I could use it with one hand.
P14	Prototype B because it was easier to use with small hands.
P15	Prototype B, I didn't have to strain my hand to get to the menu at all and I felt like I wouldn't drop my phone trying to do things one handed.
P16	Prototype A, I'm used to seeing it and I'm familiar with it. I liked having everything together.
P17	Prototype B, it just made more sense to be where it was.
P18	Prototype B, just better in every way. Being left-handed, having it down the bottom was more accessible for me, the top left was actually a little harder to reach.
P19	Prototype B, it was just less steps, easier to use, got me to where I needed to go quicker. Down the bottom of the screen was where my thumb naturally sits rather than having to reach over to the other side.
P20	Prototype B, was faster and easier to use with one hand.
P21	Prototype B, it was easier to use with my primary hand.
P22	Prototype B, simple to user, layout was easier, more thought through.
P23	Prototype B, I felt like it was faster, I really don't like stretching to the top left hand corner of the screen, I'm like a one handed warrior.
P24	Prototype B as it was super easy and different to use. The imagery also made it quite straightforward. It was good not having to click as many times to.

Table 26: Interview Question Seventeen Answers

ID	Answer
P01	Prototype B.
P02	Prototype A. It was more annoying to use with one hand.
P03	Prototype A, had no icons, just text.
P04	Prototype A because your reaching across the screen with one hand.
P05	Prototype A, it takes a lot more effort to use it, just in getting up to actually activate it.
P06	Prototype A, little bit cluttered with all the information, not very engaging.
P07	Prototype B.
P08	Neither, The more things a single button does the less it will do well (Prototype A).
P09	Prototype B, it was all up the top and you couldn't really get there.
P10	Prototype A, it just took too long to go to where I wanted to go.
P11	Prototype A, the navigation was as far away from my finger as possible.
P12	Prototype B, I just like having everything in one place, however yes it was easier to get to.
P13	Prototype A, I definitely don't like it as much as Prototype B.
P14	Prototype A, harder to use with small hands.
P15	Prototype A, nothing really wrong with it, it's quite a traditional layout but my hand is kind of small.
P16	Prototype B, just different. Not that it was bad but the change was a little bit surprising. If I wasn't used to seeing the hamburger menu in the top left it would probably feel the same.
P17	Prototype A, reaching across was difficult, everything else about it seemed pretty all right.
P18	Prototype A, doesn't have visual information and had awkward piles upon piles of navigation. It was also not very intuitive.
P19	Prototype A, I didn't like the constant filtering for each section. There was too much reading.
P20	Prototype A was physically not as easy to use.
P21	Prototype A, The hamburger menu was a bit difficult to reach with my primary hand.
P22	Prototype A, more difficult to use. Had to go into the hamburger to find what you wanted all of the time.
P23	Prototype A, everything had to go through the hamburger menu which is fine, but it was kind of annoying too.
P24	Prototype A because I had to look more for what I was asked to do.

Table 27: Interview Question Eighteen Answers

ID	Answer
P01	Probably a so I know what to expect.
P02	Both, A is convention, and B felt better to use.
P03	Prototype B, very easy to use for the most part, and the icons helped.
P04	Both were good, Both better than navigation systems on most actual live websites that are like sh*t.
P05	Would be really interested to see prototype B used again, possibly looking at different was that the categories are called out. Definitely think that It is a good idea.
P06	Both Prototypes.
P07	Prototype A.
P08	Both.
P09	Wouldn't really mind either, they both function.
P10	Definitely prototype B would be the preferred one.
P11	If I had to choose one it would be prototype B.
P12	Yeah ide say ide use Prototype A again, and B too to be honest.
P13	It would be pretty cool shopping with prototype B cause it was down the bottom and just easier.
P14	Felt normally like a usual navigation system. Would happily use both of them, despite having a favourite. Would prefer to use Prototype B over Prototype A though.
P15	Prototype B, It would limit my ability to drop my phone, because I do tend to drop them.
P16	Prototype A and B.
P17	Prototype. B or something like that having the menu down the bottom a little more often.
P18	Prototype B would be more enjoyable.
P19	Prototype B.
P20	Prototype A and B. It would be interesting to see B more because it helps show a difference in the development of mobile devices from web.
P21	Prototype B mostly, mainly because it was easier to reach and use. The key category callouts play into this too because it was a lot faster to use.
P22	Prototype B.
P23	Prototype B.
P24	Prototype B because it was different and I liked that. It was a lot easier to navigate and use. It was a nice experience.

Table 28: Interview Question Nineteen Answers

ID	Answer
P01	Maybe the icons on prototype B.
P02	No.
P03	Nothing Major.
P04	Prototype A in the top right hand corner so that it is easier to reach, if I was left handed prototype A would make complete sense and be easier.
P05	Both are quite easy and intuitive to use, not much more could be done to make them more effective.
P06	Noting major, perhaps a bit more hierarchy in both systems.
P07	No.
P08	Yes, prototype B could have the hamburger menu position switched to the opposite side but I did like it.
P09	No.
P10	Prototype B, could be interesting to try it at the top?
P11	Don't know.
P12	Prototype A possibly, but only in the placement of the hamburger.
P13	No not really.
P14	Not really no.
P15	Prototype B, the clothing button could just pop up a menu instead of going to another page
P16	No they're both pretty clear in what they are trying to do.
P17	No.
P18	Just potentially what is highlighted in the key categories.
P19	No.
P20	Categorisation on B. Potentially changing the positioning of the hamburger menu on prototype A to the top right hand side.
P21	Not that I can think of.
P22	There is room for improvement in every system, I definitely think that prototype B was the better system.
P23	I don't think so.
P24	Prototype B could be harder for left hand ed people maybe.