Menu anchor interactors in mobile website contexts

The perceived usability of menu navigation on three different types of websites

Annika Madejska and Alexander Persson
Författare
Annika Madejska och Alexander Persson

Titel
Menyinteraktörer i mobila webbsidekontexter
Upplevd användbarhet av menynavigation på tre olika typer av webbsidor

Handledare
Montather Faraon

Examinator
Kerstin Ådahl

Sammanfattning
2018 fanns det 3,6 miljarder mobila internetanvändare i världen, vilket visar att digitala designers måste tackla navigationsmöster och menyinteraktörer till smarta telefoner och små skärmar tidigt i sina projekt. Då användarnöjdhet är avgörande för en webbsidas framgång, och då en lyckad navigationsprocess genom ett menysystem är nödvändig för användarnöjdheten, är menysystemet en nyckelkomponent i gränssnittet. Den här studien avser tre typer av menyinteraktörer (obeständig dold meny, beständig toppmeny och navigationshub), på tre typer av webbsidor (enskild tjänsteleverantör, varumärkessajt och tjänsteregister). Målet var att undersöka hur webbsidans typ påverkar användarens inställning till menyinteraktörer. Den teoretiska basen utgörs av tidigare forskning på menysystem i grafiska användargränssnitt.

Studien genomfördes med hjälp av ett frågeformulär där bilder av tre olika menyinteraktörer på tre olika typer av webbsidor presenterades för deltagarna. De ombads att på en Likertskala från ett till sju bedöma hur hjälpsam den enskilda menyinteraktören uppfattas. Därtill ombads de att förtydligga sitt omdöme i ett kvalitativt svar.

De viktigaste resultaten från studien visar att användare föredrar menyinteraktörer som visar flera navigationslänkar och det finns indikationer på att den beständiga toppmenyinteraktören fungerar bäst för webbsidor av typen tjänsteregister, medan sidor av typen enskild tjänsteleverantör och varumärkessajt gynnas av en navigationshub. Resultatet visar emellertid också viken av att studera användargränssnittskomponenter i deras fullständiga gränssnittskontext, eftersom helheten påverkar den uppfattade användbarheten hon menyinteraktören.

Keywords
mény, navigation, menyinteraktör, menysystem, digital design, användbarhet, användarupplevelse, smarta telefoner, mobila användargränssnitt
Authors
Annika Madejska and Alexander Persson

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Supervisor
Montathar Faraon

Examiner
Kerstin Ådahl

Abstract
In 2018, there were 3.6 billion mobile internet users worldwide, which shows that digital designers have to tackle navigational patterns and menu anchor interactors for smartphone-sized screens early in their projects. As user satisfaction is crucial for the success of a website, and as successful navigation through a menu system is imperative to user satisfaction, the menu system is a key component in the UI. This study concerned three types of menu anchor interactors in smartphone UIs (Transient, Top persistent, and Navigation hub), on three website types (Single service, Brand, and Service directory). The goal was to investigate what influence the website type has on the user’s preferences of menu anchor interactors. The theoretical base is previous research on menu systems in graphical UIs.

The study was done by a questionnaire where the participants were presented images of three different menu anchor interactors on three different website types, and asked to score the assumed helpfulness of the menu anchor interactor from one to seven on a Likert scale. In addition, they were asked to clarify their scoring in a qualitative response.

The key findings are that users prefer menu anchor interactors that display several navigation links, and that there are indications that the Top persistent menu anchor interactor works best on the Service directory website type, while Single service and Brand website types seem to benefit from a Navigation hub. However, the results also show the importance of studying UI components in their full UI context, as the whole UI affects the perceived usability of the menu anchor interactor.

Keywords
menu, navigation, menu anchor interactor, menu systems, digital design, usability, user experience, smart phones, mobile user interfaces
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1. Introduction

Since smartphones with touch screens, downloadable software, and access to the internet were launched, the need for websites to be accessible and usable on small screens has increased rapidly, which is demonstrated by the growing number of mobile internet users. In 2018, there were 3.6 billion mobile internet users worldwide (GSMA Association, 2019). In North America, 83% of the population and in Europe 85% of the population have a mobile subscription (GSMA Association, 2019).

These figures show that the market for smartphones is expanding with a multitude of potential customers. Google, one of the internet giants, took an important step when they developed and released the Android operating system for mobile phones in 2008 because it stopped Apple and Microsoft from totally dominating the mobile market (Barwise & Watkins, 2018). By making Android an open source platform, Google secured their dominance of mobile search with a 95% share of all performed searches in May 2017 according to Netmarketshare (Barwise & Watkins, 2018).

Furthermore, in 2015, Google announced that they will reward web pages that are presented well on mobile with a better ranking in their search engine, when a search is performed on a smartphone (Makino & Phan, 2015).

This matters as Google is still the world’s leading search engine on mobile, which becomes clear when looking at the report from NetMarketShare in February 2019. The report stated that Google holds 87.10% of the search engine market, followed by Baidu holding 9.91% of the market and Yahoo! and Bing holding roughly 1% each.

As described, Google rewards web pages that display well on mobile, and because of this, responsive web design, where a web page adapts to the viewport of a device that retrieves it, has become an important tool for designers and developers as they try to mitigate the usability challenges of small screens (Jehl, 2014).

This also means that designers, working with User Experience (UX), or User Interface (UI) design, have to tackle information architecture, navigational patterns and menu anchor interactors for smartphone-sized screens early in their projects. User Experience in this case, refers to the user’s feeling after interacting with a service, product or a website (Huang, Lin, & Lu, 2018), while UI refers to the graphic design of the interface which includes visualization of objects that the user can interact with, (Benyon, 2014).

The actual menu, where the user drills down through the hierarchies to find the information they need, has to be activated. Bailly, Lecolinet, and Nigay (2016) argued that the menu bar in a
program or on a website is not the menu, but rather an anchor interactor (Bailly et al., 2016) that opens the menu.

Designing a webpage’s ontology, that is, low-level structures and hierarchies and high-level UI elements such as the menu and anchor interactor, is a very important part of a designer’s work, as findability is a large part of the user satisfaction (Mullins, 2015).

Yet there has been little research done on mobile menus or navigation patterns to support the designers in making informed decisions about solutions. This was noted by Punchoojit and Hongwarittorn (2017) who made an overview of usability studies carried out on specifically mobile UI:s from 2007 (when the first iPhone was launched) to 2017 (when their article was published). The purpose of their study was to create an explicit analysis of where the gaps in the research can be found and where further exploration is needed. They noted that research on mobile menus and navigation since 2007, has focused on things such as 2D and 3D menus, age differences (spatial ability, verbal memory etc.), cultural differences, menu adaptation, limited screen size effects on usability, efficiency, user preference and satisfaction (Punchoojit & Hongwarittorn, 2017).

Based on previous considerations, the current study will examine the preference of different menu anchor interactors on various website types.

1.1. **Scope and research objective**

In this study, we will examine whether a website type classified by purpose or function (i.e., the end user’s goal for visiting a website), would benefit in terms of perceived usability or findability from a specific menu anchor interactor.

This could in terms of improved UI, aid designers to create a better user experience. This would be done by providing the best solution for clarity and findability when selecting what type of menu anchor interactor should be displayed on mobile viewports of responsive websites. Online businesses and services may benefit from this as customer satisfaction could increase as clarity and findability of their websites would support the end user goals, that for example could be to find a cheap flight for a trip, browse to shop for clothes or find information about a restaurant they are interested in visiting.

The research process of this study is guided by the following question: **What influence does website type have on users preference of the menu anchor interactor?**

This research question will be addressed by adopting a quantitative approach, with a follow up qualitative question, which will further be described in section three.
1.2. Delimitations

This study will focus on smartphone users, mobile UI:s, and specifically websites that are created using responsive web design. The aspect of a website that we will focus on is the anchor interactor for the menu, that is, the object that the user has to interact with to open the menu. The three menu types that will be studied are top or bottom persistent navigation (navigation tabs or bars), transient hidden navigation (hamburger menu), and Springboard (list menu or navigation hub).

The three website types we will include in this study are: service directory, single service and brand website.

1.3. Definitions

The current study adopts terms and concepts, which will be defined in the following section.

- **Brand** websites hold services that are located in different places but still owned by the same enterprise (Gali, Mariescu Istodor, & Fränti, 2017).
- **Menu** is the system of grouped or categorized navigation links that open up when the user interacts by either hovering over or clicking the menu anchor interactor (Bailly et al., 2016).
- **Menu anchor interactor** is the component in the program or on a website that contains the actual menu and the structural navigation of a website (Bailly et al., 2016).
- **Menu system** is the entire system of components in the UI that makes it possible for a user to navigate. It includes both the menu and the menu anchor interactor.
- **Navigation** is the process and actions performed by the users when they try to find information/reach their goal with a visit to a website.
- **Responsive web design** is a strategy for enhancing the user experience of websites based on the size of the viewport or the browser window. When a website is opened, the same HTML document is served on all devices. Depending on the width of the user’s viewport, a specific stylesheet will be applied if a website is responsive (Niederst Robbins, 2012).
- **Service directory** websites provide services of other companies or organizations, such as travel fare aggregators (Gali et al., 2017).
- **Single service** websites hold a service that is geographically located in only one place; for example, the local restaurant that is not a part of a bigger enterprise (Gali et al., 2017).
- **Smartphone** is a handheld computer with internet connection that can be used for phone calls (Butler, 2012). The user can access websites and services either through a web browser, such as Chrome, or through applications downloaded mainly from Google Play or App Store. The very first smartphone was Apple’s Iphone that was released in 2007.
• **Springboard or Navigation Hub** was a popular navigation pattern in 2011, and they were used by a couple of big brands, including Facebook. The navigational options are shown in a grid, and therefore the options are all flattened to the same hierarchical level. The springboard navigation is still a common way to display applications on Android and iOS devices (Neil, 2014).

• **Top persistent navigation (navigation tabs or bar)** is the main navigation listed horizontally in a bar across the top of the webpage (Budiu, 2015). Persistent navigation bars provide a good overview of what a web page has to offer without having to tap or swipe, but they also take precious space on the viewport. Another drawback is that they only work well when they contain few options. The tab bar is similar to the top bar and can be seen in apps. According to Apple guidelines, the tab bar should appear at the bottom of the screen (Human Interface Guidelines) while it is more frequently located at the top on Android applications (Neil, 2014).

• **Transient (hidden) navigation (hamburger menu).** The need for transient navigation design grew bigger with the increase of mobile users. Small screen sizes on smartphones have forced the designers to think off canvas. This means hiding content outside the viewport until a gesture or tap by the user reveals the content. The most popular transient navigation design is the side drawer that is hidden and commonly revealed by tapping the hamburger menu button or swiping from the left long side of the screen (Neil, 2014).

• **Usability** is a term to determine whether a user in any given context can use a product to achieve tasks efficiently, effectively, and in an enjoyable way. The term can be used with any product type, but it has been heavily associated with digital products, such as web services and computer software. Usability is good when a product is easy to learn to use and memorable enough so that the users do not need to relearn it each time they use it (Krug, 2014).

### 1.4. Thesis structure

The following section of this study will cover the literature review on menu navigation, usability and classification of websites. Following this, a quantitative methodology was used to gather data for this study, including the creation of materials and selection of participants, will be described. Next, the results and the analysis of the data will be presented. The study concludes by a discussion of the results in relation to the theoretical background and suggestions for future work is provided.
2. Literature review

This is the overview of previous research that is relevant to our study. It will cover menu systems for both desktop and mobile UI:s as well as related studies on web usability on smartphones. Finally, we will give an account of existing frameworks for classifying website types, as the intention is to investigate the menu anchor interactors in the context of three types of websites that serve different user needs.

2.1. Menu systems in digital user interfaces

Since the web is an elemental tool for finding information and completing tasks, the need to know how to navigate on web pages is integral (Puerta Melguzio, Vidya, & van Oostendorp, 2012).

There are two ways of using a menu system. One is to provide the user an access to functionalities in computers and computer programs, and the other is to display a menu system for finding content on the world wide web (Leuthold, Schmutz, Bargas-Avila, Tuch, & Opwis, 2011).

Leuthold et al. (2011) studied two types of menu systems used on the world wide web – the vertical menu and the dynamic menu. The vertical menu always displays all group titles and navigation links under the titles; whereas the dynamic menu only displays the group titles, and the user must click on the title to reveal the navigation links. They discovered that the vertical menu outperformed the dynamic menu both in performance and in subjective preference. It also required a lot fewer eye fixations for the first click, and the users made considerably more correct choices in their clicks (Leuthold et al., 2011). This led the authors to conclude that when designing a menu system for a website, it is better to display as many logically organized navigation links as will fit on the screen (Leuthold et al., 2011).

The concept that the menu system with all links always visible performs the best is supported in a study by Puerta Melguzio et al. (2012). This study examined the effects of spatial ability, menu system type, and navigation path complexity on information gathering tasks. Their conclusion was that the users with low spatial skills benefit from the expandable menu where the full context of their navigation path remains on screen, while the users with high spatial ability navigate and find information much faster. It also became clear how large the overlap of semantic similarity between the goal of the navigation and the menu links was, which shows the importance of the words used in the menu links (Puerta Melguzio et al., 2012).

Menu system selections have become the dominating method with which humans interact with computer operating systems, applications, video games, and entertainment systems no matter
what the screen size is (Norman, 2008). Norman made an overview of the contributions that the field of human factors and ergonomics has made to the design of menu systems, from different options of presenting the menu to organization and labeling of links (Norman, 2008). Navigation starts with an intention from the user, continues with processing the information displayed in the menu to find out what will accomplish the desired task, and ends with evaluating the outcome of that choice (Norman, 2008). This means that the contents of a menu has to be displayed in an organized manner – either linearly or hierarchically, so that the user can find the desired information. The selection speed depends on how well the user remembers where the target link is located in the menu hierarchy (Norman, 2008). This supports the findings of Puerta Melguzio et al. (2012), who discovered that the users with high spatial abilities navigated faster than those with low spatial abilities. Norman’s (2008) final conclusions were that menu breadth is better than depth, and the navigation links in the menu must be organized in meaningful clusters to make it faster to find the desired information. To succeed in this task, designers need to start with understanding the users’ needs and cognitive processing abilities, and the design must be verified by empirical research (Norman, 2008).

The usability and user experience of menu systems are so critical that changes in them on important websites and applications get extensive coverage in the media, such as, for example, the privacy settings of Facebook (Bailly & Oulasvirta, 2014).

As described in this section, the menu system is crucial for the success of a website. Without a logically structured menu, the users cannot find the information they seek (Leuthold et al., 2011; Puerta Melguzio et al., 2012).

The menu system is the tool a user uses to navigate a website, and the process of navigating and interacting with the menu system begins with an intention from the user, as Norman (2008) pointed out. The anchor interactor of the menu starts the information processing and the menu selection on the screen.

2.1.1. Desktop navigation

Menu systems designed for exploring and selecting commands in computer programs first appeared in 1968 in the AMBIT/G system. Today menu systems are one of the most commonly used UI:s, which makes them an integral part of the usability and user experience of online applications (Bailly et al., 2016; Bailly & Oulasvirta, 2014).

Amongst other things, menu systems must be learnable, comply with constraints, efficient, and aesthetically pleasing. This means it is not an easy task to design them, and Bailly and Oulasvirta (2014) identified five challenges to the use of an optimization algorithm for menu systems:
1. The design space; not all dimensions of the design space for menu systems has been defined. As the techniques and technology changes, the variables of the design space keep shifting.

2. The divergence of design objectives, constraints, and users; designers usually want to optimize a menu system in many different areas, such as the users speed to find what they are looking for, discoverability, aesthetics, comfort and so on. This brings complex trade-offs into the equation as sometimes these goals can conflict.

3. Predictive models of user performance; the current models are not advanced enough to cover all the different possible menu system types. For instance, existing models do not factor in things such as gestures, hotkeys or semantics – all which are important for performance.

4. Optimization methods; the optimization algorithms used must work fast. One solution suggested by Bailly and Olausvirta, was tested on a menu system with 50 commands and finding the optimization took 15 minutes to create. More efficient algorithms are needed to handle thousands of possible commands or links and complex navigation tasks.

5. Interactive optimization; with the other challenges defined above, there is a need for human judgement. The challenge is to support designers to cope with uncertainty and recognize good solutions while entrusting the testing of different menu system combinations to an optimizer.

The conclusion by Bailly and Oulasvirta (2014) was that the bottleneck of menu optimization research is the lack of accurate predictive models of menu performance. This means that designers still have to evaluate and decide what menu system to use in an interface. While selecting what menu system to implement, the designer has to consider the context of use and what tasks the user needs to be able to perform (Bailly et al., 2016). The study by Bailly et al. (2016) focused on command menus, that is, complex menu systems in programs and applications that run as tools to perform tasks on your desktop computer. Even though this study was not focused on website menus, Leuthold et al. (2011) clearly stated that navigation menus are applied to both computer programs as well as websites.

In the article, Bailly et al. (2016) attempted to define the design space of menus, as this was one of the challenges stipulated by Bailly and Olausvirta in 2014. Bailly et al. (2016) proposed four characteristics to define a menu. 1) The menu system allows the user to select commands from a specific set of links or functions. 2) Menus provide a structure for visually presenting links and commands where they are grouped into categories or hierarchies. 3) Menus are transient, which means that they can be temporarily displayed and easily dismissed. 4) Menus
are quasimodal, which means that as long as the menu is open, the application is in a specific state that persists until the selection has been made.

Even though their article advances the understanding of menu systems, which will help designers make possible design choices, Bailly et al. (2016) still think that challenges remain. Partly because a menu system is a complex interaction technique affected by a number of properties at different levels. The properties could, for instance, be geometry (reduced distance, layout or positioning), semantics (choosing relevant function or link names, reducing length or display in menus), and temporality (selecting items in submenus or feedback) (Bailly et al., 2016). On top of this, technology advances supply the field with new possibilities, such as multi touch that allows users to interact with the UI with multiple fingers. Thus, new menu system techniques will be developed that will create new properties that need to be examined (Bailly et al., 2016).

The conclusion of the changing design space for menu systems made by Bailly and Oulasvirta (2014) and Bailly et al. (2016) is supported by the findings of Murano and Sander (2016). They argued that the unclear picture of performance and preferences when it comes to menu systems could result from the fact that users today are subjected to a plethora of menu systems that are positioned in many different parts of a UI. This reduces the effect of any significant preferences and performances.

Even though extensive research has been done on website menu systems, there are still plenty of unanswered questions regarding the performance, positioning, and user preference of the optimal menu system in desktop UIs (Murano & Sander, 2016). In this paper, Murano and Sander made a summary of the relevant studies when it comes to menu systems on websites and their positioning on the user screen. The menu systems and anchor interactors included in the study were the left- or right-hand menu, top and top in combination with left- or right-hand menu, hypertext links, top-tabbed menu, top and bottom menu, and the top fisheye menu (links get enlarged when hovered over). Some menu anchor interactors were deliberately excluded as they are less used. For example; radial and flower menus (Murano & Sander, 2016). The result of their research review was that there is no clear picture of what menu anchor interactor or position on the screen is preferred by most users. However, in some cases, it appears that a top horizontal menu anchor interactor performs the best. Most studies that Murano & Sander found focused on performance, task completion, and errors, and they recorded some sort of a subjective opinion from the users (Murano & Sander, 2016).

This shows that even though command menu systems have been around since the early 1980s (Bailly et al., 2016; Bailly & Oulasvirta, 2014), and even though research has been done on desktop navigation for both computer programs and websites, there is still much to learn about user preferences when it comes to menu systems and their positioning on the screen (Murano &
Sander, 2016). Technology advances change the design space for menu systems, and they also make the optimizing of menu systems a moving target for researchers and designers alike (Bailly et al., 2016; Bailly & Oulasvirta, 2014).

2.1.2. Mobile navigation

All website and computer application menus need to be activated either by clicking or hovering over it with the mouse marker. On touchscreen devices, such as smartphones, the user usually needs to tap an object. The fact that the menu is hidden behind an object made Bailly et al. (2016) specify that the object you click to activate the menu is in fact not the menu – it is the means to activate and open the actual menu. Instead Bailly et al. (2016) call the objects that activate the menu “anchor interactors”, and they are permanently on display on the screen with a menu attached to them.

They also defined the “optimal menu” as the design that best serves the users goals (i.e. the speed of finding what they are seeking) while paying close attention to constraints, such as screen space, which applies to the limited amount of real estate on a smartphone (Bailly et al., 2016). The limited screen space on smartphones creates a need of a navigation or a menu system in places where a desktop computer manages without one. Harms, Kratky, Wimmer, Kappel, and Grechenig (2015) studied navigation specifically in long forms on smartphones and applied four types of menu anchor interactors. These were scrolling, tabs, menus, and collapsible fieldset, a classification taken from Cockburn, Karlson, and Bederson (2009) regarding information visualization.

With the exception of scrolling, the above-mentioned menu anchor interactors correspond to a classification made by Neil (2014) in a more hands-on mobile UI design pattern book. Neil divides the websites primary navigation into two types; (1) persistent menus that are navigations always visible on the screen, and (2) transient menus that have to be tapped to open their content (Neil, 2014). The menu anchor interactors mentioned by Neil (2014) are Springboard, Cards, List menu, Dashboard, Gallery, Tab Menu, Skeumorphic, Side drawer, Toggle Menu, and finally Pie Menu (see Figure 1).
Figure 1. Different menu anchor interactors as defined and classified by Neil.

In the paper on navigation in long forms, Harms et al. (2015) noted that previous research establishes that mobile UI:s need special solutions for navigation, and that menu systems used for desktop computers might not transfer well to the small screens of smartphones. The selected item for their study was profile forms on social networks, such as Facebook and LinkedIn, and the study measured errors, efficiency, perceived usability, memorability, subjective rankings of difficulty, overview, and preference (Harms et al., 2015).

The four types of menu anchor interactors and menu systems that were subjected to testing in the study (scrolling, tabs, menu, and collapsible fieldset) differed in perceived usability, memorability, user preference and subjectively ranked overview (Harms et al., 2015). Scrolling performed the worst out of the studied navigation types, while the remaining three menu systems performed equally well. The quantitative data collected indicated that the menu systems that were
more interactive (tabs, menu, and collapsible fieldset) gave users a better overview, with the only significant difference being higher memorability of menu than collapsible fieldset (Harms et al., 2015). The menu anchor interactors studied by Harms et al. were scored on the System Usability Scale that ranges from 0-100 with a higher score being better. Scrolling had an overall score of 66.35, tabs 83.13, menu 80.94 and collapsible fieldset 78.75.

As Harms et al. (2015) pointed out, navigation techniques might not be completely transferable from desktop computers to smartphones, which is supported by Garcia-Lopez, Garcia-Cabot, Manresa-Yee, de-Marcos, and Pages-Arevalo (2017). This study focused on the usability of hyperlinks on mobile devices. Even if hyperlinks do not constitute a menu or menu anchor interactor, Leuthold et al. (2011) argued that every item that allows a user to change location on a website is a navigation component.

Garcia-Lopez et al. (2017) took guidelines from standards and organizations, such as World Wide Web Consortium (W3C), International Organization for Standardization, and U.S. Department of Health and Human Services, and examined how they work on the mobile web. They took fifteen guidelines for navigation links for desktop, for example:

- Using descriptive link labels, as the labels do not always clearly state the content of the target web page, one example of a non descriptive label could be “Click here”.
- Distinguishing neighbouring links from each other, i.e. text links written very close together should be separated visually from one another.
- Marking links to special targets, which means that the link will take the user to a special document, such as a PDF file, that might be in a different language or be very large.

Out of those fifteen they kept thirteen as they were, while two (Marking links opening new windows and Link length) underwent experimentation. Out of those two guidelines, one – Link length – was adapted for smartphone use because the users prefer the link to be as short as possible on small screens. This implies that most desktop navigation guidelines can be applied to smartphones, but one cannot assume that every guideline is applicable without modification.

This also supports Harms et al. (2015) when they deduced that techniques used for desktop computers might not transfer well to the small screens of smartphones. And in turn this illustrates the issues that arise when websites these days can be visited from multiple browsers on devices with different screen sizes, which of course has effects on the layout of web content, including the menu anchor interactor (Huang et al., 2018).

The user experience of different responsive website menu systems was examined by Huang et al. (2018). They selected three menu systems to examine: traditional (a tab or navigation bar at the top), hidden (hamburger menu that needs to be tapped or clicked to open), and direct display (the menu is open when you enter the website and you actively have to close it by clicking or
tapping a closing item), (Huang et al., 2018). The examined menu systems could have one-level or two-level deep navigation trees, and they tested the navigation models on a laptop, a tablet and a smartphone (Huang et al., 2018). They concluded that the direct display menu system worked the best on the smartphone, as it scored high in the multiple correlation coefficient in all six UX dimensions (Attractiveness, Perspicuity, Efficiency, Dependability, Stimulation and Novelty), and the second best was the hidden menu system. The traditional tab menu system had poor results (Huang et al., 2018).

While some design guidelines seem to be transferable from desktop to smartphones as shown by Garcia-Lopez et al. (2017), it cannot be taken for granted, and the recent research by Huang et al. (2018) seems to indicate that the user experience on smartphones is improved when not using a traditional tab menu system but rather displaying more of the menu content directly. This supports the earlier research by Harms et al. (2015) that concluded that menu systems and menu anchor interactors need to be adapted for the small screens of smartphones.

2.2. Web usability on mobile devices

As presented above, research has shown that the difference in screen size makes the interaction with devices such as laptop computers and smartphones different, which also suggests that the usability of the device might be influenced (García-Lopez et al., 2017). Mobile phones and handheld devices became more and more popular at the end of the 20th century, and as they offered internet connectivity, the realization of internet content being helpful for mobile users grew (Jones, Marsden, Mohd-Nasir, Boone, & Buchanan, 1999). Jones et al. (1999) wanted to have some insight into how looking at a website not adapted for a small screen affected the user. What they noticed was that the users seek information and scan the content for material that interests them. The results of their study led them to the conclusion that when designing for handheld devices you should provide a search mechanism, so that the users can directly access what they are looking for, and you need to structure the information so that users can perform task-oriented navigation (Jones et al., 1999).

Yet twenty years later, Zahra, Hussain, and Mohd (2017) deduced that usability models for smartphone applications are still in an embryonic stage. In this study, the scientists looked at seven usability models in search of guidelines and relevant metrics and criteria but found incomplete frameworks. According to Zarah et al. this is due to the fragmented field of applications produced for multiple platforms where each application category has its own functional requirements (Zahra et al., 2017).

One guideline that does exist, even if it is not specifically aimed at smartphone UI:s, is The International Organization for Standardizations (ISOs) guidelines on Usability (Bevan, Carter,
Earthy, Geis, & Harker, 2016). In the new standard ISO 9241-11: *Usability: Definitions and concepts*, which was updated in 2018, the group of experts reached the consensus of the new state-of-the-art definition of usability: ”the extent to which a system, product or service can be used by specified users to achieve specific goals with effectiveness, efficiency and satisfaction in a specified context of use”. The former definition from 1998 had not included systems and services (Bevan et al., 2016).

Related to ISO 9241-11 is the ISO 9241-220: *Processes for Enabling, Executing and Assessing Human Centred Design within Organizations* (Bevan et al., 2016). It defines human-centered design and addresses what organizations need to do at corporate level to enable processes for human-centered design. The latest draft of this standard suggests that the definition of user experience should be: ”a person’s perceptions and responses resulting from the use and/or anticipated use of an interactive system, and from the user’s interaction with the organization that supplies or delivers the interactive system; from discovering the system, adopting and using it, through to final use” (Bevan et al., 2016).

Even though Garcia-Lopez et al. (2017) could show that much that applies to desktop also works for smartphone-sized screens, and even though there is an ISO standard for usability, the visual elements for smartphone-sized screens have not been included in any existing design principles (Silvennoinen, Vogel, & Kujala, 2014). The visual elements in a UI, such as the anchor interactor for a menu, have a communicative ability that shows the user what they can interact with, but as there is no universal design language that is applicable to all design contexts, it is important to study visual elements in specific UI contexts (Silvennoinen et al., 2014).

Silvennoinen et al. (2014) conducted a study on preferences and user experience concerning color and dimensionality in mobile applications. They also studied whether these preferences changed in relation to different types of mobile applications (Silvennoinen et al., 2014). The stimulus material for their study consisted of screen captures of a UI from two different applications (one task-oriented and one application for entertainment) in a pre-use phase (Silvennoinen et al., 2014). Their study showed that color plays a major role in helping the user understand functionalities in the applications, and the black and white UI:s were disliked, as it was hard to distinguish functionalities from one another without color (Silvennoinen et al., 2014).

Dimensionality, however, was perceived differently in the two applications. In the task-oriented application, 3D effects were considered unnecessary, confusing, and as a factor that added complexity to the application. In the entertainment application, the dimensionality had no significant effect on the user experience. This led the authors to derive that context must be taken into account when designing with dimensionality for smartphone applications (Silvennoinen et al., 2014).
The research presented this far has shown that usability is not the same in desktop computers and on smartphone screens, and websites viewed on smartphone screens require adaptation. In 2009, Erik G. Nilsson presented a series of design patterns for mobile applications to help solve problems in three main areas related to mobile devices: 1. Utilizing screen space, 2. Interaction Mechanisms, and, 3. Design at large (Nilsson, 2009). When it came to the problem area Design at large, Nilsson (2009) suggested minor or larger redesigns of a webpage as one way to solve real estate problems of small screens.

Today there are three approaches to web development for smartphones; separate site, adaptive design, and responsive design (Cazañas & Parra, 2016). They all come with different challenges, and there is a trade-off between cost and user experience (Cazañas & Parra, 2016). As both separate site and adaptive design create device-specific navigations, responsive web pages come with the largest challenges when it comes to the website menu system. This can be addressed by using mobile first as a development strategy, which means that design and development is first optimized for smartphone screens before scaling the design up to bigger viewports and screen sizes like tablets and desktop computers (Cazañas & Parra, 2016). This is important as responsive web sites are the cheapest to develop and maintain and therefore a common approach (Cazañas & Parra, 2016).

In 2010, the developer and designer Ethan Marcotte coined the term responsive web design in an article (Bohyun, 2013). Before responsive web design existed, a pixel perfect design was created and implemented for an optimized screen size. If this page was viewed on a bigger or smaller display – it would look strange and wrong (Bohyun, 2013).

With responsive web design (in contrast to the pixel perfect design), came the flexible grid (the columns and rows on a web page adapt and are rendered differently in different screen sizes). This flexible grid is created by using relative units, such as percent, instead of absolute units, such as pixels. This together with making a media query in the cascading style sheet (CSS) at a breakpoint of a smaller screen size, makes it possible to apply different CSS code on a smartphone screen than on a desktop computer, and the website is rendered with a different layout (Bohyun, 2013).

One downside to responsive websites is that the website uses the same code base as the full website shown on desktop screens. One of the drawbacks of this is that on mobile the load time can become long unless you take precautions, e.g. hide some content or condition the content for smaller screens by creating and fetching smaller pictures for the smartphone version of the website (Bohyun, 2013).

Furthermore, designers and developers also need to make webpages adapt to all the different web browsers that render the pages – especially since users do not always update their browsers.
Related to this are the two influential approaches to web design, graceful degradation and progressive enhancement. Graceful degradation means that the website continues to work even if there are some unexpected errors that prevent the browser from showing the content as intended. Instead the content is shown by ignoring the bit of code that the browser is unable to read and rendering the remaining markup – for instance by replacing fonts with browser-standard fonts (Cazañas & Parra, 2016).

Progressive enhancement on the other hand, is a development method where the website is first created in a basic version that can be viewed in all browsers. After that, the developers start adding functionalities to boost the user experience on the most advanced browser and browser versions. Simply put, the developers start by presenting the content, then they add presentation layers, and finally they add behavior layers (Cazañas & Parra, 2016). By applying progressive enhancement as a development approach designers and developers will gain improved performance of the website and improved search engine optimization, semantics, accessibility, and cheaper and easier maintenance (Wells & Draganova, 2007).

Above we have established that usability on computer screens and smartphones differs and hence designers and developers need to adapt the way a website renders on a smartphone. Furthermore, there is still a lack of usability guidelines specifically for smartphone-sized screens (Zahra et al., 2017). Currently, there are three approaches to web development for smartphones, separate site, adaptive design, and responsive design (Cazañas & Parra, 2016). By developing mobile first with a progressive enhancement approach, designers and web developers are mitigating the usability challenges of small screens.

2.3. Classification of website types

As discussed above, Silvennoinen et al. (2014) pointed out that it is crucial to study visual elements in specific UI contexts, and that the navigation plays an integral role in the user’s ability to reach their goal, and thus be satisfied with their visit on a website. The satisfaction and success of the end user was shown to be dependent on the context (type of website) and goal-specific in a study by Schaupp, Fan, and Belanger (2006). They also concluded that researchers need to start classifying the websites they study and form an understanding of the goals of the website users. By understanding the user goals, the websites can be designed to support a successful website visit, (Schaupp et al., 2006).

When it comes to the classification of websites, there has been an increasing number of attempts to create a framework. Yet none have received broad consensus, and no framework covers all websites types that exist today (Suárez Torrente, Martínez Prieto, Alvarez Gutiérrez, & Alva de Sagastegui, 2013). Previous classification models have focused on the complexity of
the website development, the site functionality, and actions performed by the user (Suárez Torrente et al., 2013). Suárez Torrente et al. created the Sirius framework, a heuristic-based system to measure web usability on different website types, because they found the previous systems lacking. They proposed to classify websites by the general purpose of the site (Suárez Torrente et al., 2013). The Sirius framework ended up defining 17 different types (see Table 1) of websites (Suárez Torrente et al., 2013).

Table 1. Types of websites defined in the Sirius framework by Suárez Torrente et al. (2012).

<table>
<thead>
<tr>
<th>Public Administration/Institutional</th>
<th>Virtual Community/Internet forum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online banking</td>
<td>Leisure/Entertainment</td>
</tr>
<tr>
<td>Blog</td>
<td>Personal</td>
</tr>
<tr>
<td>E-Commerce</td>
<td>Service Portal</td>
</tr>
<tr>
<td>Communication/News</td>
<td>Image-based Interactive Services</td>
</tr>
<tr>
<td>Corporate/Company</td>
<td>None Image-based Interactive Services</td>
</tr>
<tr>
<td>Downloads</td>
<td>Webmail/mail</td>
</tr>
<tr>
<td>Education/Training</td>
<td>Hybrid</td>
</tr>
<tr>
<td>Collaborative Environments/Wikis</td>
<td></td>
</tr>
</tbody>
</table>

However, Cebi (2012) classified websites based on both users’ expectations and websites purposes. Websites were divided into three main groups; commercial, service, and mixed type. The commercial sites were divided into three subgroups; B2B, B2C and C2C. Service websites were divided into four subcategories: self-service, information, entertainment, and communication. The mixed type websites have two or more purposes at the same time. They might for instance be a B2C website with an objective to make money but at the same time provide entertainment for the user (Cebi, 2012).

Since then, very little research has been done on the classification of website types by functionality, and when Gali et al. were in need of a way to classify websites as means to provide a better tool for location-based searches on smartphones (Gali et al., 2017), they argued that the complexity of previous systems was not purposeful. Therefore, they introduced a new classification framework based on functionality from the perspective of the website’s purpose, and they ended up with three website types: single service, brand page, and service directory.

In this section, it has been shown that usability and user experience are dependent on the context of the specific UI, and that user satisfaction depends on whether the user can achieve their goal with the website visit. This in turn implies that there is a need for classifying website
types when studying UI components since a website’s purpose and the user’s goal might influence the perceived usability of a UI component.

2.4. Summary

Menu selection is the dominant method with which humans interact with computer operating systems, applications, entertainment systems, and videogames (Norman, 2008). And a well-functioning menu system is essential to the success of a website (Leuthold et al., 2011; Puerta Melguzio et al., 2012). Furthermore a good menu must comply with constraints, be efficient and learnable, and visually pleasing (Bailly & Oulasvirta, 2014).

The process of finding the right formula for optimizing menus, however, still faces many challenges, mainly because the design space for menu systems keep changing as technology makes advances and creates new properties that need to be investigated and researched (Bailly et al., 2016). The same authors also made an important distinction between the menu and the object that activates the menu. The UI component with which the user has to interact by hovering, clicking or tapping to open the actual menu is called the menu anchor interactor (Bailly et al., 2016).

It has also become clear that even though a lot of research has been done on website navigation for desktop computers, there are still unanswered questions regarding the user preferences and positioning of the menu anchor interactor in the UI (Murano & Sander, 2016). This has implications on menu systems for smartphones, as other researchers, such as Harms et al. (2015) could show that smartphone UI:s need special solutions for navigation, and that the techniques for desktop computers do not transfer well to smartphone screens. The study by Harms et al. (2015) looked at four types of anchor interactors and menu systems in long forms on smartphones (scrolling, tabs, menu, and collapsible fieldset). They could show that users got a better overview with the menu systems that were more interactive, i.e. the tabs, menu and collapsible fieldset.

In turn, Huang et al. (2018) studied three types of anchor interactors and menus specifically on responsive websites. The selected types were the traditional (a tab or navigation bar at the top of the website), hidden (the menu is behind a hamburger icon that needs to be tapped to open the actual menu) and direct display (when the menu is open when the user enters the website and must actively be closed). In their study, the direct display menu performed the best as it scored high in the multiple correlation coefficient in the six UX dimensions that were measured (Attractiveness, Perspicuity, Efficiency, Dependability, Stimulation and Novelty), (Huang et al., 2018).
The fact that Huang et al. (2018) studied menu systems in responsive websites is important because websites today can be viewed on multiple screen sizes, and there is a need to adapt and render the content in different ways for different viewports. Currently, responsive websites are the cheapest to develop and maintain (Cazañas & Parra, 2016).

But the development of responsive websites comes with its challenges, as the same code base is used for all screen sizes, and unless developers take precautions such as conditioning the content for smaller screens and fetching smaller sized photos, the load time of these websites can get slow (Bohyun, 2013). The largest challenge for responsive websites, however, lies in the fact that a smartphone screen has much less space to use for the website menu system and its anchor interactor. The best way to reduce the pain points for navigation on small screens at the moment, is to use mobile first as the development strategy, where the menu system is first optimized for smartphone UI:s (Cazañas & Parra, 2016).

One of the factors affecting users when it comes to the UI design, is their preferences. A study by Silvennoinen et al. showed that user preferences are affected by the purpose of the application. Silvennoinen et al. studied one task-oriented application and one entertainment application and could show that the purpose of use (such as a task or entertainment) influences the user preferences. The conclusion of this study was that it is important to study visual elements in the actual UI context (Silvennoinen et al., 2014).

This in turn implies that there is a need for a classification system of website types, and even though numerous attempts have been made at creating a framework, none exists that has received broad consensus (Suárez Torrente et al., 2013). With this background, Gali et al. (2017) created a classification of website types based on functionality from the angle of the website's purpose. This framework consists of three types: single service, brand page, and service directory. This is a system that meets the implications shown in the study by Silvennoinen et al. (2014), where the purpose of use influences the user’s preferences in visual UI elements.

3. Methodology

As this study aims to find user preferences of the menu anchor interactor in visual UIs for smartphones and to find out whether the preferences are affected by the website type the anchor interactor appears in, the method used for the study is quantitative. This will provide data that allows us to find patterns and correlations, which are needed to answer the research question. To support the quantitative data, the participants will be asked to motivate their choices in their own words in an open-ended question in the form. Hence the study will employ some qualitative data to support the analysis of the patterns found in the quantitative data if such patterns can be
found. The collected data will form the basis for answering our research question, and it will be used to define guidelines to support designers in their choice of a menu anchor interactor, depending on the purpose of the responsive website they are designing.

3.1. Search terms

The databases used for finding previous research that guides our study were HKR Summon, AMC Digital Library, SpringerLINK, Google Scholar, and Academia.edu.

The following words and combination of words were used for searching for relevant research for this study: menu, smartphone menu, mobile menu, smartphone navigation, smartphone navigation menu, menu navigation, computer navigation, menu techniques, computer menu, desktop menu, desktop navigation, hamburger menu, navbar menu, navigation hub menu, menu design, mobile menu design, smartphone menu design, menu user interface, smartphone menu user interface, responsive navigation menu, menu usability, smartphone menu usability, mobile menu usability, computer menu usability, desktop menu usability, mobile usability, smartphone usability, menu anchor interactor, visual design menu, visual design navigation menu, classification of websites, website classification, website types, classification website types, and user satisfaction.

3.2. Research design

Described in the section 2.1.2 of this thesis, is Neil’s (2014) classification of the anchor interactors of smartphone menus. There are persistent menus that are navigations always visible on the screen and transient menus that have to be tapped to open their content.

Both Harms et al. and Huang et al. presented three menus that fall under Neil’s classifications. Harms et al. (2015) technically presented four navigation techniques – scrolling, menu, tabs, and collapsible fieldset. As scrolling does not involve interaction with an anchor interactor; menu, tabs, and collapsible fieldset remain. Huang et al. (2018) studied menu systems in responsive UIs and classified them as traditional (tabs or top navigation bar, hidden (hamburger menu that needs to be tapped or clicked to open)), and a direct display menu that is open by default, and the user has to actively close it.

Harms et al. and Huang et al. studied the same types of menus but used different terms to describe them. The functionality is fairly similar but not exactly the same. As we intend to study similar menu anchor interactor, there is a need to establish what type of menus to include in our material. What Harms et al. call tabs and what Huang et al. call direct display follows a menu technique where the user sees all content in the menu on the main area of the screen from the
start. In the menu anchor interactor described by Harms et al. the user is presented with several closed-labeled accordions that open when tapped to reveal the content. On the other hand, Huang et al. talk about a menu that is open on the screen when the user enters the website and that can be closed by the user.

Neil (2014) presents three menu anchor interactors that correspond to the pattern of directly displaying the content of the menu on the screen, namely, springboard, list, and gallery (see Figure 1).

When several menu types are presented with a similar navigation technique but visually presented slightly differently, the menu anchor interactor is called Navigation hub in this study.

The menu anchor interactor that Harms et al. present as Menu, and Huang et al. call tabs or top navigation bar corresponds to what Neil refer to as a Tab Menu. In this study, this menu anchor interactor will be referred to as the Top persistent menu, as it is always visible on the screen and presented at the top of the smartphone screen.

Finally, what Harms et al. name the Collapsible fieldset and what Huang et al. present as the Hamburger menu, correlates to what Neil brands as the Side drawer menu. In this study, this menu anchor interactor is always visible on the screen.

These three anchor interactors, that is the Navigation hub, Top persistent menu anchor interactor, and Transient menu anchor interactor, are selected as they correspond to previous research done by Harms et al. and Huang et al.

As the intention of the study is also to consider user preferences of menu anchor interactors on different website types, there is a need for a classification framework of websites.

As shown earlier, Gali et al. (2017) introduced a new classification framework for website types. It is based on functionality from the perspective of the website’s purpose, and the three website types in their framework are the single service, brand page, and service directory. This study will follow this framework.

To construct the questionnaire to gather data for this study, it was logical to look to Huang et al. (2018) and Silvennoinen et al. (2014), as both used quantitative methods in their studies. Huang et al. (2018) conducted a quantitative study on responsive UI preferences among users and constructed a questionnaire that consisted of four parts to examine the design features. They started with demographics, followed by the user’s preference for the selected design features of smartphones, the user’s acceptance of smartphones, and finally a section on the user’s
smartphone use. Huang et al. used a seven-point Likert scale in a questionnaire examining 45 design features. The extremes of the scale were 1=least preferred and 7=most preferred.

Silvennoinen et al. (2014) also examined the role of visual elements on the user experience, and specifically in two different kinds of mobile application UIs. Their study aimed to find out whether a visual element’s color and dimensionality influence the user preferences when it comes to the element’s ability to convey their functionality (Silvennoinen et al., 2014). The color and the ”perceived dimensionality” (2D or 3D) were tested as within-subject factors in a questionnaire. Their questionnaire had three parts, starting with an AttrakDiff mini section, then a seven-point Likert-type scale to measure how well the participants liked the applications, and finally an open-ended section (Silvennoinen et al., 2014). The Likert-type scale had anchors for the extremes where 1= I did not like it at all and 7= I totally like it. Silvennoinen et al. counterbalanced the presented UI, and all four versions of the same application were presented next to each other (Color + 2D, color + 3D, black and white 2D, and black and white 3D).

As we intend to examine user preferences in an interface element, namely the anchor interactor for the responsive menu in three different types of websites in a smartphone UI, we find the quantitative studies done by Huang et al. in 2018 and Silvennoinen et al. in 2014 to align well with our intentions.

### 3.3. Participants

A total of 240 responses were recorded where 49.8% were men and 48.9% were women. 0.44% identified themselves as other and 0.88% preferred not to say. The selection of participants was based on a convenience sampling on social media, that is, Facebook and LinkedIn. All participants used their own smartphone, tablet or computer to answer the online questionnaire made with Qualtrics XM, and they did it voluntarily without any form of payment. 146 participants (60.8%) of the total 240 finished the questionnaire, and the answers scored a 0.73 on the reliability test made according to Cronbach’s alpha, where the result indicates high alpha coefficients and reaches the recommended level of 0.70 (Cronbach, 1951).

### 3.4. Materials

#### 3.4.1 Navigation prototypes

Adobe XD was used to create the images of mobile website landing pages for the experiment. The brand names of the websites are fictional but similar to real counterparts of existing websites. The Happy Chef (representing single service) is inspired by a restaurant in Helsinki while Lovi’s
heritages (representing brand page) from the Jeans brand Levi’s. EZTravel (representing service directory) was inspired by the Danish travel fare aggregator Momondo. The images were created to look and feel real but not distract the participants with well known names.

The different website types have three different designs, and the aim was to make them look authentic. The top persistent navigation menu on the Brand page is horizontally scrollable, which it is not on the service directory and single service designs. Brand pages often have more links than there is space for in a non-scrollable top persistent navigation menu. So, to enhance the authenticity of the website type, the menu had to be scrollable.
Figure 2. Images of the landing pages that were used in the questionnaire.
3.4.2 Questionnaire

The questionnaire was made with the Qualtrics XM sophisticated research tool and consisted of three parts. The first part held demographic questions where the participants were asked to specify their gender and age. In the second part, they were asked about their web browsing habits on the computer and smartphone. They were also asked whether they had a smartphone or not. If the answer was yes, they also had to specify the operating system. The third part consisted of nine pairs of questions in a random order to minimize the carry over effect. In the first step, the participants were asked to rate the usability and how helpful they thought the navigation menu was, on a seven-point Likert scale ranging from 1 (not helpful at all) to 7 (very helpful). One image was presented at a time, and then the participants were asked to clarify their score in a qualitative open question.

The questionnaire had thirteen pages of questions and two pages for the welcome message and thanks. A progression bar was always visible on the top of the pages to help the participants keep track of how much was done. All information and all questions were written in English. The questionnaire has been included in Appendix A.

3.5 Procedure

A total of four posts were made on Facebook, and one post on LinkedIn. The privacy setting was set to public, and the posts were free to share and sharing was encouraged. One post was made on a Flowdock channel with 146 participants at a digital engineering company and one post was made on a Slack channel with 15 participants at a software development company.

The participants were presented with landing pages for different types of websites. Each website was shown with three different types of menu anchor interactors, and the participants were asked to rate the usability and how helpful they thought the navigation menu was, on a seven-point Likert scale ranging from 1 (not helpful at all) to 7 (very helpful). We also asked follow-up questions where the participants got to clarify their choices. The questionnaire was available for thirteen days.

The collected data was downloaded as a CSV file and analysed using Google Spreadsheets on Google Drive and reported in text with typical quotes to show examples of the collected qualitative data.

The quantitative data was divided into eight groups. The first two groups include the responses divided by the operating systems, iOS and Android. Then there are four age groups: 20–29, 30–39, 40–49, and 50+. The last two groups are based on gender. Each group was analyzed
individually and added on a summary sheet where a ninth group with the total average was also included.

In each group, we calculated an average score to determine the menu anchor interactor with the highest average score. The averages were then analyzed to determine whether any trends can be found in the preferences of menu anchor interactor overall or specifically based on age, gender or operating system.

The qualitative answers were transferred to three Google Docs files, one for each website type and they were structured according to the menu anchor interactor. Each participant was given a number.

The clearly positive answers were manually marked with green, clearly negative answers with red, and the ambivalent or undecided answers with yellow. All color-coded answers were counted and reported in numbers with the most common reasonings reported in text and with quotes from the material to support the analysis.

### 3.6 Ethical considerations

When designing this study and the questionnaire, the four ethical guidelines stipulated by the Swedish Research Council were taken into consideration (the information requirement, the consent requirement, the confidentiality requirement, and the handling requirement). At the beginning of the questionnaire, the participants could read the title of the study, who performed the study, at what university and within what subject, what the purpose of the study was, which fulfills, and how the collected data will be handled and protected. They could also see that participation was voluntary and that they could withdraw from participation at any point while filling out the questionnaire. This fulfilled the information requirement and consent requirement, as all participants were free to choose whether they wanted to respond to the questionnaire or not. Those who did not complete the questionnaire were treated as if consent was withdrawn, and their data not taken into account in the analysis.

We did fail to attach an email address for contacting the researchers in case a participant would like to have more information, which of course is not ideal (Trost, 2014). Another solution could have been to instruct the participants to search for our names in the DIVA portal in June 2019 to read the full report.

If we would have asked the participants to submit an email address to get access to the final report, they would have given up their anonymity, and the confidentiality requirement would not have been fulfilled.

As we did not ask for any private or sensitive information or information that could be used to identify a participant, and as the responses to our questions did not pose any danger or risks to
the participants, such considerations were not necessary (Trost, 2014), which fulfills the confidentiality requirement.

The data is stored in a place where only the researchers have access to it, and it will not be used for any other purpose, which fulfills the handling requirement.

When it comes to other ethical considerations, the design of menu anchor interactors should of course follow the accessibility guidelines for the World Wide Web, as stipulated by W3C. However, since we studied the menu anchor interactor in the context of the visual UI, our study does not include how the markup and code for the menu anchor interactor with its attached menu is structured and read by screen readers.

4. Results and analysis

The research process of this study is guided by the following question: **What influence does website type have on users preference of the menu anchor interactor?**

To answer this question, we employed a quantitative questionnaire, using a Likert scale from one to seven where one was "Not helpful at all" and seven was "Very helpful". Each quantitative response was followed up with a qualitative question asking the participant to explain their score.

4.1 Single service website

The quantitative data from the questionnaire shows that on the Single service website (that is the Restaurant website in the questionnaire), the Navigation hub menu anchor interactor scored the highest with an average of 5.7, followed closely by the Top persistent menu anchor interactor with a score of 5.4 and finally, the Transient menu anchor interactor scoring 4.6 (see Table 2 for full quantitative results of the Brand website).

These results were also reflected in the qualitative comments, where the Navigation hub got 87 positive comments (59.6 percent). Mainly the participants liked the simplicity and directness and found it very clear and uncluttered. One participant found the information on the first page to be satisfactory in the following way: "Most of the things you look for on a restaurant web page is on this first page. Good that you have a search function." (participant #25). Another participant went one step further by expressing the following: "I cannot think of anything else I would need to know" (# 69).

However, seven of the responses also stated that the UI is ugly or looks outdated even if it is useful. One participant also found the word menu confusing in this setting: "Direct access to key functionality. The only thing is that I thought the layout is ugly and that I first misinterpreted the
item “menu” as the website menu, not the restaurant menu (with food courses). Maybe because I’m now triggered to think about website menus.” (#136).

The 21 negative comments about the Navigation hub concentrated around the fact that the menu now takes up the entire real estate of the phone screen and looks boring. Some expressed uncertainty of how to get back to the menu after they started navigating. For example, this participant who already started thinking about the following steps in the menu structure: "Might be difficult to navigate once you have made your first choice (menu will disappear and you might have to go back to see the menu options again” (#24).

The look and feel of the Navigation hub menu anchor interactor made the Single service website look old and outdated according to some: "Looks old and not welcoming.” (#67).

The 22 participants that had mixed feelings and could see both good and bad aspects with this type of menu anchor interactor still worried about having to click around, even though they liked the big buttons. Some would have wanted some general information about the service: "Gives more specific options, raising my confidence that I will find info, but if they are giving me this much info, why not give the address and hours here as well? That is what a huge percentage of users will be looking for. Don’t make us click around to find out how to give money to this business.” (#60).

One participant mentioned that this type of menu would benefit motorically challenged people: "Good for motorically challenged. But now the site style has vanished. I would assume the search is completely useless on this kind of site.” (#78).

A few participants from all groups found the search to be a confusing element on a website with such limited content, for example, the participant 30: "I think that the menu takes up too much of the screen. Don’t know what to do with that search field though, it’s a restaurant. Otherwise a search function is great to have.” (#30).

The small difference in the scores between the Navigation hub and the Top persistent menu anchor interactors indicate that they could both serve the purposes of the users visiting a single service type of website. The fact that the navigation hub scored a bit higher is supported by the study on Responsive Web Design made by Huang et al. (2018, p. 249), where a direct display (i.e. the menu that is open on the screen when the user enters the website) type of menu anchor interactor was preferred by users.

It is clear that the navigation hub is a trade off between visual appearance and functionality, as users find it easy to use but not very pretty. This is a drawback, as menu systems should comply with constraints, be efficient and aesthetically pleasing to be usable, and give a good user experience (Bailly & Oulasvirta, 2014).
Arguably, the Top persistent navigation and Navigation hub are quite similar, as they both show icons and a label/link name for the category or section of the website where it will take the user. However, the navigation hub has semantically more comprehensive links as there is more space to use for the labels than in the Top persistent navigation. This corresponds to the findings of Garcia-Lopez et al. (2017) that found the descriptive labels important in smartphone UIs.

When it comes to the Top persistent menu anchor interactor, 83 participants (56.6 percent) were positively inclined towards it on the Single service website. They find it clear, perspicuous, and serving their needs. Many commented that they feel confident they will find the information they might want to look for: "Clear, primary goal is in focus (book), and easy to scan through the other options without loosing the overview." (#6)

The 18 participants that were clearly negative towards the Top persistent menu anchor interactor found that the menu takes up too much space, has too small buttons and they found it unclear how helpful it could be: "Not as clear - and takes a lot of space on things I don't care about - which makes me doubt the content I will find will be easily scanned." (#3). The labels in the Top persistent menu anchor interactor were considered too small, which led to a muddled look, which affected the perceived usability: "Less helpful than the last one: messy with lots of small print." (#56). There seemed to be too few categories, which made it look like something was missing, and the priority of items in the menu seemed unclear to some: "It makes me think something has been left out. There are too many equal alternatives in my mind." (#46)

One participant, wrote that they couldn’t find the menu at all because the hamburger icon was missing, indicating that there is such a strong convention that without it there is no menu structure: "The only navigation that I see are the horizontal buttons. To me, "menu" means a vertical list, often accessed through an icon (sometimes called a hamburger) in the top left or right corner." (#129).

A total of 22 participants had mixed feelings about the Top persistent menu anchor interactor. It is a common menu type that gives a good overview of the content, but these participants found it constricted and wondered what content really exists on the site: “You can see the main contents without having to open it further. However, it also gives the feeling that that's all there is. Is it?” (#90).

The icons are not to everyone's taste, and because the labels have to be short, some participants were left wondering how well the labels reflected the actual content on the navigation targets: "It’s good to see all menu items at once, but since there is only room for a few menu items, and each words must be very short, most websites will have too much information to be able to fit in this design. The menu items will become too generic, or just wrong, as they try to fit their content into these narrow boxes" (#101)
The Top persistent menu anchor interactor performed poorly in the study by Huang et al. (2018). However, in this study it came very close to performing at the same level as the Navigation hub. The menu types that were studied by Harms et al. (2015) however, as defined in 3.1 of this thesis, ranked quite similarly with the Navigation hub, scoring 83.13 on the System Usability Scale and the Top persistent menu anchor interactor scoring 80.94 on the same scale, indicating that both these menu types serve the users’ purposes quite well.

Even though the two menu anchor interactors scored close to each other, it is apparent that the semantic clarity was affected because the words in the links had to be very short. This was described by the participant 101 above. Even though Garcia-Lopez et al. (2017) concluded that links on smartphones should be as short as possible, they still have to carry enough meaning and be descriptive enough to give the users confidence that they know what they will find when clicking a link (Garcia-Lopez et al., 2017).

The increased overview of content is mentioned by a participant, which indicates that the findability and possibility to remember where items are located in the menu system is good with a Top persistent menu anchor interactor. This again is supported by Harms et al. (2015) where this type of anchor interactor had higher memorability than the Transient menu anchor interactor.

The Transient menu anchor interactor got 49 positive comments (33.6 percent) from the 146 participants, which placed it at the bottom as the least favored menu anchor interactor on the Single service website. This is in line with the quantitative results presented above.

The participants are used to the hamburger icon. It is what they expect, and they find it a clean and simple design: “Hamburger menu for menu options and direct link to the most obvious choice. Simple and clean, easy to understand. Really good!” (#101) and “The hamburger is very well known, easy to find and use.” (#24).

Two participants specifically mentioned that the right corner is a good location, and one said it is better for right-handed users: "Ok, hamburger menu on the right side is a plus for right-handed." (#11). Five participants, on the other hand, reacted negatively to the placement of the menu icon in the right corner, stating that the Transient menu should be placed to the left instead: "It’s the symbol I’m looking for but I prefer it in the upper left corner." (#36)

A total of 49 participants were clearly negatively inclined towards the Transient Menu anchor interactor. They found it confusing, did not know what to expect, and disliked the extra click. They stated they preferred usability over looks, and they did not like that you have to perform an extra action to see what is in the menu: "Would prefer clearer approh instead of hidden menu.” (#33)

When it comes to this menu anchor interactor, 31 participants were indifferent or had mixed feelings. They assumed it would work for them, but they were not thrilled about the hamburger
icon and stated they did not really know what to expect even though the anchor interactor is conventional: "I love/hate hamburger menus. Low real estate so they look nice, but too hard to get where I want" (#71)

One participant clarified that they tend to use more complex services on desktop as they have large fingers and suffer from dyslexia, and hence tend to only use a few apps and services that they know are very functional on the phone, while saving all other use for desktop: "I tend to use more complex stuff on the pc an limit myself to a few easy to use apps and ther interfaces on my phone. This is due to complications with dyslexia and big fingers" (#35)

The rest of the participants either did not answer the question in a meaningful way, reacted to other components in the UI or answered something that was not possible to analyze in terms of how helpful they found the menu anchor interactor.

With a score of 4.5 in the quantitative result, the Transient menu anchor interactor scored the lowest numbers in both the quantitative and qualitative results. The main reason is that it is unclear, and the participants felt insecure about how helpful the menu will be when it is hidden.

However, it is also clear that the users are very used to this type of menu anchor interactor, with several mentioning it being conventional. Looking at the Usability Standard ISO 9241-11, which states that the user should be able to achieve specific goals efficiently (Bevan et al., 2016), it becomes clear that the Transient menu anchor interactor does not serve that kind of functionality well, as the users become uncertain whether they will be able to achieve their goals, which again goes against some of the fundamental attributes a menu system should posses (like being efficient, look good and be learnable) according to Bailly and Oulasvirta (2014). The participant #71 summarizes this well when commenting that they have a love/hate relationship with Transient menu anchor interactors as they look nice but make it hard to achieve their goals.
Table 2. Quantitative results for Single service websites with three different menu systems: transient menu anchor interactor, top persistent menu anchor interactor, and navigation hub menu anchor interactor. The Likert scale ranging from 1 to 7 has been used where 1 means not helpful at all and 7 means very helpful.

<table>
<thead>
<tr>
<th>Single service websites</th>
<th>Transient</th>
<th>Top persistent menu</th>
<th>Navigation hub</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating system</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>iOS</td>
<td>4.7</td>
<td>5.4</td>
<td>5.4</td>
</tr>
<tr>
<td>Android</td>
<td>4.3</td>
<td>5.4</td>
<td>5.7</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Women</td>
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<td>5.6</td>
<td>5.9</td>
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<tr>
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<td></td>
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<td>5.2</td>
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</tr>
<tr>
<td>30–39 years</td>
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</tr>
<tr>
<td>50+ years</td>
<td>3.9</td>
<td>5.5</td>
<td>5.9</td>
</tr>
<tr>
<td>Total</td>
<td>4.6</td>
<td>5.4</td>
<td>5.7</td>
</tr>
</tbody>
</table>

4.2 Brand website

The quantitative data shows that on the Brand website (that is the clothing webshop in the questionnaire), the Navigation hub menu anchor interactor scored the highest with an average of 4.7 on the Likert scale. The Top persistent menu anchor interactor and the Transient menu anchor interactor both scored 4.0 (see Table 3 for full quantitative results of the Brand website).

The Navigation hub received 56 positive comments (59.6 percent), which again matches the quantitative result as the top performer in perceived usability. The main reason why the menu anchor interactor is positively received is clarity. The participants found it easy and had good hope of finding what they were looking for and they found it intuitive. They also found it easy to get an overview of what the store contains: "Everything is there upfront, and the pretty pictures are still there too but now serve a useful function. I'd still want a contact link, though." (#10), and:
"I have the main categories available with easy access + some other useful links immediately visible." (#80).

However, 53 participants clearly disliked the Navigation hub, which indicates that the participants scored this menu anchor interactor high while expressing negative opinions about it in their qualitative response. One of the reasons was that it looks cluttered and takes up the whole screen. Some found the background pictures in the menu buttons distracting. A few had a hard time to understand the structure of the website and how navigation will look when they go deeper into the website: "The many different pictures makes it look cluttered and therefore less available for me as a user. The login button signals that there will be functions that are unavailable to me as long as I don't create a user and subscribe to a newsletter." (#134).

One participant specifically mentioned that they do not like to have to choose between men’s and women’s clothing: "I don't like having to choose between men's and women's clothes" (#53).

Again, one participant stated that they could not find the menu. This is another indication that the hamburger icon is strongly associated with providing the menu structure: "Saknar meny (translation: Missing menu)" (#50).

A total of 27 participants found themselves torn over this menu anchor interactor. They liked some parts, such as that it was obvious what sections it had. However, at the same time they felt that some categories (like "women’s clothing" and "jeans") were overlapping. Some found the look of the website messy even though the menu felt useful. Mostly the Navigation hub menu anchor interactor on this website seemed to be confusing: "The layout is clear, but the overall visual appearance is a little confusing in a small screen, with a lot of pics, etc." (#142).

One participant felt that this interface would only work in a plus-sized phone: "This navigation could only work on a Plus-phone. Get an older iPhone or smaller android the menu items would be too small to fit on one screen. Better to make them bigger and let the customer scroll to the item of choice. And besides, the Women section would be the most common button anyway." (#135)

The semantically clear and upfront display of all main categories in the Navigation hub was appealing to the participants. Norman (2008) stated that the navigation process starts with an intention from the user, and continues with processing the information on the screen to select an option that best seems to match the users goal of the website visit. The comments from the participants on the Navigation hub or the Brand website show that the menu anchor interactor helps them in this process.

However, those users that started processing the categories carefully, lost some of the clarity as they concluded that some categories overlap; can jeans not be found under the section for women’s clothing? This shows how important it is that the categories are organized in logical
clusters and designers must understand the cognitive processes of the website users as to not disrupt the navigation process by serving logical curve balls (Norman, 2008).

When it comes to the Top persistent menu anchor interactor, 31 participants were positively inclined towards it on the Brand website. This is close to the 29 participants that found the Transient menu anchor interactor easy to use – and the quantitative result scores put these two menu anchor interactors at a tie with both scoring 4.0 on the Likert scale. This indicates that they are perceived to be quite similar usability-wise, with the Top persistent anchor interactor only slightly more preferred, which is shown in the qualitative data.

What the participants liked about the Top persistent menu anchor interactor was that it is clear and easy to use. They saw many categories, which gave them hope that they would find what they were seeking. The following comment shows that the menu anchor interactor provides clarity, and the participant argues that the categories make sense and they can see what they would be most interested in: "This actually seems ok. As the site is clearly meant for Jeans, and not providing a service as the previous examples, it makes sense not to have a big search bar as the first thing you see. Categorization is ok and I guess you would actually mostly be interested in the "sales" that are being presented with big pictures" (#144)

A total of 57 participants disliked this menu anchor interactor on the Brand website. The clearly dominating reason was that there was a horizontal scroll for the tabs in this version of the Top persistent menu anchor interactor. The participants expected to make unintentional clicks and also found it annoying that they could not see all navigation options without having to scroll horizontally, before possibly scrolling back to make the selection that best suited their goals: "This is not so helpful since all items have the same style. It's confusing which page you are on and when scrolling to the side you may lose the item that you wanted to select." (#130)

Two participants assumed that the banner with the text "Shop now" would be the menu, such as in this quote: "Shop now is easier to find the second time" (#57).

One participant did not know whether the banners on the screen or the categories in the horizontally scrollable Top persistent menu anchor interactor were actually clickable: "are the images below the header clickable? not sure how to buy something. Also the top header does not appear to be anything more than a text banner. Are they clickable?" (#66).

In total, 29 participants were undecided about the Top persistent menu anchor interactor on the Brand website. They found it somewhat helpful but worried about the horizontal scroll. The clickable areas seemed too small, but it was good that the menu anchor interactor was not constraint to the small screen size so longer words could be used: "Words look like they might be hard to get the right one and scrolling would cause unintended selections. Could be good too, but I expect this to be fiddly" (#86). Some found it messy but still liked that it seemed to be able to provide all the information they might want. Five participants felt ambivalent or negative
because clothing websites in general are hard to navigate on phones: "Easy to find the section you want in most typical cases. However, it evokes feelings of the nightmarish menus in many Scandinavian clothing store web pages." (#90).

It is obvious that the horizontal scroll on the Top persistent menu anchor interactor affected the perceived usability. One comment even questioned whether the categories in the menu anchor interactor were clickable, which correlates with the findings by Garcia-Lopez et al. (2017) that navigation links need to be clearly visible. It also corresponds to the findings of Silvennoinen et al. (2014), where the black and white UI was disliked because the users found it hard to determine which components actually contained functionalities.

The comment from the participant #90, about the nightmarish menus in Scandinavian clothing web stores could be a symptom of the stores creating menu systems that are focused on depth rather than on breadth, something that Norman (2008) identified as a possible problem for menu systems. However, the designer has the size of the screen as a clear constraint on a smartphone. So, designing the optimal menu that serves the user goals the best becomes a real challenge as Bailly et al. (2016) concluded. Here the search function serves a very important role according to Jones et al. (1999) and perhaps an open search input field would serve the participant #90 better.

The UI does become a bit more busy with the Top persistent menu anchor interactor, which could be why the Navigation hub scored a bit better and was specifically recognized for its clarity. In a busy UI, it could be that the important communication of what functionality a component has becomes less clear, which is why Silvennoinen et al. (2014) found that it is important to study visual elements in particular contexts.

The Transient menu anchor interactor on the Brand website got 29 positive comments from the participants, which is only slightly fewer than the Top persistent menu anchor interactor. The main reason why the participants liked the Transient anchor interactor is that it is conventional, understandable, clear and feels natural: "The menu icon to the left indicates a well defined menu for this site." (#37).

Three participants stated that now that the hamburger icon is there, they can find the menu: "Nu finns en meny (translation: Now there is a menu)" (#50).

There were 73 participants that clearly disliked the Transient menu anchor interactor. The dominant reasoning being that it is impossible to see the menu option until you click the hamburger icon. Another pattern among the responses was a worry that these types of websites have many categories, which made the participant expect a complex menu behind the hamburger icon: "If the first impression is 'buy, buy, buy', then it's likely they haven't given much
thought to navigation." (#83), and: "These kind of sites don't usually have the necessary details available anywhere :)") (#131).

One participant wrote that they worry about dropping the phone when using a navigation at the top of the page with a thumb. And another stated that they find it hard to click menu icons that are in the corners of the screen: "When browsing with a phone, I usually don't like menu icons that are placed in the corners of the screen or the very top of the screen, in my experience the icons on the edges are not as easy to tap to open." (#142)

Four participants mistook the image with the discount offer and the call to action stating "Shop now" as the menu: "The 'shop now' is hard to find" (#57), and: "I assume the 'Shop now' button takes me to menu." (#142)

There were 26 participants with mixed feelings about the Transient menu anchor interactor on a Brand website, and mostly they did not know what to expect. They recognize it as a traditional menu anchor interactor, but they would like to see the contents of the menu rather than having to tap the hamburger icon: "This might be better. Would like to see the contents of the menu." (#69), and: "I assume that lets me go to some sort of product categories, where I can browse what I need. I might not know the proper word this site uses for the kind of product, so I doubt search would work." (#73).

The remaining responses were either not about the menu anchor interactor or did not contain any information that was possible to analyze.

Satisfaction with a visit to a website depends on whether the user can find what they are looking for. And the vast number of products in most clothing webshops make the participants wonder whether they will be satisfied with what they find under the Transient menu anchor interactor, as shown above. This is in accordance with the findings by Schauupp et al. (2006), who deduced that user satisfaction is dependent on website type and what goals the user has with the visit. As the purpose of the visit to a web shop was clear to the participants, it is reflected in the comments as the participants feel hesitant whether the menu system will actually help when the categories are not visible up front, but rather hidden under the Transient menu anchor interactor.

Another signal that the participants struggled to figure out how they could start the process of navigation is that both the participant 57 and 146 indicated that they interpreted the banner with the sale message and a call to action button with the message "Shop now" as the menu anchor interactor. Which again implies that the components in this UI failed to communicate their functionality, which is why Silvennoinen et al. (2014) stressed the importance of studying visual components in the context they are intended to appear in.
Table 3. Quantitative results for Brand websites with three different menu systems: transient menu anchor interactor, top persistent menu anchor interactor, and navigation hub menu anchor interactor. The Likert scale ranging from 1 to 7 has been used where 1 means not helpful at all and 7 means very helpful.

<table>
<thead>
<tr>
<th></th>
<th>Transient</th>
<th>Top persistent menu</th>
<th>Navigation hub</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iOS</td>
<td>3.9</td>
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<td></td>
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<tr>
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<td>4.8</td>
</tr>
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<tr>
<td>Total</td>
<td>4</td>
<td>4</td>
<td>4.7</td>
</tr>
</tbody>
</table>

4.3 Service directory website

The quantitative data shows that on the Service directory website (the Travel website in the questionnaire), the Top persistent menu anchor interactor and the Navigation hub menu anchor interactor both scored 5.4 on the Likert scale. The Transient menu anchor interactor scored 4.7 (see Table 4 for full quantitative results of Brand website) and was again the least favored menu anchor interactor. This is matched by the results in the qualitative responses. However, the comments show a bigger positive margin for the Top persistent anchor interactor, as it got 90 positive comments (61.6 percent), while the Navigation hub got 72 positive remarks (49.3 percent), which makes us interpret the result as slightly in favor of the Top persistent anchor interactor.

As stated, 90 participants liked the Top persistent menu anchor interactor. The main reasons are that it is clear, you see all options up front, and is provides choices for the user: “Cool, I can
see everything I need. Maybe I am looking for only a hotel and this actually does make it possible. I like it!” (63), and: "Since the menu contains both icons and text it's really easy to assume what to find in the different sections.” (#130).

The fact that the UI clearly shows what section is active and selected as well as always gives an option to navigate to a different section of the website is appreciated: "I like the fact that I can see which area (Flights) I have selected and that it is easy to switch to another area without having to back up to a previous page. The design on the search area could be clearer, have I selected Round-trip or One-way. If the plane icon representing the “From” destination is “taking off”, i.e. pointing upwards, should not the icon for the “To” destination be pointing downwards, i.e. landing...” (#70).

The participant #50 missed a menu again and expected it to be visible when scrolling down, which did not feel like a good option: "Meny saknas men kan ju finnas om man skrollar ner vilket inte är optimalt (translation: Menu is missing but might exist if one scrolls down which is not optimal)” (#50).

This time only 11 participants disliked the menu, and the most notable reasoning was that it gives a cluttered look. They feel items/categories are missing and that the UI is unclear: "Clutter” (#96), and: "Could be improved, seems to lack some menu options” (#24).

Participant #101 found it confusing with two menus, indicating that the search for flights displayed in the main content area of the phone was interpreted as a menu anchor interactor: "Two menus is confusing” (#101).

There were 20 participants that were indifferent or had mixed feelings about the Top persistent menu anchor interactor, and they felt it is good to have more options, but it also makes the menu anchor interactor busier. They also found some options of displayed categories confusing. This led to a concern that several of the navigation links in the menu anchor interactor need to be investigated to find the information needed: "Depending on the use case, this works really well or splits my visit into several slots that I need to go through one after another.” (#67).

Some would have liked to add items to the menu. Three comments mentioned that they missed a section about the service provider, which shows that users need to validate how reliable a service is and want to be able to read up on who is behind the service: "Its clear but does not motivate me to travel, there are no pictures. I cant find headline for finding info of the service provider.” (#76).

The rest of the participants didn’t give an analyzable answer or got distracted by other elements in the UI.

It seems that the trade offs (such as discoverability, aesthetics, and comfort) as described by Bailly and Oulasvirta (2014) in what designers need to consider when designing a menu system

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have been well balanced for this service, as so many positive comments were made. This anchor interactor/website type rendered the most positive qualitative responses out of all the combinations in this study.

The clarity of this menu anchor interactor in the context of a service directory for travel seems to be close to the optimal menu system, i.e. the one that serves the goals of the user the best while still adhering to the constraints of a small screen (Bailly et al., 2016).

The response by the participant 70 about seeing what section of the website is selected supports the previous findings by, for instance, Norman (2008), who discovered that the selection speed increases when the user remembers where in the hierarchy a target link is located – which in the Top persistent anchor interactor was visually reinforced by showing which section of a website the user has activated.

Only 11 wrote clearly negatively about this menu anchor interactor. The main reason was the cluttered look, which again shows the importance of looking at the entire environment on the screen and designing all components in a way to create a visually coherent and pleasing UI to look at, a need that Silvennoinen et al. (2014) identified.

The Navigation hub on the Service directory website got 72 positive comments (49.3 percent) from the participants. Clear, simple, focused, and easily accessible were the most common type of comments: "For this type of site a person usually wants information on Hotel, Flights, Car Rentals and vacation packages. This site has all of those options available to be accessed quickly." (#126), and: "This design is clear, easy to understand, looks good on a small screen, and would be easy to navigate on the move or in a hurry." (#129).

Two participants specifically pointed out that it would be good for older users if the colours or the site were changed for better contrast, as for example: "Very simple and easy to understand. I like the icons next to the words. An old person would love to use this." (#115).

There were 26 participants that disliked the Navigation hub on this website. The main reason was that they felt it looked cluttered, made them suspect that there are many more choices to be made behind the buttons, and they missed a button for contact. Two participants also pointed out that they hate having to navigate back to this menu every time they want to search for something else: "Hard to switch your navigation choice after doing it" (#12), and: "What am I searching? What happens after I choose a section? How did I get to this view? If this menu gets hidden to a small menu-burger, it's a 7. If I need to navigate back to this from whatever I choose, it's a 2." (#79)

The number of participants with mixed feelings were 29, and they were not convinced that this type of menu anchor interactor will work. They also found it confounding, because there is no indication on the first page how navigation will look like on deeper levels of the website: "How
Another reason for the mixed feelings was that it does not look appealing when the menu takes up the whole screen. And since the buttons take up equal space, it made the participants wonder what is most important: "Maybe because the website doesn't seem to know what is most important. You have to choose one option immediately." (#83)

The rest of the participants did not comment on the menu anchor interactor or did not respond with anything that could be analyzed.

Previous research by Leuthold et al. (2011) showed that menu systems that display as many logically organized navigation links that fit on the screen at all times perform the best. This would support the instinctive positive response to the Navigation hub by the participants. It is when the participants start thinking about what happens on the following screens. Once they have selected the first category in the Navigation hub, they start wondering how helpful it will really be. This indicates that the participants do not consider the navigation path logical. Yet logical menu systems, are crucial for aiding the user in the navigation process (Leuthold et al., 2011).

As pointed out by the participant 115, this menu anchor interactor could support older users, who might find the visual language in smartphone UIs challenging with small label texts under small buttons; whereas in the Navigation hub, there are big buttons and more space for a semantically more meaningful label content, something that was proven to be important by Puerta Melguzio et al. (2012).

Out of the 146 answers, 45 participants clearly stated that on the Service directory website (the travel site) the Transient menu was clear, and they expected to find what they need. The positive comments express a feeling of familiarity and convention: "Like the hamburger menu. It is more of a standard in mobile UI now. Not sure about the double arrows for the round trip" (#66), and: "It's easy to figure out how to use the site" (#98)

The participants that disliked the Transient menu anchor interactor were 43 in total. Their comments focused on the expectation that the menu is poorly organized, does not show clearly what services the site has, and provides poor support for accomplishing a task: "Menu icon is again in the corner, so not loving it. Plus in terms of this example being a travel site, I prefer having all the elements easily accessed if I want to compare also hotels or look at car rental, I don't want to jump up and down always through menu bar first." (#142)

The participant #19 thought that this website looks like a scam site, indicating that it is the UI in total that evokes a feeling of distrust: "För det känns lite som en billig lurendrejersajt (translation: Because it feels a bit like a cheap scam site)" (#19).

Nine participants found this menu anchor interactor confusing as they did not see a point of the menu when they could look for flights in the search field visible on the screen. This again
shows that it is the total sum of the UI that affects the participants inclination towards the menu anchor interactor: "In this case I don't see the reason for it. The point is to find trips, and the widget is clear in the middle. Also login separated from the menu feels odd." (#46). The fact that the login is separated from the anchor interactor looks odd to the user when they focus on what actually is up in the top part of the website, even though separating the login from the menu anchor interactor is quite common on similar sites, such as momondo.se or expedia.com.

Four participants commented on the placement of the hamburger icon of the menu anchor interactor, one found it oddly placed and the participant 40 wanted the logo placed to the left and the menu icon to the right: "Its good that the menu stands out from the content (pink bg). But in my opinion the menu should be on the right side and the logo (home) on the left. Right now its not that balanced. Very heavy on the left side (logo and menu button)." (#40). Two liked the placement of the menu to the left: "Again, menu icon on the left which I like." (#37).

There were 38 participants with mixed feelings about the Transient menu anchor interactor. They felt reluctant as they would have to tap the anchor interactor to actually see the contents of the menu. And the extra click or tap that it requires was also mentioned: "Seems helpful and "out off the way" of other ui elements. Though helpfulness will be decided when the menu is opened" (#79), and: "It's a standard hamburger menu in the top left of the screen, with an added accessibility feature - the word "menu" below it. Arguably this latter word is unnecessary as it can be hidden from screen view but made available to screen readers. "However" at this point the 'menu' is neither helpful or unhelpful as you can't see the content until you have clicked on the hamburger." (#2).

The rest of the answers were from participants that either got distracted by other elements and did not answer the question about the menu, or did not respond anything relevant to the study.

It is clear that the participants who like the Transient menu anchor interactor have learnt what it means and they expect to find that kind of a component in a smartphone UI. It is interesting that preferences for the right versus the left corner placement for the anchor interactor were expressed. This confirms the findings by Murano and Sander (2016), who discovered that even though extensive research has been done on menu systems for desktop UIs, there are still unanswered questions, for instance about the optimal positioning of the menu anchor interactor. And even if design guidelines cannot be directly transferred from desktop UIs to smartphone UIs, the comments by the participants in this study show that there is more to investigate when it comes to the placement of the anchor interactors on the screen.

Other than that, the participants expressed the same concerns for the structure of the entire menu system behind the Transient menu anchor interactor as on the other website types. They felt uncertain of what they will find behind the hamburger icon of the menu anchor interactor, and it is evident that the participants do not trust the information architecture of a menu that is
hidden behind a hamburger icon, which could be related to the findings of Norman (2008) where he pointed out the importance of the contents of a menu being displayed in an organized manner, either linearly or hierarchically.

Table 4. Quantitative results for Service directory websites with three different menu systems: transient menu anchor interactor, top persistent menu anchor interactor, and navigation hub menu anchor interactor. The Likert scale ranging from 1 to 7 has been used where 1 means not helpful at all and 7 means very helpful.

<table>
<thead>
<tr>
<th>Service directory websites</th>
<th>Transient</th>
<th>Top persistent menu</th>
<th>Navigation hub</th>
</tr>
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<tbody>
<tr>
<td>Operating system</td>
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<td>iOS</td>
<td>4.5</td>
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<td>30–39 years</td>
<td>4.7</td>
<td>5.6</td>
<td>5.3</td>
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<tr>
<td>40–49 years</td>
<td>4.5</td>
<td>5.3</td>
<td>4.8</td>
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<tr>
<td>50+ years</td>
<td>5.6</td>
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<td>Total</td>
<td>4.7</td>
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</tbody>
</table>

4.4 Demographic data

On the single service website the navigation hub scored the highest average of 5.7. The Top persistent menu anchor interactor scored slightly lower with the 5.4 average, while the Transient menu anchor interactor came far behind with 4.6. The age group 50+, ranked the Transient menu anchor interactor at 3.9, which is significantly lower than other age groups and the overall average at 4.6.
The 20–29-year olds are more favorable towards the Transient menu anchor interactor ranking it at 5.3, however, they still ranked the Navigation hub at 6.0, which is well above the average of 5.7.

The 30–39-year olds broke the trend and ranked the Top persistent menu anchor interactor at 5.74, while the Navigation hub scored 5.71. This means it is the only group where the Top persistent menu anchor interactor was not the most favored for the single service website.

When it comes to the Brand website, the Navigation hub scored the highest average with 4.7, followed by the Top persistent menu anchor interactor at 4. The Transient anchor interactor scored the lowest with a 4.0 average. The 20–29-year olds ranked the Transient menu anchor interactor at 5.2, which is significantly higher than the total average of 4, while the participants in the age group of 50+ ranked the Transient anchor interactor at 3.4. The 20–29-year olds were also the only group that 1.) preferred the Transient menu anchor interactor instead of the Navigation hub for the Brand website and 2.) gave the Top persistent menu anchor interactor the lowest score.

For the Service directory website, the Top persistent menu anchor interactor scored the highest with a 5.4 average. The Navigation hub scored slightly lower with an average of 5.4 while the Transient anchor interactor scored an average of 4.7. The 20–29-year olds however ranked the Transient menu anchor interactor significantly lower than any other age group at 4.2. This age group preferred the Navigation hub anchor interactor instead of the most favorable top persistent menu and gave it a score of 6.0.

The 50+ participants, on the other hand, preferred the Transient menu anchor interactor and ranked it at 5.6, which is well above the average at 4.7.

On the Single service and the Brand website, iOS users gave 4.7 and 3.9, where the average was 4.6 and 4. However, Android users, gave them lower than average scores with 4.3 and 3.5. The same trend could not be seen on the Service directory website where iOS users gave 4.5 and Android users 4.6, while the average was 4.7.

In total, men and women were in agreement over which anchor interactor they liked the most and the least on each website types. However, men gave slightly lower scores with the average of 4.7 in comparison to women’s 4.9.

Exactly the same patterns are seen when it comes to the two major smartphone operating systems. The transient anchor interactors were the least favored by both iOS and Android users, while the Navigation hub was preferred on the Single service and Brand website, and the Top persistent navigation scored the highest on the Service directory website.
4.5 Summary

The Navigation hub was the preferred menu anchor interactor on both the Single service and the Brand website. Looking at the quantitative results, the difference in preference between the Navigation hub and the Top persistent menu anchor interactor that came second on the Single service website was 0.3. On the Brand website, the Top persistent and Transient menu anchor interactors both came second with an 0.7 difference to the Navigation Hub.

When examining the qualitative responses, the Navigation hub got 87 positive (59.6 percent) and 21 clearly negative comments (14.4 percent) on the Single service website. Whereas the same menu anchor interactor got 56 positive (38.4 percent) and 53 negative comments (36.3 percent) on the Brand website.

Although the quantitative score showed the Navigation hub to be a clear favorite on the Brand website, it got a very divided set of comments, indicating that the quantitative score might not stand on such a solid ground after all.

On the Service directory website, the Top persistent menu anchor interactor and the Navigation hub both scored 5.4 on the Likert scale, which gives a draw for the most preferred menu anchor interactor if you just look at the quantitative score. The qualitative data, however, reveals something else.

There were 90 positive comments (61.6 percent) about the Top persistent menu anchor interactor and 72 positive comments (49.3 percent) about the Navigation hub. Also, the Top persistent menu anchor interactor only had 11 clearly negative comments (7.5 percent), while the Navigation hub gathered 26 negative comments (17.8 percent). This tips the scale in favor of the Top persistent menu anchor interactor as a favored menu anchor interactor for the Service Directory website.

When you only examine the qualitative comments from all the different website types, the common denominator for the Navigation hub is that it gives clarity but the trade off is the visual looks of the website since the menu anchor interactor takes up the whole screen.

The disadvantage of the Top persistent navigation is that the labels under each section need to be very short, which some of the participants mentioned. Some participants also found this anchor interactor to give a more cluttered look, which can make important communicative signals of the functionalities less clear.

The horizontal scroll was considered a drawback for this menu anchor interactor, which became evident in the qualitative responses on the Brand website where the Top persistent menu anchor interactor only got 31 positive responses (21.2 percent) and 57 negative ones (39 percent),
which is far worse than on the other websites. The participants lost the overview of the menu content as parts of the anchor interactor continued off screen.

A positive aspect of the Top persistent menu anchor interactor, that does not contain a horizontal scroll is that the user maintains overview, since the navigation link in the menu anchor interactor is highlighted on the section of the website where they currently are.

Even though the Transient menu anchor interactor came to a draw for the second place on the Brand website, it is clearly the menu anchor interactor that did worst in this study.

On the Single service website, it scored 4.6 on the Likert scale, but contracted 49 positive and 49 negative comments (33.6 percent). On the Brand website, it scored a 4.0 on the Likert scale, but got 29 positive (19.9 percent) responses and 73 negative comments (50 percent). Finally, on the Service directory website, the Transient menu anchor interactor got a score of 4.7 on the Likert scale, while contracting 45 positive (30.9 percent) comments and 43 negative (29.5 percent) responses.

It is evident in the comments, that the participants found the menu hidden behind a hamburger icon an obstacle. They felt uncertain about how helpful it will be when they try to achieve their goals with a visit to a website.

At the same time, many comments also show that the participants are used to this menu anchor interactor. This was nicely summarized by the participant #71, who described a love/hate relationship with Transient menu anchor interactors, as they look nice but make it hard to achieve the desired goals.

It is worth to mention that 20–29-year olds clearly feel more positive about the Transient menu anchor interactor on the Brand website when compared to the total average (4.0 on the Likert scale) for all participants in this study. The average score for the 20–29-year olds was 5.2 on the Likert scale, which makes it their preferred anchor interactor for the Brand website. However, the same age group disliked the Transient menu anchor interactor on the Service directory website. Here the 20–29-year olds gave this anchor interactor the lowest score, 4.2, while ranking the Navigation hub at an even 6. This is an indication that the menu anchor interactor serves these specific users better or worse depending on the goals they try to achieve and the website they visit.

Finally, the Brand website received lower scores overall, which probably has to do with the participants’ unfavorable feelings towards clothing webshops as illustrated by the comment made by the participant 90 about the nightmarish menus in Scandinavian clothing web stores. This finding is supported by the conclusion of Norman (2008) over the importance of logically organized menu content, either linearly or hierarchically, that supports the goals of the user.
5. Discussion

5.1. Purpose and goal of the study

The goal of this study was to examine whether a website type classified by purpose or function (i.e., the end user’s goal for visiting a website) would benefit in terms of perceived usability or findability from a specific menu anchor interactor.

This could help designers create a better user experience. Furthermore, online services could benefit from improved customer satisfaction when the menu systems, starting with the menu anchor interactor, would support the end user goals, which, for example, could be to find a deal on flights, buy clothing online or find information about a restaurant they intend to visit.

The research process of this study was guided by the following question: **What influence does the website type have on the user’s preference of the menu anchor interactor?**

To solve the problem framed by this question, a questionnaire was created where the participants were asked to rate three types of menu anchor interactors (Transient, Top persistent, and Navigation hub) on three website types (Single service, Brand, and Service directory). The Likert scale used was from one to seven, where one equaled “Not helpful at all” and seven equaled “Very helpful”. Each score was followed by a qualitative question where the participants were asked to clarify their rating of the menu anchor interactor.

5.2. Anchor interactor preferences

Even though certain menu anchor interactors came out on top for all website types in this study, it is also clear that one cannot just examine the quantitative score.

There are always trade offs a designer has to make when designing a UI, and even though the menu system is crucial to the success of a website (Leuthold et al., 2011; Puerta Melguzio et al., 2012), there are other aspects (such as discoverability, aesthetics, comfort, and conversion rate optimization) to consider, that all will aid the users in achieving their goal and get a satisfactory result with the visit to a website. These aspects can also sometimes be at conflict with each other, making the task even more complex for the designer (Bailly & Oulasvirta, 2014).

Schaupp et al. (2006), found that user satisfaction is dependent on the website type and the goals the user has with the visit. Thus, it is perhaps not surprising that the Service directory website type achieved a clear result in this study when looking at the positive comments of the Top persistent menu anchor interactor, as it was easy for the users to picture themselves planning
a trip. Whereas the Single Service website and Brand website might not have been equally easy to relate to because such a restaurant or clothing website might not be in accordance with the participant’s interests.

However, the qualitative results have given some insight into the participants’ reasoning considering the menu anchor interactors. And a rather clear picture of a preference in favor of menu anchor interactors that display more than just one icon with the label ”Menu” has emerged.

The Top persistent menu anchor interactor performed better in this study than it did in the one by Huang et al. (2018), with the exception of the version with a horizontal scroll on the Brand website.

On both the Single service website and Service directory website, the qualitative responses in favor of the Top persistent menu anchor interactor were plentiful (83 on Single service and 90 on Service directory). That shows that 56.9% of the participants made a positive comment about the Top persistent menu anchor interactor on the Single Service website and 61.6% of the participants made a positive comment about the Top persistent anchor interactor on the Service directory website. It seems that the clarity and overview the user gets from this anchor interactor creates a sense of usability that comes close to the optimal menu system for the user, i.e. the one that serves the goals of the user the best while still adhering to the constraints of a small screen (Bailly et al., 2016).

The number of positive qualitative comments for this menu anchor interactor on the Service directory website, together with the total average score of 5.4 on the Likert scale in the quantitative study, gives a good indication that usability as defined in the new standard ISO 9241-11: Usability: Definitions and concepts, (”the extent to which a system, product or service can be used by specified users to achieve specific goals with effectiveness, efficiency and satisfaction in a specified context of use”) is met to a high degree (Bevan et al., 2016).

The Top persistent navigation could possibly be considered quite similar to the navigation hub, as it consists of a series of buttons with labels – however, displayed horizontally rather than vertically. It is the change in the direction of display that also gives the menu anchor interactor a disadvantage because the labels under each section in the Top navigation bar need to be very short, which makes them less descriptive, which Garcia-Lopez et al. (2017) has shown works poorly in smartphones. On the other hand, this menu anchor interactor had better memorability among users than a Transient menu anchor interactor according to Harms et al. (2015).

When it comes to the Navigation hub, it was the clearly preferred menu anchor interactor on the Brand website, scoring a total average of 4.7 on the Likert scale, however, the percentage of positive comments was only 38.6% as only 56 participants had something clearly positive to say about it. With the exception of the of 20–29-year old participants.
This is one of the few results based specifically on age. This group rated the Transient menu at an average of 5.2 on the Likert scale, which made them stand out as the only group preferring the Transient menu anchor interactor on this particular website type.

When you look at some big Brand websites (levi.com, zalando.com or hm.com), they all use a transient menu anchor interactor. The result of the study regarding the 20–29-year olds implies that they might like the Transient menu anchor interactor on the Brand website type because it is what they are used to seeing.

Yet, when it comes to the Brand website, it became clear that the whole UI affects the way users perceive the usability of a menu system and their menu anchor interactors. This relates to the findings of Silvennoinen et al. (2014) who concluded that components in a visual UI need to be examined in their full context of application or website type.

The fact that the Brand website had lower scores for all menu anchor interactors, and the banner with the call to action “shop now” was interpreted as a link to the actual webshop with a menu anchor interactor shows that components of a UI should not be studied without a context.

The Top persistent menu anchor interactor on the Brand website had a horizontal scroll, which made the participants feel that they lost the overview of the categories and they worried that they would accidentally click the wrong link, which shows that hiding parts of the menu from the users is not ideal as the studies by both Leuthold et al. (2011) and Puerta Melguzio et al. (2012) show.

It is possible that the Navigation hub would score better on the Brand website with more thought put into the initially displayed categories. Leuthold et al. (2011) could show that a website menu systems benefits from displaying as many logically organized navigation links as will fit on the screen. In the case of the category links on the Brand website in this study, some of the users commented that the categories did not make sense, as they could be overlapping, like for instance ”Jeans” and ”Women’s clothing”, which then makes the displayed links confusing instead of helpful.

The categories displayed in the Navigation hub menu anchor interactor on the Single service website did however mostly work for the participants. Some found it odd to have a link in the primary menu (the one listed up front with the main selection options) for jobs offered at the restaurant, and there was not a clear sense of what category in the menu anchor interactor was the most important and singled out visually. But overall it met the users’ needs, scoring an average of 5.7 on the Likert scale (best quantitative result in this study) and receiving 59.6% positive comments from the participants.

Yet several participants did not like the look of the Navigation hub, as it prevents the website from displaying any other content when the anchor interactor takes up all the real estate of the
screen. Among the comments were statements that it looked old and uninviting – perhaps not the best impression for a restaurant. It is safe to say that it did not meet the aesthetic aspects that are helpful when the user tries to achieve a goal with the visit to a website. Menu systems should comply with constraints and be efficient and aesthetically pleasing so that they are usable and give a good user experience (Bailly & Oulasvirta, 2014).

At the same time, the bigger buttons in the Navigation hub give more space for navigation link labels, which makes them more descriptive and semantically coherent, which Garcia-Lopez et al. (2017) found crucial in smartphone UIs. This menu anchor interactor also got the only comments where participants could see a benefit for older people or people who are motorically challenged.

The overall results for the Transient menu anchor interactor, looking at all the different types of websites in this study, land it at the bottom of almost all results. In the positive comments, this anchor interactor was mentioned as clean, easy, recognizable, and giving the websites in general a more uncluttered look.

The Transient anchor interactor in the study by Harms et al. (2015) was one of the menu types that were more interactive (tabs, menu, and collapsible fieldset), and the result showed that these gave users a better overview of the website content. The only significant difference was that the menu, or what has been called Top persistent menu anchor interactor in this study, had higher memorability than the collapsible fieldset (Transient menu anchor interactor). This could be one reason for the participants’ mixed feelings over this menu type, as it gives a nice visual feeling of the webpage, but at the same time it is harder to remember where to find what content on the websites.

But even if Transient menu anchor interactors are conventional and users are very accustomed to them (some so much that they can not find a menu unless they can localize a hamburger icon in the UI), it is evident that they are not favored by users, with the exception for the 20–29-year olds on specifically the Brand website type.

Other than that, the extra interaction and the uncertainty of what is hidden in the actual menu that will open is off-putting for many users, which also shows that this type of menu anchor interactor does not have some of the fundamental attributes a menu system should have, such as being efficient and learnable (Bailly & Oulasvirta, 2014).

For designers, these results imply that they need to carefully investigate options for menu anchor interactors in the services they design, and make sure to test them in a context that is as true to the future visual style and feeling as possible, as this has a large impact on the users perceived usability of the entire menu system.
5.3 Methodological considerations

When the questionnaire for this study was created, the intention was to gather as many participants as possible. And since there was no desire to create a geographically-constrained study, the choice was made to use English as the survey language.

The majority of the participants in this study were, however, from Sweden. A good number of the qualitative answers were short and not well phrased, which could relate to the fact that most Swedes have English as their second language and therefore feel insecure when expressing their thoughts in English. It is possible that a language selector could have encouraged the participants to write longer answers in their first language, but as this would not have been possible to provide in a wide selection of languages, the best route to take was to provide the questionnaire in English only.

Qualtrics, the application that was used for the questionnaire, did not have a good progress bar or a counter on how many questions were left to answer. There was a barely visual bar at the top of the page but it was still difficult to estimate how much of the questionnaire was left. Since the questions about the menu anchor interactors were given in a random order, the questions could not be numbered. Therefore 94 participants quit before completing all the questions, and this number could have been reduced with a better overview. In the qualitative answers, some participants complained about the number of similar questions, and some even thought the questionnaire was on a loop.

The choice of words turned out to be more crucial than expected. Participants were confused with the single service website depicting a restaurant because a link with the text “menu” was in the middle instead of to the left or right – which they argued is more common. The menu link was enhanced with an icon depicting a food menu. However, despite the icon some participants took it for the commonly used hamburger menu for mobile UIs.

The visual and aesthetic appearance was distracting to a good number of participants, which drew their attention away from answering the question of how helpful the menu anchor interactors were. Color, pictures, fonts and font-sizes, shapes, and icons were elements that quite a few of the participants expressed were the reason for their scoring, while not mentioning the menu anchor interactors at all.

The participants’ past experiences of certain website types could have affected the outcome in a misleading way. The brand website depicted an online clothing store, and the qualitative results showed that a large number of the participants assumed that the navigation would be bad because they had never visited an online clothing store with a good menu system. Assumptions were also made about the search function that usually – or at least according to many participants – does not work that well because the products are not correctly tagged.
The questions in the questionnaire should have been better formulated. For the service directory design, many of the participants got confused and clarified their score by explaining how they perceived the input fields for the search engine instead of the menu anchor interactors. Some were giving the design a low score because there were no advanced search options. With that said, the score was 0.73 on the reliability test made according to Cronbach’s alpha, which shows that most participants interpreted the questions and the questionnaire in a similar way.

Two of the Top persistent menu interactors had five fixed links (the Single service website and the Service directory website), while only the Brand website’s Top persistent menu anchor was scrollable horizontally, with more links not visible on the screen. This made many participants express their bad experiences of horizontally scrollable menus and resulted in them giving it a lower score compared to the other two.

The Navigation hub was perceived as the most helpful menu anchor interactor for the single service website and brand website, and it got the highest overall score in total. However the qualitative results did reveal that many participants were insecure about how they got to the menu in the first place, and they had questions about its functionality. For instance they wondered whether the menu was accessed by tapping a hamburger menu icon, in which case they would consider the design helpful. However, if it was the starting page, it was not considered helpful at all. There is a possibility that many participants misunderstood the design and thought it was an opened transient menu since it is common for mobile UIs to have hamburger menus designed in a similar manner when the Transient menu has been opened.

Using actual interactive prototypes of the menu anchor interactors could possibly have helped with these issues. However, the risk would then be that the participants would have focused on the total menu system’s usability rather than their viceral reaction to the menu anchor interactor itself. As the reliability score for this study was measured to be 0.73 on the reliability test according to Cronbach’s Alpha, there is a clear indication that the participants interpreted the questions including the still pictures of the user interfaces in the questionnaire the same way.

6. Conclusions and future work

6.1 Concluding remarks

This study has shown that a menu system that allows users to achieve their goal with a visit to a website as efficiently and effortlessly as possible starts with the visceral first reaction to the menu anchor interactor.
The results also suggest that the context of the website type does affect the perceived usability of a menu anchor interactor. However, other components in the UI also affect the instinctive feelings that a user has about the possible helpfulness of a menu system.

Even if it is not possible to transfer all usability guidelines from one screen size to another directly, the results of this study can be applied not only to mobile or desktop screens, but also other digital artifacts (such as GPS’, interactive systems or consoles in cars and medical equipment) that currently still rely on a graphical UI to communicate their affordances to the user.

They all need a menu anchor interactor, and they have a UI context that needs to be taken into consideration as it affects the usability.

To help service providers develop menu systems that better support the end user’s goals, designers need to think through and test menu anchor interactors in the full context of the UI.

It is also clearly important to attempt to find solutions that display more navigation categories or links rather than hide the menu behind a Transient menu anchor interactor. Displaying the full first level in the menu system hierarchy (either in a Top persistent menu anchor interactor or a Navigation hub) is beneficial to perceived usability as shown in the results of this study.

All of this is in turn significant for the design of a websites ontology, in particular, the websites or artefacts that have a broad menu system with many top-level categories. Designers will have to shape the information architecture in such menu systems to fit in a few navigation links in the menu anchor interactor, without losing the logic of the categories in the menu system. This will be especially challenging on small screens, such as smartphone screens and smart watches.

6.2 Future work

It is interesting that preferences for right versus left corner for the anchor interactor are expressed. This shows that Murano and Sander (2016) are correct that even though extensive research has been done on menu systems for desktop UIs, there are still unanswered questions, for instance about the optimal positioning of the menu anchor interactor. And even if design guidelines cannot be directly transferred from desktop UIs to smartphone UIs, the comments by the participants in this study show that there is more to investigate when it comes to the placement of the anchor interactors on the screen.

The results also indicate that there could be a big difference in how helpful the users perceive the menu system to be depending on their age. 20–29-year olds clearly broke the trend and favored different menu anchor interactors than the majority when it comes to the Brand and Service directory websites. It could be interesting to study this pattern further since only 13 of the participants in this study came from this age group, and no participant was below the age of 20.
As this study was not particularly large and only covered one website per website type (Single service, Brand and Service directory), it would be interesting to see how these results develop when studying several websites from the same type. It could also be of great value to see how different types of sites within the same segment compare when looking at menu anchor interactors – for example Brand websites (clothes, electronics and game stores), Single service websites (restaurants, coffee shops or hairdressers) and Service directory websites (price comparison for products or different kinds of services).

Another form of further research would also be interesting; a qualitative study where the participants would be given a clickable prototype instead of still images of the websites. They would be able to compare initial assumptions of the helpfulness of a menu anchor interactor. And they could then test the functionality to see whether the evaluation of helpfulness changes from just looking and evaluating based on previous experience from similar websites and then the actual user experience.

Finally, studies on other artefact types with graphical UIs, such as interactive systems in cars or medical equipment would be beneficial to investigate, as they provide a different setting and context than a website, while still requiring a menu system with a menu anchor interactor.
References


APPENDIX A

Questionnaire

Introduction:
Mobile website menu navigation study
This study is part of our bachelor thesis within the field of Informatics and specifically Digital Design at Kristianstad University.
Its goal is to help Digital Designers make well founded choices when selecting a menu type for the mobile website that they are designing.
Participation is anonymous and voluntary, and you can withdraw your participation at any point while answering the questionnaire.
We follow the ethical rules of scientific studies and the collected data is confidential and will only be used for research purposes in this study.

Thank you for helping us out!

Best regards,
Annika Madejska & Alexander Persson

Question 1: What age are you?

Question 2: What gender do you identify as?
- Man
- Woman
- Prefer not to say
- Other

Question 3: Do you have a smartphone?
- Yes
- No
- I have access to one but it is not mine

Question 4 (if yes on question 3): What kind of smartphone is it?
- Android
- iOS
- Windows phone
- Other
Question 4 (if yes on question 3): How much do you use the web through a browser on a smartphone?
- Several times per day
- Once a day
- A few times per week
- A few times per month
- A few times per year
- Never

Question 5: How much do you use the web through a browser on a computer?
- Several times per day
- Once a day
- A few times per week
- A few times per month
- A few times per year
- Never

Question 6: How helpful do you assume the navigation menu on this website will be when you try to find information you want? (Image of single service website with transient menu attached)
- 1 - Not helpful at all
- 2
- 3
- 4
- 5
- 6
- 7 - Very helpful

Question 7: Why did you score the helpfulness of the navigation menu as you did?

Question 8: How helpful do you assume the navigation menu on this website will be when you try to find information you want? (Image of single service website with top persistent menu attached)
- 1 - Not helpful at all
- 2
- 3
- 4
- 5
- 6
- 7 - Very helpful
Question 9: Why did you score the helpfulness of the navigation menu as you did?

Question 10: How helpful do you assume the navigation menu on this website will be when you try to find information you want? (Image of single service website with navigation hub menu attached)
   - 1 - Not helpful at all
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7 - Very helpful

Question 11: Why did you score the helpfulness of the navigation menu as you did?

Question 12: How helpful do you assume the navigation menu on this website will be when you try to find information you want? (Image of brand website with transient menu attached)
   - 1 - Not helpful at all
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7 - Very helpful

Question 13: Why did you score the helpfulness of the navigation menu as you did?

Question 14: How helpful do you assume the navigation menu on this website will be when you try to find information you want? (Image of brand website with top persistent menu attached)
   - 1 - Not helpful at all
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7 - Very helpful

Question 15: Why did you score the helpfulness of the navigation menu as you did?
Question 16: How helpful do you assume the navigation menu on this website will be when you try to find information you want? (Image of brand website with navigation hub menu attached)
   • 1 - Not helpful at all
   • 2
   • 3
   • 4
   • 5
   • 6
   • 7 - Very helpful

Question 17: Why did you score the helpfulness of the navigation menu as you did?

Question 18: How helpful do you assume the navigation menu on this website will be when you try to find information you want? (Image of service directory website with transient menu attached)
   • 1 - Not helpful at all
   • 2
   • 3
   • 4
   • 5
   • 6
   • 7 - Very helpful

Question 19: Why did you score the helpfulness of the navigation menu as you did?

Question 20: How helpful do you assume the navigation menu on this website will be when you try to find information you want? (Image of service directory website with top persistent menu attached)
   • 1 - Not helpful at all
   • 2
   • 3
   • 4
   • 5
   • 6
   • 7 - Very helpful

Question 21: Why did you score the helpfulness of the navigation menu as you did?
Question 22: How helpful do you assume the navigation menu on this website will be when you try to find information you want? (Image of service directory website with navigation hub menu attached)

- 1 - Not helpful at all
- 2
- 3
- 4
- 5
- 6
- 7 - Very helpful

Question 23: Why did you score the helpfulness of the navigation menu as you did?

End of questionnaire message: That’s it! Thank you for participating! Annika Madejska & Alexander Persson.