UNIVERZITA KARLOVA
FILOZOFICKÁ FAKULTA
ÚSTAV INFORMAČNÍCH STUDIÍ A KNIHOVNICTVÍ

Diplomová práce

Bc. Klára Scholleová, DiS.

Hedonic or pragmatic preferences? A comparative analysis of Android and iOS users from the perspective of UX and information behaviour

Hedonické nebo pragmatické preference? Komparativní analýza uživatelů platforem Android a iOS z pohledu UX a informačního chování

Praha 2021

Vedoucí práce: Mgr. Vít Šisler, Ph.D.
Konzultant: Mgr. Jakub Ferenc

Poděkování:

Na tomto místě bych ráda poděkovala svému konzultantovi Mgr. Jakubu Ferencovi a vedoucímu Mgr. Vítu Šislerovi, Ph.D. za cenné rady a zpětnou vazbu k textu této práce. Zvláštní dík také patří Davidu Radostovi, M.Sc. za jazykovou kontrolu a Mgr. Radce Fléglové za zpětnou vazbu a studijní podporu nižším ročníkům obecně.

Děkuji také své rodině, která věřila, že jsem tuto práci schopna dokončit, a podpořila mě.

Dík patří i respondentům za jejich čas a ochotu poskytnout odpovědi pro výzkum této práce.

Nakonec za podporu musím poděkovat svým kamarádům a kolegům, kteří mě udržují při dobré náladě a kteří mě taktéž při psaní podpořili.

Prohlášení:

Prohlašuji, že jsem diplomovou práci vypracovala samostatně, že jsem řádně citovala všechny použité prameny a literaturu a že práce nebyla využita v rámci jiného vysokoškolského studia či k získání jiného nebo stejného titulu.

V Praze, dne 28. července 2021

Klára Scholleová

Abstrakt (česky)

Teoretická část práce představuje vývoj oborů interakce člověk-počítač a uživatelské zkušenosti včetně hedonicko-pragmatického modelu. Dále jsou představeny platformy a ekosystémy obecně, vývoj trhu se smartphony a samotné dvě platformy Android a iOS. Vysvětleny jsou i základní koncepty informačního a zákaznického chování. Součástí práce je kvalitativní výzkum, jenž zkoumá rozdíly v požadavcích uživatelů obou platforem na bázi hedonicko-pragmatického modelu uživatelské zkušenosti a v jejich informačním chování. Bylo zjištěno, že účastníci výzkumu – uživatelé obou platforem mají zejména pragmatické důvody, ale i některé hedonické důvody pro volbu své platformy, ale popisují je jiným způsobem; a zároveň, že uživatelé Androidu zjišťují více informací při kupování nového smartphonu a že uživatelé iOS se v některých případech, na rozdíl od uživatelů Androidu, rozhodli pro svoji platformu na základě pozorování spokojenosti okolí.

Klíčová slova: uživatelská zkušenost (UX), hedonicko-pragmatický model, interakce člověk-počítač (HCI), informační chování, Android, iOS, mobilní platformy, smartphony

Abstract (English)

The theoretical part of the thesis presents the evolution of the fields of human-computer interaction (HCI) and user experience (UX) including hedonic-pragmatic model of user experience. It further presents platforms and ecosystems in general, the evolution of smartphone market and the platforms of Android and iOS, and explains the basic concepts of information and consumer behaviour. A part of the thesis is a qualitative study examining the differences between the preferences towards smartphones of Android and iOS users, and differences in their information behaviour. It was found out that the participants – users of both platforms have mostly pragmatic reasons for their platform preference but describe them differently; that Android users seek more information at the time of smartphone purchase decision and that some iOS users, unlike Android users, started using their platform based on observation of others' good user experience with it.

Key words: user experience (UX), hedonic-pragmatic model, human-computer interaction (HCI), information behaviour, Android, iOS, mobile platforms, smartphones

Table of contents

1. Introduction

Before Steve Jobs announced the iPhone to the world in 2007 (Giachetti 2017, Merchant 2018), we could hardly imagine that one day, the phone, something that used to be a device for making phone calls over a landline, which eventually got rid of wires and started to fit in our pockets, would become an all-in-one tiny computer most of us would not imagine our lives without. Here in the Czech Republic, according to data from the Czech Statistical Office published in November 2020, 99.3 % of students and 89.8 % of working people are smartphone owners and users (Czech Statistical Office 2020).

We use smartphones not only to call (which we often do with a video as well nowadays), but to text, chat, send emails, use social media, make creative content, play games, read articles, watch videos and for many other activities. We both *create* and *consume* media through them – making smartphones vehicles of our media life, Deuze's term for the fact that we live in media, which are "what water is to fish" to us (Deuze and Izdná 2015).

Undoubtedly, smartphones have a great relevance to our everyday life. There has been an ongoing debate and even some kind of rivalry between the users of the two major mobile platforms, Android and iOS[1], about "which one is better" (Brown and Hamburger 2011): on one hand, there is Android, an open platform by Google with devices of all configurations and different flavours of the operating system, on the other, there is iOS, a closed platform that runs only on iPhones with a promise of state-of-art design, optimisation and support from Apple (Chapter 4, Chapter 6). They are, just as other platforms, wheels of experience (current) economy, where the economic offerings are not only commodities, goods and services anymore, but experiences as well; and platforms' function is to design and stage elements to create experience for their customers, making terms of user experience and customer experience highly relevant in this context (Pine and Gilmore 2013, Cicero 2020, Chapter 4).

[1] In June 2021, Android had a 72.84% and iOS 26.34% market share, making up for 99.18 % of market share in total. (O'Dea 2021)

This thesis aims to describe this "battle" between the two major smartphone platforms from various academic perspectives with a special emphasis on the experiential aspect, and by an empirical study, examine what drives users to be members of either of them.

1.1 Structure of this thesis

Chapter 2 gives an overview of the field of human-computer interaction; it presents the field and its research aims, it describes the evolution of the field, interfaces and interactions through different optics; and it also explains the terms of user-centered design, human-centered design and user experience.

Chapter 3 presents the role of hedonic qualities in user experience based on the work of Marc Hassenzahl: most of all, it presents his hedonic-pragmatic model of user experience the study in Chapter 6 builds on.

Chapter 4 explains the terms of mobile operating systems, ecosystems and platforms and the differences between them. The front platforms of this thesis, Android and iOS, are presented in this context: they are placed in the history of smartphones and compared by different criteria, and also the research on their user bases is summarised.

Chapter 5 provides a brief introduction to information and consumer behaviour research, puts "hedonic" in consumer research in relevance to its meaning in user experience, and a relevant consumer research on smartphone preferences is reviewed.

Finally, Chapter 6 presents the study that was conducted for this thesis, which examines the differences between Android and iOS users from the perspective of their user experience and information behaviour.

1.2 Methodology

Vast majority of this thesis is a critical literature review (Jesson and Lacey 2006). The search engines used were Google Scholar (Google n.d.), Web of Science (Clarivate Analytics, n.d.) and ScienceDirect (Elsevier 2012); and also Google (n.d.) itself. For all topics covered in this thesis, more search keyword variants were used; for example,

apart from “Android” and “iOS”, “mobile platforms”, “mobile operating systems” or “smartphones”, or “iPhone” instead of “iOS”, were searched as well.

The empirical study used two methods consecutively: first, user experiences of participants were assessed through Hassenzahl’s AttrakDiff (User Interface Design GmbH n.d.), and second, semi-structured interviews were conducted with the participants (Wilson 2014, Brinkmann 2020).

2. Human-computer interaction: overview

As this thesis deals with how people interact with, use and feel about their smartphones, practically small computers in their pockets and syntheses of many other crucial technologies that evolved in the past century (even centuries), I decided to study this thesis' topic mostly within the fields of *human-computer interaction (HCI)* and *user experience (UX)* which I will present in the following sections.

Grudin (2012), among other reasons, advocates for studying HCI (specifically its history) with a solid argument that while some visions had been applied quickly, some took decades to spread, and some were never realised; and by understanding the trajectory that led to these different outcomes, we can better understand the contemporary (technological) visions. Hence, I discuss both the understanding of HCI and UX in the academic world and their history, which is, I also believe, essential for understanding the path that led us to using technologies as we interact with them today.

2.1 What is HCI

With computers becoming more mainstream in the 1970s and 1980s, there was an increasing need to develop systems that were people-oriented shared by both commercial world and academia, which led to establishing Association for Computing Machinery (ACM) Special Interest Group on Computer-Human Interaction (SIGCHI) in 1982 (Roussel 2014). As Marcus (2015, 14) notes, originally, it was "a convening of psychologists, human factors specialists, social scientists, software developers, and some outliers", but later other areas, such as cognitive science, computer science, graphic design, hardware development, human factors, information architecture, social science, software psychology, software and web development were included as well. The origins of HCI lie in ergonomics and usability (Harrison, Sengers, and Tatr 2007); one of the founding publications of HCI in terms of applying existing scholarly ergonomics knowledge to the field was *The Psychology of Human-Computer Interaction* (Card, Moran, and Newell 1983) that

introduced GOMS (goals–operations–methods–selection rules) model, which imagines user's cognitive structure as an information processor.

Following the formation of the field in the 1970s and 1980s (Churchill, Bowser, and Preece 2013), in 1992, the SIGCHI published a document called *ACM Curricula for Human-Computer Interaction* that proposed a working definition of the field as follows:

"Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them." (Hewett et al. 1992, 5)

In the introduction to the book *HCI Models, Theories, and Frameworks Toward a Multidisciplinary Science,* Carroll (2003) places HCI "at the intersection between the social and behavioural sciences on the one hand, and computer and information technology on the other". HCI practitioners, according to Caroll, "analyze and design user interfaces", "integrate and evaluate applications of technology to support human activities" but "study and improve the work and organizational processes of technology development". He claims that "the sometimes troubling" impact of technologies on all different sorts of human culture is the impact of HCI.

Grudin (2012) sees HCI as something that covers "major threads of research in four disciplines: human factors, information systems, computer science, and library and information science", and criticises understanding of HCI as work in one discipline only.

According to Churchill, Bowser, and Preece (2013), who profoundly continued the work of establishing the field in terms of its curriculum, HCI practitioners focus on issues such as technologies' learnability, usability, usefulness, reliability, comprehensibility or ethics, and whether the technologies "serve, engage, and satisfy people and extend their capabilities, or frustrate, thwart, and confound them". The authors note that although the term of HCI has been traditionally associated with the term of usability, the field reaches further and carries on broadening: it also deals with technological systems' aesthetic attractiveness, emotional appeal and questions such as whether they challenge and satisfy the user at the right level. They also suggest that HCI observes the influence of technologies on humans and vice-versa over time: which human traits remain stable with changing technologies, or on the

other hand, which technological interaction styles prove themselves and which do not.

2.2 History of HCI, interface and interaction

As I already explained, this thesis deals with how humans interact with one of the most influential devices – smartphones – and specifically their *interfaces*. Therefore, following aforementioned Grudin's encouragement, I deem it helpful to take a brief look at the evolution of interaction as is seen by the most influential authors in the field, which I believe enables the understanding of the driving forces behind formation of HCI as a field, as well as the path and impact of any technology, including smartphones.

2.2.1 From hardware bond to abstraction (Manovich 2000)

In his underlying work *The Language of New Media,* influential new media theorist Lev Manovich sees the evolution of screens, interface and software in general as a history of an increasing level of abstraction (Manovich 2000). Indeed, the complexity of interaction was always reduced together with hiding the real complexity of underlying hardware to users even more: human-machine interface went all the way from mechanical circuit switching to still low-level (in terms of proximity to hardware) machine code and assemblers, that, however, enabled building higher (and higher) level programming languages, and consequently, truly abstract interfaces from textual command lines to graphical user interfaces (GUI) as we know them in many forms today (Dourish 2001, Grudin 2012, Ferenc 2018).

2.2.2 From electrical to embodied interaction (Dourish 2001)

Manovich's conceptualisation of the interaction history is not in contradiction with the one of Dourish, who describes the evolution of interface based on interactions it enabled over time. With his conceptualisation of the interaction history, Dourish endorses Grudin (1989), who identified that interface and interaction evolved from being strongly technically focused by incorporating the user's context – the surrounding physical and social world – over time.

Based on this observation, he distinguishes five stages of interaction evolution: electrical, symbolic, text, graphical and, in his term, *embodied interaction* – a pair of tangible and social computation.

By *electrical interaction*, Dourish means the first analogue computers of the first half of 20th century that involved manual switching of the electrical circuits inside, so there was no distinction between hardware and software yet.

It was *symbolic interaction* Dourish sees as the true revolution in the interaction evolution: the introduction of assemblers and subsequently higher programming languages enabled programmers to stop having to know how the instructions "physically" work. Dourish notes it was then when humans started using more "natural" – visual and cognitive – abilities to use computers. What was still missing in the symbolic phase for Dourish, though, was the "interactive loop", two-way, interactive communication with computers, that was brought by the introduction of textual user (command-line) interfaces – *textual interaction*.

Textual interaction was followed by *graphical interaction* as we know it today, bringing the ability to control computers on a two-dimensional plane – graphical user interface (GUI). Perhaps the most famous pioneer of GUI was Ivan Sutherland's Sketchpad from 1962, a program for creating computer graphics and introducing interactions such as moving or erasing. Grudin (2012, 9) even says that Sutherland's dissertation where he presented Sketchpad "could be the most influential document in the history of HCI".

A great example for Dourish's observation that the interface evolves by incorporating more and more from the outer world is the paradigm of "desktop" that was created at Xerox Palo Alto Research Center (PARC), popularised by Apple Macintosh and Microsoft Windows, working with the idea that the workspace on a computer resembles laying "stuff" on our desks. Although we do not usually use windows on smartphones[2], the metaphor is still present with icons and widgets "laying around" on both iOS and Android. At PARC, many other tools, hardware and software, were developed to enable non-trained professionals to operate computers, such as most mouse interactions we know today or WYSIWYG editing (Roussel 2014).

[2] Except for e.g. Samsung's DeX environment (Samsung n.d.) https://www.samsung.com/us/explore/dex/

An influential design trend was *skeuomorphism* (Ferenc 2018) that tried to make the interface mimic the real world as much as possible. This trend followed Norman's suggestion of *perceived affordances* that help users tell a function based on their appearance (Norman 2004 as cited in Wu et al. 2015). This trend was present in many Apple products, including iOS (e.g. by realistically paper-like looking notes, page animations that mimicked "turning") until 2013. A vocal critic of this approach, though, was Alan Cooper (Cooper, Reimann, and Cronin 2007 as cited in Ferenc 2018) who warned that these visual metaphors are limiting and that their alleged intuitiveness is dependent on social-cultural factors and called for using more abstract idioms in UI instead. Also early versions of Android were mostly skeuomorphic as well, but Google, sooner than Apple, followed the trend of *flat design* most profoundly introduced by Microsoft (Curtis 2015), which started favouring minimalism to realisticness of the objects (Wu et al. 2015). Nevertheless, many residues of skeuomorphism still exist in contemporary UIs (trash bin on both MacOS and Windows) and it is nowadays making its comeback with *neomorphism* – in iOS's markup feature, for example, the pens and highlighters were recently changed from "flat" back to realistic (Malewicz 2019). In contrast, the latest version of Android, 12, at the time of writing thesis in public beta, seems to be pushing flat design even further than before (Brown 2021).

Returning to Dourish's five stages of interaction evolution, to him, the last stage of interface evolution is the *embodied interaction* his book *Where the Action Is* is about (2001). Idea of embodied interaction covers concepts of *tangible computing* and *social computing*. *Tangible computing* is an area within HCI that explores how interaction can be taken "off-screen" e.g. by manipulation with physical objects or taking advantage of our physical skills. By introducing the term of *Social computing*, Dourish reflects that the technology we are using is placed in a larger social context; the more we are using it, the more it is incorporated into our (social) lives which it influences and vice versa. The idea of embodied interaction sparked a great interest in HCI, for example Harrison et al. (2007) suggest it is one of the core concepts of HCI's third paradigm which I will present in the following section.

Manovich realised the social context of computing, as well, and described the idea of *cultural interface:* interface reflects "logic, ideology and imagery of society" and computing mediates all parts of our lives (Manovich 2000). Already much earlier,

Bødker (1991 as cited in Bødker and Klokmose 2011) argued that human activity is mediated by technological artifacts.

The central topic of this thesis, smartphones, only underline all these thoughts. Although Dourish used the term several years before the dawn of smartphone era, they are a good example of embodied interaction: the mere touch control and direct system response under our fingers is much closer to our natural abilities than mice or keyboards are, augmented reality lets us interact with real-life objects (even like scanning a QR code!), with the right goggles, they take us to virtual reality; but most of all, they become an essential part of many aspects of our social lives.

2.2.3 From ergonomics to phenomenology and experience

Seeing how interaction evolved, what were the driving forces behind the evolution of the HCI as a field? Already abovementioned Harrison et al. (2007), following Kuhn's theory of scientific revolutions (1970 as cited in Harrison et al. 2007, 3), described two original paradigms in HCI and argued for a next, third (the contemporary) one.

Combining human factors and engineering, the *first paradigm* aimed to optimise the ergonomics of technology to humans as it saw the mutual interaction as, what authors call, "man-machine coupling". It focused on identifying problems in this "coupling" and "developing pragmatic solutions to them", yet it ignored the meaning of interaction context until it was "causing problems". Authors' example was a choice to start using a woman's voice for warnings in Air Force's cockpits in the 1960s – as pilots were mostly men, this was a clever solution to audibly distinguish between hearing another pilot over a radio and an actual emergency.

In opposition, the *second paradigm* saw "mind and computer as symmetric, coupled information processors" and was mostly influenced by cognitive psychology (Sampson 2019). As Harrison et al. (2007) explain, "at the center is a set of information processing phenomena or issues in computers and users such as 'how does information get in', 'what transformations does it undergo', 'how does it go out again,' 'how can it be communicated efficiently' etc." On top of the first paradigm's error reduction, this approach brought more efficient information transmission. However, the information-centrism of the second paradigm considered only marginally interaction aspects that did not relate to information processing, such as

emotions, e.g. how users feel about interaction or simply what is fun for them, or larger context of where interaction is taking place.

Hence, the authors argued for the then-arising third paradigm in HCI, underlined by Dourish's embodied interaction. Although, as authors note, embodiment was present in the first and second paradigms, too – the ergonomic focus of the first paradigm paid attention to things like fit of mouse or font size, the cognitive focus of the second brought knowledge e.g. of how quick humans can react to various situations – the third paradigm's embodiment builds around phenomenology: "... the way in which we come to understand the world, ourselves, and interaction derives crucially from our location in a physical and social world as embodied actors" (Harrison et al. 2007, 6). It is not the physical embodiment according to authors, nevertheless, that is central to the third paradigm, it is the "phenomenological viewpoint, in which all action, interaction, and knowledge is seen as embodied in situated human actors". For this reason, they named the third paradigm the *phenomenological matrix*.

Bødker (2006, 2015) sees the shifts in HCI in three waves that cannot be mapped to Harrison et al.'s paradigms 1:1 but align to a great extent as she herself recognises. To her, the first wave of HCI was cognitive science and human factors; it studied humans and their interactions with computers through rigid methods and guidelines. The second shifted focus to group collaboration, work settings and newly considered context and terms like situated action or distributed cognition; it also brought methods such as workshops or prototyping. In the third wave, according to Bødker, "the use of contexts and application types broadened, and intermixed, relative to the second wave's focus on work". It brought forth experience and meaning-making, challenging e.g. the second wave's focus on efficiency. In her retrospective of the third wave though, Bødker (2015) was concerned that innovation in the field of work-related technology was suppressed in favour of the development of consumer technology; work technology did develop, but "mostly as a continuation of things like Web technology and by integrating smartphones and other mobile devices".

Nevertheless, Duarte and Baranauskas (2016) draw attention to the fact that despite the three waves (or paradigms) being chronological, one never replaced the previous and they remain to co-exist next to each other in the same academic community. At

the time of writing their paper, the authors observed studies aligned with the point of view of each of the waves.

Sampson (2019) disagrees with the discontinuity between the second, work efficiency-focused wave and the third, experience-focused wave seen by Bødker. On the contrary, he argues that there is an apparent continuity between all the waves in "the efficiency analysis of work and consumption in which experiences are similarly put to work". Moreover, he argues that HCI had been omitting the political and economic dimension of user experience and hence, alongside exploring experience from the point of view of the phenomenological matrix, he calls for taking what he calls *experience capitalism*, "the role market logic plays in putting user experiences to work", into account, as well. He even suggests calling the last paradigm *experience paradigm* instead of phenomenological matrix. His term of experience capitalism is closely related to experience economy, a term coined by Pine and Gilmore (1998) for the current economy model following agrarian, industrial and service economy, in which experience becomes a commodity and an added value to goods and services themselves, and well-describes the current digital landscape. Indeed, Sampson (2019) points out, citing Norman (2004), that "as the notion of the user experience (UX) becomes embedded in the HCI curriculum, commercial practices, and the operational level of digital media, it simultaneously develops into a powerful marketing tool that business enterprises readily utilize to tap into experiential triggers that establish, some argue, cognitive, emotional, and visceral engagements between consumers and the digital commodities, services, and brands they consume".

I will discuss the user experience, together with user-centered design, and their place within HCI, in the following section.

2.3 UCD, HCD and UX: human as a user

After its establishment in the 1980s, HCI had been predominantly concerned with the term of *usability* (Rajanen et al. 2017, Wright, McCarthy, and Marsh 2001). *A*ccording to its ISO definition (ISO 2019a), usability is an *"extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use"*, or simply, how easy and pleasant it is to use interactive product's features (Nielsen 2012).

This term, nevertheless, proved to be too narrow to be only studied in HCI; it deals with how usable product is, but is not much concerned with users' needs (in the first place), emotions and experiences when using interactive products, and it had somewhat work- and task-related perceived connotation (Hassenzahl and Tractinsky 2006). Hence, it was challenged with concepts that go beyond this notion and see the user as a needing, feeling, error-making and not always-working human being: user- and human-centered design (UCD and HCD) and user experience (UX).

2.3.1 User- and human- centered design: users are humans

Already in 1977, Kling criticised that users themselves are being forgotten in the software design process and introduced a conceptual framework of *user-centered design.* He argued that "(...) Systems which are poorly designed or do not meet actual needs of their users are not effectively utilized, nor do they satisfy people who use them," effectively putting users' needs first. In his recommendations, for instance, he called for designers spending time with users "in their milieu to appreciate their needs" (Kling 1977).

The term of user-centered design was adopted and mostly popularised by Don Norman through a co-authored publication *User-Centered System Design: New Perspectives on Human-Computer Interaction* (Norman and Draper 1986) and probably his most well-known book *The Psychology Of Everyday Things* (POET) (Norman 1988), later republished as *The Design of Everyday Things* (DOET) (Norman 2002, Norman 2013). In POET, he advocated for UCD as "a philosophy based on the needs and interests of the user, with an emphasis on making products usable and understandable" (Norman 2002, 188). Note how usability is an important element of that philosophy, but the needs and interests of users and understandability are considered, as well.

UCD takes the user into account at every step of the design process (Garrett 2011). With its philosophy in mind, many today common design and research methods were developed and are being used, such as prototyping, use cases, user personas, user scenarios, focus groups, interviews, focus groups and many others (Marcus 2015). It was and still is widely accepted and used in academic literature and the number of businesses implementing its concepts is increasing (Chochoiek 2017).

Some see applying UCD as the cornerstone of some businesses' success, such as Airbnb's (Still and Crane 2017).

In the newer editions of DOET, Norman started using the term *human-centered design* (HCD) as the central idea instead[3]. The difference is apparent: instead of considering someone using a specific product, people as *humans* and their *human* needs, capabilities and behaviours are being put first, and design is there to accommodate these needs, capabilities and ways of behaving (Norman 2013, 8). HCD is an expansion of UCD: it considers how "human capabilities and characteristics are affected by the system beyond direct interaction with the interface or system itself" and often considers ethnographic and demographic characteristics such as gender, race or class (Ritter, Baxter, and Churchill 2014). One of the most influential and successful proponents of HCD is IDEO agency[4], that describes the HCD process in words derived from the abbreviation: *hear, create, deliver* (IDEO 2015).

Sometimes, the terms of UCD and HCD are used interchangeably (e.g. Still and Crane 2017), although more than slight nuance between the two terms is apparent. It is the latter though that has an ISO standard (ISO 2019b).

Some claim that the term of user experience, a highly demanded professional field in today's world, is just a "rebranding" of the concept of human-centered design (Christensen et al. 2020). As many explained and so will I in the next section, although the two terms are indeed closely related, they are not synonymous.

2.3.2 User experience: humans feel

As defined by perhaps greatest authorities in the field, Don Norman and Jakob Nielsen, and in my view best-fitting for the topic studied in this thesis, user experience *"encompasses all aspects of the end-user's interaction with the company, its services, and its products"* (Norman and Nielsen n.d. as cited in Christensen et al. 2020). Authors note that it is important to distinguish UX from UI (user interface, which, for example, may be good itself, but if it does not provide or allow what a

[3] While in (Norman 2002), for example, both terms are still being used, in the latest edition of DOET (Norman 2013), user-centered design is omitted completely.
[4] In the last edition of DOET (Norman 2013), Norman thanks several IDEO fellows for having learnt from them (p. 303), recommends several of their publications (p. 307) and also cites IDEO's HCD toolkit (p. 324). He was a fellow himself between 2010 and 2018 (https://www.linkedin.com/in/donnorman) (LinkedIn n.d.).

user needs, it is not a good experience) and traditional usability (which is a quality aspect of UI). They further explain:

"The first requirement for an exemplary user experience is to meet the exact needs of the customer, without fuss or bother. Next comes simplicity and elegance that produce products that are a joy to own, a joy to use. True user experience goes far beyond giving customers what they say they want or providing checklist features. In order to achieve high-quality user experience in a company's offerings there must be a seamless merging of the services of multiple disciplines, including engineering, marketing, graphical and industrial design, and interface design." (Norman and Nielsen n.d.)

The credit for coining the term in 1993 when he became a head of Apple's research group is being given to Don Norman, who himself takes it (Lialina 2018): *"I invented the term because I thought human interface and usability were too narrow. I wanted to cover all aspects of the person's experience with the system including industrial design graphics, the interface, the physical interaction and the manual."* The mindset was, nevertheless, not completely new in HCI – for example, already in a usability engineering journal from 1987, Whiteside and Nixon argue that "Usability exists in the experience of the person. If the person experiences a system as usable, it is. A commitment to designing for people means that, at base, we must accept their judgement as the final criterion for usability (…) The starting point for usability engineering must be the uncovering of user experience." (Whiteside and Nixon 1987 as cited in Araz 2018). Some also acknowledge Walt Disney as one of the pioneers of user experience, although not calling it so, for how he envisioned a place where "the latest technology can be used to improve the lives of people" and for what he taught to his team of engineers when designing Disney worlds: "know your audience, wear your guest's shoes, communicate with color, shape, form and texture..." (Kovatcheva 2018).

Also UX has an ISO definition (it is part of the same standard as human-centered design): "person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service" (ISO 2019b). Nevertheless, Bevan et al. (2016) assert that the ISO definition[5] lacks the consideration of time, i.e. how UX "evolves from expectation, through actual interaction, to a total experience that

[5] Bevan et al. (2016) write about "New ISO Standards for Usability, Usability Reports and Usability Measures" to be seen in standards ISO 9241-220 published in 2016/2017, supposed UX definition of which differs from the cited ISO definition here. Nevertheless, the ISO 9241-220 revised in 2019 as cited here still reads as Bevan cited it back in 2009.

includes reflection on the experience" and that it can be seen in three different ways: either as "an elaboration of the satisfaction component of usability", something "distinct from usability, which has a historical emphasis on user performance" or "an umbrella term for all the user's perceptions and responses, whether measured subjectively or objectively" (also cited in Zarour and Alharbi 2017). The long-term user experience was studied by Kujala et al. (2011) on the dimensions of *general attractiveness, ease of use, utility* and *degree of usage* (in time).

Other academic definitions of UX include, for example, Kuniavsky (2010, 14), who sees UX as "the totality of end users' perceptions as they interact with a product or service", where the perceptions include "effectiveness (How good is the result?), efficiency (How fast or cheap is it?), emotional satisfaction (How good does it feel?), and the quality of the relationship with the entity that created the product or service (What expectations does it create for subsequent interactions?)" (also cited in Christensen et al. 2020). Rajanen et al. (2017), based on Clemmensen et al. (2013), acknowledge two distinct UX definitions: *system-oriented* which is the four-dimensional long-term perception of UX by Kujala et al. (2011) and *human-oriented* by McCarthy and Wright (2004) who described user experience along four threads: *sensual, emotional, compositional and spatio-temporal* (McCarthy and Wright 2004 as cited in Rajanen et al. 2017).

Very influential were works on hedonic aspects of UX by Hassenzahl (e.g. 2001, 2003), which will be presented in detail in the following chapter. Based on self-regulation/action theory, Hassenzahl also distinguished two different levels of user experience and interaction: *motor-level* (How) – the physical interaction itself – and *be-level* (Why) – the thoughts, feelings and meaning triggered by the interaction (Hassenzahl 2010). Relatedly, Lenz, Diefenbach and Hassenzahl (2017) showed that the most efficient interaction does not necessarily mean the most enjoyable interaction; further challenging traditional understanding of the importance of usability and emphasising *interaction aesthetics*. Hassenzahl's work was also acknowledged by Don Norman (e.g. Norman 2013, 233). Nonetheless, there is no universally agreed upon academic definition of UX (Christensen et al. 2020, Zarour and Alharbi 2017).

The difference between HCD and UX is that HCD is a process, while UX (design) is a broader concept (U.S. General Services Administration 2020) with its own factors

(such as affect, interpretation or meaning), methods, tools and criteria not included in HCD (Roto, Vermeeren, and Hoonhout 2011).[6]

UX has become highly demanded in today's business (Christensen et al. 2020). Unsurprisingly, a product with a bad user experience has close to zero probability of success. On the other hand, a good user experience boosts revenues and overall conversion, increases development efficiency, customer loyalty, customer satisfaction, customer retention, it strengthens brand loyalty and additionally, investments in UX also lead to lower costs on customer acquisition and support (Dam 2019, Christensen et al. 2020). Oftentimes, also a related concept of *customer experience* (CX) is being used, which *"comprises customers' non-deliberate, spontaneous responses and reactions to offering-related stimuli along the customer journey"* (Becker and Jaakkola 2020) and has more marketing background. In the case of interactive products, this means that CX goes beyond mere use of these products but involves all interactions with the company to which the user is a customer; for example, a bank application's UX may be good, but if the communication with the bank is a struggle otherwise, the overall CX is not as good. Design Management Institute reported that in 2015, design-centered companies such as Apple, IBM or Starbucks and Walt Disney outperformed SandP Index by 211% (Rae 2016). Indeed, Apple is known for its heavy focus on user experience, and it is user experience that justifies the higher prices of its products to many (Johnson et al. 2012).

It is apparent that to understand differences between users of the two largest smartphone platforms, we need to also understand the experiences they have with their devices just as the experiences they *seek*. Therefore, the next chapter is dedicated to understanding the user experience in more depth through Hassenzahl's hedonic-pragmatic model of user experience.

[6] Being a UX design professional myself, I would subjectively say that while HCD is somewhat an ideal, UX became the practise. What I mean is that while HCD describes an ideal process leading to an ideal product, as a UX designer I rarely start designing based on researched demand from users (as much as I would love to, for I believe in HCD) but based on business demands. What I do is that I try to advocate for the users and bridge the gap between them and my clients (businesses); and design products that are both usable and enjoyable while satisfying my clients' assignments.

3. "Hedonic" in UX

In this chapter, I present the theoretical framework this thesis builds upon – Marc Hassenzahl's hedonic-pragmatic model of user experience (Hassenzahl 2003) and its predecessor ergonomic-hedonic model of appealing software (Hassenzahl et. al 2000). At the end, I discuss alternative approaches to the assessment of user experience.

3.1 Ergonomic–hedonic model of appealing software (Hassenzahl et al. 2000)

As already mentioned, at the turn of millennia, the field of HCI was still predominantly concerned with the classical concept of (objective) usability and the term of UX and research of subjective perception of interactive products' quality had only started emerging.

In their paper from 2000, Hassenzahl, Platz, Burmester and Lehner joined the previous criticism of the usability's then strong focus on task-related efficiency and effectiveness (Adams, Des, and Sanders 1995; Kim and Moon 1998; Logan, Augaitis, and Renk 1994) and called for an expanded concept of usability that would comprise a user's enjoyment and satisfaction as the major design goal, while not disregarding the importance of the efficiency and effectiveness in a work context (Hassenzahl et al. 2000). They presumed that making software systems usable and interesting would lead to higher enjoyment of using them and deemed the research in this direction as a step closer to "designing user experiences instead of merely making a software usable". The authors acknowledged Logan's two-component usability concept that consisted of *behavioural* (more or less traditional usability) and *emotional usability* ("the degree to which a product is desirable or serves a need(s) beyond the traditional functional objective") from 1994 (Logan 1994) but lacked model or data how the two influence each other.

Therefore, they presented and tested their own hypothesised model of appealing software systems that distinguished between two different quality dimensions: *ergonomic quality* (EQ, such as simplicity, controllability etc.) and *hedonic quality* (HQ,

such as novelty or originality). By EQ, the authors understood "quality dimensions that are related to traditional usability, i.e. efficiency and effectiveness" and "focuses on task-related functions or design issues" while HQ authors explain as "quality dimensions with no obvious relation to the task the user wants to accomplish with the system, such as originality, innovativeness, beauty etc. Although not task-related, the users may regard HQ as an important quality aspect for its own sake." (Hassenzahl et al. 2000). As explained by Hassenzahl (2001), this model encompasses three layers: "(a) objective product quality (intended by the designers), (b) subjective quality perceptions and evaluations (cognitive appraisal by the users), and (c) behavioural and emotional consequences (for the user)."

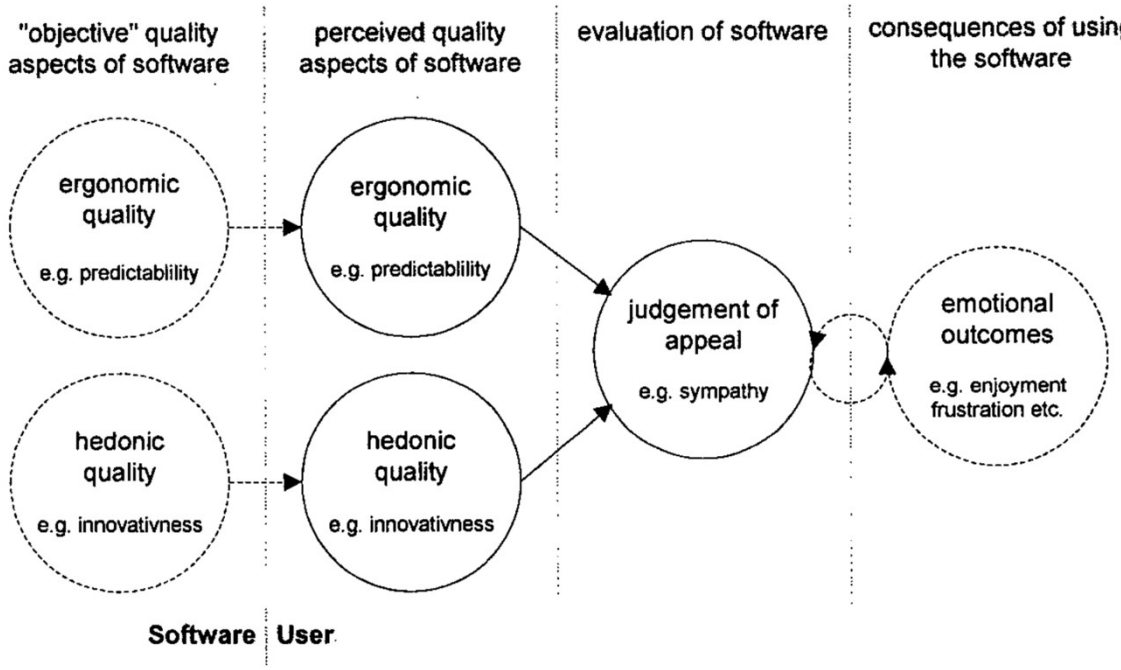

Figure 1: Model of appealing software systems (Hassenzahl 2001)

To test the model, the authors carried out a study on 6 women and 14 men, employees of Siemens Corporate Technology in Munich, whose task was to switch off a pump in an assumed industry plant using seven different software prototypes created for the purposes of the study. The prototypes were designed by students of visual, industrial and ergonomic design with heterogeneity as their main intention – the prototypes differed e.g. by colours, styles and one was left without animated parts. (Hassenzahl et al. 2000).

The study confirmed both EQ and HQ as two subjectively different quality aspects perceived independently by the users. Furthermore, the study showed that for users, both aspects contribute almost equally to forming overall appeal of judgement and can compensate for each other, but that both aspects might be impossible to maximise from a software design perspective as some of the qualities' metrics are negatively correlated with each other. (Hassenzahl et al. 2000).

The authors also examined perceived *expected* and *experienced* EQ and HQ and observed that generally, HQ increases while EQ decreases over time of experiencing software. Based on this observation, they argue that HQ and EQ are not based solely on the appearance of the software, but also on the experience the users have with the system.

Among other challenges, most importantly to carry on in the research direction the paper set, the authors called for establishing how to measure HQ and overall appeal of software in future research – by then, only traditional usability questionnaires were available (usable for measuring EQ).

The study had several considerable limitations, though. As the authors themselves and later Hassenzahl (2001) pointed out, the study's generalisability was questionable due to stimuli provided – the pump control board prototypes which were out of participants' scope of daily experience. Furthermore, the participants could interact with each prototype only for two minutes. An unanswered question additionally remained whether the used scales of considered quality aspects were correct, as no previously accepted methods for measuring HQ existed (authors assumed EQ could be measured by alternation of existing usability scales).

Hassenzahl's following study which put the model to further testing under improved conditions (tested product relevant to participants' lives, increased time to perform the tasks) however replicated the results of the original study (2001). Hassenzahl also observed that EQ attributes "predictable–unpredictable" and "familiar–strange", two positive attributes from the perspective of usability, had a negative impact on HQ. This observation correlates with Caroll and Thomas' argument that "that ease of use (i.e., EQ aspects) and fun of use (i.e., HQ aspects) may not necessarily complement each other (Caroll and Thomas 1988 as cited in Hassenzahl 2001).

3.2 Hedonic-pragmatic model of user experience

Hassenzahl first presented the hedonic-pragmatic model of user experience in his 2003 paper *The Thing and I: Understanding the Relationship Between User and Product* (Hassenzahl 2003) as a further elaboration and improvement on the previous ergonomic-hedonic model of appealing software (Hassenzahl et al. 2000). The model assumes that user experience can be in two dimensions: products' hedonic and pragmatic attributes. The model is described in detail in the following sections.

3.2.1 Intended versus apparent product character and consequences

Hassenzahl argues that designers choose *product features* such as content, presentation, functionality or interaction to convey certain intended *product character* (i.e. its pragmatic and hedonic attributes). Nevertheless, this character is only intended and subjective from the point of view of the designer and there is no guarantee the users will perceive the product the same way. Hence, the intended character must be communicated to users well.

Users, on the other hand, first perceive these features and based on them, together with their own standards and experiences, construct their subjective *apparent product character*. The fact that their own standards and experiences come in play when forming the judgment explains why different individuals perceive products differently. Furthermore, the apparent character may change just as the experiences with the product increase. For this, Hassenzahl provides the simplest example of a product that could be perceived as "novel and stimulating" and may naturally lose these characteristics over time.

This apparent product character leads to *consequences* – users make a judgment about the product's appeal and emotions (such as pleasure or disappointment) and possible behavioural changes (e.g. increased time of using the product) are triggered. Consequences may vary much more over time than perceptions because depending on usage situation, certain characters may be sometimes perceived positively and sometimes negatively. Hassenzahl provides an example of ATMs: dividing the process into small clear steps makes it understandable when withdrawing money for the first time, but later, already after some experience and in a scenario of time

pressure, it may be frustrating to go through all these steps instead of a more straightforward way. Vice versa, something that could be not understandable and frustrating at first may become familiar and hence satisfying with growing experience over time. No matter the available information about the product, this process of perception, character construction and experiencing consequences always takes place.

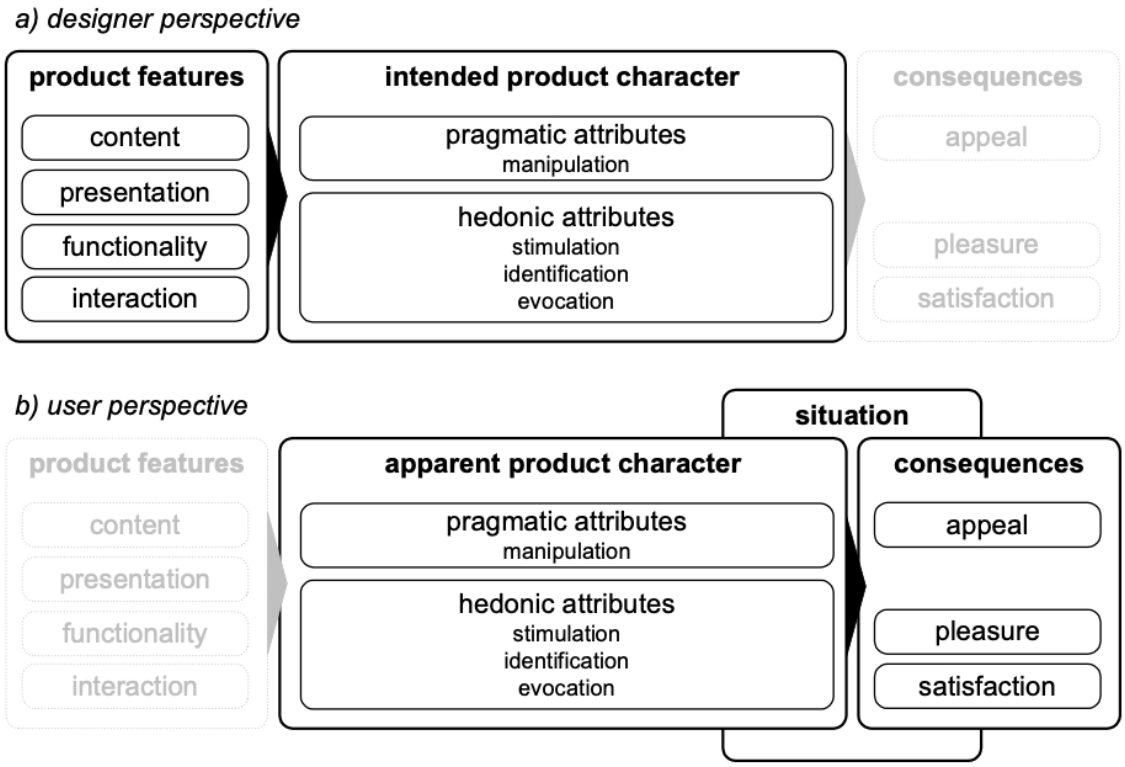

Figure 2: Designer vs. user perspective (Hassenzahl 2003)

This concept resembles Norman's *mental models* (Norman 2013, 31) (see Figure 3). Norman argues that conceptually, user, designer and product form a triangle; where user and designer are somewhat disconnected vertices with their own conceptual (mental) models which communicate through the product's system image. Product's system image is "what can be perceived from the physical structure that has been built (including documentation, instructions, signifiers, and any information available from websites and help lines)". The designer has their conceptual model, which is their conception of the product and their expectation of what the user's conceptual model will be. The user, however, forms their *own* conceptual model from

the system image through interaction with the product, reading documentation etc. As the designer cannot be there with the user when they are using the product, it is the system image that mediates the communication.

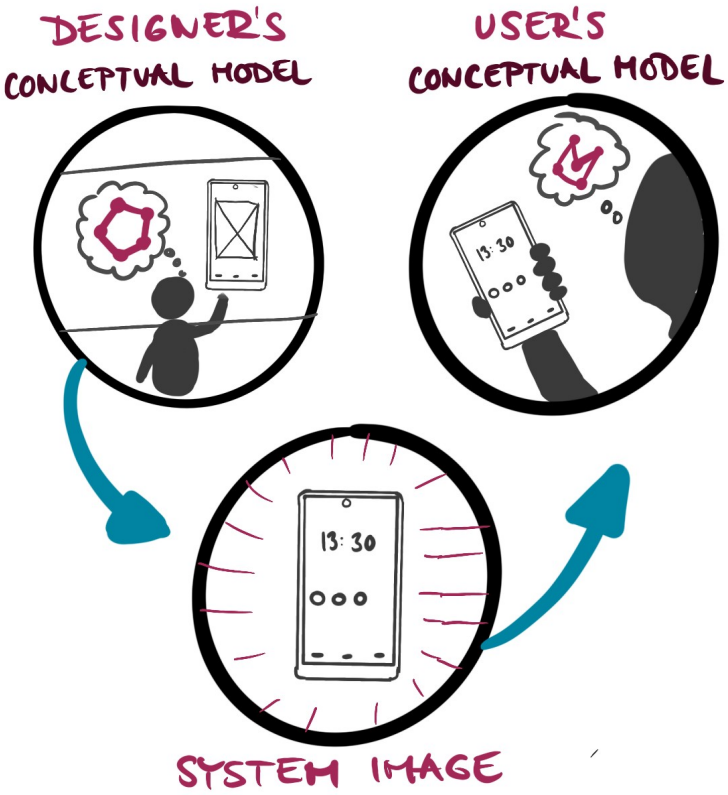

Figure 3: The Designer's Model, the User's Model, and the System Image, adopted from Norman (2013, 13)

3.2.2 Product character

The product character is a cognitive structure that represents its attributes and "relations that specify the co-variation of attributes". It has two dimensions: *pragmatic attributes* and *hedonic attributes* (Hassenzahl 2003).

Pragmatic attributes are those related to *manipulation* with or using the product – the relevance of the product's functionality (i.e. its utility, e.g. "clear") and the accessibility of this functionality (i.e. its usability, e.g. "useful"). In my understanding, the shift from the word "ergonomic" in (Hassenzahl et al. 2000) to "pragmatic" is due to the additional consideration of utility alongside the usability (ergonomics). As he further summarises and generalises in (Hassenzahl 2010), the pragmatic attributes are linked to *"do-goals"* – describe products' ability to enable *doing* something, like "making a phone call" or "finding a product on an e-shop".

The object of focus in assessing the pragmatic attributes is hence the product itself, i.e. "its utility and usability in relation to potential tasks".

Hedonic attributes are all remaining attributes; Hassenzahl explains the choice of word to "highlight that hedonic attributes and the underlying functions of the product strongly differ from pragmatic attributes" (Hassenzahl 2003). They represent *"be-goals"* – a product's ability to make users feel like *being* something, for example competent, successful or just special. That means, though, that in assessment of hedonic attributes, the object of focus is not the product, but the user themself – *why* they own and use a certain product. (Hassenzahl 2010). Hassenzahl further divides the hedonic function of products to three main subfunctions:

1) providing stimulation
    - In their study, McGrenere and Moore (2000) found that only 25 % participants wanted to remove unused functions of Microsoft Word, although only 27 % were used. Hassenzahl argues that this can be explained as that users view these unused functions as exciting future opportunities – although they do not fulfil momentary do-goals, they have potential to improve ways to accomplish tasks in the future or even enable new goals in general.
2) communicating identity (*identification*)
    - Hassenzahl refers to Prentice (1987 as cited in Hassenzahl 2003) and her argument that physical objects are being used to express individuals' selves and Schwartz and Bilsky (1987 as cited in Hassenzahl 2003) who recognise social recognition and exertion of power over others as basic domain of human motives; hence assumes the importance of products communicating identity.
3) provoking valued memories (*evocation*)
    - Hassenzahl provides an example of vintage video games that arguably do not provide excitement from great graphics or advanced controls but from triggering the memories of "good old days". (Hassenzahl 2003)

In the model (Figure 4), the product character emerges from the combination of the pragmatic and hedonic attributes. A product with weak both hedonic and pragmatic attributes is straightforwardly *unwanted*. Exact opposite, i.e. product with strong

hedonic and pragmatic attributes is *desired*. Two special product characters in Hassenzahl's models are ACT products (strongly pragmatic, weakly hedonic) and SELF products (strongly hedonic, weakly pragmatic). The ACT products, being primarily pragmatic, are linked to certain tasks (do-goals) and their appeal may change according to their current relevance, i.e. if I stop *needing* an ACT product, it becomes less appealing. On the other hand, SELF products as primarily hedonic are linked to satisfying "users' self, e.g. their ideals, and relationships" all of which are quite stable variables, and hence SELF products' appeal is much more stable.

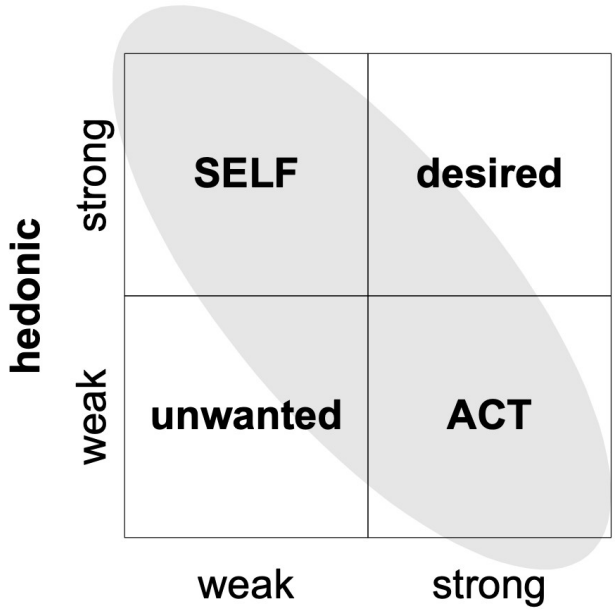

Figure 4: Hassenzahl's hedonic-pragmatic model of user experience (Hassenzahl 2003)

Hassenzahl notes that "... products can be pragmatic or hedonic for different reasons. For example, a tool of a certain brand may be hedonic because this tool communicates professionalism to relevant others (i.e., communicates identity)." (Hassenzahl 2003). However, according to Hassenzahl, hedonic attributes subsume much stronger potential for pleasure than the product's pragmatic function and moreover, they are main contributors to product's acceptance (Hassenzahl 2003). This was confirmed by Minge's experiment in 2008 (Minge 2008).

3.2.3 Reception of the model

The first significant review of the impact of introduction of hedonic to user experience is that of Diefenbach, Kolb, and Hassenzahl (2014). Among 151 reviewed

publications that discussed hedonic as a quality aspect of interactive products, the authors found that 65 % referred to Hassenzahl for the definition of hedonic quality, (Hassenzahl 2003) being among the most cited one. 11 % of the publications referred to the origins of the concept in consumer research, mostly that of Hirschman and Holbrook who saw hedonic as "esthetic, intangible, and subjective aspects of consumption" (1982) and 9 % referred to van der Heijden's thoughts that "hedonic information systems aim to provide self-fulfilling rather than instrumental value to the user" and "encourage prolonged rather than productive use" (2004).

Twelve years after publishing the model, Zarour and Alharbi (2017) recognised Hassenzahl's distinction between pragmatic and hedonic user needs as dominantly accepted in the academic UX community and as one of the main UX research disciplines. Also Hornbæk and Hertzum (2017) declare Hassenzahl's model "prominent" in UX literature.

3.3 Alternative assessments of UX

Alternative significant UX model proposition in literature is that of Thüring and Mahlke (2007) as recognised e.g. by Hornbæk and Hertzum (2017), that viewed user experience as a compound of user's perception of instrumental and non-instrumental qualities and their emotional responses to these perceptions. Minge and Thüring (2018) (second author being a co-author of the model) acknowledge that the distinction between instrumental and non-instrumental qualities do share similarities with the distinction between hedonic and pragmatic qualities as Hassenzahl understands them.

However, some UX researchers criticised this reductionist, model-based approach towards UX (be it Hassenzahl or Minge and Thüring's). For example, Forlizzi and Battarbee (2004) argued that "emotional responses are hard to understand, let alone quantify". In Roto et al. (2011), Höök questions whether "measuring the end-user experience as a few simplistic measurable variables is really helping us to do better design or to better understand the user experience" and the mere possibility of assessing some "UX value".

3.4 Hedonic-utilitarian scale

It cannot be left unmentioned here that consumer and marketing research investigated consumer attitudes alongside two dimensions, hedonic and utilitarian, already much earlier than Hassenzahl; the idea dates back already to a series of articles by Hirschman and Holbrook (1982) (as cited in Diefenbach and Hassenzahl 2019, Voss et al. 2003). Following Batra and Ahtola (1990), Voss et al. (2003) adopted two-dimensional conceptualization of consumer attitudes: one dimension being hedonic "resulting from sensations derived from the experience of using products" and second dimension being utilitarian "derived from functions performed by products". Coming from this conceptualisation, they developed a related assessment method, *hedonic-utilitarian scale* (HED/UT), that comprises ten subscales:

- five assessing hedonic aspects of products: Not fun/fun, Dull/exciting, Not delightful/delightful, Not thrilling/thrilling, Enjoyable/unenjoyable
- and five assessing products' utilitarian aspects: Effective/ineffective, Helpful/unhelpful, Functional/not functional, Practical/impractical.

Although this conceptualisation is very similar to his model of user experience with interactive products, Hassenzahl notes in (2007) that "hedonic" in this literature (specifically, he refers to Batra and Ahtola 1990) differs slightly: while consumer research sees "aesthetics, affect and pleasantness per se" behind the term, in his model, he understands "hedonics as the suggested fulfilment of be-goals" as explained in the previous sections.

4. Mobile platforms: the case of Android and iOS

In this chapter, I dive into the very two platforms in question of this thesis: Android and iOS. I look at their history and impact, but most of all explain their key characteristics and philosophy. Before that, I lay down general key terms relevant for this topic: operating systems (OS), platforms and ecosystems. "Android" and "iOS" can be related to all these terms, but it needs to be explained what the semantic difference is.

4.1 Mobile operating systems, platforms and ecosystems

4.1.1 Mobile operating systems

An operating system (OS) is a term from computer science for a set of programs that controls and supervises computer hardware and software and provides an interface between a computer and a user (Bidgoli and Prestage 2003). An ancestor of modern operating systems is considered to be Honeywell Multics from 1969, that introduced some of their important concepts such as processes, device independence or a high-level language shell, based on which perhaps the most influential operating system of all times, UNIX, was developed (Lien 2005). On desktop computers, most contemporarily wide-spread operating system is Microsoft Windows[7] (Microsoft n.d.) with almost 73 % market share in June 2021 (Liu 2021).

By *mobile OS,* we usually mean an operating system running on a mobile phone (a smartphone) and Android and iOS are dominant examples of them (Hamed, Dara, and Kremer 2017). Apple's iOS evolved from its earlier operating system, Darwin, that was based on UNIX, and is being used exclusively on the brand's iPhones and iPads[8] (Apple n.d.). Android is based on Linux, an open source[9] operating system by

[7] https://www.microsoft.com/en-us/windows
[8] For the iPad, the iOS was rebranded to iPadOS (https://www.apple.com/ipados/ipados-14/), therefore in this thesis, I use "iOS and iPhone" interchangeably sometimes.
[9] Open source is free redistributable and modifiable software with publicly accessible source code. (Open Source Initiative 2007)

Linus Torvalds, that was inspired by UNIX[10] (Novac et al. 2017), so architecturally, it shares some similarities with iOS; and is installed on many different smartphones (and other devices) of many different brands. In narrower understanding, they are exactly the software that enables users to interact with the hardware of their phones – in their own ways.

Apart from Android and iOS, popular mobile operating systems in the last two decades were e.g. Symbian OS, Windows Phone (originally Windows Mobile) or BlackBerry OS. This history will be discussed in 4.2.

4.1.2 Platforms

Platforms are quite a broad term (much broader than operating systems), that is gaining growing scholarly interest in the past two decades and is being studied from many different perspectives. The "founding fathers" of the research field of platform studies, Ian Bogost and Nick Montfort, understand platform to be "a computing system of any sort upon which further computing development can be done". The authors explain that platforms can be both purely hardware or software (that can run on different hardware platforms), but can also be a combination of the two. They also acknowledge Sun Microsystems's definition of platform as "the hardware or software environment in which a program runs" (1995 as cited in Bogost and Montfort 2009) and Andreessen's: "a system that can be reprogrammed and therefore customized by outside developers—users—and in that way, adapted to countless needs and niches that the platform's original developers could not have possibly contemplated, much less had time to accommodate" (2007 as cited in Bogost and Montfort 2009). They also argue that often, platforms contain other platforms "just as McLuhan's notion of a medium contains other media" (Bogost and Montfort 2009)[11].

Platforms are also an important element of Benjamin Bratton's concept of *Stack*, who defines a platform as "a standards-based technical-economic system that simultaneously distributes interfaces through their remote coordination and centralizes their integrated control through that same coordination" (Bratton 2015, 42). Alternatively, it can be defined as "a foundation technology or set of components

[10] Sometimes Linux is called "UNIX-like", as it is very similar, only cannot be called UNIX directly as that is a licensed name. (Estes 2018)

[11] Authors do not cite, but I presume the authors refer to McLuhan's claim that "the 'content' of any medium is always another medium" in his influential article "The Medium is the Message" (McLuhan 1964, 646).

used beyond a single firm and that brings multiple parties together for a common purpose or to solve a common problem" (Gawer and Cusumano 2002 as cited in Jansen and Cusumano, 2012).

In his influential book *Platform Capitalism,* Nick Srnicek explains platforms as "digital infrastructures that enable two or more groups to interact". In his view, platforms act as intermediaries bringing together all kinds of different groups of users, such as customers, service providers, or even physical objects (Internet of Things). Platforms also allow users to build their own products, services and marketplaces on top of themselves; Apple's App Store and associated SDK being one example, other examples including Google search engine, allowing advertisers target people searching for information, or Uber, connecting drivers and passengers. Srnicek highlights that the platforms' positioning both *between* users and as the *ground* upon which their activities occur is the key to platforms' advantage over traditional business models when it comes to data: this gives their providers a privileged access to record them. Google, for example, has vast amounts of information on people's desires based on their searches; Uber collects traffic data and learns about activities of drivers and riders; Facebook records and learns from various intimate social interactions (Srnicek 2017, 30). Also Van Dijck et al. (2018, 9) assert that platforms are "fueled by data, automated and organized through algorithms and interfaces, formalized through ownership relations driven by business models, and governed through user agreements". The authors argue that along with money and attention, data and user valuation are often used as currencies in the context of platforms, drawing platform services being "free" a myth: on many platforms, services are being traded for personal information.

Second essential characteristic of platforms (not just) Srnicek mentions are *network effects* – the value of the network (platform) depends on other users; the more users a platform has, the more valuable it becomes for everyone else (Srnicek 2017, 30, Eisenmann 2008). Platforms often consciously leverage the network effects – for example, while it is possible to make a phone call between an Android phone and an iPhone just fine, Apple boosts the network effects for iPhone users e.g. through enhanced features of iMessage available to them exclusively (McIntyre, Srinivasan, and Chintakananda 2021). iMessage's (negative) network effects even cause something I dare to call *a green bubble phenomenon* – in the Messaging app on iPhone, messages from users using non-iPhone devices appear as green, which is often being

considered somewhat "shameful", sometimes these users are being left out of chats, while at the same time this stops some users from switching from iPhone (Cornell University 2018, Carman 2019, Leskin 2019).

The third pillar of platforms for Srnicek is the tactic of cross-subsidisation: one arm of a firm offers goods or services for a reduced price or even for free, while other bumps the prices up in order to compensate for the losses. Srnicek provides an example of Google offering – a free email service to attract new users while earning money through advertising. This can be extended to the Android operating system as well: Srnicek acknowledges that using the tactic of cross-subsidisation by offering Android for free to hardware makers, Google managed to undercut Apple's enclosed system and occupy the mobile OS market with more than 80 per cent in 2017 (Srnicek 2017, 60).[12]

Finally, Srnicek remarks that "platforms are also designed in a way that makes them attractive to its varied users" and while "often presenting themselves as empty spaces for others to interact on, they in fact embody a politics" – all associated platform's rules, from product and service development to marketplace interactions, are set by the platform's provider (Srnicek 2017, 31). Platforms' ability to "take on a powerful institutional role, solidifying economies and cultures in their image over time" was also observed by Bratton, who even goes as far as claiming that as platforms can "be based on the global distribution of Interfaces and Users (...), platforms resemble markets" and as "their programmed coordination of that distribution reinforces their governance of the interactions that are exchanged and capitalized through them (...), platforms resemble states" (Bratton 2015, 41).

By *mobile platforms,* platforms built on top and around mobile operating systems such as Android and iOS are meant; and the two names apply to the platforms as well (and in this thesis, when these names are used, the whole platforms are meant). They are platforms on top of which third parties can develop their own applications (apps) and through which users can purchase them or download them for free and use them (specifically through respective app stores). They are *multi-sided platforms* as defined by Evans (2003):

[12] Here I can offer another example of "paid compensation" to the free product: Google stopped offering unlimited free storage for photos in Google Photos app, which was another free caveat for Android users, starting from June 2021, limiting the free storage to 15 GB and charging for more (Google 2020).

1. they have at least two distinct types of customers (e.g. users, handset makers, network operators, advertisers, chip makers, and application developers),
2. there are externalities arising from the interconnection among different customer types (users benefit from developers making apps; developers benefit from attracting more users), and
3. intermediary is required to internalize the externalities flowing from one side of the platform to the other – the intermediaries here are the respective operating systems (Campbell-Kelly et al. 2015).

Both companies, Apple and Google, facilitate the platforms (app development) through software development kits (SDKs) and application programming interfaces (APIs). Initially, the iPhone launched in 2007 as a closed smartphone that supported only pre-installed apps. The "iPhone platform" in the true sense of opening itself to third-party developers was launched in 2008. Google opened its app store (Android Marketplace) only shortly after that as well (Sørensen, de Reuver, and Basole 2015); it did not come with the first release of an Android phone either. From "platform politics perspective", they differ already by *openness*. Apple only allows users to use apps that were downloaded through the App Store, and for an app to be published there, it must go through a rigorous review process.[13] In contrast, Android is licensed as open source and does not restrict where the apps are installed from. Apart from the official Play Store, there are other alternative app stores for Android as well and it is also possible to install apps manually. Nevertheless, Google imposes some kind of control by making some of the API access dependent upon Google Play services subscription (Parker, Van Alstyne, and Jiang 2016).

4.1.3 Ecosystems

The term *business ecosystem* was coined by James F. Moore in the Harvard Business Review article *Predators and Prey: A New Ecology of Competition* for "an economic community supported by a foundation of interacting organizations and individuals —the organisms of the business world" (Moore 1993).

According to Pidun, Reeves, and Schüssler (2019), a *business ecosystem* is "a dynamic group of largely independent economic players that create products or services that together constitute a coherent solution", which "can be characterized by a specific

[13] It is possible to "sideload" an app to an iPhone, but it requires an unofficial and partly risky process called "jailbreaking" (Cooke 2020).

value proposition (the desired solution) and by a clearly defined, albeit changing, group of actors with different roles (such as producer, supplier, orchestrator, complementor)". Similarly, Adner (2016) defines *business ecosystems* by "the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize."

Examples of ecosystems are various marketplaces connecting producers of products or services with potential customers, such as Amazon and eBay in retail or in, relevantly to this thesis, "IT systems that integrate components and applications from multiple providers on a common platform" such as Windows, Android or iOS (Pidun et al. 2019). Pidun et al. (2019) identify four major characteristics of business ecosystems:

1) *Modularity* – components of ecosystems are designed independently but work as a whole and customers can often select among them (a good example being independently developed apps that do not come preinstalled on smartphones and are installed by users)
2) *Customization* – components in ecosystems are made so they are compatible with the rest of the ecosystem (for example apps are developed for a specific platform using its compatible technologies, programming languages, APIs etc.)
3) *Multilateralism* – ecosystems are not a set of bilateral relationships; those are mutually interconnected (for example a success of a phone maker-developer relationship can be compromised by a failure of phone maker-carrier relationship)
4) *Coordination* – there is no full hierarchical control over ecosystems, but some kind of coordination is achieved through e.g. shared standards, rules and processes (such as platforms APIs).

More specifically, *a software ecosystem (SECO)* is "a set of actors functioning as a unit and interacting with a shared market for software and services, together with the relationships among them. These relationships are frequently underpinned by a common technological platform or market and operate through the exchange of information, resources and artifacts." SECOs are usually facilitated by one or more parties, typically the companies that produce SECOs' underlying technologies – the software platforms (Jansen and Cusumano 2012). De Lima Fontao, Pereira dos

Santos, and Dias-Neto (2015) further specify that a *mobile software ecosystem (MSECO)* is a SECO that comprises of a (mobile) platform, users (downloading apps and creating interactions within MSECO), both individual and organisational developers, communities (of users, developers and experts), applications, app stores and evangelists (experts aiming to expand MSECOs and recruiting new developers).

Both SECOs and MSECOs have links to the more general term of *a digital ecosystem*, "…a self-organizing, scalable and sustainable system composed of heterogeneous digital entities and their interrelations focusing on interactions among entities to increase system utility, gain benefits, and promote information sharing, inner and inter cooperation and system innovation" (Li, Badr, and Biennier 2012, 119). Sussan and Acs (2017) use a biological metaphor to explain the term: they emphasise that biological ecosystems, unlike "just systems", consist of both living and non-living components "linked together through nutrient cycles and energy flows" and that they are "robust, scalable architectures that can automatically solve complex dynamic problems" (Li, Badr, and Biennier 2012). In Sussan and Acs' view, digital technologies can be seen as the digital ecosystem's non-living component and the people using them as the living one; with their mutual interactions and changes resulting from them forming the behaviour of the ecosystem. The authors recognise Apple and Google for succeeding in managing the surrounding ecosystems of their platforms, iOS and Android; and that being the reason behind their success: it was the third-party developers and their apps which were crucial for attracting users for the platforms. In contrast, Windows or BlackBerry mobile platforms failed at managing their platforms' ecosystems and that is why they failed ultimately (Sussan and Acs 2017).

As was already hinted, Apple and Google use different strategies to govern their ecosystems. The iOS ecosystem is often said to be closed, with Apple imposing a high level of control over app development on a limited series of devices with the objective of ensuring high quality user experience. Google, on the other hand, offers Android as open source, allowing different manufacturers to adopt it, modify and develop it to their liking. As a result, Android comes in many different flavours on many kinds of hardware, making its ecosystem and its governance much more complex (Kapoor and Agarwal 2017).

Srnicek (2017, 60) observes that ecosystems neither merge companies directly competing together, neither they merge companies within the same supply chain, and neither they merge companies supplying similar or complementary products. They are a set of "rhizomatic" connections made strategically by the firms, so they occupy the key positions in order to sustain access to data collected within them. This applies to the aforementioned Google example: by offering Android for free and dominating the market, it achieved an expedient position to collect data from users to fuel its advertising business. Ultimately in fact, according to Kenney and Pon (2011), Google does not care whether a device runs Android on iOS, what it cares about is that as many devices as possible show its ads, Android being one of the vehicles driving it towards this goal.

From a meta perspective in a book of the same name, Van Dijck et al. present the concept of a *platform society*, a term referring to "a society in which social and economic traffic is increasingly channeled by an (overwhelmingly corporate) global online *platform ecosystem* that is driven by algorithms and fueled by data" (2018, 4). By the platform ecosystem, the authors understand an assemblage of interconnected platforms and their ecosystems (a kind of an "ecosystem of ecosystems"). The Western platform ecosystem consists of the "Big Five": Alphabet (Google's parent company; with its many Google services such as GMail, GDrive or GPay, Android and many more), Apple (with App and Apple Store, its device family, services such as TV+, iTunes, …), Facebook (and its social media including Messenger, WhatsApp and Instagram, but also e.g. Oculus or login API), Amazon (its stores but also cloud services – AWS) and Microsoft (Windows, Office, …). "Big Five's" services are *infrastructural* to the ecosystem, but are complemented by *sectoral platforms,* designed to integrate with the infrastructural services not only in the market, but various private and public sectors as well. The sectoral platforms are, however, dependent on the infrastructural ones. For example, Spotify depends on Google Cloud services and Netflix on AWS, many platforms such as AirBnB need to embed Google's or Apple's map interfaces for functioning and almost all platforms depend on their apps being published in App Store or Google Play (Van Dijck et al. 2015, 15). The lesson is that platforms cannot be seen apart only, but also as mutually interdependent – as an ecosystem on its own.

4.2 A brief history of (smart)phones

In the following section, I give a brief overview of the development of the contemporary smartphone market. I name the most influential platforms and devices over the last two decades, concluding with the failure of Windows Phone. I dedicate separate sections to in-depth investigation of Android and iOS platforms.

4.2.1 90s: the dawn of mobile telephony

It is probably needless to present Graham Bells' invention here, but when it comes to devices that combined telephony and computing, the first concepts emerged in the 1970s from researchers such as Theodore G. Paraskevakos. In the 1990s, the first (rather bulky) prototypes of multifunctional phones from firms such as Motorola or Nokia emerged. These devices operated on low data-rate networks at speeds less than 100 kbps, ran only a few proprietary applications and received input from numeric keyboards. Nevertheless, they paved the way for more advanced integrated devices (Islam and Wang 2014, Yu and Feng 2019). The second half of the 1990s, also importantly, brought new single-function devices such as various media players, digital cameras or GPS navigation systems. These soon started being integrated into phones as well, but those were called feature phones rather than smartphones in the beginning (Campbell-Kelly et al. 2015).

4.2.2 The first "smartphone"

According to Campbell-Kelly et al. (2015), the term *smartphone* came into use in 1997 for practically universal handheld computers with the capability of making phone calls. What distinguished them from ordinary mobile feature phones was the ability to run software that was not proprietary and extended the phones' default functionalities, which were later started being called apps. The first phone that was marketed as a smartphone was the Ericsson R380 in 2000, but this device was far from what we imagine to be a smartphone, e.g. it did not have a camera, music player nor coloured display (Yu and Feng 2019).

4.2.3 Personal digital assistants (PDAs)

Not "phone functionality-wise" closer to smartphones and presumably partly their predecessors were what used to be called PDAs (Personal Digital Assistants). The first PDA was Apple's Newton MessagePad (the credit for coining the term goes to Apple), but it was not very successful. One of its "killer features" was supposed to be a handwriting recognition, ultimately though, that was one of the things that killed the product as it did not work very well, and its mistakes became a target of many jokes. On top of that, Steve Jobs was not very fond of the device, either, and he stopped the production when he returned to leading Apple. Nevertheless, Newton pioneered the idea of taking computers out of the office and was also one of the first devices to use ARM processors, the same architecture that powers contemporary smartphones[14] (Honan 2013). In some way, shutting down Newton allowed Jobs to "get it right" much later in 2007 with the iPhone. As he reminisces in his biography:

"If Apple had been in a less precarious situation, I would have drilled down myself to figure out how to make it work. I didn't trust the people running it. My gut was that there was some really good technology, but it was fucked up by mismanagement. By shutting it down, I freed up some good engineers who could work on new mobile devices. And eventually we got it right when we moved on to iPhones and the iPad." (Isaacson 2011, 339).

Quite successful and well-known were PDAs by Palm Computing, founded in 1992 by Jeff Hawkins. In 1996, it introduced the PalmPilot 1000. The device had (in contemporary view only) 128k of memory and a monochrome touchscreen display, and its main purpose was to replace paper to its owner; it did not have the ambition to replace a computer in any way. The device only had four proprietary "apps" – calendar, addresses, to-do list and memos. Nonetheless, there were more than a million units sold in the first 18 months after the introduction. Palm PDAs became "smart" in 2001, when they got an operating system called Palm OS. (Campbell-Kelly et al. 2015).

The success of PalmPilot 1000 started the boom of other PDAs. Microsoft did not stay behind and in 1994, it launched a project codenamed "Pegasus" to develop its own mobile operating system Windows CE. In 1996, Microsoft closed deals with Casio, Compaq, HP, LG Electronics (for Hitachi), NEC, and Philips to bring their own

[14] In fact, thanks to its power efficiency and computational power, also computers, such as the one I am using to write this thesis – a Macbook Pro with Apple's own ARM processor M1.

Windows-based PDAs to market. These devices were not very successful, though. In late 1997, Palm ruled two thirds of the market and the Windows-based PDAs were considerably behind. The first smartphone running Windows CE (2.0) was only released in 2002 (Campbell-Kelly et al. 2015).

4.2.4 Symbian and BlackBerry: form PDAs to smartphones

Other two important actors in mobile OS history were indisputably Symbian and BlackBerry.

Symbian evolved from an operating system called Epoc that was developed by a British company Psion. Psion released several Epoc-based handheld computers in 1997 and also established a partnership with the Finnish conglomerate Nokia, which used Epoc for their Communicator series, devices that combined PDAs and mobile phones. However, although Epoc was generally considered to be superior to Windows CE, Psion did not want to engage in a battle with a much larger player and saw a chance on a different battleground: mobile phones market. Therefore, together with Nokia, Ericsson and Motorola, it founded Symbian Ltd. to make an operating system dedicated to mobile phones. The first smartphone running Symbian, Nokia 9210 Communicator, was released in 2001.

BlackBerry phones and their operating system were developed by a firm called Research in Motion (RIM) that was founded already in 1984 originally as an electronics and computer-science consulting business. In 1999, RIM gained an international reputation with their first BlackBerry, a strongly business-focused device that gave business executives access to their corporate emails wirelessly from anywhere, anytime (Islam and Wang 2014, Campbell-Kelly et al. 2015). 2002's BlackBerry 5810 was, according to Ahmad (2011), the "the first truly successful smartphone" with enterprise email support, text messaging and browser.

In 2006, the mobile OS market was dominated by Symbian with 60% share, second place was held by PalmOS with 12.72 %, third was Windows Mobile with 9.25 % and BlackBerry sat at fourth place with 8 % (Friedman 2019). This market was about to be shaken in 2007 by Apple "getting it right": the introduction of the iPhone.

4.2.5 The iPhone revolution

Contrary to popular belief, credit for "inventing and designing the iPhone" does not go to Steve Jobs nor sir Jony Ive directly; its journey was started already in the early 2000s by a small group of Apple engineers and one industrial designer. These people, including an HCI wizard Joshua Strickon, former Newton lead Greg Christie or "the Lennon and McCartney of user interface design" Imran Chaudhri and Bas Ording, believed that traditional mouse and keyboard were obsolete and in secret, without Jobs' knowledge, started experimenting with unconventional interactions, multi-touch technology in particular. Eventually, they created the first prototype of a device that eventually evolved into the iPhone (Merchant 2018).

Undeniably though, Jobs as Apple's CEO and visionary was the person who "gave the iPhone to the world". At the annual Macworld Conference and Expo in January 2007, he announced:

"Every once in a while a revolutionary product comes along that changes everything. Today, we're introducing three revolutionary products of this class. The first one is a widescreen iPod with touch controls. The second is a revolutionary mobile phone. And the third is a breakthrough Internet communications device […]. These are not three separate devices, this is one device, and we are calling it iPhone. Today Apple is going to reinvent the phone." (Giachetti 2017, 23)

The way Apple "thought different" about the iPhone was that unlike other competitors such as Windows Mobile, Palm OS, Symbian or BlackBerry, it did not focus on the mere technical specifications and features "on paper". Instead, the iPhone focused on user experience: speed, design and overall consistency, and making several key features such as browser, maps, music player (iTunes and its ecosystem) and the touch interface including touch keyboard better than the competition (Dutta et al. 2017). iPhone's overall product design was revolutionary for the appealing, clean form factor – "a rectangle with a screen" without any physical keyboard or styluses[15] that were common for BlackBerries, Motorolas, Nokias and Palms. Furthermore, on the iPhone, Apple took existing, but not commonly used technology of multi-touch to perfection and to where we know it today: it introduced

[15] It is also Jobs' memorable quote from the iPhone keynote: "Who wants a stylus? You have to get 'em, put 'em away, you lose 'em. Yuck! Nobody wants a stylus. So let's not use a stylus." In 2015, 4 years after his death, Apple started selling styluses called Pencils, but they work only with Apple's tablet devices iPads and not with iPhones (Goldman 2015).

interactions such as zooming and pinching which made viewing e.g. web content, photos or maps more natural and enjoyable (Giachetti 2017, 26).

This approach was indeed successful: the next year, in 2008, Apple sold nearly 14 million iPhones as practically a newcomer to the industry compared to 60 million well-established Nokias the same year. Giachetti argues that iPhone's success is explainable by Apple implementing so-called "blue ocean strategy" (Chan Kim and Mauborgne 2005): instead of competing within the boundaries of market's status quo, it essentially created a new market with no direct competition. Giachetti identifies two key ways of achieving this: first, Apple *looked across substitute industries* – not just at the mobile industry, but also at the portable music and the Internet communication devices industries – and merged these device categories to one device. Second, although Apple created iPhone to be a part of its own device ecosystem equipped with an OS (base) found in its other products, it *looked across complementary product and service offerings* as well and managed to attract a wide ecosystem of app developers who made App Store (opened in 2008) another "selling point" of the whole platform with the rich offering of different apps that extended the iPhone's default functionality (Giachetti 2017). Similarly, Christensen, Raynor, and McDonald (2015) explain the initial success of the iPhone by its overall product superiority and the subsequent success by *disruption,* not in the field of smartphones, however, but among laptops. According to authors, "iPhone created a new market for internet access and eventually was able to challenge laptops as mainstream users' device of choice for going online".

4.2.6 Rise of Android

iPhone's greatest competition, Android, has its origins in 2003. In an interview with Bloomberg Businessweek that year, Andy Rubin, its co-founder and "father", highlighted "a tremendous potential in developing smarter mobile devices that are more aware of its owner's location and preferences", saying that "if people are smart, that information starts getting aggregated into consumer products" (Elgin 2011).

Only two months later, in October 2003, Android was founded by Rich Miner, Nick Sears, Chris White, and Andy Rubin. In his speech at an economic summit in Tokyo in 2013, Rubin admitted that the operating system was originally developed for digital cameras with the aim to bring cloud storage to these devices and showed

slides he was still using for pitching that idea to investors in 2004. But the team soon realised the digital camera market was not big enough, noticed the potential in smartphones and made necessary changes in the code. From the beginning, the team offered their software for free and saw the commercial potential in becoming a platform for selling other services and products built on top. For that plan, though, Android Inc. needed a stronger partner. That became a reality in 2005 when Android was bought by Google, hiring Andy Rubin as the vice president of mobile and digital content.

In 2007, when Steve Jobs announced the first iPhone, Google was still working on Android in secret, but in November 2007, it slowly started revealing the aim to compete with Apple on the smartphone battlefield – Android Open Source Project (AOSP) was released and Open Handset Alliance, a group of hardware, software and telecom companies such as Google, HTC, Motorola or T-Mobile with an aim to develop Android to be used as their flagship operating system was formed (Rutnik 2020; Krajci and Cummings 2013; Gilski and Stefański 2015). The greatest promise of Android was to provide a unified, universal platform for app development reducing the need to reimplement apps for different devices and other platforms. Unlike proprietary iOS iPhones, Android was offered as open source under the Apache license (Krajci and Cummings 2013).

The first Android-powered phone was T-Mobile G1 (Gozalvez 2008) also known as HTC Dream (Krajci and Cummings 2013), but similarly to the first release of iPhone, it only came with pre-installed apps designed to be used with Google services such as e-mail, maps or calendar. In September 2008, the phone got a software update from beta to production version of Android Astro 1.0, that brought Android Marketplace – ability to download apps (today called Google Play) (Krajci and Cummings 2013).

Android was the first real threat to the iPhone. Being open-source, Android could be used by any manufacturer and adapted to their preferred flavours and in 2010, manufacturers such HTC, Samsung or LG each had at least one Android phone offering. Android's decisive advantage was this variety that customers did not have with the iPhone. Additionally, in the USA, Android phones were available from main service providers Sprint, Verizon, T-Mobile and AT&T, whereas iPhones were only available and could be used with ATandT. In Q3 2010 in North America, 200,000

Android smartphones were sold daily, compared to 80,000 iPhones. As a platform, it surpassed the iOS and BlackBerry in North America in Q3 2010 with 39% over 27% and 28% market share: crunching Symbian down to 3% and Microsoft's Windows Mobile only to 2%. (Butler 2011).

4.2.7 Windows Phone: the Microsoft-Nokia competition

Seeing its rapid decline in the field of mobile devices, Microsoft attempted to revive mobile Windows through Windows Phone, a complete redesign of the system, which was announced in 2010 (Novac et al. 2017). Same year, the former head of the Microsoft Business Division, Stephen Elop, was appointed as the new CEO of Nokia and soon closed a strategic partnership with Microsoft to "create a new global mobile ecosystem". In the spirit of this partnership, Nokia decided to replace Symbian for Windows Phone as the operating system of its phones for (at least) three years (Lamberg et al. 2019). Windows Phone was not exclusive to Nokias, although those were its flagship phones, there were also Windows phones by Samsung, HTC or Dell, putting great emphasis on novel, iOS- and Android- unlike design (Savov 2017).

Eventually, Microsoft acquired Nokia in 2013 and for a while, Nokia phones were branded as Microsoft phones running Windows (Lamberg et al. 2019). In 2015, Windows Phone evolved to Windows 10 in Microsoft's attempt to provide as much unified experience between phones and computers as possible (Novac et al. 2017).

Nevertheless, although having been the only real competition to Android and iOS since their rise, Windows on mobile phones did not succeed; in 2015, five years after its launch, it had only 2.5% market share and in 2017, Microsoft officially announced its end, despite its originality and ability to run smoothly even on basic hardware (Savov 2017). The reason behind the failure was Microsoft's inability to attract app developers and build a sufficient ecosystem, which would cause indirect network effects and gain a critical mass of users (Sussan and Acs 2017, The Netherlands Authority for Consumers and Markets 2019); the platform simply did not have enough apps (Novac et al. 2017), including e.g. Instagram (Savov 2017).

4.2.8 The dark side of a smartphone

Sadly, the smartphone revolution comes at a cost. Merchant (2018) describes that around 15000 people, including several thousands of children, work at Cerro Rico, a

Bolivian mine where the tin used in iPhones and also devices of other brands is sourced from. Nicknamed "The Mountain That Eats Men", Cerro Rico is infamous for brutal working conditions, and fatalities are sadly common. Some of the total of more than 60 different metals average smartphones contain are being mined in Congo, often utilising child and/or slave labour.

The assemblage of the smartphone parts is sometimes stained by blood, too: DiGangi and Hang (2018) report that half of Samsung phones are made in Vietnam by workers who are forced to stand 70–80 hours a week, causing severe pain in their bones, joints, and legs, dizziness and collapses; in a noise that exceeds legal limits. More horrifyingly, most of these workers are women in their twenties, to whom this environment often causes miscarriages. In 2016, Samsung was even accused of poisoning its own workers. Foxconn, a Chinese electronics manufacturer for an array of companies including Apple, HP, Dell or Huawei, is often connected to horrible working conditions as well; in 2018 for example, it was accused of forcing teenage workers to work up to 11 hours a day to deliver the iPhone X (the company claimed it was voluntary, though). Disturbingly, Cooper (2018) concludes that in practice, it is virtually impossible to make a 100% ethical smartphone purchase decision neither in the iPhone or Android world.

4.3 Android versus iOS

In the following section, I provide a look at the present by a brief comparative analysis of the two platforms central to this thesis. Note that in some parts, such as in comparing current versions of the systems or their UIs and features, apart from literature review, I use in HCI accepted autoetnographical approach (Lucero et al. 2019)[16] and describe the systems based on my hands-on experience with an iPhone 12 Mini updated to the newest iOS, a Samsung S21 running the latest One UI based on Android 11 and a Nokia 3.2 running the latest stock Android 11; together with my 10 years of previous experience with many other Android smartphones and iPhones. In form and method, from scholarly work I take some inspiration from Lazareska and Jakimovski (2017) and Sahani (2017), but I hope to provide information up to date in July 2021 (hence it is not possible to cite some of the information from scholarly work).

[16] "Et al." here includes Hassenzahl.

4.3.1 Market share

In June 2021, Android had a 72.84% and iOS 26.34% market share, leaving other mobile platforms that emerged in the past two decades almost non-existent (O'Dea 2021). Looking at the worldwide smartphone vendor market share in the same period, there is almost a tie on the first two positions: Samsung is narrowly winning with 27.48% and Apple comes second with 26.35%[17]. The two giants are followed by Xiaomi with 10.8%, Huawei with 8.66%, Oppo with 5.67% and other brands with shares below 5% including (in share-wise descending order) Vivo, Realme and LG (StatCounter 2021c). With the obvious exception of Apple, all the named vendors produce smartphones running Android[18], which explains the correlation of the platform vs. vendor market share statistics.

Nevertheless, it should be noted that none of the aforementioned Android smartphone vendors use so-called *stock Android*[19], i.e. Android as designed, developed and intended by Google (Rutnik 2019). Vast majority of these vendors use proprietary *flavours*[20] of the system – their own custom variants of Android with different UI designs and set of functionalities which differentiate their smartphones from competition; AOSP serving as the base for this extension and modification (Rutnik 2019, Cotroneo, Iannillo, and Natella 2019). The stock Android can be found installed and regularly updated by Google directly on Google's own smartphone line, Pixels, and additionally on smartphones participating in Android One programme[21] (Google n.d.) by vendors such as HMD Global (Nokia), HTC or Motorola. From the statistics above, however, it is apparent that stock Android is relatively rare as these brands possess only marginary market share – in North America, the strongest stock Android smartphone vendor is Google with only 2.11 % and in Europe, it is Motorola with even just 1.65 % (StatCounter 2021c). This needs to be considered when comparing the user experience with the smartphones: while

[17] I source this statistic from a different provider to the OS market share, hence the slight difference of 26.34% share of iOS among mobile OSes vs 26.35% of Apple in the smartphone market – the 1:1 correlation is still very clear, though.
[18] That is, nevertheless, about to change, as Huawei will soon ship its smartphones with its own operating system, HarmonyOS, which it developed after the trade ban imposed by Donald Trump caused that Huawei lost access to some Google apps, most notably Android's main app store – Google Play, which severely limited Android functionalities on its phones (Kleinman 2021).
[19] Sometimes also called "vanilla" or "pure" Android (Rutnik 2019).
[20] Sometimes the term of "skin" is being used, such as in Rutnik (2019), but I personally find this term not descriptive enough, because the various vendor Android flavours differ from stock Android more than just by the mere user interface.
[21] https://www.android.com/one/

iPhones perform very consistent user experience across all iPhones as all run the "same iOS", for example, Samsung and Xiaomi smartphones have many differences already in the UI as they use One UI[22] (Samsung n.d.) and MIUI[23] (Xiaomi n.d.) respectively.

4.3.2 Version distribution and updates

The fragmentation of Android in terms of various flavours has one substantially negative effect on the updates of the system: although Google makes improvements and updates to Android regularly, the vendors need to adapt their system customisations to these changes, leading to late (and in fact often none) adoptions of the core Android updates (Mahmoudi and Nadi 2018). To illustrate, in June 2021, only 17.5 % of Android smartphones worldwide ran latest release version 11 released in September 2020, similar number of devices ran two generations older version 9 from 2018 (17.03 %) and most common was version 10 with 35.91 % (StatCounter 2021b) from 2019.

In contrast, 44.83 % iPhones ran the latest update of iOS 14.6, 5.56 % iOS 14.5 and 30.05 % ran iOS 14.4 in June 2021 – making up for more than 80 % of iPhones running iOS updates released this year (in 2021), and those being increment updates of an iOS version released in late 2020 (StatCounter 2021c). Apple is considered to have an edge in this domain, as unlike many Android manufacturers to their phones, it provides iOS updates to up to six years old iPhones[24], and all eligible iPhones get the updates at the same time (Cunningham 2019).

4.3.3 Hardware options and prices

Android smartphones come in many low-end to high-end hardware configurations and form factor designs in a wide-spread price range: for example now in July 2021, an electronics retailer Alza.co.uk sells an Android handset as cheap as 35 GBP (Alcatel U3) and as expensive as 1399 GBP (Motorola Razr 5G), selling 211 different Android smartphones in total[25] (Alza n.d.). In contrasts, there are currently only 5 available models of iPhones (12 Pro, 12, SE, 11, XR) officially available from Apple

[22] https://www.samsung.com/cz/apps/one-ui/
[23] https://en.miui.com/
[24] For example, 6 years old iPhone 6 and 6S are still expected to receive an upcoming version update to iOS 15 in fall 2021 (Johnson 2021).
[25] https://www.alza.co.uk/mobile-phones/18843445.htm when filtered by Software > Android.

UK; cheapest starting at 399 GBP and most expensive one at 999 GBP[26] (Apple 2019a). In fact, there were only 29 different iPhone models in their whole history that started in 2007 (Carey 2021).

There are Android handsets that "win" over iPhones in some strictly hardware aspects. For example, the Samsung's flagship Galaxy S21 Ultra, compared to iPhone flagship 12 Pro, has a larger capacity of battery (5000 mAh vs 3678 mAh), higher display refresh rate (120Hz vs 60Hz), supports faster charging (25W vs 20W) or has higher-resolution display (1440 x 3200 vs 1284 x 2778 in pixels) at a similar price level. At the same time, Android offers a selection of low-end devices for tight budgets or undemanding users, and also a variety of mid-end devices with internals close to substantially more expensive devices offering fast experience. Additionally, some hardware features are not available in the iPhone line-up in contrast to some Android handsets, such as USB-C type charger or female headphone jack connector; and apart from the iPhone SE 2020, current higher-end iPhones do not have a fingerprint reader as a biometric security element, which has been inconvenient during the world pandemic outbreak in 2020 due the need to wear masks. There are also Android smartphones in more nonstandard form factors, such as foldable devices (Anderson 2021, Martin 2021, Cunningham 2021).

However, sole hardware specifications do not mean everything to user experience: apart from Pixels and with Android being an open-source OS which is being adapted by manufacturers, Google does not have control over hardware-software optimisation of most devices running it; while Apple designs its own hardware to "work hand-in-glove" with the iOS and hence iPhones are generally more reliably well-optimised (Martin 2021). Moreover, as discussed in this thesis, user experience does not comprise pragmatic, such as hardware, aspects only.

4.3.4 Software, controls and features

It is out of scope and intention of this thesis to compare user interfaces and affordances of Android and iOS due to the variety of Android flavours. Nevertheless, the following can be generalised (also because flavours usually do not change the core UI logic of Android).

[26] https://www.apple.com/uk/iphone/

Nowadays, most smartphones of both platforms offer a similar set of software features out-of-the-box: from the most basic functionalities such as phone calls, messages, contacts, calendars, e-mails, browsers, weather apps etc., to more advanced features such as voice assistants – Google Assistant on Android and Siri on iOS; Google Assistant being in general a bit more advanced in some aspects than its iOS counterpart (Berdasco et al. 2019). Importantly, over 80 % of top-rated apps are available on both platforms; although some (same) apps are priced differently on each platform with Android having more free apps, but those paid, on average, slightly more expensive than their iOS counterparts (Ali, Joorabchi, and Mesbah 2017).

Also the logic of the systems is similar with some exceptions: both across Android flavours and on iPhones, there is a *lock screen* upon waking / picking the phone up with time, media controls, some quick actions not requiring unlocking the phone and notifications; and *home screens* with apps' *shortcuts* (that can be placed in *folders*) and *widgets*, simplified views of some applications intended for home screens[27]. Slight difference is that next to home screens where icons and widgets can be placed freely anywhere on the grid, Androids have *app drawers* with the list of installed apps; and moreover, users can install special apps called *launchers* that can change the look and feel of the pre-installed ones (Lazareska 2017). Traditionally, there have been the home screens with more predefined layout on iOS containing all apps' shortcuts only, not providing the ability to have some shortcuts on home screens and the complete list in a separate interface, and without the possibility to install an alternative way of launching apps. Only in September 2020, iOS 14 brought *App Gallery*, an interface with a complete list of apps automatically organised to thematic folders, reducing the need to have all app shortcuts on home screens (Gartenberg 2020). All in all though, Android is considered to have a more customisable interface (Lazareska and Jakimovski 2017, Sahani 2017, Martin 2021).

Other examples of slight differences are e.g. that on Android, swiping from the top of the screen shows a unified interface for quick settings and notifications, while on iOS, *Notification Center* and *Control Center* are separated; also the management of notifications itself differs in some respects. A traditional difference is also system-wide *back button* unique to Android that used to be physically present on the

[27] Home screen widgets are fairly new to iOS, though, having been introduced in iOS 14 released in September 2020 (Gartenberg 2020) while on Android, widgets were an integral part of the user interface right from the beginning.

handsets, then moved to be on-screen and in the latest versions can be replaced with a swipe gesture from either side of the screen. On iOS, "going back" is different in both nature and interaction in different parts of apps and the system. The minimalist trend of reducing visual on-screen indicators of possible actions in favour of more icon-only and gesture-based interfaces is common to both platforms. This was observed and criticised by Norman (2015), who said that Apple "has gotten carried away by the slick, minimalist appearance of their products at the expense of ease of use, understandability, and the ability to do complex operations without ever looking at the manual", with the lack of "undo" on iPhones and iPads being an example; and Google for having "caught the same disease". Android at least, according to Norman, still offers more on-screen indicators such as menu icons.

4.3.5 "Apple ecosystem" and "Google ecosystem"?

A bit of a special term in this context is "the Apple ecosystem". Apart from the meaning in line of aforementioned definitions that is used in scholarly work, where it is used more in the context of the business ecosystem or MSECO, i.e. that of Apple, users, app developers and other actors; in media and in non-scholarly circles, the term is being mostly used to denote the family of Apple devices and the synergy and seamless synchronisation between them (Villas-Boas 2016, Myftari 2017). In other words, "Apple ecosystem" stands for the advantages users enjoy if they own multiple Apple devices including Mac, iPad or Watch, such as AirDrop (seamless file sharing between both iOS and Mac devices), iMessage (text message synchronisation), synchronisation of task lists and notes, shared clipboard (Handoff), sharing WiFi connection or simplified connection and switching of Apple's headphones, AirPods. All of these are part of Apple's *vendor lock-in* strategy, as this motivates consumers to buy different new Apple devices, but at the same time, makes it difficult and often also expensive for them to switch to alternatives (Kotapati 2020, Kenney and Pon 2011)[28].

While the strategy of "locking-in" to its devices is logical for Apple, traditionally a device manufacturer, Google as traditionally a service provider, whose revenues rely on advertising and cloud business, does not need to create similar "lock-in stickiness" in between its products (Kenney and Pon 2011). Nevertheless, Android

[28] Allegedly in 2010, Steve Jobs outlined the strategy to "tie all of our products together, so we further lock customers into our ecosystem" in an internal email to Apple's employees as a part of a "holy war against Google" (Reisinger 2014).

users can experience similar "synergies" to some extent as well: Microsoft develops ways to synchronise Android phones with Windows and similarly to iPhones/Macs, users can e.g. synchronise text messages or make or receive phone calls via their PCs (Wen 2020). Eligible devices can even "mirror apps" to PCs so they can be used within Windows' multitasking, e.g. be "alt-tabbed to" (Warren 2020). Moreover, Google has been working on its own response to the "iPhone-Mac synergy" for a while – a closer integration of its own Pixel smartphones and its laptop line Chromebooks (Brown 2018, Duke 2021). Google also competes with Apple in the field of Internet of Things (IoT), building its own smart home ecosystem "native" to Android (Low 2021). All in all, however, closer and more seamless integration of various devices closer to Apple's ecosystem may be seen as an opportunity for Google (Bhutani 2020).

4.3.6 Security and privacy

Based on their study and in line with older research, Garg and Baliyan (2021) suggest that from a security viewpoint, Android is more vulnerable to various security breaches and malware attacks compared to iOS given its increasing market share and open-source nature. Nevertheless, an acclaimed cybersecurity expert and the modern firewall inventor Gil Shwed argues that while Apple makes it harder to attack iPhones, it does not mean they are necessarily "safer"; because at the same time, for its closed nature, there are not as many user options to protect the iPhone compared to Android phones (Doffman 2021).

Concerning user privacy, Apple claims its protection is at the heart of the philosophy of their products (Apple 2019b)[29], including iPhone: the privacy is one of the main iPhone/iOS selling points. Indeed, Greene and Shilton (2017) suggest that in general, Apple uses more authority to encourage privacy protection on iPhones e.g. through its thorough process of inspecting apps before publishing them on the App Store. Furthermore, Leith (2021) claims that Android sends up to 20x more data to Google than iOS to Apple; but his claims were neglected by Google (Goodin 2021).

Apple recently introduced a feature called App Tracking Transparency to iPhones providing users the option to ask apps not to track their behaviour for commercial purposes such as targeted advertisement and making it harder for trackers to get

[29] https://www.apple.com/privacy/

around this feature (O'Flaherty 2021); nevertheless Google announced that it plans to introduce a similar feature as well (McGee 2021).

4.4 Android(ists) vs iPhone(ists)

As the study conducted for this thesis examines how the users of the two major platforms, Android and iOS, differ by their preferences, here I summarise existing research on how they differ as people.

4.4.1 Personality differences

A massive research conducted by Shaw et al. (2016) investigated both user groups and showed that in comparison, Android users tend to have higher levels of honesty and humility, which the authors characterise as people who avoid manipulation for personal benefit, as well as higher levels of openness and effort to avoid similarity with others. iOS users, on the other hand, came out of the research as users with higher scores in emotionality.

Nevertheless, only a year older work by Götz et al. (2017), that tried to describe the differences in personality characteristics between the users of both platforms, concludes that there are almost none such distinct features. According to these authors, the only personality predictor for a platform preference appeared to be openness in the case of iOS users, which is however a contradictory conclusion to Shaw et al. (2016).

Brown (2017) focused on a specific personality trait – arrogance. The author describes an experiment where both user groups were shown different advertisements which tried to convince customers that by owning a certain product of a certain brand, one becomes superior to others. By a significant margin, the customer group that reacted more positively to such advertisements were the iPhone users.

4.4.2 Demographic differences

Shaw et al. (2016) suggest that women are more likely to use iOS than men; and in general, that iOS users are younger. Götz and col. (2017) showed that people with higher monthly budgets are more likely to use iOS, proving the economic welfare of users being a significant factor for platform preference.

Based on their large-scale international study, Jamalova and Milán (2019) show that from a macroeconomic perspective, iOS users come from developed countries (iPhone is especially preferred in countries with high human development index) and have significantly high levels of education and life expectancy, while Android flourishes in less developed countries among people with lower monthly income, mid-level education and not as long lifespan. In developed countries, the average price of Androids sold is higher than in developing countries; and high- and mid-end Androids' target group is the middle class where it competes with iPhones.

4.4.3 Preference differences

One of the two main focuses of this thesis' study is to find out how Android and iOS users differ by the character of their preferences towards their handhelds. A relevant paper on this topic is the diploma thesis by de Amorim (2017). Although the author focuses on customer preferences in the field of audio devices (the work is a case study of Apple's AirPods), a substantial part of the research is a survey and analysis of the relationships between hedonic and utilitarian preferences of smartphone users. According to the author, the common characteristic for utilitarian groups is higher likelihood to purchase a smartphone from a less well-known brand. For the hedonic group, on the other hand, owning (and enjoying) Apple products is characteristic; underlining their preference to own fashionable, design products providing superior status level and matching their own identity.

4.4.4 Smartphone as a symbol

A lot of artifacts of daily use are also connected to a question to what extent they are self-expressions of their users or what these artifacts say about them. In the case of smartphones, this is no different.

Shaw et al. (2016) found that Android users do not consider their phones as such status symbols as iPhone users do. Also in a study of cultural differences among youth in the US, Bertrand and Kamenica showed that in general, iPhones are considered to be status symbols much more than Android smartphones (2018).

Furthermore, a smartphone does not have to be just a status symbol, but a symbol by itself: Campball and La Pastina (2010) illustrate this on how the iPhone had been called a "Jesus phone" or "saviour phone" and how the nickname quickly spread,

showing how expressions of religion can and are being often applied to artifacts of new media. Indeed, no other smartphone brand has a reputation for making people wait in long lines even overnight just to get a new model (Gibbs 2017). For reasons like this, Apple is often being compared to a certain kind of religion or cult-like organisation (Wu and Minor 2019).

5. Information and consumer behaviour

As the following study aims to find "what makes an Android or iPhone user", a natural question to ask is, based on what kind of information the users became (and are staying) users of their platforms. To be able to work with the concepts in the study, in this chapter, I provide an overview of the relevant theoretical framework – I define information and consumer behaviour and the buying decision process, and also summarise what factors influence the smartphone preference.

5.1 Information behaviour

Wilson (2000) defined *information behaviour* as "the totality of human behaviour in relation to sources and channels of information, including both active and passive information seeking, and information use", that thus "includes face-to-face communication with others, as well as the passive reception of information as in, for example, watching TV advertisements, without any intention to act on the information given". Furthermore, he defined three related terms:

- *information seeking behaviour* as "the purposive seeking for information as a consequence of a need to satisfy some goal" during which the individual uses "offline" sources such as newspapers or libraries, and/or computer-based systems such as the Internet,
- *information searching behaviour* as "the 'micro-level' of behaviour employed by the searcher in interacting with information systems of all kinds"; it consists of methods of interacting with the information systems from various perspectives, such as what human-computer interaction is used or what strategy is followed; and it also involves the "mental acts, such as judging the relevance of data or information retrieved",
- and *information use behaviour* as the "physical and mental acts involved in incorporating the information found into the person's existing knowledge base"; which may range from e.g. highlighting important passages in texts to assessing the new information and comparing it with existing knowledge.

All these terms starting from information behaviour are nested within the previous one, information behaviour being the umbrella concept for the rest (Wilson 1999). Several scholars proposed models and concepts to assess information behaviour; I will present those I find helpful to this thesis in the following sections.

5.1.1 Wilson's models

Wilson based the model of information behaviour presented in Figure 5 from 1996 as a revision of his previous models. The focus of the model is a person in a given context of information need, where this context, information seeking behaviour and information processing and use are in a loop. Compared to his previous models, an important addition are the *intervening variables* (such as psychological or demographical factors) that may both support or prevent the information use. Wilson also incorporates stress/coping theory which can explain why not all needs invoke information-seeking behaviour, risk/reward theory as a framework for identifying what sources of information an individual may use more than others, and social learning theory for the concept of *self-efficacy*, "the conviction that one can successfully execute the behaviour required to produce the [desired] outcomes" (Bandura 1977 as cited in Wilson 1999).

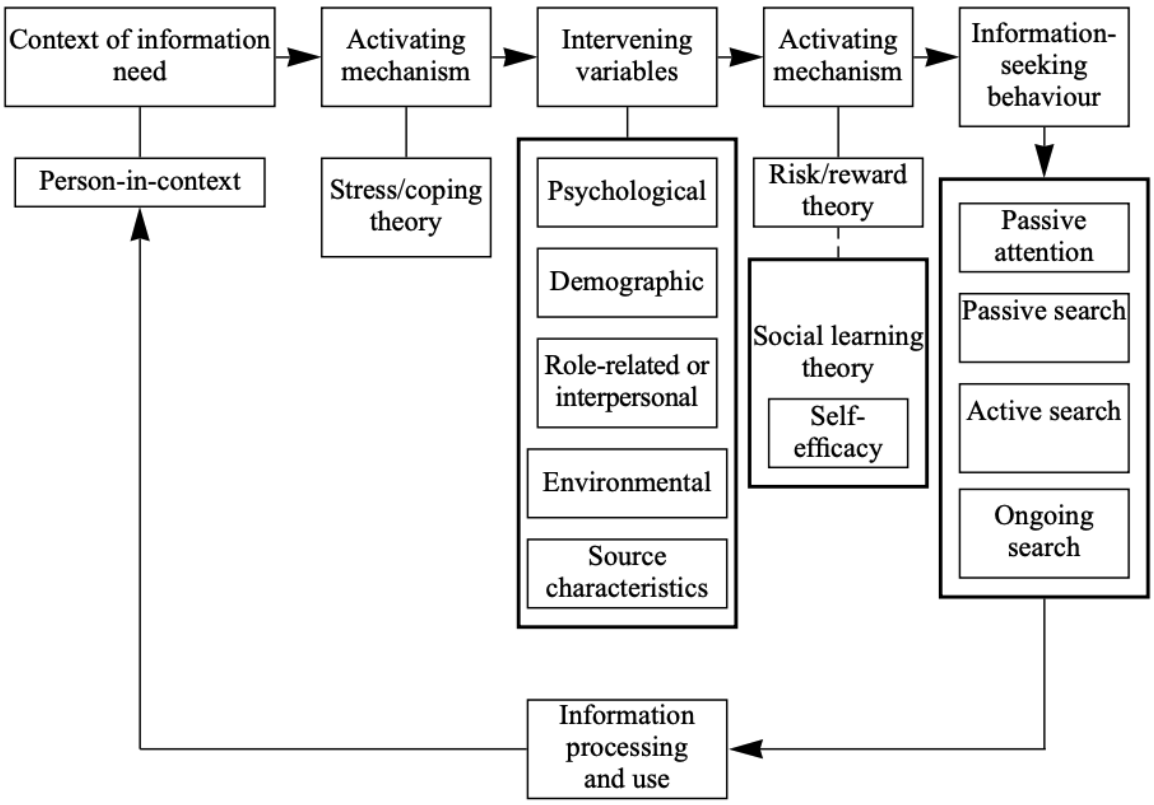

Figure 5: Wilson's model of information behaviour (Wilson 1999)

Apart from this model, Wilson also discussed merging two existing models – Kuhlthau's (1994 as cited in Wilson 1999) and Ellis's (Ellis and Haugan 1997 as cited in Wilson 1999). In Figure 6, Ellis's actions of the information seeking process are displayed in the middle, and Kuhlthau's stage process model, built around the idea of sequential, granular refinement of a problem, is displayed at the top and the bottom (as Stages and Actions). However, Wilson (1999) reiterates that while Kuhlthau's model describes consecutive stages, Ellis's actions appear in varying sequences, and suggests that Ellis's model might be considered a set of activities within Kuhlthau's stages, all nested within his own general model of information behaviour.

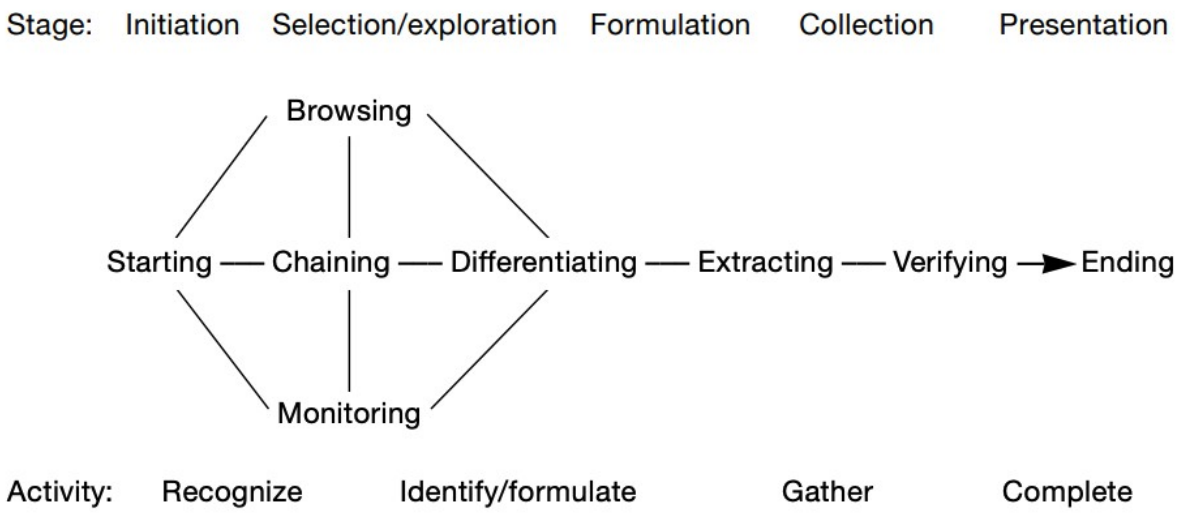

Figure 6: Wilson's merger of Kuhlthau's and Eliss's models (Wilson 1999)

5.1.2 Dervin's sense-making

Brenda Dervin and her colleagues started developing the theory of sense-making in 1972 (Dervin 1999). It focuses on understanding how people make sense out of information; the concept is being explained through the so-called Sense-Making Metaphor. An individual is pictured in a certain context-laden situation in time-space, crossing a bridge made of ideas, thoughts, emotions etc. over a gap of questions, confusions, muddles, riddles or angst to the other bank, where they find outcomes in form of helps, facilitations, consequences and effects of the sense-making (see Figure 7 for detail) (Naumer, E. Fisher, and Dervin 2008; Wilson 1999).

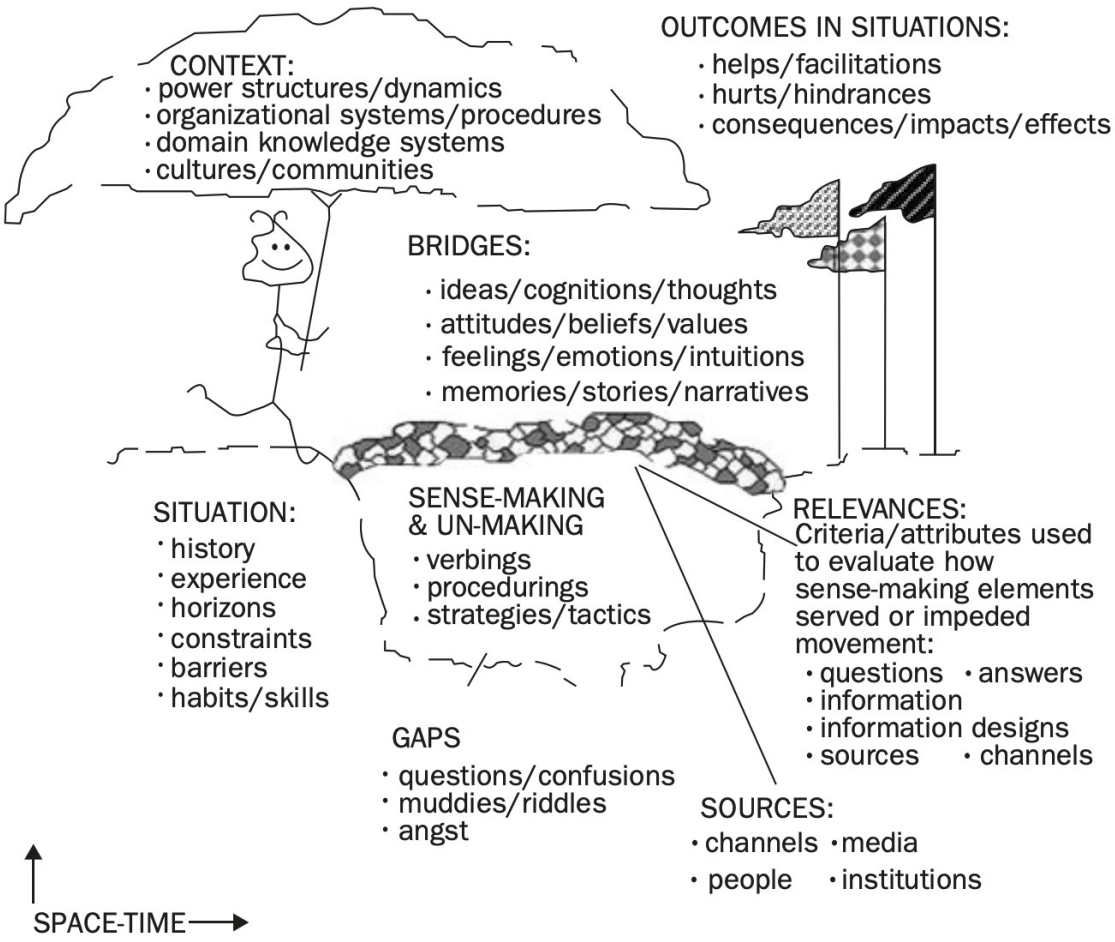

Figure 7: Sense-making Metaphor (c) Brenda Dervin 2005 (Naumer et al. 2008)

The methodology goes deeper than just this metaphor, nevertheless. Among other hallmarks of the methodology, sense-making assumes e.g. that people constantly move between states of certainty and uncertainty and therefore studies certainty and simple patterns just as uncertainty and chaos. Furthermore, rather than on descriptors, it focuses on studying the *processes* of the ways people "communicate internally and externally to make and unmake sense". Finally, sense-making also sees all "ordinary" humans as theorists, perpetually identifying "the nouns of their world and the linkages between them". While it admits that humans have often rather unarticulated understanding of various phenomena, they have ways to turn some of the unarticulated knowledge to articulated, such as through effective communication (Dervin 1999, Naumer et al. 2008).

Dervin's work has been seen as one of the influential to the shift from system-centered to user-centered research as well (Naumer, E. Fisher, and Dervin 2008). Wilson (1999) praises the concept for that "it can lead to a way of questioning that

can reveal the nature of a problematic situation, the extent to which information serves to bridge the gap of uncertainty, confusion, or whatever, and the nature of the outcomes from the use of information".

5.1.3 McKenzie's two-dimensional model of information practices

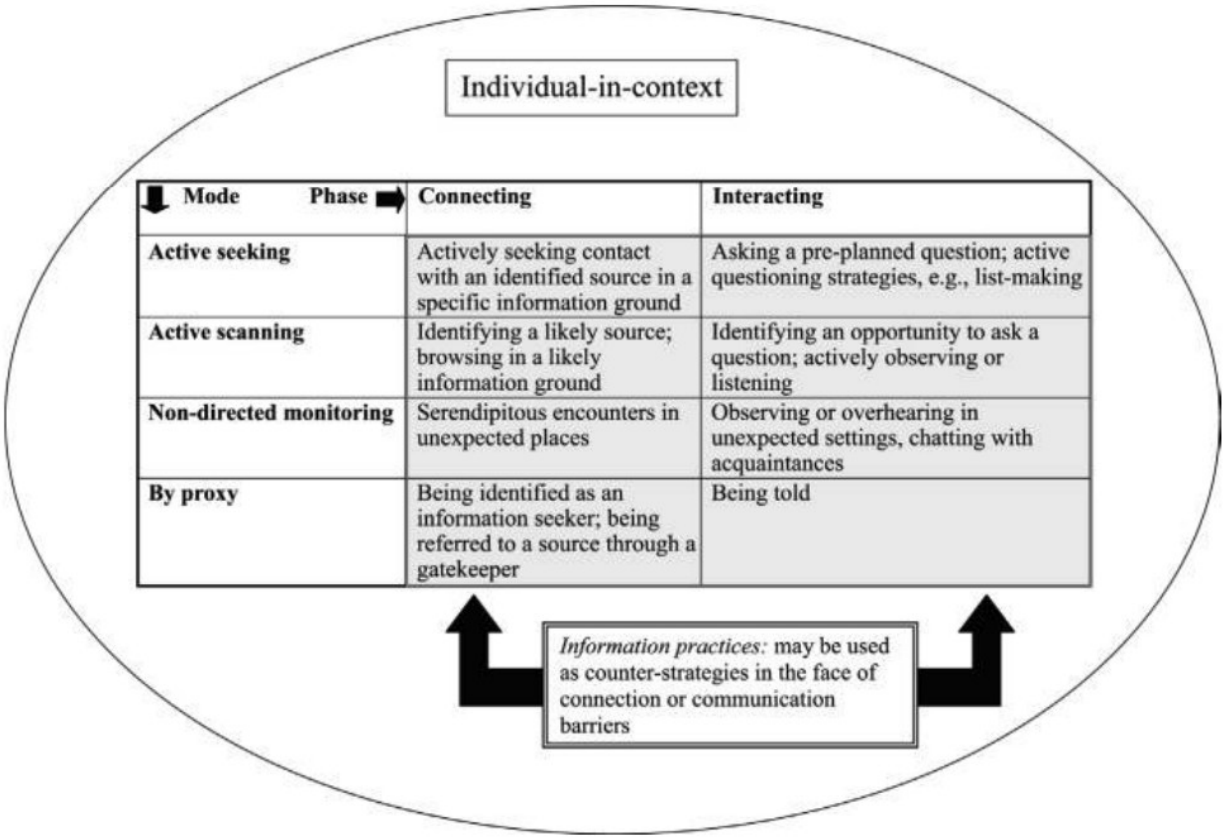

Figure 8: McKenzie's two-dimensional model of information practices (McKenzie 2003)

McKenzie (2003) found many of previous research-based models of information seeking behaviour "limited in their ability to describe everyday life information seeking" (ELIS), arguing that Ellis's, Kuhlthaus's or Wilson's models do not capture the complexities during ELIS, and hence proposed her own model of ELIS (see Figure 8). She identifies two stages of the information practise in ELIS (the top row of the model) to be

- *making connections* – considering "barriers and practices involved in identifying (or being identified by) and making contact (or being contacted by)

information sources or potential sources, whether directly or through a referral"

- and *interacting with sources* – considering "barriers and practices involved during the actual encounter with an information source, once the identification and contact have been established".

These stages can happen in four different modes:

- *active seeking* (related to Wilson's active search), which includes e.g. utilisation of previously identified source, systematic search or active questioning,
- *active scanning*, involving e.g. "semi-directed browsing or scanning in likely locations, (...), systematic observation of physical characteristics or behaviour, identification of opportunities (...) or active listening to conversations or questions in likely locations",
- *non-directed monitoring* such as coincidental encounters in unlikely places, either "while not seeking information at all (chatting with acquaintances) or while monitoring information sources (such as reading the daily newspaper)",
- and *by proxy*, when the information seeking individual asks another individual (agent) to make contact or interact with the information sources; this includes asking for help or being given advice. This mode in particular, McKenzie argues, is not captured in the Wilson's model.

In the following study, I take inspiration from all of the presented authors and consider all of their perspectives mutually compatible: I view "smartphone platform allegiance-making" as Dervin's sense-making for that it is a complex, continuous phenomenon that is context and situation-dependent and may change in time and space; McKenzie provides a sound categorisation of how the relevant information is gathered in everyday life; and Wilson provides a solid umbrella framework of the information behaviour. To my study, particularly important are observations that information behaviour can be imagined as a loop and that it is affected by intervening variables, causing some information seeking to not happen at all.

5.2 Consumer behaviour

As the users of Android and iOS can be also viewed as consumers – customers of their smartphones' brands, a relevant research field to this thesis is also *consumer behaviour*, "all activities associated with the purchase, use and disposal of goods and

services, including the consumer's emotional, mental and behavioural responses that precede or follow these activities" (Kardes, Cronley, and Cline 2011). Although this thesis looks at the Android and iOS users through the optics of user experience and information behaviour, i.e. does not aim to be primarily a contribution to the consumer behaviour research field per se, I present two concepts – types of buying decision behaviour and buyer decision process – that I find relevant for the following study as the users typically *buy* smartphones, or at least are bought for them.

5.2.1 Types of buying decision behaviour

Figure 9: Types of buying decision behaviour. Adapted from Kotler et al. (2017, 154)

In the study, I examine the character of preferences of Android and iOS users towards their smartphones as typically, one owns a smartphone because they *bought it* (or *were bought* one). Kotler et al. (2017, 154) describe buying decision behaviour along two axes: the involvement of the consumer in the buying process and the differences between brands.

Complex buying behaviour occurs when the consumer is highly involved in the process, typically when buying expensive products, and sees a lot of differences between brands. According to the authors, the consumer must usually learn a lot about different alternatives.

Dissonance-reducing buying behaviour occurs when the consumer is highly involved in the process as well but sees little differences between the brands. In this case, consumers may respond to a better price or purchase convenience. Consumers can

also experience *post-purchase dissonance* if they notice the differences (particularly other brands being better in certain aspects) after the purchase.

Habitual buying behaviour occurs when the consumer is not particularly involved in the buying process and there are few significant differences between various brands. Due to the low involvement, consumers may not evaluate the choice either before or after the purchase.

Finally, *variety-seeking behaviour* occurs in situations of low consumer involvement but significant differences between the brands. Typically, this leads to brand switching – buying one brand's product for evaluation and then trying another brand's one next time, which occurs rather for the sake of trying different alternatives than for dissatisfaction.

5.2.2 Buyer decision process

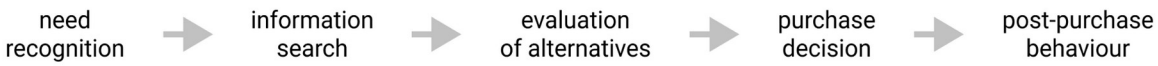

Figure 10: Buyer decision process (adapted from Kotler et al. 2017, 155)

Sole *purchase decision* to buy a certain product is preceded by other steps in the buying process. First, the consumer must *recognise the need*, which can be triggered either by *internal stimuli,* such as needing a new smartphone after the old one stops functioning, or by *external stimuli,* e.g. when an advertisement or talking to a friend makes "one thinking" about buying something.

The need recognition is followed by *information search* with different source options: personal (friends, family, acquaintances…), commercial (advertising, websites…), public (social and mass media, ratings sites…) and experiential (examining and using the product).

Before the purchase decision, *evaluation of alternatives* may occur. This process is highly individual and depends on the buying situation – while some consumers go through a thorough process of thinking and calculations, some do little to no evaluation and follow their instincts. The evaluation results in *purchase intention.*

Finally after these stages, the *purchase decision* occurs. In general, normally it would be to buy the preferred brand after the preceding process – going with the purchase

intention, but this can still be influenced by *attitudes of others* (last-minute persuasion of someone else to not go with the preferred variant) or *unexpected situational factors*, such as sudden drop of price of an alternative or someone providing negative feedback on the product the consumer intended to buy.

After the purchase decision, *post-purchase behaviour* occurs – the actions based on the consumer's satisfaction or dissatisfaction, which are influenced by the relationship between the consumer's expectations and perceived performance. Consumers who just made a major purchase decision often experience *cognitive dissonance*, the uneasy feeling about the drawbacks of bought brands and losing the advantages of the competition. (Kotler et al. 2017)

In this model as presented by Kotler (2017), many links to information behaviour and user experience are evident – information search and evaluation of alternatives are kinds of information behaviour and furthermore, Kotler mentions the experience with a product as one of the main sources for information search – making the user experience relevant.

5.2.3 Hedonic and pragmatic (utilitarian) behaviour

In this section, I will bridge the consumer behaviour perspective with the earlier presented hedonic-pragmatic model of UX: because a logical question to ask is which qualities – hedonic or pragmatic – play the main role in choice situations such as buying behaviour processes, and how the consumer behaviour can be characterised using these constructs. Ahtola (1985) distincted hedonic and utilitarian[30] to be aspects of an attitude towards a behaviour, hedonic being related to "pleasure experienced or anticipated from the behavior" and utilitarian related to "usefulness, value, and wiseness of the behavior as perceived by the consumer". Nevertheless, first, Ahtola remarks that these aspects are bipolar: apart from the positive ones, the hedonic also relates to negative feelings such as pain or unpleasantness for the hedonic, and the utilitarian to e.g. judgements about foolishness and irrationality. Second, Ahtola suggests that it would not be "conceptually sound" to divide behaviours into or classify them as either hedonic or utilitarian, but that some behaviours are more hedonically motivated than others.

[30] Unlike "hedonic", which is understood slightly differently by Hassenzahl / UX, and consumer research literature as explained above, utilitarian and pragmatic are synonyms. In (2019), Hassenzahl and Diefenbach replaced the word "pragmatic" with "utilitarian", and it is apparent from the paper that the same thing is meant.

Scarpi (2020, 15) identifies two camps of consumer behaviour researchers: ones see hedonic and utilitarian consumers as two extremes of a continuum; the others see "hedonism" and "utilitarianism" as separate dimensions – in their view, consumers can be highly hedonic and utilitarian at the same time just as almost neither of the two. Scarpi and Ahtola belong to the second camp, and the two-dimensional view seems to be mentally similar to Hassenzahl's model of user experience, hence I share this view in this thesis.

Okada (2005) demonstrated that when two alternatives, one more hedonic and one more utilitarian of comparable value, are presented *individually*, people tend to prefer the hedonic one. However, when these two alternatives are presented *side by side* (e.g. in a situation "if I gave you this amount of money to spend on one of these goods, which would you choose"), people tend to choose the utilitarian alternative. The author also examined the need for justification in the choosing process and argued that consumers are willing to pay extra money for utilitarian goods, but at the same time are willing to spend more time searching for good deals on hedonic goods. Nevertheless, this study was comparing different types of goods; utilitarian alternatives being "convenience goods", such as food processors and hedonic alternatives being unnecessities such as media players.

Botti and McGill (2011) showed that some consumers may use the same products with different goals – either for pleasure (hedonic qualities), or to achieve utilitarian goals. In "*The dilemma of the hedonic – Appreciated, but hard to justify"*, Diefenbach and Hassenzahl (2011) examined this phenomenon but with the base of the hedonic-pragmatic model, looking at preferences towards one type of goods alongside both quality dimensions. Based on their study where participants were asked to choose from pre-selected mobile phones, some "more beautiful" (hedonic) and some "more practical" (pragmatic), authors suggest that most people make their decisions based on products' pragmatic qualities as those are easier to *justify*. At the same time, authors argue that the pragmatic qualities are often overemphasised at the expense of hedonic desires, here considered as the "true" ones; and that people who choose based on hedonic qualities, following their "true desires", are later "happier" with their choice. This more than slight difference seems to be in line with the findings of Chitturi, Raghunathan, and Mahajan (2008), who showed that while both hedonic and utilitarian product benefits correspond to loyalty towards the product or brand; the hedonic benefits are also related to *delight*, while the utilitarian benefits "only" to

satisfaction; and that the customer delight improves the word of mouth and repurchase intentions more than the mere satisfaction.

Diefenbach and Hassenzah'sl subsequent study (2019) based on qualitative interviews about different products confirmed that utilitarian qualities are considered primary and crucial criteria in choice situations for most people, nevertheless, authors suggest the subsequent experience with a product is dominated by hedonic, experiential attributes. Therefore, although not being assigned much importance in the choice situation, lack of product's hedonic attributes may end up in a weak emotional attachment and feelings of "I need something new, something better" resulting in constant search for alternatives (Diefenbach and Hassenzahl 2019, 15).

5.2.4 Factors of smartphone preference

Different aspects of smartphone preferences have been studied in previous research. Both utilitarian and hedonic qualities seem to have importance to customers according to Chun, Lee, and Kim 2012; who also observed that while ease-of-use has an impact on perceived usefulness (a pragmatic quality), it is responsiveness that also triggers hedonic enjoyment. Several studies show importance of utilitarian qualities such as ease-of-use (Can and Erdil 2018), system quality (Filieri and Lin 2016; Can and Erdil 2018), features and hardware specifications (Chen, Chen, and Lin 2016; Rahim et al. 2017; Attri, Maheshwari, and Sharma 2017) just as hedonic qualities such as visual design (Can and Erdil 2018, Filieri and Lin 2016) or brand identification and symbolism (Yeh, Wang, and Yieh 2016; Nykänen et al. 2015).

Seemingly most often, scholars discuss the role of the brand to smartphone purchase intentions and acknowledge brand loyalty as one of the most decisive factors (Akkucuk and Esmaeili 2016, Can and Erdil 2018). Different authors determine different influential factors of brand loyalty:

- cultural influences, perceived quality, brand popularity and design of the brand's devices (Filieri and Lin 2016)
- functional, emotional, and social value together with brand identification (Yeh, Wang, and Yieh 2016), where with higher age, emotional and social value become more prominent at the expense of the brand identification, which is more important for younger people

- perceived value, brand experience, trust, satisfaction, quality of customer care and its engagement (Chen, Chen, and Lin 2016).

Hew, Badaruddin, and Moorthy (2017) argue it is brand attachment (emotional attachment towards a specific brand) which is most influential to smartphone preferences.

Confirming the importance of brand, Rahim et al. (2017) argue that also social influence is a significant factor influencing smartphone purchase intention, similarly to Filieri and Lin (2016) or Rai (2021). According to Nykänen et al. (2015), the social influences are specific to iPhone owners; apart from praises such as "iPhone is just so cool", many of their respondents referenced the value created by the network effect, such as the seamless ability to connect with their friends who use iPhones as well or synchronisation with other devices that no other smartphone brand manifested as strongly. This seems to be in line with the perception of iPhone as a symbol as discussed in 4.4.4, and furthermore, the authors also recognise a certain "sense of belonging" to Apple's culture. Indeed, several studies find Apple to have the most loyal customers (Chen and Ann 2014; Ann, Chen, and Liu 2018; Kim, Lee, and Lee 2020) and Kim, Lee, and Lee (2020) affirm the special case of Apple's brand loyalty being influenced by peer-pressure and image. While observing Apple having the highest customer loyalty as well, interestingly, Chen and Ann (2014) assert that the satisfaction of Apple's consumers in comparison to Samsung's is similar.

In the following chapter, I present an empirical study that sheds more light on many of the phenomena presented in this section. Most importantly, while the presented previous research only lightly touches upon the differences between factors influential to preferences for users of Android and iOS, the presented study aims to be a comparative analysis of preferential factors for the two user groups.

6. Differences of Android and iOS users in smartphone preferences and information behaviour

In the previous chapters, I provided an overview of the evolution of HCI and smartphones, reviewed previous research on the differences between the users of the two platforms and also provided an overview of information and consumer behaviour and factors influencing smartphone preferences. However, with the exception of de Amorim (2017), to my best knowledge and ability to perform a literature review, I find a gap in research on two topics:

- how the users of the two platforms differ in the priorities they have towards their smartphones, as the previous consumer research seems to focus on factors influencing smartphone purchase decisions generally,
- and also in how they differ in their information behaviour in the context of smartphones – I was unable to find any connections between a platform preference and the interest in and general awareness about the smartphone market.

6.1 Research aim

Therefore, the goal of this thesis' study is to investigate the differences between the users of Android and iOS from the two perspectives:

1) User experience based on hedonic-pragmatic model by Hassenzahl (2003) – what qualities of the user experience with smartphones are more important for the two user groups, whether one group puts more emphasis on hedonic and one on pragmatic qualities of smartphones in daily use and at the moments of purchase decisions (RQ1),
2) Information behaviour – whether the two groups differ in their information behaviour within the field of smartphone market, i.e. in how and when they get and seek information about smartphones and smartphone market (RQ2).

6.2 Hypotheses construction

6.2.1 Differences in smartphone preferences

From the literature review in the preceding chapters, especially from the historical evolution, the direct comparison of the two platforms and research about factors influencing smartphone preferences, Android seems to be the "value" option of the two platforms, as it in general provides more features at a comparable price level and a wide selection of different configurations at all price levels. In contrast, there seems to be an undeniable "magic" of the iPhone given its history as a "revolutionary" device, its famous design features, creating a network in which it is almost seamless to connect with others and being a status symbol overall. Furthermore, since Diefenbach and Hassenzahl (2011) and Chitturi et al. (2008) suggest that the greatest long-term satisfaction and delight come with hedonic aspects of the experience, and as according to the consumer research summed in 5.2.4, Apple seems to have the most loyal, hence assumingly most delighted smartphone consumers, the iPhone presumably scores in more hedonic aspects than Android phones.

Based on these observations, I assume that Android users seek more pragmatic qualities such as specific technical specifications in their smartphones, and do not put as much emphasis on their hedonic qualities like design, sense of belonging to a community or status symbolism; while iOS users prefer iPhones for their hedonic qualities such as their design, status symbolism and the connectivity to and community with other iPhone users, and may care less about specific technical specifications and hardware features, i.e. pragmatic qualities. Hence, the two hypotheses drawn from these assumptions are:

H1: The platform preference of Android users is based on more pragmatic qualities compared to iOS users.

H2: The platform preference of iOS users is based on more hedonic qualities compared to Android users.

6.2.2 Differences in information behaviour

I found no research directly linking differences in information behaviour to Android and iOS users, nor papers with a specific focus on what sources during the

information search in the buyer decision process are prominent when buying a smartphone. Rather, the smartphone purchase related research seems focused on all the purchase factors in general and brand influences as presented in 5.2.4.

Nevertheless, seeing it is harder to choose an Android phone given its variety of options, I assume that Android users must seek more information (such as specifications or reviews) at the time of purchase decision, just as that they must continuously keep themselves more up to date with news from the smartphone market to stay oriented; utilising all active scanning, active seeking, non-directed monitoring and proxies as understood by McKenzie (2003). In comparison, I presume that iOS users, who seem to show loyalty to Apple, do not have such a motivation as they have just a few iPhone options and seemingly low intention to switch to a different (Android) alternative (Chen and Ann 2014; Ann, Chen, and Liu 2018), and hence seek less information about alternatives nor at the time of purchase decision, nor continuously. Additionally, seeing the iPhone to be a certain symbol of status and great reputation (Betrand and Kamenica 2018), and the sense of belonging to a certain community it seemingly induces (Nykänen et al. 2015), I presume that many iOS users built their preference towards iPhones under the influence of their peers, friends, acquaintances and family: by observing their good experience with iPhones, being given recommendations to start using the iPhone which seems to fall under the non-directed monitoring (McKenzie 2003), and perhaps, in part, under certain peer-pressure as well.

Therefore, I will test the following hypotheses as well:

H3: Android users seek more information at the time of purchase decision than iOS users.

H4: Android users seek more information about the smartphone market continuously compared to iOS users.

H5: Building a smartphone preference under the influence of peers, friends, family or acquaintances rather than based on more proactive information search is a more common phenomenon in the case of iOS users compared to Android users.

6.3 Research design and evaluation method

The study had two components. First, the participants were asked to fill in an AttrakDiff questionnaire (precisely its Czech adaptation implemented via Google Forms) to assess their attitudes towards their smartphones using the hedonic-pragmatic model (Hassenzahl, Burmester, and Koller 2003; User Interface Design GmbH n.d.) with an intention to facilitate their thinking about their smartphone use in both pragmatic and hedonic ways before the interviews as well as measure their attitudes towards their smartphones – their user experience with them. Subsequently, semi-structured interviews further investigating their attitudes and preferences towards smartphones and their information behaviour were conducted.

6.3.1 AttrakDiff

AttrakDiff was selected as a method designed specifically by Hassenzahl for assessing perceived product qualities based on his model (Hassenzahl et al. 2003); it is a questionnaire that measures user attitudes along dimensions of perceived pragmatic quality (PQ), hedonic qualities of identification (HQ-I) and stimulation (HQ-S) and general attractiveness on 7-point semantic differential scales. Despite some limitations, such as that some scales might be confusing for respondents (Takahashi and Nebe 2019), the method was validated and used in other studies as well (Walsh et al. 2014, Ribeiro and Providência 2020). Originally, Microsoft Desirability Toolkit also known as Microsoft Research Cards method (Benedek and Miner 2002, Moran 2016) was planned to be used, however, the method is designed for feedback in lab usability testings, not a long-time user experience assessment, and additionally, it is not related to the hedonic-pragmatic model, there are only a few "pragmatic" product attributes.

Although the AttrakDiff has its own official web application (User Interface Design GmbH n.d.) that can be used for free[31], I found three limitations to using it with participants. First, the questionnaire is only available in English and German, the participants were all Czech and I did not want to limit the study to participants with a good command of either of the languages. Second, I needed to collect the informed consent with participation from the participants as well but wanted to keep the promise to them they would have to fill only one form in, which would not be

[31] http://attrakdiff.de/

possible there. Lastly, it was the UX of the application, e.g. the welcome screen of the questionnaire is always in German and must be switched to English, and also, I wanted to provide a familiar form experience to the participants and not intimidate them with an unfamiliar interface.

Hence, I translated the AttrakDiff questionnaire to Czech, had the translation peer-reviewed by the supervisor of this thesis and a friend with a proficient command of Czech and English and academic background in information systems and digital innovation (see Table 1: Czech translations of AttrakDiff scales) and made the questionnaire on Google Forms platform[32] (Google n.d.). I afterwards transferred the collected data to the AttrakDiff web application for evaluation – the app generates the graphs of the user attitudes diffusion on the model and average scores of the individual attributes.

6.3.2 Semi-structured interviews

Semi-structured interviews (Wilson 2014, Brinkmann 2020) were conducted with participants individually after they filled in the AttrakDiff questionnaire with the purpose of getting deeper insights about their smartphone preferences, attitudes, experiences and opinions; and additionally about if and how they seek information about smartphones when buying a new one and continuously. AttrakDiff evaluation alone would not be sufficient as it only assesses the attitude / satisfaction of the users with their phones, this solely would not provide an insight into their decisive preferences and information behaviour, a deeper insight provided by semi-structured interviews was necessary. The interviews were conducted in Czech, some in person and some over video chat (Google Meet) and took between 15 and 30 minutes.

The interview guide (Wilson 2014) was prepared as follows:

1. Introduction of the participant with the interviewer and vice versa, thanking for filling in the questionnaire, introduction of purpose and topic, asking how the participant perceived the questionnaire, whether everything was clear
2. *How did you get your phone?*
    - If the participant bought it / was choosing it:
      Were you choosing it alone or did you rely on others' recommendations?

[32] https://www.google.com/forms/about/

If you were choosing it, how?

What was the decisive factor for the phone you ended up getting?

3. *Do you watch what smartphones are on the market at the moment?*
4. *If you were about to buy a new smartphone, how would you choose it?*
    - *Would you proceed similarly?*
    - *Would you do any research?*
5. *What would you require next time buying a new phone?*
6. *Why do you have an Android and not an iPhone / Why do you have an iPhone and not an Android? Do you perceive any differences between the two platforms?*
7. *Do you have any experience with the second platform?*
    - If yes:

      Was there anything you wish was also on your smartphone?

      Was there anything to discourage you from getting a phone of that platform?
    - If not:

      Are you considering trying it out?
8. *A bonus question: if you could choose between a free top-tier model of iPhone and Samsung, which one would you choose and why?*
9. *Thank you for the interview, do you have any other thoughts on the topic of Android and iOS?*
10. Closing comments, post-interview conversation

In case the participant answered some question in depth as part of their answers of some other question, the question was left out. On the other hand, I tried to get more in-depth by asking additional questions to the prepared ones (hence semi-structured interview).

The interviews were transcribed to a written form, re-read several times, their main points were summarised and coded by emerging topics[33] (Saldaña 2013) using Notion[34] application (Notion n.d.). Notion further allowed to query different criteria (such as "how many Android users cared about technical specifications"). From this overview, the results are discussed per the set hypotheses, and an additional phenomenological insight on the research questions is provided. For H1 and H2, the approach – model-based and phenomenological analysis – is inspired by Diefenbach and Hassenzahl (2019), H3, H4 and H5 are discussed mostly phenomenologically.

[33] The table with this summary and codes is provided in a separate file attached with this thesis.
[34] https://www.notion.so

6.4 Sample

Most participants were recruited via a call sent to an email list of employees of several IT and marketing agencies of the same group of firms (one of the two marketing agencies being an exception as the group had sold it to different owners, yet it is still on the email list). The participants were informed the study would consist of filling in a 5-minute questionnaire and an approximately 15-minute interview either in person or via Google Meet based on their preference. Almost all of those who showed willingness were invited to participate; appointments were scheduled with participants based on their time conditions and they were sent a link to the Google Form with the AttrakDiff questionnaire preceded by a page asking the participants for their informed consent. Two participants (female Android users) were invited individually to get more gender/platform balance.

Among the 25 total participants, there were 3 female and 8 male Android users, and 5 female and 9 male iOS users. The participants were 24–55 years old (34.16 on average, mean age of Android users was 36 and mean age of iOS users was 32.5). The participants had various IT- and marketing-related occupations: programmer/developer, email specialist, web analyst, product manager, product support, tester, business analyst, account manager, IT consultant, copywriter, communications manager; no profession had a significantly greater representation in the participant pool. While this may give the study a slight bias, on the positive side, this presumably ensured all participants had salaries providing resources to buy a smartphone of their preference, not of what "they can afford" (additionally, several participants mentioned their employer provides them with a substantial financial contribution to buy their preferred phone). Furthermore, the similar background of participants can be viewed as a positive: the study compares different stances among people within a common social environment.

The Android smartphone models the participants were using ranged from mid-range to high-end product lines of well-known brands, mostly Samsung (M, A and S-series, Note), Xiaomi and Honor, but there was also a Dodgee and a Blackview (high-durable phones). The iOS users' iPhones were SE, 6S, 7, XS Max, 11, 11 Pro, SE 2020 and 12 Pro; both older and newest and both mid-range and high-end.

6.5 Results and discussion

6.5.1 Smartphone preferences

Based on the participants' AttrakDiff evaluations, it seems that iOS users have a slightly more positive attitude towards their phones than Android users in all aspects measured by the tool – pragmatic qualities, hedonic qualities (identification and stimulation) and general attractiveness (Figure 11). However, average Android phones scores copy the curve of the average iPhone scores (Figure 11) and are quite high in general as well, therefore, the Android users' satisfaction with their phones seems very similar to that of iOS.

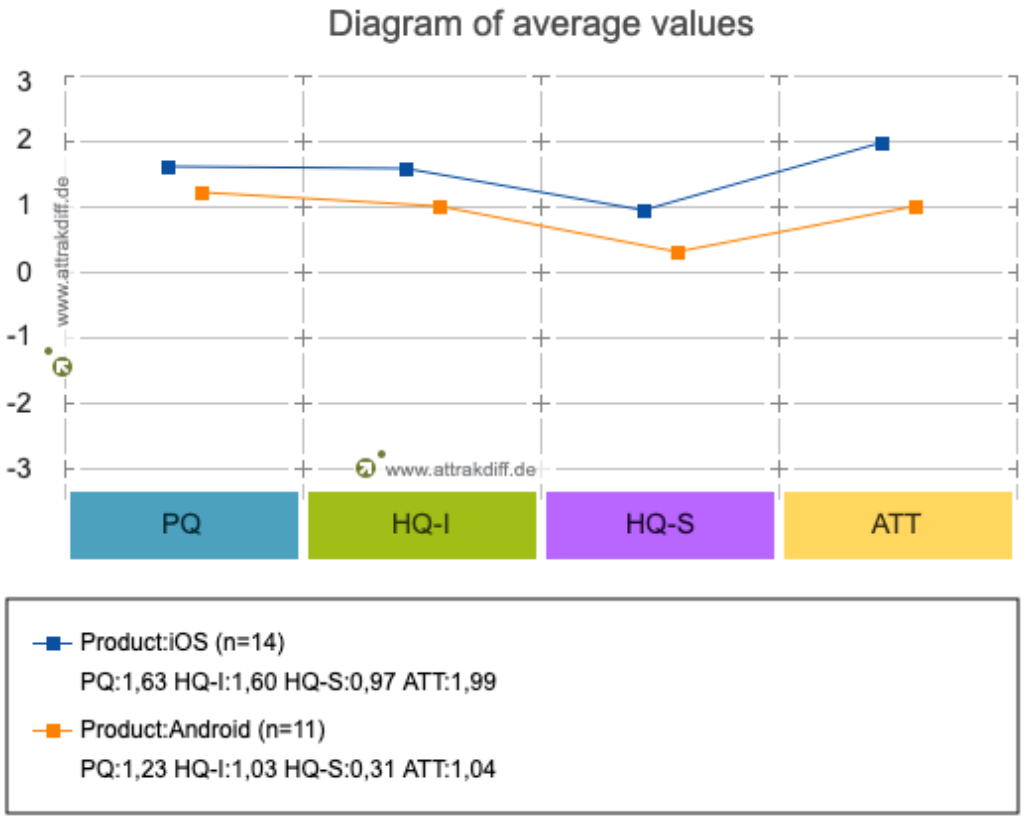

Figure 11: Diagram of average values – scores in pragmatic quality, hedonic quality (identification and stimulation) and attractiveness

Figure 12 shows the general orientation of the two platforms on the hedonic-pragmatic model of user experience: Android phones were assessed as task-oriented and almost desired; iPhones were evaluated as desired (both strongly task-oriented and self-oriented; Androids scored less in both aspects).

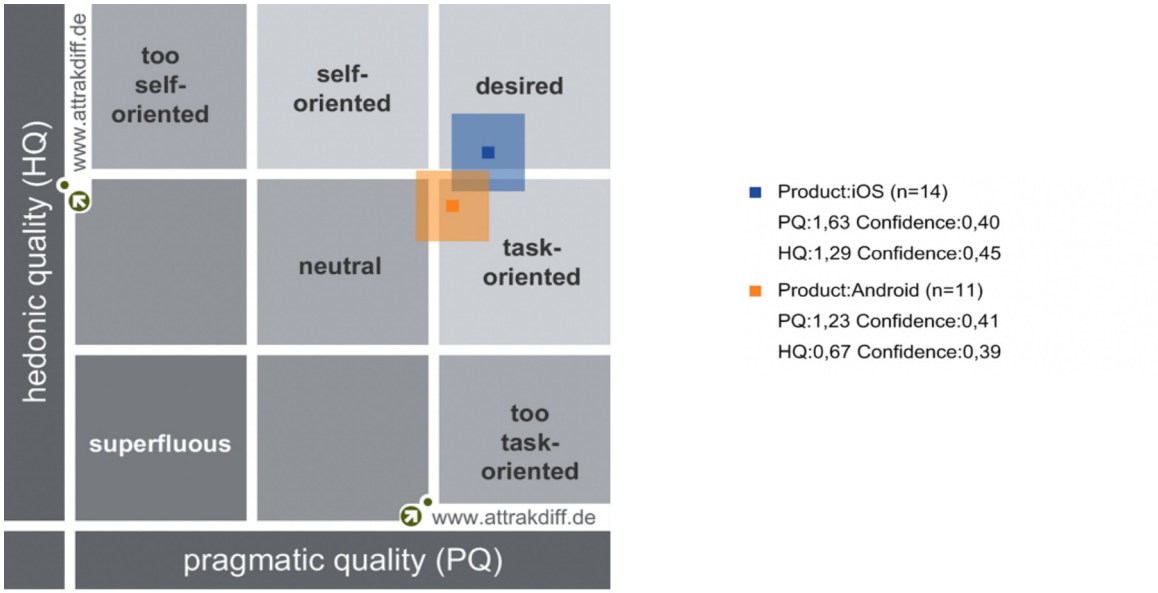

Figure : Android phones and iPhones on the hedonic-pragmatic model of user experience

Figure 12: Android phones and iPhones on the hedonic-pragmatic model of user experience

Android phones only scored slightly higher on four semantic differential scales – Android users consider their phones slightly more practical (PQ), slightly more clearly structured (PQ), slightly more connective (HQ-I) and slightly bolder (HQ-S) (Figure 13).

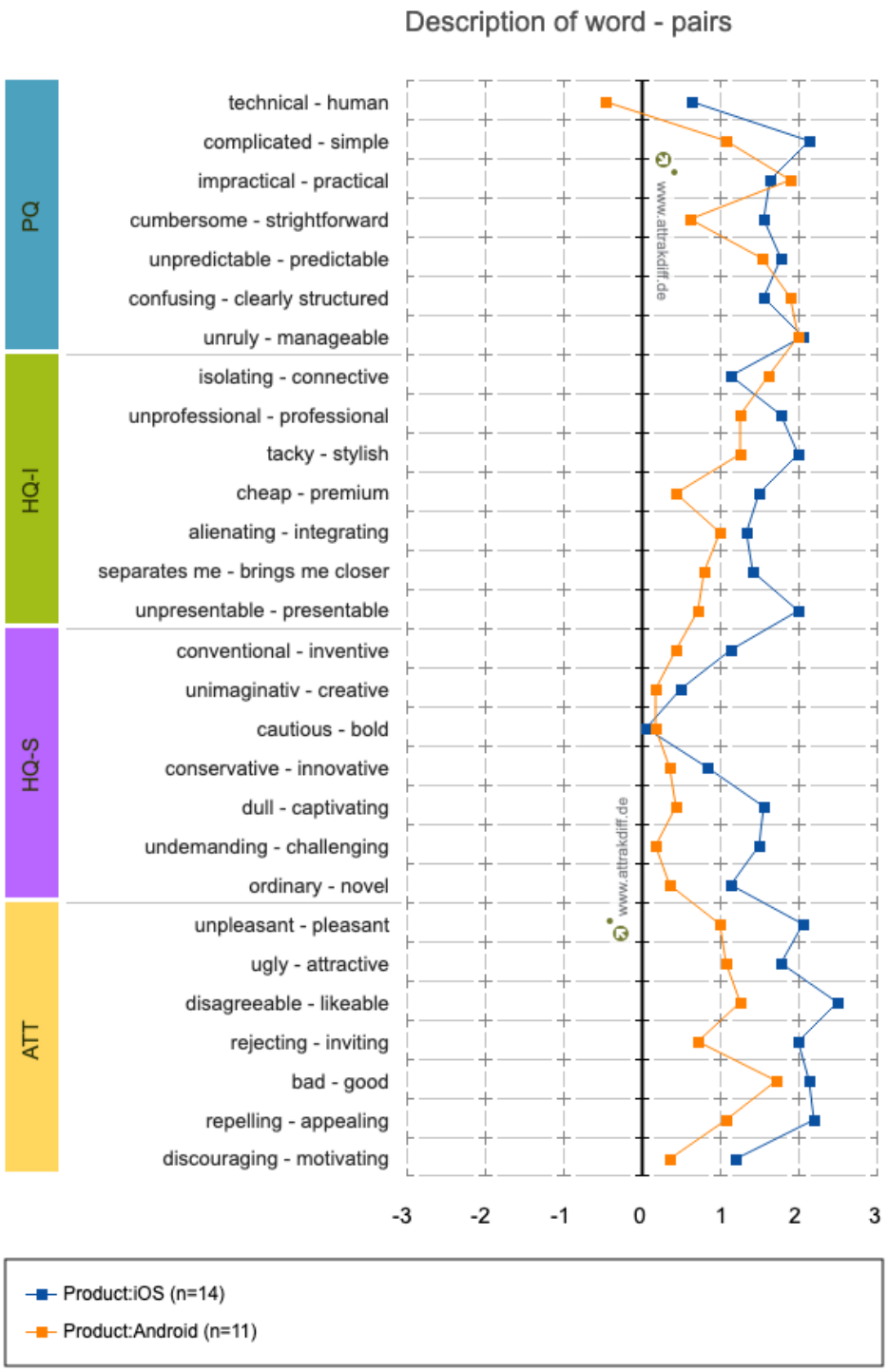

Figure 13: Average scores on individual subscales

As discussed above, AttrakDiff evaluation only has a corresponding value of the users' evaluation of their smartphones; it does not provide deeper insight into the preferences the users have – "what they expect of their phones"; this was provided by the interviews.

The interviews revealed that in general, both user groups have a lot of both pragmatic and hedonic reasons to prefer their platform; however, how they specify them differs.

When asked what factors they last considered or would consider when buying a new smartphone, 10/11 Android users named specific technical specifications (one of them planning to switch to iOS, compared to only 6/14 iOS users mentioning some technical specification they care about, two of them preferring Android if they were buying private phones). They were often specific, i.e. the users said they cared about battery capacity, display size, storage size; three users specifically required high durability of their phones (one of these users said *"Apple just does not have an offer to this niche segment I am part of"* in relation to the durability requirement, and one of them additionally wanted to have a pen input, which is even further specific). Two Android users specifically required long guaranteed software support and hence used Samsungs, two wanted the durability for a similar reason, so they would not have to buy a new smartphone soon. From further pragmatic reasons "not to have iPhones", 6/11 Android users participants considered Androids to have better price/value ratio than iPhones or said Androids are cheaper/ iPhones are too pricey.

From hedonic point of view, 5/11 Android users mentioned they cared about the design (in a sense of visual appeal) of their smartphone in some way when buying one, compared to only 3/14 iPhone users explicitly mentioning caring about the design. Specifically to the Android users, three explicitly appreciated the Android's open philosophy in the abstract/hedonic sense (one additional condemned "iPhone being too closed", but there it sounded more pragmatically based, as it was in context of not being able to side-load applications and the need to enter the ecosystem to fully utilise the platform). Two Android users also said that they like the fact they do not have a phone like everyone else, unlike iPhone users.

As aforementioned, in AttrakDiff, Android users valued their phones as more practical than iOS users; where, of course, depends, what one imagines under "practical". No less interestingly, the Apple ecosystem and its practicality was probably the most common theme for iOS users to prefer iPhones – 9/14 users said they were liking and utilising it. The users named perks such as seamless file sharing, synchronisation and the general symbiosis of the devices (*"I can rely on it all just working well together"*, *"I just want a phone that works well in an ecosystem"*, *"Awesome is*

the connection with Mac – AirDrop, synchronisation, the whole ecosystem, that I write something on Mac, and it is on the phone as well"). 6/14 users also appreciated that "it just works" or the ease-of-use of the iPhones: 11/14 users in total talking about either of the ecosystem or the general usability. Several (5/14) iOS users also said they liked that unlike Androids, iPhones do not slow down over time, four of them having direct experience with the phenomenon on Androids and for one of them this being seemingly the main (and only) reason to have switched from Android.

The ecosystem showed to have a certain hedonic quality as well: 5/14 iOS users said that it is important that they are connected with their family and friends who have iPhones as well through iMessage or AirDrop; although some sounded like almost not having a choice to leave iOS as they would lose this contact, steering the positive hedonic quality back to certain pragmatism. Otherwise, contrary to what was expected, hedonic qualities were not a common theme to iOS users. Only 4/14 users appreciated the iPhone's design in some way: one marginally after mostly talking about pragmatic advantages of the iPhone, one saying iPhone "is really pretty" but this user would buy an Android if buying a private phone (hence not as a decisive factor) and one saying Apple is "always one step ahead in design" but not caring much; only one user seemed to give a great importance to the Apple's design (*"I loved iPods (...), it looked pretty, it was thin, it was sexy. Then I saw other people's iPhones and I loved them too, so I got one and haven't bought anything else since. (...) I despise the looks of Androids.")* Also only three iOS users seemed to be either iPhone or Apple "fans" in a sense of talking expressively positively about their devices. Only two users said that the status symbolism of having the iPhone was important to them *("I perceive that who has an iPhone, is 'better', I find it weird when someone doesn't", "The social status of 'having an iPhone' has definitely a role to me as well")*.

To summarise, for Androids users in general, it could be concluded that their phones satisfy more specific, variable, and more commonly pragmatic needs, which could not always be satisfied by Apple's offer; but have a lot of hedonic requirements as well (more than iOS users explicitly cared about design, some appreciated the philosophy and "being original"). In contrast, all iOS users talked either about the convenience of the ecosystem or the general ease-of-use or that "it just works"; most common hedonic appreciation being the connection with other Apple users, which can be, however, seen pragmatically at the same time. I expected more people would

either give importance to the design of iPhones or mention the social status the iPhone provides.

Seeing these observations, **neither H1 nor H2 could be confirmed.** Based on this study, it seems that both user groups base their preference on more pragmatic than hedonic qualities, only of different natures – while Android users seek specific features or specifications, iOS users want the iPhones for their general, seemingly impeccable usability, reliability and long life; and furthermore, iOS users seemed to be "caring more" about these qualities, somewhat contradicting H1. Furthermore, Android users seemed to be slightly more hedonic as a group, in direct contradiction to H2.

6.5.2 Information behaviour

What people look for in their smartphones had been discussed in the previous section. When it comes to their information search before their smartphone purchase decisions, some difference was apparent: 5/11 Android users make research encompassing more than just filtering by parameters on a particular e-shop around the time of buying a new phone, such as studying and comparing different specifications, reading reviews or keeping themselves "up-to-date with the market" specifically around this time; in contrast, only two iOS users said they do research before buying, but one said that about buying an Android phone and only one about iPhones, who used to be an Android user for a long time and has a smartphone expert background. Three additional Android users chose their smartphones based on filtering concrete specifications on an e-shop and comparing these alternatives based on further investigation and comparison of these specifications. iPhone users seemed to mostly "go-and-buy" and not have very specific demands; at most, they consider what size of iPhone fits them best, what storage capacity they need, or price – 6/14 had "budget" iPhones saying there is not an added value among the higher-end models to them; two had used phones, hence probably had to find a good offer. These considerations seemed to be "just considerations", they did not seem to be based on further reading or research. **H3 was confirmed,** although not as clearly as was expected**.**

Only 1 of 11 Android users said, however, that he watched the smartphone market on a regular basis and two others said they watched the smartphone market

occasionally; two Android users said they watched new technologies in general, but neither said they would be interested in smartphones very much. Among iOS users, 1/14 said he watched the smartphone market for "both being really interested and having to", one said he did not watch the smartphone market in detail but that he likes to watch smartphone reviews on YouTube. This user said to "watch Apple though", just as 3 other iOS users who do not watch the smartphone market otherwise. Two Android users and three iOS users said they get some information by hearsay. Nevertheless, **H4 could not be confirmed,** and it could be said that slightly more Apple users showed interest in the world of their smartphones. It was interesting that 2 iOS users also said they "used to" watch the smartphone market; and 1 Android user and 1 iOS user said they "purposefully ignored" the smartphone market.

3 of 14 iOS users mentioned they wanted an iPhone after seeing others being very satisfied with them, one additional Android user was planning to switch to iOS for the same reason; the same user also said that she bought her current Android phone after having her relative choose for her. A similar effect was not observed in the Android world: no Android user said they would base their smartphone choice on seeing others being satisfied or getting recommendations from hearsay (apart from one long-time Android and Samsung user mentioning his wife being satisfied with Samsung and the iOS user owning an Android, who also asked for help choosing the Android). Interestingly, one iOS user also said that while he researches on his own a lot when buying an Android phone, he asked colleagues for help with choosing his iPhone. **H5 was confirmed** as the phenomenon existed among the iOS users and the person planning to become one and did not become apparent among Android users.

6.5.3 Other observations and discussion

- As mentioned, one Android user said she planned to get an iPhone to be her next phone, saying that although she does not see such a difference between the two platforms, the experience of others convinced her; and being very happy with her Mac, she said she "just trusts" Apple. This further confirms the H5 and shows the influence of the Apple brand. Additionally, one user said he was "seriously considering" buying an iPhone to be able to (buy and) use an LTE-enabled Apple Watch, so he would not have to carry his phone around – showing the ingenuity and attraction of the Apple ecosystem. The

"device network effect" may work reversibly as well, though: 5 Android users said that they did not have an iPhone for not being in this ecosystem (and not planning to), one even called this *"a barrier I do not need nor want to overcome"*.

- There was no iOS user considering switching to Android, there was only one ex-iOS user among the Android users, whose reason to switch was mostly that *"the iPhones started being disproportionately pricey"*. Two iOS users had Androids as their private phones, one saying she would buy an Android if she was buying a smartphone herself, the other said *"I don't need to fool around with iPhones, I just need it at the moment"*.
- Most iOS users seemed quite loyal and "more convinced" than Android users in line with the presented previous research and AttrakDiff results, and several manifested certain Apple brand satisfaction. Interesting was the case of Samsung, which seemed to trigger different emotions: while 5 Android users manifested loyalty to and long-time good experience with Samsung, two Android users and one of the iOS users owning an Android explicitly said they hated Samsungs. The iOS user who loved the design of iPhones and hated Androids' looks admitted that Samsung is the only competition to iPhones in terms of design.
- One Android user specified that she uses Android because of its synergy with Windows she is a loyal user of, and an additional one mentioned utilising the Windows-Android synergy after the interview as well. Inversely, there was an iOS user who was very satisfied with the iPhone despite using Windows.
- An additional interesting phenomenon that emerged among iOS users was the appreciation of decision paralysis reduction, which is in part another factor of preference and in part a sign of specific information behaviour. These users explicitly appreciated that owning an iPhone or owning Apple devices in general allows them not to have to choose from many options when buying a new device; one using the term I adopted *("Mac reduced a lot of my decision paralyses and iPhone brought this to me, too. I have the Apple ecosystem because I know I can rely on it and there are just a few devices I have to make choices between.*"), the other appreciating "not having to scan ⅔ of the market to buy a phone" and the third calling it "minimalism" (*"I also like Apple because I'm a minimalist, I can have a world where the computer is Mac, a phone is an iPhone, I can rely on it, it works well together, I'm not overwhelmed by many different brands.")*

- In general, it seemed that both user groups were very satisfied with their phones. There were several iOS users with bad experience with Android phones, but always several years old, and it was not further investigated what models (brand, price category) they used to have. Apart from the Android user who is planning to switch to iPhone, no current Android users seemed to complain about or be dissatisfied with their phones.

6.6 Limitations

There are several limitations to this study. First, the study was qualitative on a relatively small sample (25 participants), hence, its results cannot be generalised; it only provides an in-depth insight and explanations of certain phenomena, but it may inspire further research as further discussed below.

Furthermore, as already discussed, the sample could have been more diverse; the study provides an insight to preferences and information behaviour of this specific group of people with IT background (and mostly from one firm) in vast majority. It would be interesting to conduct this study among people of different professional and social backgrounds as well; already the participants with marketing background seemed to provide an insight to a world where this technological battle seemed to be perceived in a different light (I suspect the peer-pressure to have an Apple device could be stronger there). Also very interesting could be to investigate the perception of smartphones among children, which was suggested by one of the participants, who (after the interview) said his children cared about others' smartphones significantly, while his peers did not[35].

Several methodological limitations were found as well. One was the fact the AttrakDiff questionnaire was translated to Czech, possibly further distancing the word-pair meanings from the original (already Takahashi and Nebe (2019) admitted the possibility of the official English translation I based the Czech translation on changing the meanings a little from the Hassenzahl's German original). Field for feedback on AttrakDiff was provided to participants in the form, and some participants said that some word-pairs seemed confusing or repetitive, or that they did not know what to imagine under the words when talking about their smartphones. Finally, the AttrakDiff could have been utilised more, perhaps the

[35] Also a friend of mine who is teaching English to children privately told me her students were asking her which iPhone she had and mocked her for "having just a 6S".

interview could have been started with having the participants select and talk about qualities in AttrakDiff word-pairs that describe their smartphone preferences the most (taking inspiration from Microsoft React Cards), which could have provided additional insight. Nevertheless, AttrakDiff was a very useful tool to assess the participants' general attitudes and I believe that filling in the AttrakDiff questionnaire helped participants think about their smartphone preferences from different perspectives, which some of them said themselves.

A lot of insight into user preferences was provided, nevertheless, some phenomenons may have not been given enough space to come to the surface in the prepared questions; I cannot rule out that some preference factors are also very important to the users, but simply do not mention them as prominent or at all despite best effort to provide the space for realisation (especially some hedonic aspects, as Hassenzahl and Diefenbach (2011, 2019) suggest that people tend to not think about the hedonic qualities when articulating their preferences). Additionally, the interview design could have gone more in-depth and be more specific in the questions targeting the information behaviour, allowing to discuss it more in relation to the previously presented models.

6.7 Future research

The presented study raises several topics that could be investigated in future research.

As already discussed, the research design could be improved in some aspects of the discussed limitations and the study could be conducted with participants from more professional and social backgrounds, and also children. The study could also benefit from better targeting of the sample; apart from different professional and social backgrounds, the "hardcore fans" of both platforms could be targeted as well (here, it was not a purpose).

Seeing many iOS users having an old bad user experience with Androids, an interesting experiment would be to target such people and have them use Android phones competitive to iPhones over a prolonged period of time to test whether they would change their opinion about Androids.

Finally, future research could investigate a better empirical method or model to assess the real driving factors behind product preferences, also possibly to be able to study this topic quantitatively as well (the qualitative approach of this study allowed to discover more phenomena that could be studied). I attempted to develop such a model but found it would be out of scope of this thesis to test this model enough to be able to base my findings on it.

7. Conclusion

This thesis provides a critical overview of the "Android versus iOS battle" from various perspectives.

The platforms are presented in the historic context of interaction evolution, evolution of HCI as a field including UCD, HCD and UX; and the evolution of the smartphone market itself. Terms of operating systems, ecosystems and platforms and their differences are explained, Android and iOS platforms themselves are compared in different aspects; and also the research on their user bases is presented. Apart from the theoretical background of HCI and UX, operating systems, ecosystems and platforms, also the core concepts of information and consumer behaviour are explained.

The presented empirical study examines the differences between Android and iOS users from the perspective of UX and information behaviour. In the sample, users of both groups have relatively good and comparable user experience with their phones (and their platforms), only iOS users seemed to be slightly more satisfied in both hedonic and pragmatic aspects. It was not confirmed Android users would base their platform preference on more pragmatic aspects of user experience, and both Android and iOS users seemed to have very pragmatic reasons to choose smartphones they have. These preferences had only a different nature: while Android users appreciated the choice in various specific technical specifications more often, the iOS users talked about the overall usability of the platform. Nor was it confirmed that iOS users would base their platform preference on more hedonic aspects of user experience; almost none mentioned they would want their smartphone to be a status symbol, and moreover, there were more Android users who mentioned design importance. It was also found that Android users seek more information at the time of purchase of a new smartphone and that several iOS users based their platform choice on observing others having a good experience with it, while a similar effect was not observed among Android users. It did not seem that Android users were interested in the smartphone market more than iOS users in general, however.

The contribution of this thesis to academic literature lies, apart from the content itself, also in bridging the several research fields and its holistic approach; to my

knowledge, UX is not commonly studied together with information behaviour, and furthermore, while consumer research acknowledges experience as an important factor to consumer behaviour, at least in the studies I reviewed for this thesis, it does not go in depth with examining it using the tools the UX research field offers.

References

Adams, Edie, M.E. Des, and Elizabeth B-N Sanders. 1995. "An Evaluation of the Fun Factor for the Microsoft Easyball Mouse." *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* 39 (5): 311–15. https://doi.org/10.1177/154193129503900504.

Adner, Ron. 2016. "Ecosystem as Structure." *Journal of Management* 43 (1): 39–58. https://doi.org/10.1177/0149206316678451.

Ahmad, Majeed. 2011. *Smartphone: Mobile Revolution at the Crossroads of Communications, Computing and Consumer Electronics*. North Charleston, South Carolina: Createspace.

Ahtola, Olli T. 1985. "Hedonic and Utilitarian Aspects of Consumer Behavior: An Attitudinal Perspective." *ACR North American Advances* NA-12. https://www.acrwebsite.org/volumes/6348/volumes/v12/NA-.

Akkucuk, Ulas, and Javed Esmaeili. 2016. "The Impact of Brands on Consumer Buying Behavior." *International Journal of Research in Business and Social Science (2147-4478)* 5 (4): 1–16. https://doi.org/10.20525/ijrbs.v5i4.551.

Ali, Mohamed, Mona Erfani Joorabchi, and Ali Mesbah. 2017. "Same App, Different App Stores: A Comparative Study." IEEE Xplore. May 1, 2017. https://doi.org/10.1109/MOBILESoft.2017.3.

Alza. n.d. "Mobile Phones, Mobiles | Alza.co.uk." Alza. Accessed July 25, 2021. https://www.alza.co.uk/mobile-phones/18843445.htm.

Amorim, Marta Maria Rodrigues Pessoa de. 2017. "Hedonic and Utilitarian Attitudes towards Technology and Innovation : Purchase Intentions of Audio Devices : The AirPods Case." *Core.ac.uk*. https://doi.org/oai:repositorio.ucp.pt:10400.14/22128.

Ann, Bao Yi, Chun Mei Chen, and Hsian Ming Liu. 2018. "Product Attributes and Purchase Intention for Smartphones: A Moderated Mediation Model." *International Journal of Mobile Communications* 16 (1): 1. https://doi.org/10.1504/ijmc.2018.10005322.

Apple. 2019a. "IPhone." Apple (United Kingdom). 2019. https://www.apple.com/uk/iphone/.

———. 2019b. "Privacy." Apple. 2019. https://www.apple.com/privacy/.

———. n.d. "IPadOS 14." Apple. https://www.apple.com/ipados/ipados-14/.

Araz, Caglar. 2018. "Why You Should Ditch Your UX Definition, and Use This One Instead." Medium. UX Collective. March 15, 2018. https://uxdesign.cc/we-have-lost-track-of-what-ux-actually-means-8d55259dacb0.

Attri, Rekha, Shreta Maheshwari, and Vijit Sharma. 2017. "Customer Purchase Behavior for Smartphone Brands." Papers.ssrn.com. Rochester, NY. June 1, 2017. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3214320.

Bandura, Albert. 1977. "Self-Efficacy: Toward a Unifying Theory of Behavioral Change." *Psychological Review* 84 (2): 191–215. https://doi.org/10.1037/0033-295x.84.2.191.

Batra, Rajeev, and Olli T. Ahtola. 1990. "Measuring the Hedonic and Utilitarian Sources of Consumer Attitudes." *Marketing Letters* 2 (2): 159–70. https://doi.org/10.1007/bf00436035.

Becker, Larissa, and Elina Jaakkola. 2020. "Customer Experience: Fundamental Premises and Implications for Research." *Journal of the Academy of Marketing Science* 48 (4): 630–48. https://doi.org/10.1007/s11747-019-00718-x.

Benedek, Joey, and Trish Miner. 2002. "Measuring Desirability: New Methods for Evaluating Desirability in a Usability Lab Setting." In *Conference Proceedings*. Usability Professionals' Association.

Berdasco, López, Diaz, Quesada, and Guerrero. 2019. "User Experience Comparison of Intelligent Personal Assistants: Alexa, Google Assistant, Siri and Cortana." *Proceedings* 31 (1): 51. https://doi.org/10.3390/proceedings2019031051.

Bertrand, Marianne, and Emir Kamenica. 2018. "Coming Apart? Cultural Distances in the United States over Time." *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3208730.

Bevan, Nigel. 2009. “What Is the Difference between the Purpose of Usability and User Experience Evaluation Methods?” *INTERACT 2009*. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.460.6252&rep=rep1&type=pdf.

Bevan, Nigel, Jim Carter, Jonathan Earthy, Thomas Geis, and Susan Harker. 2016. “New ISO Standards for Usability, Usability Reports and Usability Measures.” *Lecture Notes in Computer Science*, 268–78. https://doi.org/10.1007/978-3-319-39510-4_25.

Bhutani, Dhruv. 2020. “Apple’s Singular Vision for the Future Should Be a Wake up Call for Google.” Android Authority. August 1, 2020. https://www.androidauthority.com/google-vs-apple-ecosystem-1132801/.

Bidgoli, Hossein, and Andrew Prestage. 2003. “Operating Systems.” *Encyclopedia of Information Systems*, 377–90. https://doi.org/10.1016/b0-12-227240-4/00126-x.

Bødker, Susanne. 1991. “Through the Interface - a Human Activity Approach to User Interface Design.” *DAIMI Report Series* 16 (224). https://doi.org/10.7146/dpb.v16i224.7586.

———. 2006. “When Second Wave HCI Meets Third Wave Challenges.” *Proceedings of the 4th Nordic Conference on Human-Computer Interaction Changing Roles - NordiCHI ’06*. https://doi.org/10.1145/1182475.1182476.

———. 2015. “Third-Wave HCI, 10 Years Later---Participation and Sharing.” *Interactions* 22 (5): 24–31. https://doi.org/10.1145/2804405.

Bødker, Susanne, and Clemens Nylandsted Klokmose. 2011. “The Human–Artifact Model: An Activity Theoretical Approach to Artifact Ecologies.” *Human–Computer Interaction* 26 (4): 315–71. https://doi.org/10.1080/07370024.2011.626709.

Bogost, Ian, and Nick Montfort. 2009. “Platform Studies: Frequently Questioned Answers.” *Escholarship.org*, December. https://escholarship.org/uc/item/01r0k9br.

Botti, Simona, and Ann L. McGill. 2011. “The Locus of Choice: Personal Causality and Satisfaction with Hedonic and Utilitarian Decisions.” *Journal of Consumer Research* 37 (6): 1065–78. https://doi.org/10.1086/656570.

Bratton, Benjamin H. 2016. *The Stack: On Software and Sovereignty*. Cambridge, Massachusetts: The Mit Press.

Brinkmann, Svend. 2020. “Unstructured and Semistructured Interviewing.” In *The Oxford Handbook of Qualitative Research*, edited by Patricia Leavy, 423–56. https://doi.org/10.1093/oxfordhb/9780190847388.013.22.

Brown, C. Scott. 2018. “Chrome OS 71 Is All about Synergy between Your Chromebook and Phone.” Android Authority. December 14, 2018. https://www.androidauthority.com/chrome-os-71-934978/.

———. 2021. “Android 12 Redesign: The Biggest Revamp in Years.” Android Authority. May 18, 2021. https://www.androidauthority.com/android-12-redesign-1225716/.

Brown, Haakon T. 2012. “So What If I Dont Have an IPhone? The Unintended Consequences of Using Arrogance in Advertising.” *Journal of Applied Business Research (JABR)* 28 (4): 555. https://doi.org/10.19030/jabr.v28i4.7040.

Brown, Lauren, and Ellis Hamburger. 2011. “THE GREAT DEBATE: Here’s What Tech Gurus, Entrepreneurs, and CEOs Think of Android vs. IPhone.” Business Insider. December 1, 2011. https://www.businessinsider.com/android-vs-iphone-debate-quotes-2011-12.

Butler, Margaret. 2011. “Android: Changing the Mobile Landscape.” *IEEE Pervasive Computing* 10 (1): 4–7. https://doi.org/10.1109/mprv.2011.1.

Campbell, Heidi A., and Antonio C. La Pastina. 2010. “How the IPhone Became Divine: New Media, Religion and the Intertextual Circulation of Meaning.” *New Media & Society* 12 (7): 1191–1207. https://doi.org/10.1177/1461444810362204.

Campbell-Kelly, Martin, Daniel Garcia-Swartz, Richard Lam, and Yilei Yang. 2015. “Economic and Business Perspectives on Smartphones as Multi-Sided Platforms.” *Telecommunications Policy* 39 (8): 717–34. https://doi.org/10.1016/j.telpol.2014.11.001.

Can, Yesim, and Oya Erdil. 2018. “Determining Antecedent of Re-Purchase Intention: The Role of Perceived Value and Consumer’s Interest Factor.” *International Business Research* 11 (4): 17. https://doi.org/10.5539/ibr.v11n4p17.

Card, Stuart K, Thomas P Moran, and Allen Newell. 1983. *The Psychology of Human-Computer Interaction*. Hillsdale, N.J.: L. Erlbaum Associates.

Carey, Conner. 2021. "The Evolution of the IPhone: Every Model from 2007–2020." IPhoneLife.com. April 8, 2021. https://www.iphonelife.com/content/evolution-iphone-every-model-2007-2016.

Carman, Ashley. 2019. "Why Apple Gives Android Users a Green Bubble in IMessage." The Verge. May 15, 2019. https://www.theverge.com/2019/5/15/18624681/apple-imessage-android-blue-green-bubble-color-meaning-whyd-you-push-that-button-podcast.

Carroll, John M. 2003. *HCI Models, Theories, and Frameworks : Toward a Multidisciplinary Science*. San Francisco, Calif.: Morgan Kaufmann.

Carroll, John M., and John M. Thomas. 1988. "FUN." *ACM SIGCHI Bulletin* 19 (3): 21–24. https://doi.org/10.1145/49108.1045604.

Chan Kim, W., and Renée Mauborgne. 2005. "Value Innovation: A Leap into the Blue Ocean." *Journal of Business Strategy* 26 (4): 22–28. https://doi.org/10.1108/02756660510608521.

Chen, Chun-Mei, and Bao-Yi Ann. 2014. "Efficiencies vs. Importance-Performance Analysis for the Leading Smartphone Brands of Apple, Samsung and HTC." *Total Quality Management & Business Excellence* 27 (3-4): 227–49. https://doi.org/10.1080/14783363.2014.976937.

Chen, Yu-Syuan, Tso-Jen Chen , and Cheng-Che Lin. 2016. "The Analyses of Purchasing Decisions and Brand Loyalty for Smartphone Consumers." *Open Journal of Social Sciences* 04 (07): 108–16. https://doi.org/10.4236/jss.2016.47018.

Chitturi, Ravindra, Rajagopal Raghunathan, and Vijay Mahajan. 2008. "Delight by Design: The Role of Hedonic versus Utilitarian Benefits." *Journal of Marketing* 72 (3): 48–63. https://doi.org/10.1509/jmkg.72.3.048.

Chochoiek, Nadine. 2017. "Explaining the Success of User-Centered Design - an Empirical Study across German B2C Firms." *Junior Management Science* 2 (1). https://doi.org/10.5282/jums/v2i1pp81-116.

Christensen, Clayton M., Michael E. Raynor, and Rory McDonald. 2015. "What Is Disruptive Innovation?" Harvard Business Review. December 2015. https://hbr.org/2015/12/what-is-disruptive-innovation.

Christensen, Seth Y., Joan Dickinson, Kristin Machac, and Holly Cline. 2020. "Define UX Design." *2020 Intermountain Engineering, Technology and Computing (IETC)*, October. https://doi.org/10.1109/ietc47856.2020.9249146.

Chun, Heasun, Hyunjoo Lee, and Daejoong Kim. 2012. "The Integrated Model of Smartphone Adoption: Hedonic and Utilitarian Value Perceptions of Smartphones among Korean College Students." *Cyberpsychology, Behavior, and Social Networking* 15 (9): 473–79. https://doi.org/10.1089/cyber.2012.0140.

Churchill, Elizabeth F., Anne Bowser, and Jennifer Preece. 2013. "Teaching and Learning Human-Computer Interaction." *Interactions* 20 (2): 44. https://doi.org/10.1145/2427076.2427086.

Cicero, Simone. 2020. "Experience Platforms: Staging Experiences through an Ecosystem — with B Joseph Pine II." Boundaryless – Medium. November 30, 2020. https://stories.platformdesigntoolkit.com/experience-platforms-staging-experiences-through-an-ecosystem-with-b-joseph-pine-ii-9238ca1f91a5.

Clarivate Analytics. n.d. "Web of Science." Webofknowledge.com. https://www.webofknowledge.com.

Clemmensen, Torkil, Morten Hertzum, Jiaoyan Yang, and Yanan Chen. 2013. "Do Usability Professionals Think about User Experience in the Same Way as Users and Developers Do?" *Human-Computer Interaction – INTERACT 2013*, 461–78. https://doi.org/10.1007/978-3-642-40480-1_31.

Cooke, Thomas N. 2020. "Metadata, Jailbreaking, and the Cybernetic Governmentality of IOS: Or, the Need to Distinguish Digital Privacy from Digital Privacy." *Surveillance & Society* 18 (1): 90–103. https://doi.org/10.24908/ss.v18i1.13118.

Cooper, Alan, Robert Reimann, and Dave Cronin. 2007. *About Face : The Essentials of Interaction Design*. Indianapolis, In: John Wiley And Sons.

Cooper, Daniel. 2018. "You Can't Buy an Ethical Smartphone Today." Engadget. February 6, 2018. https://www.engadget.com/2018-02-06-ethical-smartphone-conscious-consumption.html.

Cornell University. 2018. “Network Effect and Apple IMessage : Networks Course Blog for INFO 2040/CS 2850/Econ 2040/SOC 2090.” November 28, 2018. https://blogs.cornell.edu/info2040/2018/11/28/network-effect-and-apple-imessage/.

Cotroneo, Domenico, Antonio Ken Iannillo, and Roberto Natella. 2019. “Evolutionary Fuzzing of Android OS Vendor System Services.” *Empirical Software Engineering* 24 (6): 3630–58. https://doi.org/10.1007/s10664-019-09725-6.

Cunningham, Andrew. 2019. “IPhone vs. Android: Which Is Better for You?” *The New York Times*, October 31, 2019. https://www.nytimes.com/wirecutter/reviews/ios-vs-android/.

Curtis, Ambrose. 2015. “"RHETORIC of FLAT DESIGN and SKEUOMORPHISM in APPLE’S IOS GRAPHICAL USER INTERFACE.” Master’s Thesis. https://digitalcommons.uri.edu/theses/638.

Czech Statistical Office. 2020. “Jednotlivci v ČR Používající Mobilní Telefon, 2020.” *Czech Statistical Office*. https://www.czso.cz/documents/10180/90577057/062004190501.pdf/1a2cc5ff-73ef-4b13-9c6d-bbbfc218e2ab?version=1.1.

Dam, Rikke. 2019. “Improve Customer Experience with UX Investments That Increase ROI.” The Interaction Design Foundation. UX courses. April 30, 2019. https://www.interaction-design.org/literature/article/improve-customer-experience-with-ux-investments-that-increase-roi.

Dervin, Brenda. 1999. “On Studying Information Seeking Methodologically: The Implications of Connecting Metatheory to Method.” *Information Processing & Management* 35 (6): 727–50. https://doi.org/10.1016/s0306-4573(99)00023-0.

Deuze, Mark, and IzdnáPetra. 2015. *Media Life = Život v Médiích*. Praha: Univerzita Karlova v Praze, Nakladatelství Karolinum.

Diefenbach, Sarah, and Marc Hassenzahl. 2011. “The Dilemma of the Hedonic – Appreciated, but Hard to Justify.” *Interacting with Computers* 23 (5): 461–72. https://doi.org/10.1016/j.intcom.2011.07.002.

———. 2019. “Combining Model-Based Analysis with Phenomenological Insight: A Case Study on Hedonic Product Quality.” *Qualitative Psychology* 6 (1): 3–26. https://doi.org/10.1037/qup0000096.

Diefenbach, Sarah, Nina Kolb, and Marc Hassenzahl. 2014. “The ‘Hedonic’ in Human-Computer Interaction.” *Proceedings of the 2014 Conference on Designing Interactive Systems - DIS ’14*. https://doi.org/10.1145/2598510.2598549.

DiGangi, Joseph, and Pham Thi Minh Hang. 2018. “Your Cool New Samsung Smartphone Brought to You by Noise, Pain and Miscarriages.” USA TODAY. March 14, 2018. https://eu.usatoday.com/story/opinion/2018/03/14/your-cool-new-samsung-smartphone-brought-you-noise-pain-miscarriages-pham-digangi-column/397173002/.

Doffman, Zak. 2021. “No, Your IPhone Is Not More Secure than Android, Warns Cyber Billionaire.” Forbes. March 16, 2021. https://www.forbes.com/sites/zakdoffman/2021/03/16/iphone-12-pro-max-and-iphone-13-not-more-secure-than-google-and-samsung-android-warns-cyber-billionaire/?sh=583d617123f8.

Dourish, Paul. 2001. *Where the Action Is the Foundations of Embodied Interaction*. The Mit Press.

Duarte, Emanuel Felipe, and M. Cecília C. Baranauskas. 2016. “Revisiting the Three HCI Waves.” *Proceedings of the 15th Brazilian Symposium on Human Factors in Computer Systems - IHC ’16*. https://doi.org/10.1145/3033701.3033740.

Duke, Kent. 2021. “Your Pixel and Chromebook Will Soon Work Even Better Together.” Android Police. June 30, 2021. https://www.androidpolice.com/2021/06/30/your-android-phone-and-chromebook-are-about-to-work-even-better-together/.

Dutta, Amitava, Abhinay Puvvala, Rahul Roy, and Priya Seetharaman. 2017. “Technology Diffusion: Shift Happens — the Case of IOS and Android Handsets.” *Technological Forecasting and Social Change* 118 (May): 28–43. https://doi.org/10.1016/j.techfore.2017.01.024.

Eisenmann, Thomas R. 2008. “Managing Proprietary and Shared Platforms.” *California Management Review* 50 (4): 31–53. https://doi.org/10.2307/41166455.

Elgin, Ben. 2011. “Google Buys Android for Its Mobile Arsenal.” Web.archive.org / Bloomberg Businessweek. February 5, 2011.

https://web.archive.org/web/20110205190729/http://www.businessweek.com/technology/content/aug2005/tc20050817_0949_tc024.htm.

Ellis, David. 1989. "A Behavioural Approach to Information Retrieval System Design." *Journal of Documentation* 45 (3): 171–212. https://doi.org/10.1108/eb026843.

Ellis, David, and Merete Haugan. 1997. "Modelling the Information Seeking Patterns of Engineers and Research Scientists in an Industrial Environment." *Journal of Documentation* 53 (4): 384–403. https://doi.org/10.1108/eum0000000007204.

Elsevier. 2012. "ScienceDirect.com | Science, Health and Medical Journals, Full Text Articles and Books." Sciencedirect.com. 2012. https://www.sciencedirect.com.

Estes, Phil. 2018. "Linux vs. Unix: What's the Difference?" Opensource.com. 2018. https://opensource.com/article/18/5/differences-between-linux-and-unix.

Evans, David S. 2003. "The Antitrust Economics of Multi-Sided Platform Markets." *Yale Journal on Regulation* 20 (2): 325. https://heinonline.org/HOL/LandingPage?handle=hein.journals/yjor20&div=13&id=&page=.

Ferenc, Jakub. 2018. "Postkognitivistické HCI: Vidět Interface Jako Sociotechnický Vztah." *Dspace.cuni.cz*, September. https://dspace.cuni.cz/handle/20.500.11956/101729.

Filieri, Raffaele, and Zhibin Lin. 2017. "The Role of Aesthetic, Cultural, Utilitarian and Branding Factors in Young Chinese Consumers' Repurchase Intention of Smartphone Brands." *Computers in Human Behavior* 67 (February): 139–50. https://doi.org/10.1016/j.chb.2016.09.057.

Forlizzi, Jodi, and Katja Battarbee. 2004. "Understanding Experience in Interactive Systems." *Proceedings of the 2004 Conference on Designing Interactive Systems Processes, Practices, Methods, and Techniques - DIS '04*. https://doi.org/10.1145/1013115.1013152.

Friedman, Alan. 2019. "Video Shows How Android Grew to Dominate the Global Mobile OS Market." Phone Arena. October 13, 2019. https://www.phonearena.com/news/Watch-how-Android-grabbed-85-percent-of-the-mobile-opersting-system-market_id119622.

Garg, Shivi, and Niyati Baliyan. 2021. "Comparative Analysis of Android and IOS from Security Viewpoint." *Computer Science Review* 40 (May): 100372. https://doi.org/10.1016/j.cosrev.2021.100372.

Gartenberg, Chaim. 2020. "All the New Features IOS 14 Borrows from Android." The Verge. June 23, 2020. https://www.theverge.com/21299641/apple-ios-14-vs-android-11-features-beta-iphone-google.

Gawer, Annabelle, and Michael A. Cusumano. 2002. *Platform Leadership: How Intel, Microsoft, and Cisco Drive Industry Innovation*. *Amazon*. Harvard Business Review Press. https://www.amazon.com/Platform-Leadership-Microsoft-Industry-Innovation/dp/1578515149.

Giachetti, Claudio. 2017. "Explaining Apple's IPhone Success in the Mobile Phone Industry: The Creation of a New Market Space." *Smartphone Start-Ups*, November, 9–48. https://doi.org/10.1007/978-3-319-67973-0_2.

Gibbs, Samuel. 2017. "IPhone X: Thousands Queue as Apple Proves It Still Has the X Factor." *The Guardian*, November 3, 2017, sec. Technology. https://www.theguardian.com/technology/2017/nov/03/iphone-x-apple-thousands-queue-overnight-fans.

Gilski, Przemyslaw, and Jacek Stefański. 2015. "Android OS: A Review." *TEM Journal* 4 (1): 116–20. https://www.ceeol.com/search/article-detail?id=788006.

Goldman, David. 2015. "'Over My Dead Body:' the Pencil and Four Other Things Steve Jobs Would Hate." CNNMoney. September 10, 2015. https://money.cnn.com/2015/09/10/technology/apple-pencil-steve-jobs-stylus/index.html.

Goodin, Dan. 2021. "Android Sends 20x More Data to Google than IOS Sends to Apple, Study Says." Ars Technica. March 30, 2021. https://arstechnica.com/gadgets/2021/03/android-sends-20x-more-data-to-google-than-ios-sends-to-apple-study-says/.

Google. n.d. "Android One: Secure, Up-To-Date and Easy to Use." Android. Accessed July 25, 2021. https://www.android.com/one/.

———. n.d. "Google." Google.com. https://www.google.com.

———. n.d. "Google Forms - Create and Analyze Surveys, for Free." Google Forms. Accessed July 25, 2021. https://docs.google.com/forms/u/0/?usp=direct_url.

———. n.d. “Google Scholar.” Google.com. https://scholar.google.com/.

———. n.d. “Updating Google Photos’ Storage Policy to Build for the Future.” Google. Accessed July 9, 2021. https://blog.google/products/photos/storage-changes/.

Götz, Friedrich M., Stefan Stieger, and Ulf-Dietrich Reips. 2017. “Users of the Main Smartphone Operating Systems (IOS, Android) Differ Only Little in Personality.” Edited by Susana Jiménez-Murcia. *PLOS ONE* 12 (5): e0176921. https://doi.org/10.1371/journal.pone.0176921.

Gozalvez, Javier. 2008. “First Google’s Android Phone Launched [Mobile Radio].” *IEEE Vehicular Technology Magazine* 3 (4): 3–69. https://doi.org/10.1109/mvt.2008.931524.

Greene, Daniel, and Katie Shilton. 2017. “Platform Privacies: Governance, Collaboration, and the Different Meanings of ‘Privacy’ in IOS and Android Development.” *New Media & Society* 20 (4): 1640–57. https://doi.org/10.1177/1461444817702397.

Grudin, Jonathan. 1989. “The Computer Reaches Out: The Historical Continuity of Interface Design.” *DAIMI Report Series* 18 (299). https://doi.org/10.7146/dpb.v18i299.6693.

———. 2012. “A Moving Target—the Evolution of Human-Computer Interaction.” In *Human Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications, Third Edition*, edited by Julia A. Jacko. Taylor & Francis.

Hamed, Tarfa, Rozita Dara, and Stefan C. Kremer. 2017. “Intrusion Detection in Contemporary Environments.” *Computer and Information Security Handbook*, 109–30. https://doi.org/10.1016/b978-0-12-803843-7.00006-5.

Harrison, Steve, Phoebe Sengers, and Deborah Tatr. 2007. “The Three Paradigms of HCI.” In . https://people.cs.vt.edu/~srh/Downloads/TheThreeParadigmsofHCI.pdf.

Hassenzahl, Marc. 2001. “The Effect of Perceived Hedonic Quality on Product Appealingness.” *International Journal of Human-Computer Interaction* 13 (4): 481–99. https://doi.org/10.1207/s15327590ijhc1304_07.

———. 2003. “The Thing and I: Understanding the Relationship between User and Product.” *Funology*, 31–42. https://doi.org/10.1007/1-4020-2967-5_4.

———. 2007. “The Hedonic/Pragmatic Model of User Experience.” *Towards a UX Manifesto*. https://www.academia.edu/2880396/The_hedonic_pragmatic_model_of_user_experience.

———. 2010. “Experience Design: Technology for All the Right Reasons.” *Synthesis Lectures on Human-Centered Informatics* 3 (1): 1–95. https://doi.org/10.2200/s00261ed1v01y201003hci008.

Hassenzahl, Marc, Michael Burmester, and Franz Koller. 2003. “AttrakDiff: Ein Fragebogen Zur Messung Wahrgenommener Hedonischer Und Pragmatischer Qualität.” *Berichte Des German Chapter of the ACM*, 187–96. https://doi.org/10.1007/978-3-322-80058-9_19.

Hassenzahl, Marc, and Noam Tractinsky. 2006. “User Experience - a Research Agenda.” *Behaviour & Information Technology* 25 (2): 91–97. https://doi.org/10.1080/01449290500330331.

Hassenzahl, Mare, Axel Platz, Michael Burmester, and Katrin Lehner. 2000. “Hedonic and Ergonomic Quality Aspects Determine a Software’s Appeal.” *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems - CHI ’00*. https://doi.org/10.1145/332040.332432.

Heijden, Hans van der. 2004. “User Acceptance of Hedonic Information Systems.” *MIS Quarterly* 28 (4): 695–704. https://doi.org/10.2307/25148660.

Hew, Jun-Jie, Mohd Nizam Bin A. Badaruddin, and M. Krishna Moorthy. 2017. “Crafting a Smartphone Repurchase Decision Making Process: Do Brand Attachment and Gender Matter?” *Telematics and Informatics* 34 (4): 34–56. https://doi.org/10.1016/j.tele.2016.12.009.

Hewett, Thomas, Ronald Baecker, Stuart Card, Tom Carey, Jean Gasen, Marilyn Mantei, Gary Perlman, Gary Strong, and William Verplank. 1992. *ACM SIGCHI Curricula for Human-Computer Interaction*. Association for Computing Machinery. https://doi.org/10.1145/2594128.

Hirschman, Elizabeth C, and Morris B Holbrook. 1982. “Hedonic Consumption: Emerging Concepts, Methods and Propositions.” *Journal of Marketing* 46 (3): 92–101. https://doi.org/10.2307/1251707.

Honan, Mat. 2013. “Remembering the Apple Newton’s Prophetic Failure and Lasting Impact.” WIRED. WIRED. August 5, 2013. https://www.wired.com/2013/08/remembering-the-apple-newtons-prophetic-failure-and-lasting-ideals/.

Hornbæk, Kasper, and Morten Hertzum. 2017. "Technology Acceptance and User Experience." *ACM Transactions on Computer-Human Interaction* 24 (5): 1–30. https://doi.org/10.1145/3127358.

IDEO.org. 2015. *The Field Guide to Human-Centered Design*. San Francisco, Calif: IDEO.

IGI Global. n.d. "What Is Brand Attachment | IGI Global." Www.igi-Global.com. Accessed July 18, 2021. https://www.igi-global.com/dictionary/brand-attachment/53761.

Isaacson, Walter. 2011. *Steve Jobs*. New York: Simon & Schuster.

Islam, Nayeem, and Roy Want. 2014. "Smartphones: Past, Present, and Future." *IEEE Pervasive Computing* 13 (4): 89–92. https://doi.org/10.1109/mprv.2014.74.

ISO. 2019a. "ISO 9241-11:2018(En) Ergonomics of Human-System Interaction — Part 11: Usability: Definitions and Concepts." Iso.org. 2019. https://www.iso.org/obp/ui/#iso:std:iso:9241:-11:ed-2:v1:en.

———. 2019b. "ISO 9241-220:2019(En) Ergonomics of Human-System Interaction — Part 220: Processes for Enabling, Executing and Assessing Human-centered Design within Organizations." Iso.org. 2019. https://www.iso.org/obp/ui/#iso:std:iso:9241:-220:ed-1:v1:en.

Jamalova, Maral, and Constantinovits Milán. 2019. "The Comparative Study of the Relationship between Smartphone Choice and Socio-Economic Indicators." *International Journal of Marketing Studies* 11 (3): 11. https://doi.org/10.5539/ijms.v11n3p11.

Jansen, Slinger, and Michael A. Cusumano. 2012. "Defining Software Ecosystems: A Survey of Software Platforms and Business Network Governance." *Software Ecosystems*, 13–28. https://doi.org/10.4337/9781781955635.00008.

Jesse James Garrett. 2011. *The Elements of User Experience : User-Centered Design for the Web and Beyond*. Berkeley, Ca: New Riders.

Jesson, Jill, and Fiona Lacey. 2006. "How to Do (or Not to Do) a Critical Literature Review." *Pharmacy Education* 6 (2): 139–48. https://doi.org/10.1080/15602210600616218.

Johnson, Allison. 2021. "The Six-Year-Old IPhone 6S Will Get IOS 15, and That Rules." The Verge. June 8, 2021. https://www.theverge.com/2021/6/8/22523351/ios-15-iphone-6s-plus-se-compatibility.

Johnson, Katherine, Yang Li, Hang Phan, Jason Singer, Hoang Trinh, and Trinh Hoang. 2012. "The Innovative Success That Is Apple, Inc." https://mds.marshall.edu/cgi/viewcontent.cgi?article=1420&context=etd.

Kapoor, Rahul, and Shiva Agarwal. 2017. "Sustaining Superior Performance in Business Ecosystems: Evidence from Application Software Developers in the IOS and Android Smartphone Ecosystems." *Organization Science* 28 (3): 531–51. https://doi.org/10.1287/orsc.2017.1122.

Kardes, Frank R, Maria L Cronley, and Thomas W Cline. 2011. *Consumer Behavior*. : Cengage Learning.

Kenney, Martin, and Bryan Pon. 2011. "Structuring the Smartphone Industry: Is the Mobile Internet OS Platform the Key?" *Journal of Industry, Competition and Trade* 11 (3): 239–61. https://doi.org/10.1007/s10842-011-0105-6.

Kim, Jinwoo, and Jae Yun Moon. 1998. "Designing towards Emotional Usability in Customer Interfaces—Trustworthiness of Cyber-Banking System Interfaces." *Interacting with Computers* 10 (1): 1–29. https://doi.org/10.1016/s0953-5438(97)00037-4.

Kim, Junghun, Hyunjoo Lee, and Jongsu Lee. 2020. "Smartphone Preferences and Brand Loyalty: A Discrete Choice Model Reflecting the Reference Point and Peer Effect." *Journal of Retailing and Consumer Services* 52 (January): 101907. https://doi.org/10.1016/j.jretconser.2019.101907.

Kleinman, Zoe. 2021. "Huawei Operating System Coming to Smartphones in Asia." *BBC News*, June 2, 2021, sec. Technology. https://www.bbc.com/news/technology-57316621.

Kling, Rob. 1977. "The Organizational Context of User-Centered Software Designs." *MIS Quarterly* 1 (4): 41. https://doi.org/10.2307/249021.

Kotapati, Bapu, Simon Mutungi, Melissa Newham, Jeff Schroeder, Shili Shao, and Melody Wang. 2020. "The Antitrust Case against Apple." *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3606073.

Kotler, Philip, Gary Armstrong, Lloyd C Harris, and Nigel Piercy. 2017. *Principles of Marketing European Edition*. 7th ed. Harlow Pearson.

Kovatcheva, Eugenia. 2018. “User Experience Design Models for Internet of Things.” *Serdica Journal of Computing* 12 (1-2): 65–82. http://serdica-comp.math.bas.bg/index.php/serdicajcomputing/article/view/320.

Krajci, Iggy, and Darren Cummings. 2013. “History and Evolution of the Android OS.” *Android on X86*, 1–8. https://doi.org/10.1007/978-1-4302-6131-5_1.

Kuhlthau, Carol Collier. 1994. *Seeking Meaning : A Process Approach to Library and Information Services*. Norwood, NJ: Ablex Publishing.

Kuhn, Thomas S. 1970. *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.

Kujala, Sari, Virpi Roto, Kaisa Väänänen-Vainio-Mattila, Evangelos Karapanos, and Arto Sinnelä. 2011. “UX Curve: A Method for Evaluating Long-Term User Experience.” *Interacting with Computers* 23 (5): 473–83. https://doi.org/10.1016/j.intcom.2011.06.005.

Kuniavsky, Mike. 2010. *Smart Things: Ubiquitous Computing User Experience Design*. Amsterdam ; Boston: Morgan Kaufmann Publisher.

Lamberg, Juha-Antti, Sandra Lubinaitė, Jari Ojala, and Henrikki Tikkanen. 2019. “The Curse of Agility: The Nokia Corporation and the Loss of Market Dominance in Mobile Phones, 2003–2013.” *Business History*, June, 1–47. https://doi.org/10.1080/00076791.2019.1593964.

Lazareska, Lazarela, and Kire Jakimovski. 2017. “Analysis of the Advantages and Disadvantages of Android and IOS Systems and Converting Applications from Android to IOS Platform and Vice Versa.” *American Journal of Software Engineering and Applications* 6 (5): 116. https://doi.org/10.11648/j.ajsea.20170605.11.

Leith, Douglas J. 2021. “Mobile Handset Privacy: Measuring the Data IOSand Android Send to Apple and Google,” March. https://www.scss.tcd.ie/doug.leith/apple_google.pdf.

Lenz, Eva, Marc Hassenzahl, and Sarah Diefenbach. 2017. “Aesthetic Interaction as Fit between Interaction Attributes and Experiential Qualities.” *New Ideas in Psychology* 47 (December): 80–90. https://doi.org/10.1016/j.newideapsych.2017.03.010.

Leskin, Paige. 2019. “I’ve Been Trying to Switch to an Android Phone for Months, but the IMessage Blue Bubble Won’t Let Me Leave.” Business Insider. September 26, 2019. https://www.businessinsider.com/apple-imessage-android-phone-texts-blue-green-bubble-status-symbol-2019-9.

Li, Wenbin, Youakim Badr, and Frédérique Biennier. 2012. “Digital Ecosystems.” *Proceedings of the International Conference on Management of Emergent Digital EcoSystems - MEDES ’12*. https://doi.org/10.1145/2457276.2457297.

Lialina, Olia. 2018. “RICH USER EXPERIENCE, UX and the DESKTOPIZATION of WAR.” *INTERFACE CRITIQUE JOURNAL* I. https://doi.org/10.11588/ic.2018.0.44737.

Lien, Yao-Nan. 2005. “Operating Systems.” *The Electrical Engineering Handbook*, 355–66. https://doi.org/10.1016/b978-012170960-0/50030-x.

Lima Fontao, Awdren de, Rodrigo Pereira dos Santos, and Arilo Claudio Dias-Neto. 2015. “Mobile Software Ecosystem (MSECO): A Systematic Mapping Study.” IEEE Xplore. July 1, 2015. https://doi.org/10.1109/COMPSAC.2015.121.

LinkedIn. n.d. “Don Norman.” Linkedin.com. https://www.linkedin.com/in/donnorman.

Liu, Shanhong. 2021. “Global Market Share Held by Operating Systems for Desktop PCs, from January 2013 to June 2021.” Statista. Statista. 2021. https://www.statista.com/statistics/218089/global-market-share-of-windows-7/.

Logan, Robert J. 1994. “Behavioral and Emotional Usability: Thomson Consumer Electronics.” In *Usability in Practice: How Companies Develop User-Friendly Products*, 59–82. Boston: Ap Professional.

Logan, Robert J., Sheila Augaitis, and Thomas Renk. 1994. “Design of Simplified Television Remote Controls: A Case for Behavioral and Emotional Usability.” *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* 38 (5): 365–69. https://doi.org/10.1177/154193129403800503.

Low, Cherlynn. 2021. “Google’s Commitment to Matter Could Unite the Fragmented Smart Home Industry.” Engadget. May 19, 2021. https://www.engadget.com/google-smart-home-io-2021-matter-nest-android-000026115.html.

Lucero, Andrés, Audrey Desjardins, Carman Neustaedter, Kristina Höök, Marc Hassenzahl, and Marta E. Cecchinato. 2019. "A Sample of One." *Companion Publication of the 2019 on Designing Interactive Systems Conference 2019 Companion*, June. https://doi.org/10.1145/3301019.3319996.

Lynn Anderson. 2021. "Samsung Galaxy S21 Ultra 5G (Exynos) Battery Review: Good Charging Efficiency." DXOMARK. May 10, 2021. https://www.dxomark.com/samsung-galaxy-s21-ultra-5g-exynos-battery-review-good-charging-time/.

Mahmoudi, Mehran, and Sarah Nadi. 2018. "The Android Update Problem." *Proceedings of the 15th International Conference on Mining Software Repositories*, May. https://doi.org/10.1145/3196398.3196434.

Malewicz, Michal. 2019. "Neumorphism in User Interfaces - UX Collective." Medium. UX Collective. December 17, 2019. https://uxdesign.cc/neumorphism-in-user-interfaces-b47cef3bf3a6.

Manovich, Lev. 2000. *The Language of New Media*. Cambridge: MIT Press.

Marc, Andreessen. 2007. "Analyzing the Facebook Platform, Three Weeks In." June 12, 2007. http://web.archive.org/web/20071021003047/blog.pmarca.com/2007/06/analyzing_the_f.html.

Marcus, Aaron. 2015. *HCI and User-Experience Design : Fast-Forward to the Past, Present, and Future*. London: Springer.

Martin, Alan. 2021. "IPhone vs Android: Which Is Best for You?" The Independent. March 17, 2021. https://www.independent.co.uk/extras/indybest/gadgets-tech/phones-accessories/iphone-vs-android-apple-b1817403.html.

McCarthy, John, and Peter Wright. 2004. "Technology as Experience." *Interactions* 11 (5): 42. https://doi.org/10.1145/1015530.1015549.

McGee, Patrick. 2021. "Subscribe to Read | Financial Times." Www.ft.com. June 3, 2021. https://www.ft.com/content/ff67e5a6-ca3e-42d2-98b8-01e656a6d396.

McGrenere, Joanna, and Gale Moore. 2000. "Are We All in the Same 'Bloat'?" *Proceedings of Graphics Interface 2000*, 187–96. https://doi.org/https://doi.org/10.20380/GI2000.25.

McIntyre, McIntyre, Arati Srinivasan, and Asda Chintakananda. 2021. "For Platforms, Durability Is the New Strategic Imperative." LSE Business Review. February 15, 2021. https://blogs.lse.ac.uk/businessreview/2021/02/15/for-platforms-durability-is-the-new-strategic-imperative/.

McKenzie, Pamela J. 2003. "A Model of Information Practices in Accounts of Everyday−Life Information Seeking." *Journal of Documentation* 59 (1): 19–40. https://doi.org/10.1108/00220410310457993.

McLuhan, Marshall. 1964. "Understanding Media: The Extensions of Man." *American Quarterly* 16 (4): 646. https://doi.org/10.2307/2711172.

Merchant, Brian. 2018. *The One Device: The Secret History of the IPhone*. London: Corgi Books.

Microsoft. n.d. "Explore Windows 10 OS, Computers, Apps, & More | Microsoft." Microsoft.com. https://www.microsoft.com/en-us/windows.

Minge, Michael, and Manfred Thüring. 2018. "Hedonic and Pragmatic Halo Effects at Early Stages of User Experience." *International Journal of Human-Computer Studies* 109 (January): 13–25. https://doi.org/10.1016/j.ijhcs.2017.07.007.

Moore, James F. 1993. "Predators and Prey: A New Ecology of Competition." Harvard Business Review. August 1993. https://hbr.org/1993/05/predators-and-prey-a-new-ecology-of-competition.

Moran, Kate. 2016. "Using the Microsoft Desirability Toolkit to Test Visual Appeal." Nielsen Norman Group. February 28, 2016. https://www.nngroup.com/articles/microsoft-desirability-toolkit/.

Myftari, Odhise. 2017. "Apple – 40 Years Product and Service Innovation, Lessons Learned from Their Success." *!E Student Researcher* 4 (1): 69–82.

Naumer, Charles, Karen E. Fisher, and Brenda Dervin. 2008. "SenseMaking: A Methodological Perspective." In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*.

Nielsen, Jakob. 2012. "Usability 101: Introduction to Usability." Nielsen Norman Group. January 3, 2012. https://www.nngroup.com/articles/usability-101-introduction-to-usability/.

Norman, Don. 2015. "Apple's Products Are Getting Harder to Use Because They Ignore the Principles of Design." Jnd.org. August 10, 2015.

https://jnd.org/apples_products_are_getting_harder_to_use_because_they_ignore_principles_of_design/.

Norman, Don, and Jakob Nielsen. n.d. "The Definition of User Experience (UX)." Nielsen Norman Group. Accessed June 26, 2021. https://www.nngroup.com/articles/definition-user-experience/.

Norman, Donald A. 1988. *The Psychology of Everyday Things*. New York: Basic Books.

———. 2002. *The Design of Everyday Things*. New York, New York: Basic Books.

———. 2004. *Emotional Design: Why We Love (or Hate) Everyday Things*. New York: Basic Books.

———. 2013. *The Design of Everyday Things: Revised and Expanded Edition*. The MIT Press.

Norman, Donald A, and Stephen W Draper. 1986. *User Centered System Design : New Perspectives on Human-Computer Interaction*. Hillsdale, N.J.: Lawrence Erlbaum.

Notion. n.d. "Notion – the All-In-One Workspace for Your Notes, Tasks, Wikis, and Databases." Notion. https://www.notion.so/.

Novac, Ovidiu Constantin, Mihaela Novac, Cornelia Gordan, Tamas Berczes, and Gyongyi Bujdoso. 2017. "Comparative Study of Google Android, Apple IOS and Microsoft Windows Phone Mobile Operating Systems." *2017 14th International Conference on Engineering of Modern Electric Systems (EMES)*, June. https://doi.org/10.1109/emes.2017.7980403.

Nykänen, Jussi, Virpi Tuunainen, Jouni Piispanen, and Tuure Tuunanen. 2015. "Social Influences in Consumers' Mobile Phone Switching Behavior." *AMCIS 2015 Proceedings*, June. https://aisel.aisnet.org/amcis2015/EndUser/GeneralPresentations/24/.

O'Dea, S. 2021. "Mobile Operating Systems' Market Share Worldwide from January 2012 to June 2021." Statista. Statista. 6, 2021. https://www.statista.com/statistics/272698/global-market-share-held-by-mobile-operating-systems-since-2009/.

O'Flaherty, Kate. 2021. "Apple Issues New Blow to Facebook with Stunning IPhone Privacy Move." Forbes. May 21, 2021. https://www.forbes.com/sites/kateoflahertyuk/2021/05/21/apple-issues-new-blow-to-facebook-with-stunning-iphone-privacy-move.

Okada, Erica Mina. 2005. "Justification Effects on Consumer Choice of Hedonic and Utilitarian Goods." *Journal of Marketing Research* 42 (1): 43–53. https://doi.org/10.1509/jmkr.42.1.43.56889.

Open Source Initiative. 2007. "The Open Source Definition | Open Source Initiative." Opensource.org. 2007. https://opensource.org/osd.

Parker, Geoffrey, Marshall W. Van Alstyne, and Xiaoyue Jiang. 2016. "Platform Ecosystems: How Developers Invert the Firm." *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2861574.

Pidun, Ulrich, Martin Reeves, and Maximilian Schüssler. 2019. "Do You Need a Business Ecosystem?" BCG Global. September 27, 2019. https://www.bcg.com/publications/2019/do-you-need-business-ecosystem.

Pine, B. Joseph, and James H. Gilmore. 2013. "The Experience Economy: Past, Present and Future." In *Handbook on the Experience Economy*, 21–44. https://doi.org/10.4337/9781781004227.00007.

Pine, Joseph, and James Gilmore. 1998. "Welcome to the Experience Economy." Harvard Business Review. August 1998. https://hbr.org/1998/07/welcome-to-the-experience-economy.

Prentice, Deborah A. 1987. "Psychological Correspondence of Possessions, Attitudes, and Values." *Journal of Personality and Social Psychology* 53 (6): 993–1003. https://doi.org/10.1037/0022-3514.53.6.993.

Rae, Jeneanne. 2016. "Design Value Index Exemplars Outperform the S&P 500 Index (Again) and a New Crop of Design Leaders Emerge." *Design Management Review* 27: 4–11. https://doi.org/https://doi.org/10.1111/drev.12040.

Rahim, Azira, Siti Zaharah Safin, Law Kuan Kheng, Nurliyana Abas, and Siti Meriam Ali. 2016. "Factors Influencing Purchasing Intention of Smartphone among University Students." *Procedia Economics and Finance* 37: 245–53. https://doi.org/10.1016/s2212-5671(16)30121-6.

Rai, Bharat. 2021. "A Study of the Antecedents of Smartphone Purchase Decision." *International Research Journal of Management Science* 5 (1): 39–59. https://doi.org/https://doi.org/10.3126/irjms.v5i1.35860.

Rajanen, Dorina, Torkil Clemmensen, Netta Iivari, Yavuz Inal, Kerem Rızvanoğlu, Ashok Sivaji, and Amélie Roche. 2017. "UX Professionals' Definitions of Usability and UX – a Comparison between

Turkey, Finland, Denmark, France and Malaysia." *Human-Computer Interaction – INTERACT 2017*, 218–39. https://doi.org/10.1007/978-3-319-68059-0_14.

Reisinger, Don. 2014. "Steve Jobs Wanted to 'Further Lock Customers' into Apple's 'Ecosystem.'" CNET. April 2, 2014. https://www.cnet.com/news/steve-jobs-wanted-to-further-lock-customers-into-apples-ecosystem/.

Ribeiro, Iara Margolis, and Bernardo Providência. 2020. "Quality Perception with Attrakdiff Method: A Study in Higher Education." *Springer Series in Design and Innovation*, October, 222–33. https://doi.org/10.1007/978-3-030-61671-7_21.

Ritter, Frank E, Gordon D Baxter, and Elizabeth F Churchill. 2014. *Foundations for Designing User-Centered Systems : What System Designers Need to Know about People*. London Etc.: Springer, Cop.

Roto, Virpi, Effie Law, Arnold Vermeeren, and Jettie Hoonhout. 2011. "Demarcating User Experience." In *Abstracts Collection of Dagstuhl Seminar*.

Roto, Virpi, Arnold Vermeeren, and Jettie Hoonhout. 2011. "USER EXPERIENCE WHITE PAPER Bringing Clarity to the Concept of User Experience Result from Dagstuhl Seminar on Demarcating User Experience." http://www.allaboutux.org/files/UX-WhitePaper.pdf.

Roussel, Nicolas. 2014. "Looking Back: A Very Brief History of HCI," January. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.679.5753&rep=rep1&type=pdf.

Rutnik, Mitja. 2019. "What Is Stock Android? Check out Our Short Explainer." Android Authority. January 20, 2019. https://www.androidauthority.com/what-is-stock-android-845627/.

———. 2020. "Did You Know: Android Was Originally Designed for Digital Cameras Not Phones." Android Authority. May 2, 2020. https://www.androidauthority.com/android-history-digital-cameras-1111795/.

Sahani, Aditya. 2017. "Android V/S IOS – the Unceasing Battle." *International Journal of Computer Applications* 180 (3): 23–26. https://doi.org/10.5120/ijca2017915990.

SaldañaJohnny. 2016. *The Coding Manual for Qualitative Researchers*. Los Angeles, California ; London: Sage.

Sampson, Tony D. 2019. "Transitions in Human–Computer Interaction: From Data Embodiment to Experience Capitalism." *AI & SOCIETY*, February. https://doi.org/10.1007/s00146-018-0822-z.

Samsung. n.d. "DeX Mode | Device Multitasking | Samsung US." Samsung Electronics America. https://www.samsung.com/us/explore/dex/.

———. n.d. "One UI | Samsung US." Samsung Electronics America. https://www.samsung.com/us/apps/one-ui/.

Savov, Vlad. 2017. "Windows Phone Was a Glorious Failure." The Verge. October 10, 2017. https://www.theverge.com/2017/10/10/16452162/windows-phone-history-glorious-failure.

Scarpi, Daniele. 2020. *Hedonism, Utilitarianism, and Consumer Behavior*. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-43876-0.

Schwartz, Shalom H., and Wolfgang Bilsky. 1987. "Toward a Universal Psychological Structure of Human Values." *Journal of Personality and Social Psychology* 53 (3): 550–62. https://doi.org/10.1037/0022-3514.53.3.550.

Shaw, Heather, David A. Ellis, Libby-Rae Kendrick, Fenja Ziegler, and Richard Wiseman. 2016. "Predicting Smartphone Operating System from Personality and Individual Differences." *Cyberpsychology, Behavior, and Social Networking* 19 (12): 727–32. https://doi.org/10.1089/cyber.2016.0324.

Sørensen, Carsten, Mark de Reuver, and Rahul C Basole. 2015. "Mobile Platforms and Ecosystems." *Journal of Information Technology* 30 (3): 195–97. https://doi.org/10.1057/jit.2015.22.

Srnicek, Nick. 2017. *Platform Capitalism*. Cambridge ; Malden: Polity.

StatCounter. 2021a. "IOS Version Market Share Worldwide." StatCounter Global Stats. June 2021. https://gs.statcounter.com/ios-version-market-share/.

———. 2021b. "Mobile & Tablet Android Version Market Share Worldwide | StatCounter Global Stats." StatCounter Global Stats. June 2021. https://gs.statcounter.com/android-version-market-share/mobile-tablet/worldwide.

———. 2021c. “Mobile Vendor Market Share Worldwide | StatCounter Global Stats.” StatCounter Global Stats. June 2021. https://gs.statcounter.com/vendor-market-share/mobile/worldwide.

Still, Brian, and Kate Crane. 2017. *Fundamentals of User-Centered Design : A Practical Approach*. Boca Raton, Florida: Crc Press.

Sun Microsystems. 1995. “About the Java Technology (the Java™ Tutorials > Getting Started > the Java Technology Phenomenon).” Docs.oracle.com. 1995. http://java.sun.com/docs/books/tutorial/getStarted/intro/definition.html.

Sussan, Fiona, and Zoltan J. Acs. 2017. “The Digital Entrepreneurial Ecosystem.” *Small Business Economics* 49 (1): 55–73. https://doi.org/10.1007/s11187-017-9867-5.

Takahashi, Lico, and Karsten Nebe. 2019. “Observed Differences between Lab and Online Tests Using the AttrakDiff Semantic Differential ScaleJUS.” *Journal of Usability Studies* 14 (2). https://uxpajournal.org/attrakdiff-semantic-differential-scale/.

The Netherlands Authority for Consumers & Markets. 2019. “Market Study into Mobile App Stores.” https://www.concurrences.com/IMG/pdf/netherlands.pdf?59309/382a5b83e90b93529caf6e9943b8c0ec1062e1f2.

Thüring, Manfred, and Sascha Mahlke. 2007. “Usability, Aesthetics and Emotions in Human–Technology Interaction.” *International Journal of Psychology* 42 (4): 253–64. https://doi.org/10.1080/00207590701396674.

U.S. General Services Administration. 2020. “HCD, UX, and CX: Why Their Differences Matter and Why They Don’t | GSA - IT Modernization Centers of Excellence.” Coe.gsa.gov. January 23, 2020. https://coe.gsa.gov/2020/01/23/cx-update-18.html.

User Interface Design GmbH. n.d. “AttrakDiff.” Attrakdiff.de. Accessed July 18, 2021. http://attrakdiff.de/index-en.html#hintergrund.

Van Dijck, Jose, Thomas Poell, and Martijn De Waal. 2018. *The Platform Society: Public Values in a Connective World*. Kettering: Oxford University Press.

Verge. 2011. “Android: A 10-Year Visual History.” The Verge. December 7, 2011. https://www.theverge.com/2011/12/7/2585779/android-10th-anniversary-google-history-pie-oreo-nougat-cupcake.

Villas-Boas, Antonio. 2016. “These 5 Little Features Make the Mac and IPhone Combo Hard to Beat.” Business Insider. June 17, 2016. https://www.businessinsider.com/apple-ecosystem-2016-6?r=UK&IR=T.

Voss, Kevin E., and Eric R. Spangenberg. 2003. “Measuring the Hedonic and Utilitarian Dimensions of Consumer Attitude ARTICLE in JOURNAL of MARKETING RESEARCH · AUGUST 2003.” Edited by Bianca Grohmann. *Journal of Marketing Research* Vol. XL (August 2003): 310–20. https://doi.org/10.1509/jmkr.40.3.310.19238.

Walsh, Tanja, Jari Varsaluoma, Sari Kujala, Piia Nurkka, Helen Petrie, and Chris Power. 2014. “Axe UX.” *Proceedings of the 18th International Academic MindTrek Conference on Media Business, Management, Content & Services - AcademicMindTrek ’14*. https://doi.org/10.1145/2676467.2676480.

Warren, Tom. 2020. “Microsoft Integrates Android Apps into Windows 10 with New Your Phone Update.” The Verge. August 5, 2020. https://www.theverge.com/2020/8/5/21355997/microsoft-your-phone-app-windows-10-android-support.

Wen, Howard. 2020. “10 Ways Android and Windows 10 Can Work Well Together.” Computerworld. January 24, 2020. https://www.computerworld.com/article/3188392/10-ways-android-and-windows-10-can-work-well-together.html.

Whiteside, John, and Dennis Wixon. 1987. “The Dialectic of Usability Engineering.” *Human–Computer Interaction–INTERACT ’87*, 17–20. https://doi.org/10.1016/b978-0-444-70304-0.50013-3.

Wilson, Chauncey. 2014. “Semi-Structured Interviews.” *Interview Techniques for UX Practitioners*, 23–41. https://doi.org/10.1016/b978-0-12-410393-1.00002-8.

Wilson, T. D. 2000. “Human Information Behavior.” *Informing Science: The International Journal of an Emerging Transdiscipline* 3 (2): 049–56. https://doi.org/10.28945/576.

Wilson, T.D. 1999. “Models in Information Behaviour Research.” *Journal of Documentation* 55 (3): 249–70. https://doi.org/10.1108/eum0000000007145.

Wright, Peter, John McCarthy, and Tim Marsh. 2001. “From Usability to User Experience.” *Interfaces 46*, 2001.

Wu, Lei, Tian Lei, Juan Li, and Bin Li. 2015. “Skeuomorphism and Flat Design: Evaluating Users’ Emotion Experience in Car Navigation Interface Design.” *Design, User Experience, and Usability: Design Discourse*, 567–75. https://doi.org/10.1007/978-3-319-20886-2_53.

Wu, Yi-Chia, and Michael S. Minor. 2020. “The Brand Relationship of Cult-like Following: Developing Scales of Measurement in Apple and Catholic Devotees.” *EMAJ: Emerging Markets Journal* 9 (2): 27–36. https://doi.org/10.5195/emaj.2019.185.

Xiaomi. n.d. “MIUI 12.” En.miui.com. Accessed July 25, 2021. https://en.miui.com/.

Yeh, Ching-Hsuan, Yi-Shun Wang, and Kaili Yieh. 2016. “Predicting Smartphone Brand Loyalty: Consumer Value and Consumer-Brand Identification Perspectives.” *International Journal of Information Management* 36 (3): 245–57. https://doi.org/10.1016/j.ijinfomgt.2015.11.013.

Yu, Kam, and Juhong Feng. 2019. “Moore’s Law and Price Trends of Digital Products: The Case of Smartphones.” Papers.ssrn.com. Rochester, NY. July 11, 2019. https://ssrn.com/abstract=3424363.

Zarour, Mohammad, and Mubarak Alharbi. 2017. “User Experience Framework That Combines Aspects, Dimensions, and Measurement Methods.” Edited by Eunil Park. *Cogent Engineering* 4 (1). https://doi.org/10.1080/23311916.2017.1421006.

List of figures

Abbreviations

ACM = Association for Computing Machinery

HCI = human-computer interaction

HCD = human-centered design

MSECO = mobile software ecosystem

SECO = software ecosystem

SIGCHI = Special Interest Group on Computer-Human Interaction

UCD = user-centered design

UX = user experience

Attachment

Table 1: Czech translations of AttrakDiff scales

EN	EN	CS	CS
Human	Technical	Lidský	Technický
Isolating	Connective	Izoluje mě od lidí	Spojuje mě s ostatními
Pleasant	Unpleasant	Příjemný	Nepříjemný
Inventive	Conventional	Invenční	Konvenční
Simple	Complicated	Jednoduchý	Složitý
Professional	Unprofessional	Profesionální	Neprofesionální
Ugly	Attractive	Ošklivý	Přitažlivý
Practical	Impractical	Praktický	Nepraktický
Likeable	Disagreeable	Sympatický	Protivný
Cumbersome	Straightforward	Těžkopádný	Přímočarý
Stylish	Tacky	Stylový	Odbytý
Predictable	Unpredictable	Předvídatelný	Nepředvídatelný
Cheap	Premium	Levný	Luxusní
Alienating	Integrating	Odcizující	Integrující
Brings me closer to people	Separates me from people	Přibližuje mě lidem	Odlučuje mě od lidí
Unpresentable	Presentable	Nereprezentativní	Reprezentativní
Rejecting	Inviting	Odrazující	Lákavý
Unimaginative	Creative	Šablonovitý	Kreativní
Good	Bad	Dobrý	Špatný
Confusing	Clearly structured	Matoucí	Přehledný
Repelling	Appealing	Odpuzující	Přitažlivý
Bold	Cautious	Odvážný	Opatrný
Innovative	Conservative	Inovativní	Konzervativní
Dull	Captivative	Nudný	Poutavý
Undemanding	Challenging	Nepodnětný	Podnětný
Motivating	Discouraging	Motivující	Odrazující
Novel	Ordinary	Originální	Obyčejný
Unruly	Manageable	Neovladatelný	Ovladatelný