Couch: A Mobile Application Designed to Investigate the Relationship Between Aesthetics and Persuasion

by

Mustafa Arda Aydin

A thesis submitted to the Faculty of Graduate and Postdoctoral Affairs in partial fulfillment of the requirements for the degree of

Master of Applied Science

in

Human-Computer Interaction

Carleton University
Ottawa, Ontario

Abstract

Aesthetics is an important aspect of the user experience. It is also among the principles for persuasive systems in the frameworks such as the functional triad by Fogg and the Persuasive Systems Design by Oinas-Kukkonen and Harjumaa. Yet, literature directly investigating the influence of aesthetics on persuasion is limited. Similarly, despite the significance of aversive stimuli on behaviour change, the research is also sparse. To understand how aesthetics affect reported persuasion, I designed a mobile app named Couch with two levels of each aesthetics and persuasion, utilizing aversive stimuli, with the aim of reducing sedentary behaviour. Participants reported significantly higher levels of persuasion in persuasive group compared to control group, showing the success of persuasion attempts. However, aesthetics had no significant effect on persuasion. I report additional findings regarding aesthetics, and discuss the implications for future work.

Acknowledgments

First, I would like to thank my supervisor Audrey Girouard for guiding me along the way, and providing me this opportunity to work on the field I am truly excited about.

To my friends, both abroad and here, I am truly thankful for your presence and support. It is a blessing to be surrounded by such people, and I am looking forward to having you around for many years to come, regardless where we are.

Many thanks to my parents who are the reason I can be here, able to write this thesis. I am so grateful for your support and encouragement, for always doing your best, while I could focus on what I desired to do.

Finally, I would like to thank my partner for his endless moral support, even when I did not realize I needed. Thank you for always being there for me and for your reassurance.

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Chapter 1. Introduction

B.J. Fogg [33] introduced the concept of persuasive technology as "any interactive computing system designed to change people's attitudes or behaviours" in 2003, and since then, principles he suggested have been applied in many different domains, especially in health and wellness [71, 82]; or have been adopted into new frameworks, such as the Persuasive System Design (PSD) framework by Oinas-Kukkonen and Harjumaa [95]. The studies in the domain of persuasive systems differ in terms of principles utilized and duration of experiments, but most of the literature has demonstrated positive results of the persuasion attempts [96].

Nevertheless, there are still gaps in the current body of the available literature. First, the literature does not give the same level of attention to all the persuasive principles from Fogg's functional triad and the PSD Framework, such as aesthetics. Literature suggests visually attractive technology to be more persuasive, yet studies investigating its effects on persuasion is limited in terms of number and scope.

On the other hand, aesthetics have been an important consideration in Human-Computer Interaction (HCI). Since the first suggestion on its importance back in 1996 [2], there has been a great amount of research on

aesthetics, especially on the user experience factors such as usability and performance. Some studies reported positive influence of aesthetics [52, 124], even resulting in users ignoring usability faults of a system [75], where other studies found no correlation [77, 78]. Although there is not an overall conclusion on the matter of usability and aesthetics, the importance of aesthetics in user experience is clear.

In addition, many studies explored the ways to understand how humans perceive and evaluate aesthetics of a system [49, 50, 72, 91]. Despite the differences in study methodology and terminology, literature acknowledges the importance of understanding how humans perceive aesthetics of a system and how it affects other characteristics and features of a system [52, 75, 115].

Another apparent gap in the literature on persuasive systems is the lack of aversive stimuli and conditioning. While Fogg's functional triad makes use of positive reinforcement and conditioning, the PSD Framework completely excludes conditioning. On the other hand, some argue the importance of using aversive stimuli and using mix of positive and negative feedback in addition to punishment to fully benefit from operant conditioning [20, 66].

This master's thesis contributes to the investigation of the gaps mentioned in the literature and answers following research questions:

- Can a mobile app following persuasive design principles while also utilizing aversive stimuli succeed at persuading its users?
- Do aesthetics influence the persuasiveness of an app?

Following the persuasive principles and suggestions on using aversive stimuli, I designed an app with four different variants in two levels of each persuasion and aesthetics, trying to persuade users to stand up more and reduce their sedentary behaviour. This choice comes from the suggestions in several health guidelines [39, 70] and growing interest on overall physical activity in persuasive systems domain [82, 96]. Using both qualitative and quantitative methods, I analyzed participants' evaluation of aesthetics and persuasiveness of the system in a short-term study.

The study contributes to the literature in two novel ways. First, it is the first to evaluate the effects of aesthetics of a mobile app on its persuasiveness directly. Second, it utilizes aversive feedback to fully benefit from operant conditioning in the domain of health and wellness, which is an overlooked area in persuasive systems.

The following chapter details the literature on aesthetics and studies in HCI, in addition to principles for persuasion (Chapter 2). Next, I discuss the design of the app and manipulation of aesthetics and persuasion levels (Chapter 3), followed by the methodology and procedure of the study (Chapter 4). Chapter

5 provides the results of reported persuasion and aesthetics evaluation of each variant, in addition to the interesting comments participants made. Afterwards, I discuss the findings and their implications, in addition to the limitations of the study. Last, I provide the conclusion and underline the directions for future work.

Chapter 2. Literature Review

2.1. Aesthetics: Definition and Studies in HCI

Ancient Greek philosophers; such as Plato and Aristotle, discussed aesthetics as "beautiful objects incorporate proportion, harmony, and unity among their parts" and "universal elements of beauty are order, symmetry, and definitiveness", respectively [115]. In other words, aesthetics focuses on how we perceive objects and make judgments [81].

Hassenzahl [47] states that aesthetics can be narrowed down to the visual attractiveness, that is beauty. Similarly, in a study by Jacobsen et al. [57] investigating word associations that individuals produced for "aesthetics", results showed that "beautiful" and "ugly" are the most archetypical for the aesthetic judgment, showing how people perceive aesthetics.

Sutcliffe [119] argues that although "beauty lies in the eye of the beholder", it is still possible to describe some general principles for aesthetic design, such as using advice from graphic design. Extending on some of the heuristics and principles on website design [93], he provides the following for attractiveness and aesthetic design: judicious use of colour, symmetrical, structured and consistent visual layout, use of layers, choice of media to attract attention, use of personality to attract and persuade, and design of challenging images. According to Sutcliffe, aesthetics is a quality of attractiveness. Last, Sutcliffe

[120] claims that most studies tend to ignore the context-dependent nature of the user judgment; hence beauty depends on not only the "beholder" but also who they are and what they are doing. Similar to Sutcliffe's approach, the present study considers aesthetics based on principles from visual and graphical design literature, that are valid across multiple disciplines [76].

Starting with Alben's [2] emphasis on aesthetics as a part of quality user experience in 1996, there is an increasing number of studies on aesthetics in HCI. The present study provides prior work on the aesthetics in the following ways: dimensions of users' perception of visual aesthetics for assessment, and its relationship with user experience factors such as usability.

2.1.1. Measures of Aesthetics for Assessment

Multiple studies consider aesthetics to be a major contributor in overall user experience [2, 47, 91], hence it is critical to measure aesthetics assessments. Some studies attempt to develop scales and verify their validity, where some studies prefer to use ad-hoc developed scales.

One of the most cited studies on the topic, also among the first attempts to measure aesthetics, is the study by Lavie and Tractinsky [72], where they have found two dimensions, named classical and expressive aesthetics, which reflect the users' perception of aesthetics of websites. For items that measure

the construct of perceived aesthetics, they conducted a detailed literature review to identify the aesthetic construct and consulted experts in different design fields (e.g. web design, HCI, interior design, architecture) to generate adjectives to represent aesthetics. Followed by four studies to refine the generated pool and to assess the validity, they concluded that the two dimensions, classical aesthetics and expressive aesthetics, to refer to certain design attributes. Classical aesthetics (e.g. clear, symmetric, clean) corresponds to the traditional notions of design [59, 68] and is about visual clarity [92]. The expressive aesthetics (e.g. creative, original, fascinating) corresponds to creativity and originality of the design, similar to the revolutionary approach of the Romantic period [5] and is about visual richness [92].

However, there are several authors who criticized this scale. First, Sutcliffe [120] argues that the items in the classical aesthetic are more related to the traditional usability concepts (e.g. consistency and structural layout) than aesthetics, where expressive aesthetics dimension is a better reflection of the user engagement[1]. Moreover, Moshangen and Thielsch [91] argue that the item "uses special effects" in the expressive aesthetics dimension "isn't necessarily aesthetically per se" and add that the item "aesthetic" which is

[1] Sutcliffe [120] proposes the term "user engagement" to describe "how people are attracted to use interactive products" and explain why applications attract people to use them within a session, where he reserves the UX (user experience) for broader explanation of adopting and continued use of a particular design over a period of time.

present only on the classical aesthetics dimension should be in both of the dimensions. In addition, they note that the scales might not represent all the relevant aspects of visual aesthetics due to the neglect of colour in the scales, which is an important part of the aesthetic design.

In their study to develop scales to measure aesthetics, Moshagen and Thielsch [91] identified four interrelated facets of perceived visual aesthetics of websites in the construction of Visual Aesthetics of Website Inventory (VisAWI) as follows: Simplicity, Diversity, Colours, Craftsmanship. Simplicity is related to Gestalt concepts such as clarity, homogeneity, orderliness and balance [5]. As previously mentioned, Lavie and Tractinsky [72] showed this aspect to be important in visual aesthetics considerations in HCI. Diversity refers to dynamics, novelty and creativity; provoking interest and arousal [12]. Similarly, other studies have also considered this aspect as important [72, 125, 126]. The colourfulness facet consists of impressions of the selection, placement and combination of colours. Multiple studies agreed on the effect of colour on aesthetic judgment [5, 23, 90, 111, 119]. Lastly, craftsmanship refers to skilful and coherent integration of all relevant design dimensions. Authors have reported strong evidence for the validity of constructed scale and showed that VisAWI was very responsive to changes in design of the website.

Hassenzahl [49, 50] developed one of the most widely used questionnaires to measure certain qualities of a product called AttrakDiff. These are pragmatic quality, hedonic quality, beauty and goodness; pragmatic quality refers to broader understanding of usability as "quality on use", where hedonic quality refers to product's potential in supporting "pleasure in use". Lastly, beauty and goodness refer to the overall evolution of the product, affected by both pragmatic and hedonic quality, where beauty is based on the product's visual, that is mostly on hedonic attributes. Studies in many domains and technologies including games, websites, mobile phones, software, and systems based on gestures and speech command [24] used this questionnaire.

However, studies investigating aesthetics in HCI do not necessarily use the mentioned scales. Actually, it is possible to see many studies using ad-hoc developed scales, both single-item [115, 124] and multiple-item measures [23, 45, 65, 78, 90] varying greatly in terms of how they measure aesthetics.

Critics argue that single-item measures are not reliable due to the lack of average-out of measurement errors which is possible in multiple-item scales [110, 116]. Moreover, some argue that single-item measures are not adequate enough to fully capture the construct [11], and cannot distinguish between different levels of visual aesthetics [91], only allowing a coarse assessment [27, 116]. Additional criticism includes that single-item measures assume

visual aesthetics to be one-dimensional, which contradicts the findings, such as by Moshagen and Thielsch [91] and Lavie and Tractinsky [72]. Finally, Moshagen and Thielsch [91] argue that researchers use different words such as “beautiful”, “appealing”, “aesthetically pleasing” in different studies, which makes it “impossible” to understand if they all refer to the same construct, making it hard to compare the results of different studies.

There are also several drawbacks with ad-hoc developed multiple-item measures. Similar to single-item measures, Moshagen and Thieslch [91] argue that it is difficult to compare different studies due to the lack of standardization and proper validation. Authors state that some of the items in the scales are more about usability than aesthetics, such as in a study by van Schaik and Ling [108] where authors used items such as “comprehension”. Moshagen and Thielsch also report inconsistencies within some studies, such as by Loiacono et al. [79, 80] where the same question is asked more than once (such as “visually pleasing” and “visually appealing”) in the aesthetics scale of the WebQual. Critics argue that this causes systematic bias [104, 106].

The present study uses AttrakDiff due to its wide-applicability [24], and its focus on both hedonic quality and pragmatic quality. The relationship

aesthetics has with usability gained attention in HCI, as detailed next, and AttrakDiff allows this research to also report on that relationship.

2.1.2. Aesthetics and Usability

The International Organization for Standardization [55] defines usability as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use". This definition contains measures for both objective measures such as performance time [90], and subjective feelings of the users such as usefulness, ease-of-use [75]. In the literature on usability and aesthetics, this distinction is widely common and accepted [49, 122].

One of the best-known studies on perceived aesthetics and perceived usability is on different ATM layouts, where researchers found a strong influence of aesthetics on usability before actual use [69]. Later, Tractinsky et al. [124] conducted a similar experiment with ATM layouts, investigating aesthetics and usability both before and after use. They reported a high correlation between perceived usability and aesthetics before use but also found that those ratings remained the same after actual use, concluding "what is beautiful is usable". Moreover, results indicated the strong effect of aesthetics on both perceived aesthetics and perceived usability than the actual usability of the system.

A similar conclusion is also present in a study by Lee and Koubek [75] where authors concluded that high level of aesthetics may help users to perceive a system as more usable than its actual usability. Similarly, a study by Van der Heijden [52] also showed the significant effect of visual attractiveness on perceived usefulness, enjoyment and ease-of-use.

Furthermore, Thüring and Malke [122] investigated usability and aesthetics using different versions of portable digital audio players. Authors found that high level of visual aesthetics enhanced the performance on poor usability condition, resulting in reduced number of errors, showing that aesthetics helped the poor usability. Sonderegger and Sauer [115] also reported a similar result in their study on user performance and aesthetics. They utilized two functionally identical mobile phones in two different levels of aesthetics, “highly appealing” and “not appealing”, and asked participants to complete series of tasks. Participants rated highly appealing phone as more usable, and authors found that visual aesthetics positively affected performance.

However, there are also several studies that found no effect of aesthetics on usability. In a study by Lindgaard and Dudek [78], the authors conducted two experiments; the first experiment had two websites with different levels of

usability and second experiment had two websites with different levels of usability and high aesthetics. They found that the correlation between perceived usability and perceived aesthetics was not significant after actual use. In another study by Lindgaard and Dudek [77] where they investigated relation of beauty and other design characteristics such as usability, authors reported no correlation. Similarly, Hassenzahl's [49] study on mp3 players with different skins found no correlation between usability and aesthetics. He concluded that whether "what is beautiful is usable" still remains inconclusive [47].

Overall, literature on aesthetics and usability shows two different results: some studies reported a positive influence of aesthetics on a system's usability, where some found no correlation. Regardless, aesthetics is considered to be an important part of overall user experience, and as De Angeli and Sutcliffe [4] argues that result might simply depend on the context.

2.2. Persuasion and Behaviour Change

Fogg [33] defines persuasive technology as "any interactive computing system designed to change people's attitudes or behaviours". Fogg states that, the history of such systems can be traced back to 70s and 80s, to a system called Body Awareness Resource Network (BARN), which aimed to teach about health issues, focusing on changing behaviours of teens in these areas [14].

Fogg argues that interactivity gives a big advantage to the computing technology over other persuasive media. The system can use the knowledge it gains about its users and adjust persuasion techniques it uses over time to help reach the target behaviour, where traditional media would not be able to easily provide that.

Moreover, Fogg states that computers have distinct advantages such as greater persistency and anonymity, the ability to manage large volumes of data and scale, use of many modalities to persuade, and ubiquity, over human persuaders. Persistency is rather trivial; he states that machines do not get tired or frustrated. The anonymity helps especially in sensitive areas, such as sexual behaviour or psychological problems; it is easier and less embarrassing to interact with a computer and get information or help than someone in person. Such anonymity can also help to overcome social forces that affect people's behaviour. The ability to manage large quantities of data

can help persuade more effectively, and sometimes it is the amount of data provided that can change what people believe and do [99]. The modality refers to the ways information is presented, and computers can use multiple modalities to produce the optimal persuasion. Next is the ability to scale; computers can reach as many people as needed; whereas in a human persuader, although it might be possible to increase the scope of the influence, the original experience might get lost. Lastly, computers can be anywhere, including places humans may not be welcome (such as bathroom or bedroom) or cannot go (such as inside clothing or other wearable devices). This is especially true with the wide availability of mobile devices [100] and recently becoming more and more available and accepted wearables [35].

2.2.1. Functional Triad

Fogg investigates persuasive technology under three different roles, referred to as Functional Triad. These rules are tools, medium and social actors. Figure 1 summarizes the functional triad below:

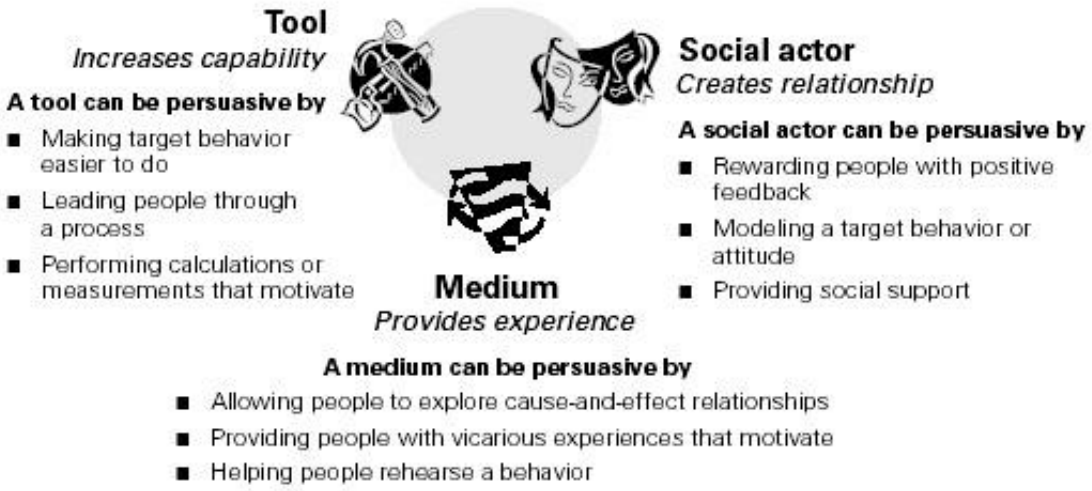


Figure 1 Functional Triad [33]

Functional triad is important to understand as persuasion strategies used will differ with regards to the role computers take. For example, as a tool, the product can persuade by making target behaviour easier to perform, such as by providing calculations and measurements. As a medium, the product can provide the relationship between cause-and-effect and enable people to explore those experiences to achieve persuasion. Lastly, as a social actor, the product can use the same principles humans use to influence and persuade others, such as by providing feedback social support. Most products use mix of those functions and blend different roles for the successful strategy for the target behaviour.

Tools

Fogg [33] states that a persuasive tool would utilize more than one type to achieve the desired outcome. There are 7 types of persuasive technology tools, to change attitude or behaviour or both my making the target outcome easier to achieve. These tools are reduction, tunnelling, tailoring, suggestion, self-monitoring, surveillance and conditioning.

Reduction is about simplifying complex behaviours to increase the benefit and cost ratio of the behaviour to influence the users. That stems from the theories in psychology, economy and cognitive science which suggest that humans are inclined to do calculations to minimize costs and maximize gains [128]. Hence, principle of reduction increases the benefit/cost ratio of the behaviour, resulting in increased motivation to engage in the behaviour [9].

The principle of **tunnelling** is providing opportunities for persuasion while the system guides users through a process or experience. Fogg gives the example of people hiring personal trainers to guide them during their workouts as a tunnel situation which is voluntary and done to change behaviours or attitudes. He states that this strategy is effective because people regard consistency positively.

The principle of **tailoring** is considering users' needs, interests, personality, usage context or other relevant factors to tailor the provided information by the computing technology. In their system aimed to changing the eating habits of its users, Kaptein et. al. [61] found personalized messages to be more effective than non-personalized ones, showing the success of this principle.

The principle of **suggestion** is intervening at the right time that is appropriate to act.

The principle of **self-monitoring** is providing people ways to monitor themselves to modify their attitudes or behaviours, as self-monitoring technologies might be intrinsically motivating.

Applying computer technology to observe others' behaviour to increase the likelihood of achieving the desired outcome is the principle of **surveillance**, as people behave differently when they know they are being watched [53]. According to the research, when a person observes that others' behaviours are being used to punish or reward them, the person is likely to change their action to meet the expectations of the observer [43]. An important note Fogg makes is that if surveillance is not overt, it will turn into a punishment, not persuasion.

The principle of **conditioning** is using positive reinforcement to shape complex behaviours or turn existing ones into habits. The simplest example to this principle is teaching a dog tricks and rewarding it (e.g. with praise, petting or snack) after a successful performance. Fogg argues that operant conditioning is pervasive among human beings and individuals do subtly shape future behaviour by even giving a gift, whether it is intentional or not. He further states that positive reinforcements should be random (i.e. unpredictable) to be effective.

On the other hand, Chiu et al. [20] concluded that rather than just using positive reinforcements, combining positive and negative reinforcements together makes users feel a contrast in reinforcements, therefore causing positive reinforcement to "stand out" in their study about a social persuasion system designed to motivate office workers to drink healthy amounts of water. Authors of the study call for further studies on how to mix such feedback for motivation.

Medium

Computers as persuasive medium focuses on simulations to shape attitudes or behaviours. Fogg states that such simulations can create experiences that will be similar to those in real world, as people react to them as if they are

real [103]. Among these simulations, he gives three examples of different types: cause-effect simulations, environment simulations and object simulations.

Cause and effect simulations can help people understand different scenarios in a short time [60, 118]. Fogg suggests that as people are in an exploration mode while interacting with such simulations: they expect to find new things, which makes it easier for them to adopt new behaviours [112, 113]. One of the examples of this type of simulation is HIV Roulette, a kiosk designed for an exhibit in San Francisco's Exploratorium in 1996 [30, 33]. The simulation allowed people to see the health consequences of their choices on sexual activity, and reported the probability of them contracting HIV or other sexually transmitted diseases. However, no data on effectiveness or reported persuasion levels are available.

Environment simulations enable people to rehearse a behaviour in a virtual environment which can change their attitude or behaviour. Fogg [33] argues that such simulations are persuasive because people can practise the target behaviour. In addition, such simulations can adopt other people's perspective and provide controlled exposure. An example of environment simulations is by Dye [29] where the study utilized persuasion and simulation gaming to change attitudes of nurses towards mental illnesses and aging. The

simulation enabled nurses to explore the experiences and problems common to mentally ill and aged. The results showed significant change in opinions on mental illness.

Lastly, object simulations take place in real-world setting to highlight the impact of certain behaviours to motivate change in behaviour or attitude. Fogg states that this type of simulation is less dependent on imagination and enables users to experience the impact of what is being simulated directly in their daily routine. For example, Strachan and Gorey [117] used a realistic infant simulator to change attitude of teenagers about becoming teen parents. Results showed the positive impact of a realistic infant simulator on attitudes of adolescents in high school about future parenting, stating the change in their notions about their responsibilities towards reality. They have also found that other group who merely observed their classmates were also positively influenced.

Social Actors

According to Fogg, persuasive power of computers as social actors comes from the instinctive reactions of human beings to things that seem alive in some way [103]. Social presence can stem from different cues such as physical, psychological, language, social dynamics and social roles.

Physical cues can occur through movement or other physical attributes, such as attractiveness. Fogg suggests that visually attractive technology is likely to be more persuasive. He argues this might be due to halo effect which is explained as associations of positive traits with more attractive individuals [25] and more positive judgment on other aspects such as intelligence with that individual [87]. Moreover, Fogg states that a screen character that is more attractive, or cute for instance, would also benefit from greater persuasive power. In fact, in a study by Khan and Sutcliffe [63] on attractiveness of virtual agents in a system designed to help guide users through a "desert survival task", more attractive agent was perceived as more persuasive, and participants who interacted with the more attractive agent associated higher quality traits with that agent.

Psychological cues can lead people to believe that product has emotions, preferences and even a personality. Such cues can be portrayed though simple messages (e.g. "I am sorry") and icons (e.g. sad face), or be even more complex. A study by Andrews [3] on personality traits where users had a dialogue with the system on choosing a restaurant found that user's perception of those traits directly influenced the persuasiveness of the system. Users' extraversion influenced the persuasiveness of the system, and the number of supports used in a dialogue influenced the perceived

personality of the system. Andrews suggests tailoring the personality of a system to its user to improve the persuasion.

Language is also a cue to create social presence and persuade people. Fogg argues that one of the most powerful uses of language to persuade is through praise. Some literature on praise and people's attitudes shows that to be true as well. A study by Eyck et al. [31] utilized a virtual coach and used praise along with tunnelling and tailoring to see the effects of presence of the virtual coach on motivation. They found that participants with the virtual coach enjoyed the biking exercise more, had higher motivation, and biked longer in the optimal range for heartbeat.

Social dynamics, unwritten rules of how people interact with each other, can also be utilized to convey social presence and persuade people. Fogg argues that social reciprocity has the potential for persuasion among the social dynamics. This unwritten rule is about paying back a favour when you receive one [42]. Budiu [121] suggests that user interface design can also implement this rule by giving users something before asking anything from them. In a study by Gamberini et al. [38], authors tested two conditions: the first condition required users to give their information in a form fill-in before accessing the free content where second condition gave access to the content first but required users to provide their information if they wanted to

download it, based on the reciprocity rule. They found that users gave more information on the second condition, highlighting the influence of social dynamics.

Computers can also adapt social roles to persuade, such as by the role of authority, friend, entertainer and opponent. In a study by Sakai et al. [107], authors applied the role of authority as different messages given by gym instructors and doctors along with other strategies to encourage people to take stairs rather than elevators in an adaptive ambient system called APStairs. In the preliminary results, authors have reported the success of authority strategy on the estimated effectiveness to persuade.

Below is the summary of principles from Fogg's functional triad (Table 1):

Table 1 Summary of Principles from Functional Triad [33]

	Principle	Description
Tool	Reduction	Using computing technology to reduce complex behaviour to simple tasks increases the benefit/cost ratio of the behaviour and influences users to perform the behaviour.
	Tunnelling	Using computing technology to guide users through a process or experience provides opportunities to persuade along the way.
	Tailoring	Information provided by computing technology will be more persuasive if it is tailored to the individual's needs, interests, personality, usage context, or other factors relevant to the individual.
	Suggestion	A computing technology will have greater persuasive power if it offers suggestions at opportune moments.
	Self-monitoring	Applying computing technology to eliminate the tedium of tracking performance or status helps people to achieve predetermined goals or outcomes.
	Surveillance	Applying computing technology to observe others' behaviour increases the likelihood of achieving the desired outcome.

	Conditioning	Computing technology can use positive reinforcement to shape complex behaviours or transform existing behaviours into habits.
Medium	Cause-effect	People can be persuaded to change their attitudes or behaviours by enabling them to observe immediately the link between cause and effects.
Social actor	Physical cues	A computing technology that is visually attractive to target users is likely to be more persuasive as well.
	Psychological cues	Using psychological cues from a computing product can lead people to infer that the computer has a psychology.
	Language	Computing products also can use written or spoken language to convey social presence and to persuade.
	Social dynamics	Computing technology can apply social dynamics (unwritten rules for interacting with others) to convey social presence and to persuade.
	Social roles	Computing technologies using social roles (such as authority, friend, entertainer, opponent) can cause people to change their attitude or behaviour.

In addition to the principles from functional triad, Fogg [33] argues that credibility of computers is important in HCI, especially when they are used in the contexts such as instructing users, reporting measurements and about their own state, providing information and analysis to be persuasive.

He defines credibility as a perceived quality in dimensions of trustworthiness and expertise, or simply as "believability". He proposes four types of credibility that is relevant to computing products, summarized in Table 2 below:

Table 2 Types of Credibility [33]

Type of Credibility	Basis for believability
Presumed	General assumptions in the mind of the perceiver
Surface	Simple inspection or initial firsthand experience
Reputed	Third-party endorsements, reports, or referrals
Earned	Firsthand experience that extends over time

Last, Fogg argues that networking and mobile technologies have persuasive potentials. These potentials come from the portability, ease of use, simplicity and other features of mobile devices that would also benefit some of the principles in the functional triad, such as a built-in pedometer helping the principle of self-monitoring. Moreover, he states that the connectivity of mobile technologies would help them become more persuasive as they can provide more relevant and current information, and can use social influence strategies such as social presence, social comparison, peer pressure, social

learning, and intrinsic motivators such as competition, co-operation, recognition.

Fogg's functional triad is an important framework to understand for computer systems to motivate and persuade. The principles provided in the roles computers can take has been used in literature in different ways as mentioned, and the present study also utilizes this framework, following the implementation examples, described in detail in the following chapters.

2.2.2. Persuasive Systems Design Framework

Harjumaa & Oinas-Kukkonen [95] created the Persuasive Systems Design (PSD) framework, adopting and modifying it from Fogg's functional triad. Authors argue that the need for modifications to Fogg's functional triad was due to its limitations on its applicability during design and development of persuasive systems. Another weakness they claim is the lack of explanation on how to transform and implement the persuasive principles into software requirements and system features.

PSD Framework provides the design principles in multiple categories including primary task support and dialogue support. Table 3 summarizes these categories and principles of the PSD Framework.

Table 3 PSD Framework [95]

	Principle	Description
Primary task support	Reduction	A system that reduces complex behaviour into simple tasks helps users perform the target behaviour, and it may increase the benefit/cost ratio of a behaviour.
	Tunnelling	Using the system to guide users through a process or experience provides opportunities to persuade along the way.
	Tailoring	Information provided by the system will be more persuasive if it is tailored to the potential needs, interests, personality, usage context, or other factors relevant to a user group.
	Personalization	A system that offers personalized content or services has a greater capability for persuasion.
	Self-monitoring	A system that keeps track of one's own performance or status supports the user in achieving goals.
	Simulation	Systems that provide simulations can persuade by enabling users to observe immediately the link between cause and effect.

	Rehearsal	A system providing means with which to rehearse a behaviour can enable people to change their attitudes or behaviour in the real world.
Dialogue support	Praise	By offering praise, a system can make users more open to persuasion.
	Rewards	Systems that reward target behaviours may have great persuasive powers.
	Reminders	If a system reminds users of their target behaviour, the users will more likely achieve their goals.
	Suggestion	Systems offering fitting suggestions will have greater persuasive powers.
	Similarity	People are more readily persuaded through systems that remind them of themselves in some meaningful way.
	Liking	A system that is visually attractive for its users is likely to be more persuasive.
	Social role	If a system adopts a social role, users will more likely use it for persuasive purposes.

One of the differences these principles have from Fogg's functional triad is the lack of surveillance and conditioning. The authors argue that these methods are not acceptable for persuasive systems, due to people often being unable to choose whether they may be observed or not, and conditioning being not open/apparent. Moreover, they state that users act and behave based on beliefs and values, not as a result of conditioning.

Principles in dialogue support category is also partly adopted from Fogg's approaches, where authors have excluded the rule of reciprocity, arguing it is a characteristic rather than a feature. The liking principle in definition also includes the attractiveness of the system, and authors list "system should have a look and feel that appeals to its users" as an example requirement while implementing this principle.

In addition to the provided categories that mostly match with Fogg's functional triad, authors also list system credibility support and social support, both also adopted from Fogg's work. System credibility includes authority (similar to social roles in Fogg's functional triad) where excluding principles such as presumed, reputed and earned credibility from the category. PSD also adopts social support category from Fogg's principles on mobility and connectivity to leverage social influence, such as by competition, co-operation and comparison.

2.2.3. Aversive Stimuli and Operant Conditioning

Skinner introduced the term operant conditioning in 1938 [114], as a method of changing behaviour by the use of reinforcement that is given after the desired response. He described three types of operant as neutral operants, positive and negative reinforcers, and punishers.

However, there are a lot of criticism against Skinner's work. These include its inability to fully explain the learning process [10], generalization of studies on animals to humans [15], and ethical issues in operant conditioning, especially in punishment [73]. On the other hand, some argue that when punishments are used in conjunction with reinforcements, they have greater efficacy [37], hence making it "sometimes ethical" [102], and some state that ethics of operant conditioning are not different from any procedure that can be misused [88].

When it comes to persuasive technologies, same controversy exists. With regards only use of positive reinforcements in Functional Triad, Fogg refers to ethical problems and argues that it is not an appropriate use of conditioning in technology [33]. On the other hand, Foster et al. [36] state that although aversive effects are ethically questionable, when punishment is presented as a form of aversive feedback playfully and carefully, it does not result in users' disengagement and can support the behaviour change.

2.3. Gaps in the Literature

Despite the number of studies on persuasive technologies and aesthetics, there are still some areas that are not investigated well. These include the lack of studies on use of aversive feedback and full implementation of operant conditioning (i.e. lack of negative reinforcement and punishment), and the lack of studies on the relationship between aesthetics and persuasion.

Aversive Stimuli & Negative Reinforcement

As previously mentioned, operant conditioning as an important principle in persuasive system design. However, Fogg [33] suggests use of only positive feedback, and use of rewards for performing the target behaviour where PSD Framework [95] completely excludes operant conditioning from its principles.

Some authors argue that persuasive systems must also implement negative feedback and punishment to fully benefit from operant conditioning. Kirman et al. [66] states that when only positive feedback and rewards are utilized, there is no meaningful feedback when the user does not perform the target behaviour and gets the reward. Hence, they argue that persuasive systems would benefit from aversive stimuli when the user does not perform the target behaviour, also increasing the overall frequency of feedback. Similarly, Chiu et al. [20] suggest combining both positive and negative reinforcements in persuasive systems. In their study on a system to motivate people to drink

more water, the system used negative reinforcement if the water intake was too low. Authors found that users reported strong affinity to the avatar used, and the positive/negative contrast helped the positive reinforcement to stand out. They underline the need for studies on this mixed approach in persuasive systems. Lastly, in their short term exploratory study to promote better food management and reduce food waste using a mobile app, Aydin et al. [6] reported that aversive stimuli were effective in eliciting desire to change behaviour. Authors call for future work to be done in the field.

Nevertheless, despite the increasing interest in aversive stimuli in the field, the literature on this matter in persuasive technologies is limited [19, 21]. For example, Orji and Moffatt [96] reported that, over 85 studies they reviewed on persuasive technology for health and wellness, only 3 studies utilized negative reinforcement. Furthermore, studies who use the PSD Framework to design and evaluate systems often lack negative reinforcements, as the framework excludes operant conditioning and only uses rewards among its principles. These highlight the lack of and need for studies on implementing full operant conditioning.

Relationship of Aesthetics and Persuasion

Both PSD Framework [95] and Fogg's functional triad [33] list "visual attractiveness" among principles to increase persuasion of a system. Matthews et al. [82] found that, out of the 20 studies on mobile applications promoting physical activity they reviewed using PSD framework, 6 of them utilized "liking" principle. Some studies used "fun" way to represent information [44], and some featured "visually pleasing display features" to convey complex information [64], in addition to metaphorical representations [7, 86]. Nevertheless, none of the studies compared different levels of aesthetics, or investigated its effects on persuasion.

The mentioned gaps in the literature help the present study to contribute new information to research on persuasive design and aesthetics. First, this study investigates aesthetics and its influence on persuasion directly by manipulating both aesthetics and persuasion levels. Second, this study implements aversive feedback to fully benefit from operant conditioning in addition to the mentioned persuasive design principles. I describe the manipulation of these levels and inclusion of aversive stimuli in detail in the following chapters.

Chapter 3. Design & Ideation

3.1. Design of the Couch App

I built the "Couch" app in four different variants to see the success of persuasive principles mentioned previously and influence of aesthetics on persuasion. These variants were in two groups; persuasive group and control group and each group had two levels of aesthetics; high aesthetics and low aesthetics. This section details the details of manipulation on persuasion and aesthetics and the difference of variants.

3.1.1 Visual Design & Aesthetics

To understand the influence of aesthetics on the reported persuasion, I created two levels of aesthetics, high and low, following principles from visual, graphical and interaction design literature [76, 120]. I chose to use two levels of aesthetics because of the positive effect associated with aesthetically appealing design compared to less aesthetically pleasing ones, as suggested by Norman [94], Moshagen et al. [90] and Hartmann et al. [46]. Moreover, many studies in the field of HCI that investigated influence of aesthetics and its relationship with other factors such as overall user judgments [122], usability [22, 74, 90, 115, 122], and performance [90], and virtual agents [63] did utilize two levels of aesthetics in their experimental designs, and reported successful manipulation of aesthetics levels, thus

supporting the choice of the implementation of two levels of aesthetics in the present study as well.

To control the two levels of aesthetics, I followed multiple studies, described in detail in this section. I did manipulations on colour, the aspect ratio of visual elements, symmetry and alignment of the layout and other graphic design factors, all agreed to affect aesthetic appeal [120]. In both levels, I kept the usability levels the same, as manipulations described in this section have no effect on it [22, 75].

Manipulation of Aesthetic Levels

This section describes the manipulation of aesthetics levels, first high aesthetics followed by low aesthetics. I followed Gestalt effects in the high aesthetics variants, as suggested by Sutcliffe [120]. These effects are recognized and interpreted naturally, and Gestalt theory attempts to describe how people tend to organize visual elements into groups. These effects are summarized in Table 4 and Figure 2 below:

Table 4 Gestalt Effects

Effect	Description
Closure	perceiving shapes that are not complete
Proximity	grouping by distance or location
Similarity	grouping by type
Symmetry	grouping by similar visual attributes

Continuity	grouping by visual sequence or flow
Figure ground	higher order structures emerging from the image based on juxtaposition of visual features or grouping of shapes

Figure 2 Gestalt Effects [40]

Gestalt effects are important as they form the basis for principles of visual organization, where the effects of visual layout on aesthetics have been shown in multiple studies [75, 123, 124], concluding the success of the manipulation of aesthetics levels, together with change in fonts and colours [22].

Colour was an important consideration for controlling two levels of aesthetics, high and low. Palmer et al. [98] suggest that for the preference for single colours, there are reliable patterns based on the three dimensions of colour, that is hue, saturation and brightness. For combinations of colour, they suggest that people often like harmonious combinations. Colour combinations can be used to enhance aesthetics [76], such as by using analogous colours (adjacent colours on the colour wheel), complementary colours (opposing colours on the colour wheel), triadic and quadratic colours

("colours at the corners of a symmetrical polygon circumscribed in the colour wheel" [76]). Lidwell et al. [76] suggest using colours of higher saturation to attract, adding that people perceive such colours as more exciting and dynamic.

Based on these suggestions and to create an energetic design that also captures attention, I chose the colour orange (associated with energy, activity and excitement [89]) and its shades for the high aesthetics variants. For the other colours used in the app, I used Adobe Color CC[2], a tool to help designers create colour palettes, based on the colour theory and combination methods mentioned before. Figure 3 shows the colour palette used for the high aesthetic variants of the app.

Figure 3 Colour palette for high aesthetics variants

Font styles have been also a consideration for manipulating aesthetic levels in designs, such as in the studies by Lee and Koubek, [74] and Conklin et al. [22]. In addition, McCracken and Wolf [83] recommend using consistent fonts to improve the overall design. Lidwell et al. [76] also recommend use of

[2] color.adobe.com

consistent fonts for the overall aesthetics of the typography. Moreover, Ivory and Hearst [56] list font types and sizes within their web page quality metrics, underlining the overall effect of fonts on aesthetics.

For the high aesthetics variants, I considered using VAG Rounded font due to its “informal” and “dynamic” tags [127]. Instead, as a free alternative, I chose Valken font with similar characteristics (Figure 4), to pair with the potato character designed. For the high aesthetics and persuasive variant, I used this font to achieve consistency and aesthetic typography [76]. The other fonts used in high aesthetics variants are Monaco (only numerals) and Montserrat (Figure 5). These fonts are the only fonts used on the control and high aesthetics variant due to lack of potato figure.

Figure 4 VAG Rounded (left) & Valken (right)

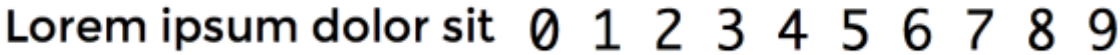


Figure 5 Montserrat (left) and Monaco[3] (right), Fonts for High Aesthetics and Control variant

I followed the same guidelines in a reverse way to create the low aesthetics variants. The choice of highly saturated magenta (considered as “zany and

[3] This font was used in numerals for high aesthetics variants of both persuasive and control groups

whimsical" [89]), came from its very high saturation, coupled with other highly saturated colours, red and cyan, to create too much contrast, making an inharmonious palette. I chose the colour on the profile screen for the low aesthetics to create a similar contrast as in the high contrast variant (orange and dark blue): the greenish-brown colour, Pantone 448C, was also rated the worst in a market research, and found to have "ability to minimize appeal" [26]. The colours used in low aesthetics variants are provided in Figure 6 below.

Figure 6 Colour palette for low aesthetics variants

The low aesthetic designs were also against gestalt effects and visual organization principles with visually misaligned and unsymmetrical elements, and distorted (unnatural) aspect ratio on icons.

Lastly, I chose two different display fonts which were rated the lowest in terms of aesthetics in a study by Shaikh [67], namely Impact and Playbill, to disrupt the overall aesthetics of typography [76] for the low aesthetics variant, provided in Figure 7.

Lorem ipsum dolor sit Lorem ipsum dolor sit

Figure 7 Fonts for low aesthetics variants, Impact (left) and Playbill (right)

Following figures illustrate the screens of each variant of the app:

Figure 8 Home/Today Screen

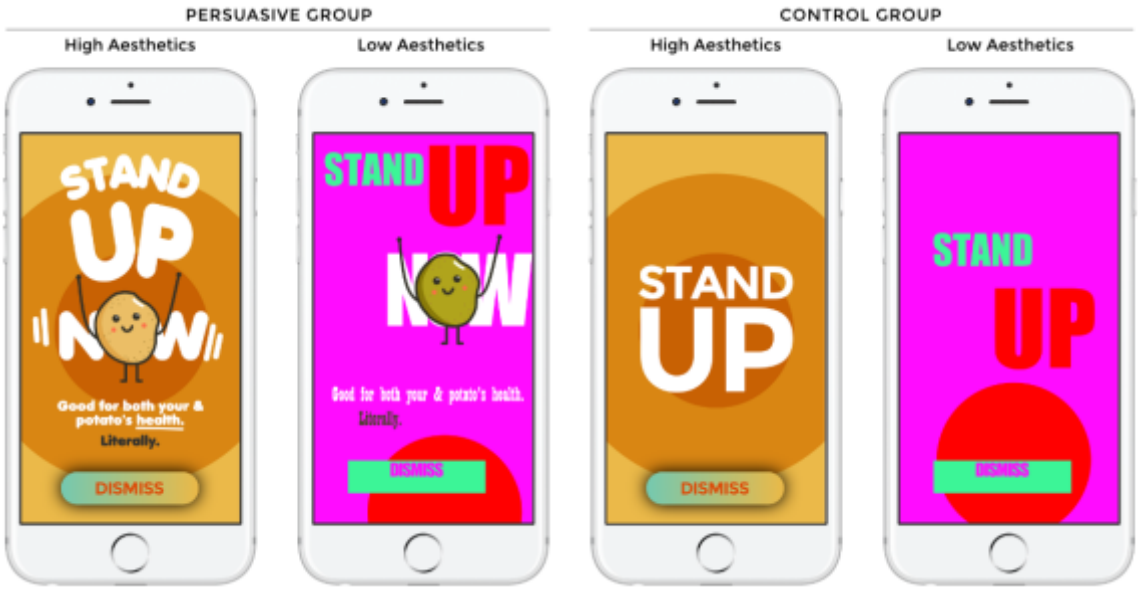


Figure 9 First Stand Up Notification

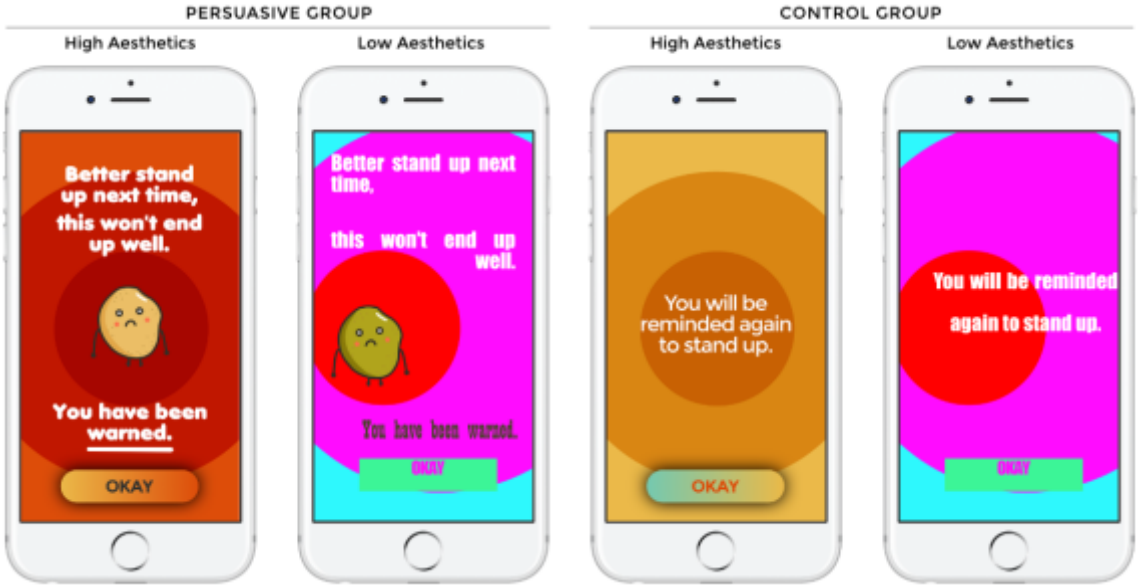


Figure 10 Dismissed Screen

Figure 11 Second Stand Up Notification

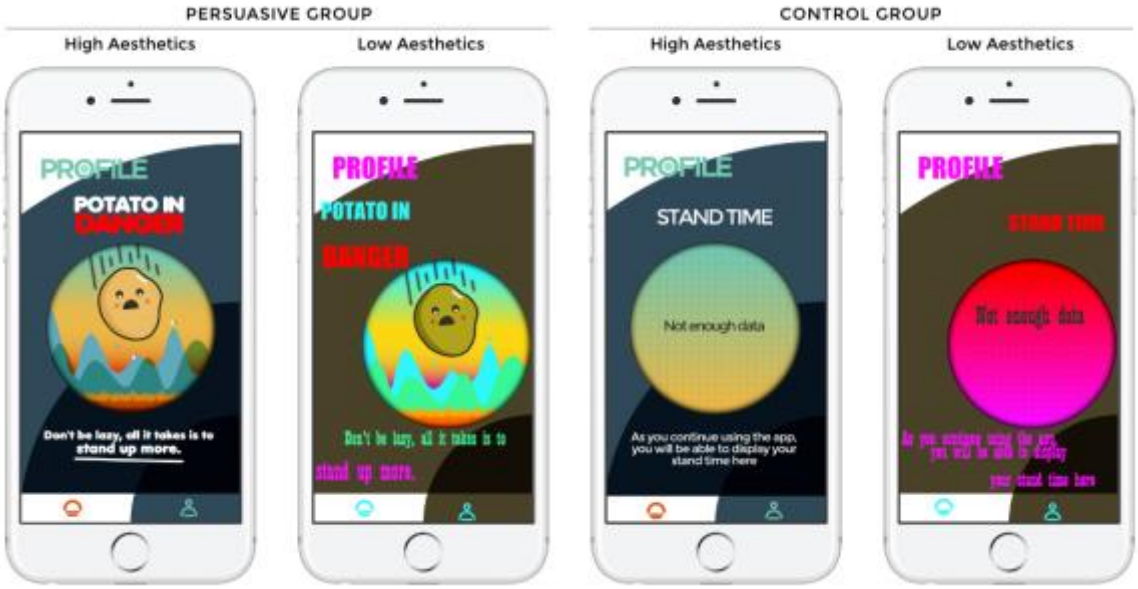


Figure 12 Profile Screen

3.1.2. Persuasive Design

I designed the persuasive variants of the app following Fogg's functional triad and design principles [33] as previously mentioned in the Literature Review section. Moreover, I also followed Persuasive System Design (PSD) framework [95], which is based on Fogg's functional triad with modifications and additions, and adapted them for the design of the Couch app. Lastly, I implemented suggestions by Kirman et al. [66], Chiu et al. [20] and Aydin et al. [6] on persuasive design to include aversive stimuli in the app. To accomplish that, they recommend using not only positive reinforcement but also negative reinforcement and punishment, to increase the frequency of feedback and to fully benefit from operant conditioning. Therefore, I have modified appropriate sections of the principles in PSD Framework and Fogg's functional triad, taking these suggestions into consideration.

3.1.2.1. Fogg's 8 Step Design Process for Creating Persuasive Technologies

I followed Fogg's 8-step process in the early design phase of persuasive technologies [32] for the design of the app, as provided in Figure 13 below:

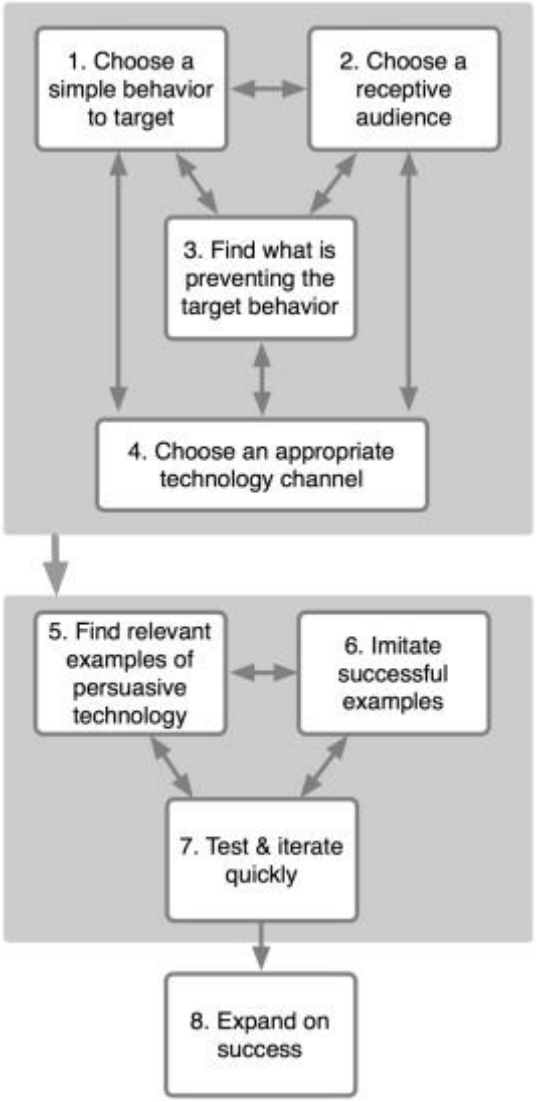


Figure 13 Fogg's 8 Step Design Process for Creating Persuasive Technologies [32]

Step 1. *Choose a simple behaviour to target.* The target behaviour in the Couch app is physical activity but only focused on standing up. This is a simple behaviour to change and is already recommended in several health guidelines, [39, 70].

Step 2. *Choose a receptive audience.* I chose people above the age of 18 and the only restriction was to be comfortable using smartphones and to be comfortable speaking in English. This was due to the chosen technology channel, which is smartphones and widely used by all age groups [100]. Moreover, young adults and adults are recommended to reduce their sedentary behaviour the most [39, 70].

Step 3. *Find what is preventing the target behaviour*. People often forget how much time they have been sitting for, especially if busy with something else.

Step 4. *Choose an appropriate technology channel*. I chose to build a smartphone application due to wide availability and usage of smartphones [100], as well the portability and other features such as sensors that could be utilized in the app, while displaying reminders to stand up.

Step 5. *Find relevant examples of persuasive technology.* This step suggests finding a relevant and successful example to be used in following steps to imitate, test and expand. However, successful examples that utilize aversive feedback is limited. The study by Jeen et al. [58] utilized a website for a self-diet system comparing three different intervention methods; Social Facilitation, Source Credibility, and Reinforcement. However, authors did not report significant results from reinforcement, hence the study was not a

successful result. The study by Aydin et al. [6] on promoting food consumption before expiry reported success of implementing aversive feedback. Similarly, Chiu et al. [20] concluded use of mixed feedback to create contrast between positive and negative reinforcement. The present study adapts these examples in adapting persuasive principles, described in detail in this chapter.

In addition to these steps, I adapted the remaining steps to this case, for the Couch app. The persuasive elements and their applications are explained in detail next.

3.1.2.2. Fogg's Functional Triad and Application of Aversive Stimuli

As previously mentioned in the Literature Review chapter, Fogg's functional triad provides three persuasive roles of computers: computers as tools, computers as medium and computers as a social actor. Fogg suggests using a combination of tools and strategies to achieve effective results [33]. In addition to the functional triad, Fogg also suggests the use of mobile technology to increase persuasion.

Application of selected principles from functional triad and their adaptations for this study are as follows:

***Reduction**:* Couch app makes it easier to remember when to stand up, as well as making the goal setting effortless, as the goal is predefined which is reducing sedentary behaviour and users only need to follow the app.

***Suggestion**:* The app uses reminders to stand up, and the reminder screens are presented full screen to capture attention.

***Self-Monitoring**:* The app lets users see their data regarding standing and sitting time (Figure 8).

***Surveillance**:* Fogg suggests that people behave differently when they know they are being observed [33]. As the app keeps tracks of activity and gives reminders, users of the app would be aware that the Couch app is observing them, which would also be reflected on their profile.

***Conditioning**:* Differently from Fogg's suggestion of only using positive reinforcement, the app also uses negative reinforcement, by language and emotions/status reflected on the potato character (Figure 15). For example, when the user dismisses a stand up notification, the potato becomes sad (Figure 10), or when the user has sat for a long time, the profile section displays the potato figure in danger with scared emotion (Figure 12).

***Cause-Effect**:* For this principle, I used suggestions from PSD framework [95], where Fogg's approach focuses on use of simulation. In the app, users can see the link between their behaviour (standing up or not) and its effect on the status on the profile screen (potato's condition). For instance, when users sit for a prolonged time, the potato becomes in danger (Figure 12), expressed with graphics and textual elements.

***Physical cues**:* I designed a potato graphic/character (Figure 15) in the app as part of social and physical cues. For this principle, I followed the implementation example in the PSD framework, where authors mention use of cute animal pictures on a website designed for encouraging children to take care of their pets [95].

***Psychological cues**:* Use of different facial expressions and language (described next) gives users psychological cues [95], giving the impression for them to subconsciously conclude that the product has a psychology [33]. Fogg suggests that this can be established by icons or text messages that portray emotion. The potato figure portrays emotion; happy (Figure 9), sad (Figure 10), and scared (Figure 11), and is under different conditions based on users' behaviour.

***Language**:* Fogg suggests that language can be used to persuade people by social presence, however, his principle is based on praise. In this study, as previously mentioned, there are aversive stimuli, hence language used in the app reflects that as well. Furthermore, the language has a tone to communicate with the user directly and in a more human-like way, such as "potato is counting on you" (Figure 11) and "don't be lazy" (Figure 12), to augment the social role of the app.

***Social Dynamics**:* I have used the potato character to make the overall experience more fun and engaging. In addition, to reflect such dynamics, focus of notifications is the potato figure displaying emotions (Figure 15), giving limited options, making it hard to say "no" to (Figure 11).

***Social Roles**:* On the PSD framework, suggested social role is authority [95], similar to "principle of authority" on Fogg's functional triad. However, Fogg states that although authority has received the most attention, other roles such as a friend, entertainer and opponent can persuade people, too [33]. Thus, in this study, potato acts as a friend, not only by making suggestions, such as by stating that standing up is healthy for both potato and the user (Figure 9), but also someone that is directly influenced by actions of the users. In this case, potato is happy during the first notification (Figure 9), however, as users keep their sedentary behaviour and dismiss notifications,

it becomes sad (Figure 10), counts on the user to save it (Figure 11), and is under danger (Figure 12).

In addition to the principles from functional triad, Fogg suggests that mobile devices have the power of persuasion [33]. Those principles mostly focus on the ease of use, simplicity, ease of access and other features that connect with the principles mentioned. Therefore, by choosing a mobile app as the channel to persuade, and utilizing most of the features smartphones have, the Couch also follows this principle.

As previously mentioned, the persuasive variants of the app also use aversive stimuli, to fully benefit from operant conditioning, as per suggestions by Chui et al. [20], Kirman et al. [66], and Aydin et al. [6] including negative reinforcements and punishments, rather than solely using positive reinforcements in Fogg's model. To achieve that, when the user dismisses the first notification (Figure 9), the app uses negative reinforcement by showing a warning (Figure 10), and the second notification showing the character in danger (Figure 11 and Figure 12), where the user's choice of dismissing is reflected negatively; punishment is applied by displaying effects of undesired user behaviour on the potato character.

3.2. Prototyping

3.2.1. Character Design

The inspiration to create a character comes from the persuasive design principles mentioned in this section, to give the app a social role, in this case a friend. I designed the initial version of the character (Figure 14) using the Paper by 53 on iPad Air, with several iterations. Once the character was established, I transferred them to a MacBook Pro computer and created vector designs (scalable) using Affinity Designer, to be used in the prototype (Figure 15).

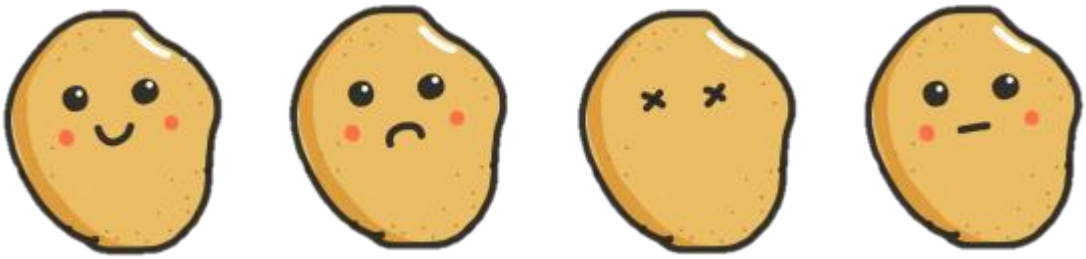


Figure 14 Initial Sketches for Potato Character

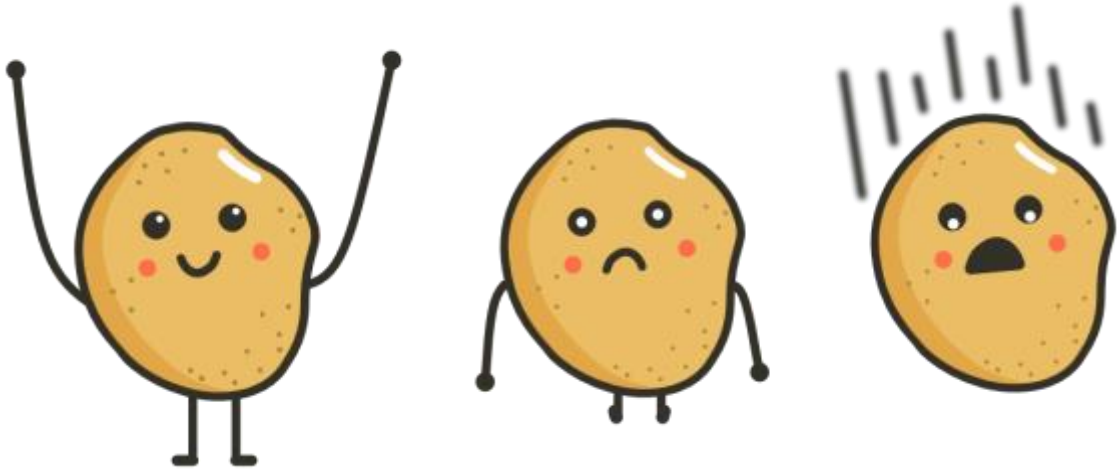


Figure 15 Finalized Potato Character for the Prototype (left to right: happy, sad/disappointed, scared/in danger)

3.2.2. App Preparation

I built the prototypes using the prototyping tool Origami Studio[4] on the macOS system. I imported finalized designs to the software, and prepared four different prototypes for four different variants available, each having the same structure and timers. The notifications appeared with a slide in from bottom animation and utilized the vibration to simulate the real-world use. Then, I exported prototypes to iPhone 6 device to be launched using the Origami app on iOS for the study sessions. I installed the fonts separately on the device using a 3rd party app to ensure correct display of the textual elements.

[4] Available to download at origami.design

The advantage of using Origami Studio over many other available tools is the performance, as prototypes can be either mirrored or exported to the device. Moreover, it makes it possible to utilize certain features of the device, wherein this study, it was the vibration, which would not be possible with other tools.

The major limitation in the prototype is the screen being on all the time, which is due to both the prototyping tool, which does not let the screen go off while the prototype is running, and the Quicktime app used for screen recording, which stops recording when the screen turns off, sometimes causing crashes. However, as participants were reading the articles provided and the interaction with the device was limited in time, about 5–10 minutes in total, this limitation had no effect on the study.

3.3. Ideation and Target Behaviour, Reducing Prolonged Sitting

Current health guidelines suggest at least 150 minutes of physical activity per week [8, 97]. With the increase of TV viewing and computer use, in addition to physically less demanding jobs, people are spending more time sitting [17, 101]. Studies show that an adult spends about 60% of their day in sedentary behaviour [51], such as recreation, transportation and other social activities [109]. Recent studies show that sedentary behaviour, independently from the lack of exercise, has negative metabolic effects, thus bringing a new perspective and distinguishing between too much sitting from too little

exercising [8, 97]. Prolonged sitting has detrimental effects on health [8, 13]. These include increased risk of certain types of cancer [13, 109], cardiovascular disease and diabetes [13, 18, 28, 34], and obesity [54].

The American Cancer Society [70] and The American College of Sports Medicine [39] suggest limiting sedentary behaviour to decrease the risk of cancer, and to aid maintenance of healthy body weight, regardless of the physical activity level of an individual. However, Schmid and Leitzmann [109] state that there are some global recommendations on physical activity for health still missing the points on sedentary behaviour, such as by World Health Organization [41] and US Department of Health and Human Services [1] underlining the need for additional work.

These suggestions form a basis for this study, thus focusing on an aid to reduce sedentary behaviour. Based on that, I designed a smartphone app, titled “Couch”, to change the behaviour around prolonged sitting and to reduce it, following the persuasive design principles and suggestions detailed in this chapter.

Chapter 4. Methodology

This chapter describes the study objectives and research questions, experiment design and variables, in addition to details about data collection and procedure.

4.1. Study Objectives

This study aims to answer the following questions:

1. Can a mobile app designed to help its users reduce their sedentary behaviour by following persuasive design principles and aversive stimuli change users' behaviour?
2. Do aesthetics influence the persuasiveness of an app?

To answer these questions, I designed the Couch app in four different variants in two groups: Persuasive and Control. Then, as described in Chapter 3, I designed two levels of aesthetics, high and low, for each group. Therefore, the groups and variants of the experiment stimuli are summarized in Table 5 below:

Table 5 Variants of Experiment Stimuli

Group	Aesthetic Level
Persuasive	High Aesthetics
	Low Aesthetics
Control	High Aesthetics
	Low Aesthetics

4.2. Experiment Design

This study adopted a between-subject design, where participants interacted with one variant of the Couch app. Each participant had the same tasks, and answered the same questions, described in next subsections of this chapter.

The independent variables in this study are aesthetics levels (categorical; high and low), and persuasion levels (categorical; persuasive and control). The dependent variables in this study is the persuasion level reported by the participant, obtained through their responses to questions and observed behaviours, in addition to participants' evaluation of usability and aesthetics, collected through the AttrakDiff questionnaire.

The experiment aims to test the following hypotheses:

H1: Persuasive variants of the app (both high and low aesthetics variants) will be more persuasive than control (non-persuasive) variants to change users' behaviour about prolonged sitting

H2: In both the persuasive and control groups, high aesthetics variant will be more persuasive than the low aesthetics variant.

4.3. Data Collection

To collect data relevant to the study, I used pre-study and post-study questionnaires, follow-up questions, think-aloud protocol and behaviour observations, provided in the Appendices chapter (Appendix C, F, G). Following are the methods used to collect data during the studies.

4.3.1. Questionnaires

In this study, there were two questionnaires: a survey on demographics (Appendix C) and the AttrakDiff (Appendix F).

Survey on Demographics

Participants first filled out a questionnaire about their demographic information, education background, whether they owned a smartphone, and whether they owned a smart device with fitness tracking capabilities (such as Fitbit, Apple Watch, etc.).

AttrakDiff: Evaluation of Aesthetics and Usability

I used AttrakDiff [48] questionnaire to understand participants' perception of usability and aesthetics of the app after the follow-up questions. I chose AttrakDiff due to its focus on both hedonic and pragmatic quality, where subscales are presented as word pairs on a 7-point Likert scale. This

questionnaire has been applied to many fields in HCI, including games, websites, software and mobile phones [24].

I used the short version of AttrakDiff in the study containing ten items in total [50]. The authors have reported high reliability and consistency with the long version. The questionnaire contains four items for pragmatic quality, four items for hedonic quality, and two additional items for "goodness" and "beauty" [50], where goodness is the overall evaluation and beauty is the same but focuses on visuals, the presentation of the product, both coming from the judgments of combination of pragmatic and hedonic quality. Pragmatic quality refers to judgments on usability in a more extended manner, also including the "appropriateness of the functionality", and hedonic quality refers to how well the product supports "pleasure in use".

The choice of the shorter version for the questionnaire was preferable as participants had to answer questions during the interaction and afterwards as follow-up questions on their experience in the interview form, enabling me to allocate more time to those questions to better understand their persuasion levels while still allowing to get accurate results for their aesthetics and usability ratings.

4.3.2. Think-Aloud Protocol & Verbal Feedback

I asked participants to think aloud while interacting with the app to gather feedback about their feelings and thoughts of the app. This helped me to collect valuable data regarding how they felt and reacted to screens and messages, both for the evaluation of attractiveness as well as persuasion.

4.3.3. Observation

During the study, I observed participants' behaviours and reactions to the app, to better understand their experience, also in order to capture details about their attention and instinctive reaction, especially during the stand up notifications. This was especially important to understand the reported persuasiveness of the app.

4.3.4. Interview & Follow-Up Questions

After the interaction with the device, I asked participants follow-up questions (in Appendix G) in an interview form to better understand their overall experience, how they felt using the app, what they thought of the feedback and notifications given by the app, whether they felt motivated or encouraged, and whether they felt like this app might change their behaviour about prolonged sitting or not. This allowed participants to elaborate even more on their answers to questions asked during the interaction, and reveal

more about the potential long-term effects of the app on their behaviour and attitude towards sedentary behaviour.

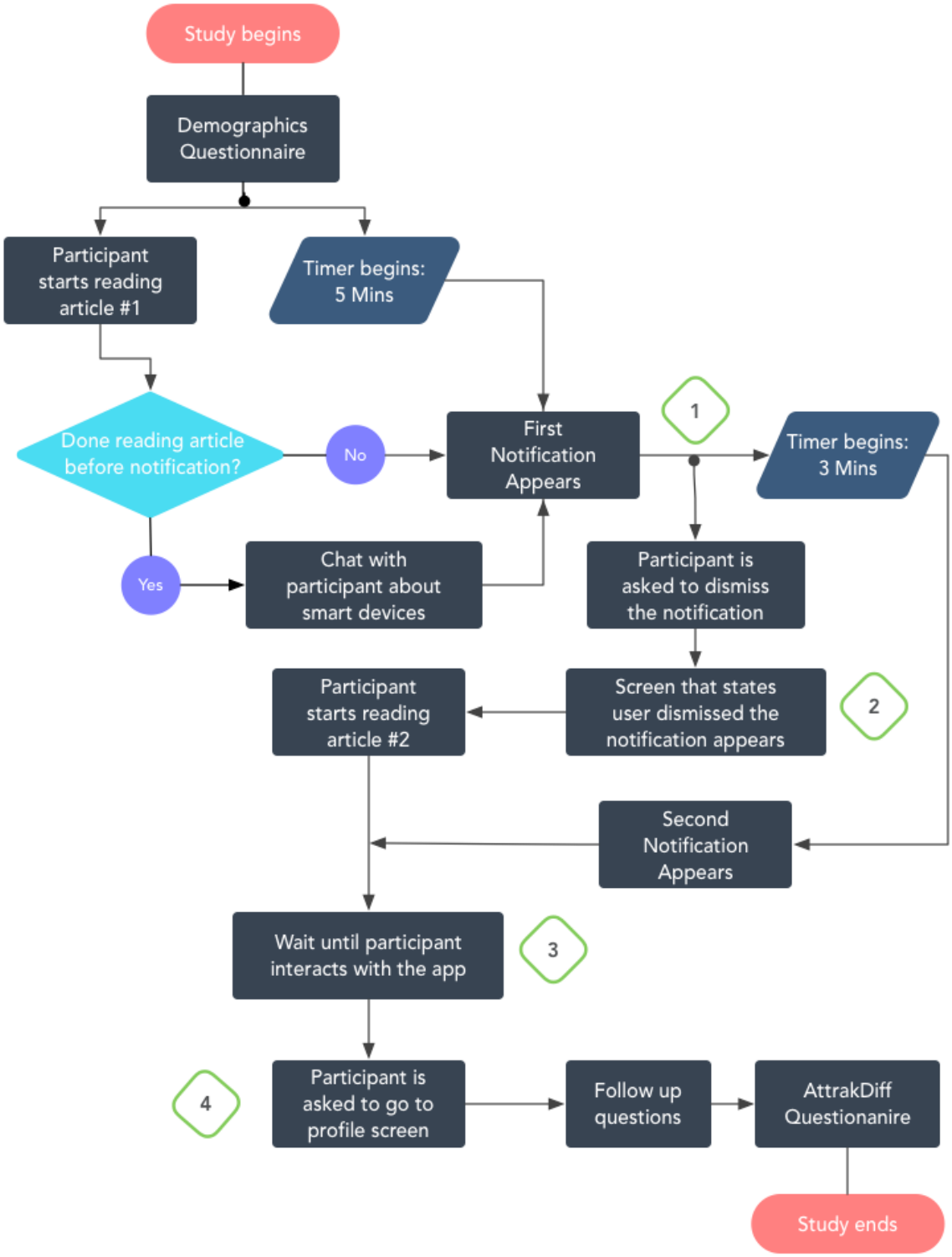
4.3.5. Recordings and Researcher Notes

During the study, I took notes based on their answers and behaviour based on observation to capture data. Moreover, I recorded participants' voices and screen of the device. Later, I coded and analyzed recordings to ensure no point was missed, to add additional insight based on their comments, but most importantly, to understand how persuaded they felt.

4.4. Procedure

To evaluate the reported persuasion from the app as well as the effects of aesthetics, I used iPhone 6 smartphone to run the prototypes. I recorded the sessions using the Quicktime software on macOS, with the built-in microphone of a MacBook Pro computer, where the iPhone was connected to the computer during the study for recording the screen of the device.

The procedure for the study is summarized in Figure 16 below:


Study begins
Demographics Questionnaire
Participant starts reading article #1
Timer begins: 5 Mins
Done reading article before notification?
No
Yes
First Notification Appears
1
Timer begins: 3 Mins
Chat with participant about smart devices
Participant is asked to dismiss the notification
Participant starts reading article #2
Screen that states user dismissed the notification appears
2
Second Notification Appears
Wait until participant interacts with the app
3
4
Participant is asked to go to profile screen
Follow up questions
AttrakDiff Questionanire
Study ends

1. App displays positive notification for persuasive variants and neutral notification for control variants (Figure 9). Before asked to dismiss, participant answers questions about how they feel about the screen.

2. For persuasive variants, app displays negative screens and for control variants, app displays neutral screens (Figure 10). Before tapping “okay”, participant answers questions about how they feel about the screen.

3. Some participants stopped reading and interacted with the app, where some finished reading first before interacting with the app. No participant finished reading before the notification appeared.

4. In the profile screen (Figure 12), participants answered questions to understand how they felt about the screen, whether they felt motivated or not, and other questions to better understand their experience, before answering follow-up questions.

Figure 16 Study Procedure

I equally distributed participants to one of the four variants randomly: high aesthetics and persuasive, low aesthetics and persuasive, high aesthetics and control (no persuasion) and low aesthetics and control (no persuasion).

The session began once participants signed the consent form (Appendix B). First, I asked them to fill a pre-study questionnaire (Appendix C) on demographic information, education background, and their experience with smart devices, both smartphones and other devices with fitness tracking capabilities, if any. After that, I briefed them about the app, its purpose, their tasks and the study steps overall. I informed participants that the app would keep track of their sitting and standing time, and would automatically detect when they stood up. I also added that the app was in a prototype stage and it

may not work at all times. The app simulated this unimplemented feature by using timers, similar to the Wizard of Oz usability testing technique [62], and results by Bradley et al. [16] who found no difference between participants who knew the technology was faked or not. I asked participants to think aloud at all times an interaction took place with the device. Then, they started reading an article about smartwatches due to their increasing popularity, especially in health and fitness [35], provided in Appendix D section. The first notification took five minutes to appear, and if participants were still busy reading and didn't stop to respond to the notification, I did not interrupt them. If they finished reading before notification appeared, I asked them questions about the article, and their overall opinion about and the experience with the smartwatches and similar devices. I chose to utilize this secondary task to simulate the way we use smartphones, and to observe the natural reaction of the participant to a notification while they were engaged in with something else.

When the first notification appeared and participants were looking at the screen, I asked them how they were feeling and what they would do, before asking them to keep sitting down and tapping dismiss. If they attempted to stand up after seeing the notification, I noted this behaviour. When participants dismissed the first notification, I asked similar questions for the following screen which showed a negative feedback (persuasive condition) to

understand their feelings and see their reaction. I also asked what they would do to understand if they felt motivated to stand up or not. The control condition variants only showed a stand up notification followed by a screen that stated they would be reminded again to stand up. For both conditions, once tapped okay, the home screen with a countdown to stand up again (in three minutes) appeared, and I gave another article to read. This article, provided in Appendix E section, was about chairs and technology, as the study was about prolonged sitting. As previously, I did not interrupt participants if they were busy reading the article and did not respond the notification. The second notification screen for the persuasive variants displayed a negative feedback. The control variants displayed a stand up notification exactly the same notification as the first one. I asked participants the same questions about how they felt and what they would do, to understand their motivation level and behaviour. This concluded the first part of the interaction.

The second part began with participants visiting the profile screen on the app and reflecting on their status being reported by the app. The persuasive variants displayed negative feedback and punishment, where control variants didn't display any information other than the message "not enough data". I asked participants how they felt and what they thought of their profile status, in addition to what they would do next after seeing this screen,

to better understand their motivation and whether they would consider standing up or not. Once done, second part of the interaction was complete.

Following the study, I asked participants follow-up questions (in Appendix G) to better understand their experience, how they felt, whether they felt motivated/encouraged or not and their likes/dislikes about the app. Once done, I provided them with the AttrakDiff questionnaire. When they completed the survey, I asked them if they had any additional questions or comments, which concluded the session. The study session took approximately 30–45 minutes.

Chapter 5. Results

5.1. Participants

Among the 48 participants, 31 were female,15 were male and 2 did not choose to indicate their sex. No participant withdrew from the study.

Participants included students and faculty staff at Carleton University, and some members from the wider community. Participants' ages ranged from 18 to 57, with a mean of 24 (Table 6). They had various backgrounds including Social Sciences, Political Sciences, Environmental Sciences, Science, Engineering, Business, Arts, Design, Communication Studies, Law and Legal Studies. The completed education level ranged from High School to Doctorate (Figure 17).

All participants owned and used a smartphone, whereas only 9 out of 48 reported owning a smartband or smartwatch, such as Fitbit and Apple Watch.

Table 6 Participant Ages

Age	Count
18	9
19	4
20	3
21	5
22	3
23	2
24	3
25	1
26	1
27	6
28	2
31	2
32	2
35	1
36	1
38	1
43	1
57	1

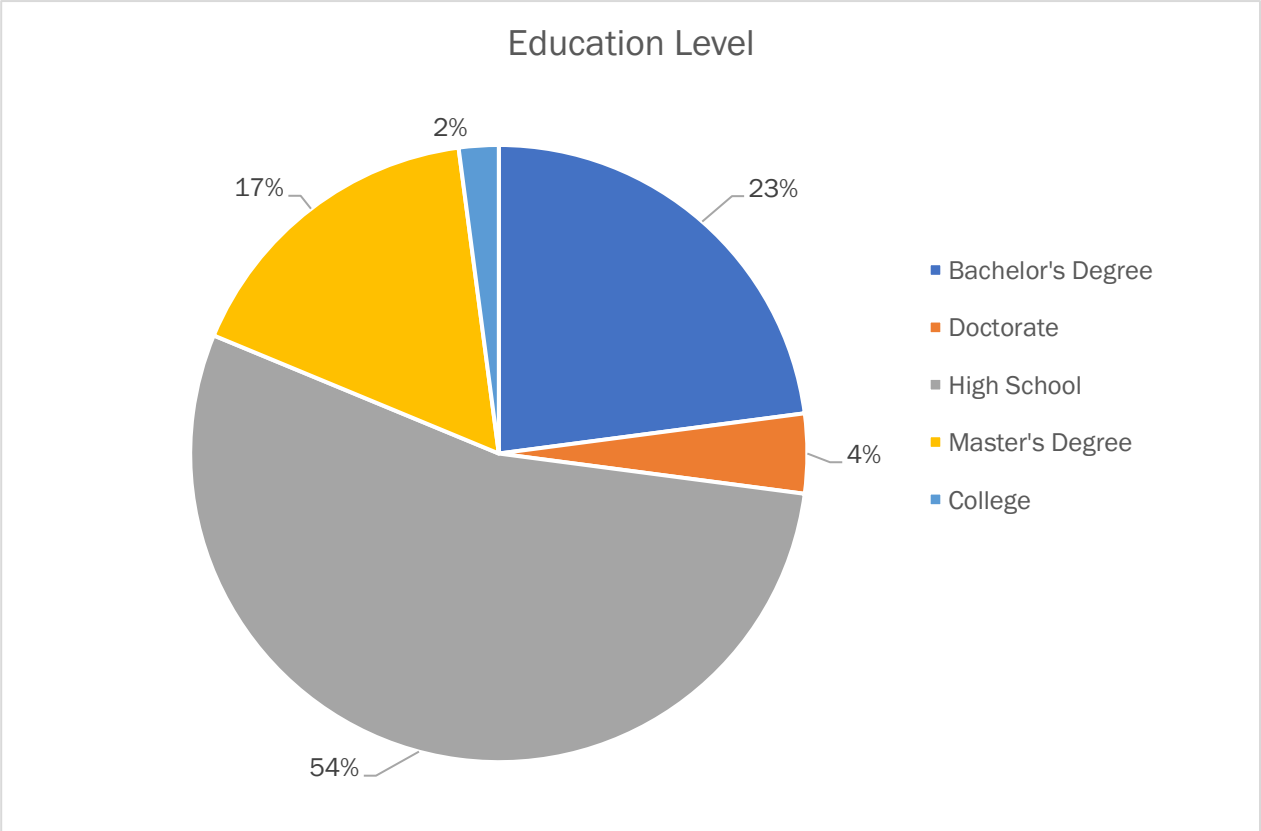


Figure 17 Education Level of Participants

5.2. Main Findings

5.2.1. Reported Persuasion

I coded reactions of participants from the recordings and notes based on Table 7 below:

Table 7 Reaction Coding

Code	Reaction
Positive reaction to persuasion attempt	"I would stand up", "I want to stand up", "I love the potato", "Potato is so cute", "I feel like I should stand up", "Oh no, I want to make my profile status better", "I want to use the app and change my profile", etc.
Negative reaction to persuasion attempt	"I do not feel like standing up", "I do not want to stand up", "This is stupid", "It is just a potato on the screen", "It is just a reminder, it is not going to make me do it", "I do not like being told what to do", etc.

When a participant responded both positive and negative to the same question or the screen, I tagged that reaction as both positive and negative. Figure 18 illustrates the reactions and reported persuasion levels of each variant.

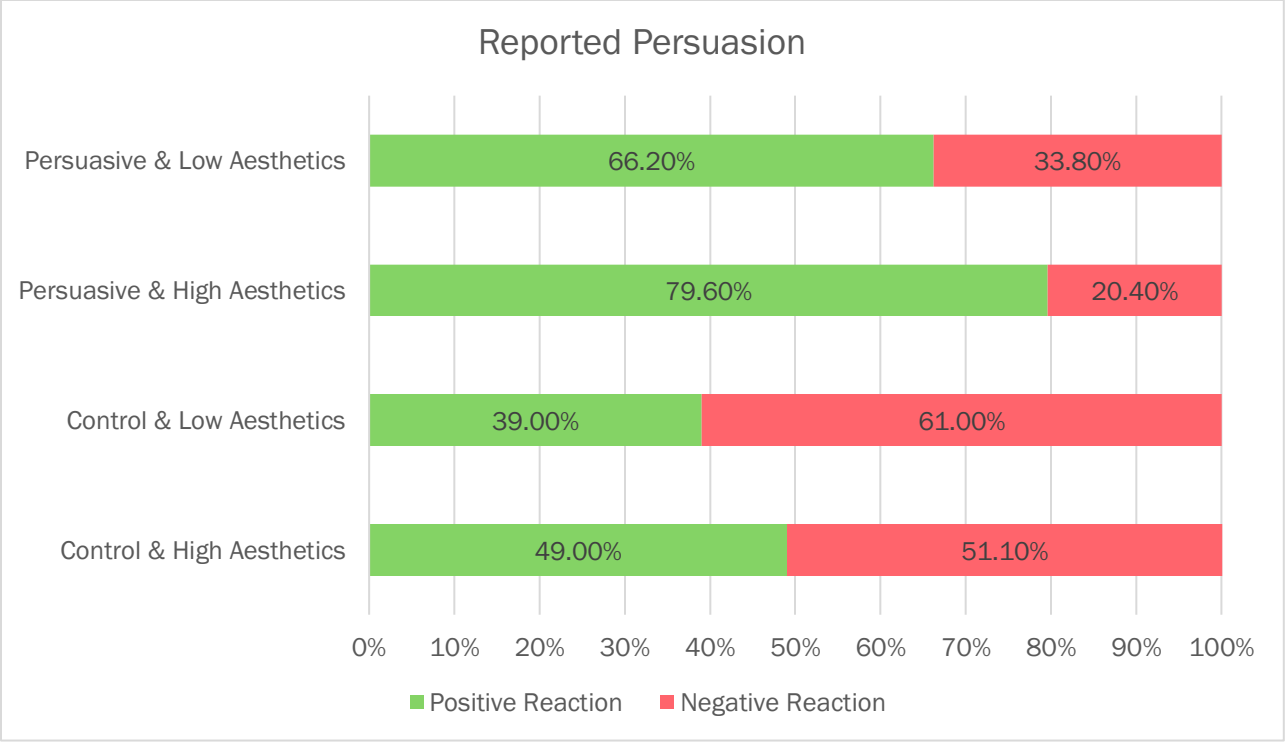


Figure 18 Reported Persuasion of Variants, Percentages of Coding Frequencies

Based on these results, participants in the persuasive group, both in high and low aesthetics variants, reported higher persuasion than the control group. Furthermore, High Aesthetics variants, both in control and persuasive groups, reported higher persuasion than Low Aesthetics variants. Lastly, participants of Control variants reported more negative reaction overall than positive reaction.

To test the statistical significance of these results, I ran two-way ANOVA between subjects, with two independent variables (Aesthetics Level: High and Low; Persuasion Level: Persuasive and Control), and reported persuasion

as the dependent variable. The significance level (α) was 0.05. Figure 19 shows the results of descriptive statistics below:

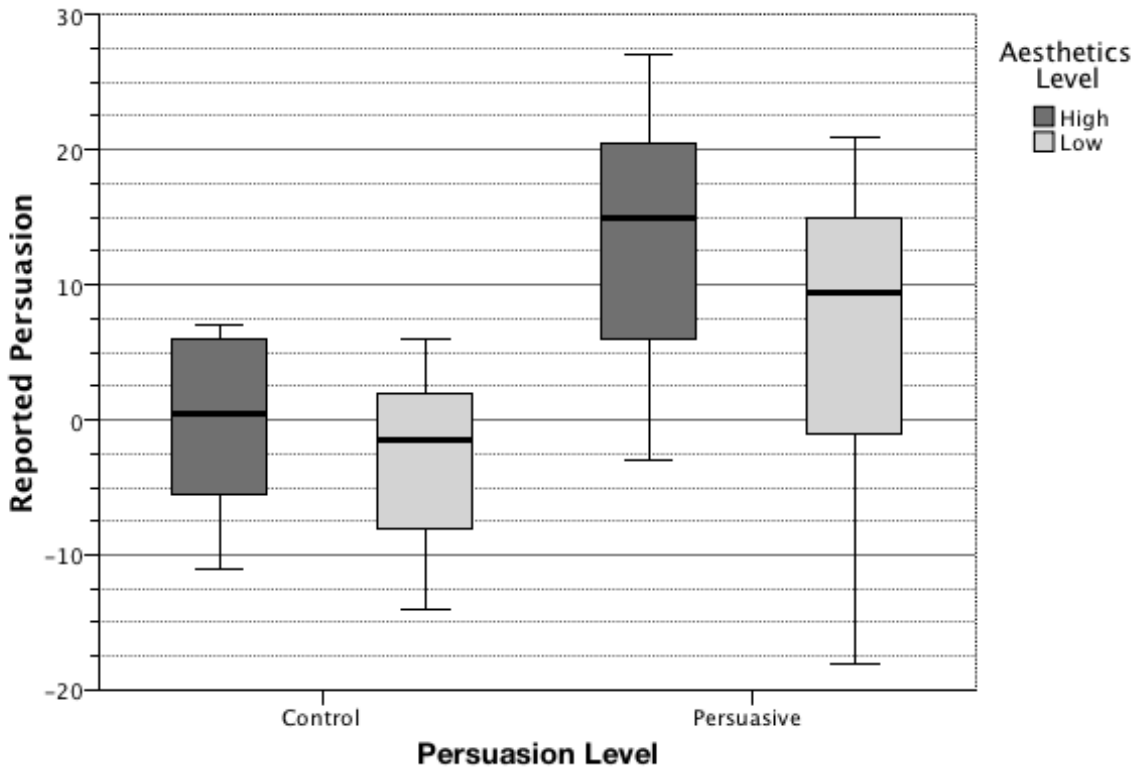


Figure 19 Reported Persuasion

Results showed that the reported persuasion levels of persuasive variants were significantly more persuasive than control variants ($p<0.005$), which confirms the first hypothesis of this study, "Persuasive variants will be more persuasive than the control variants".

However, the results also show that, the difference in reported persuasion between aesthetics levels, shown in Figure 18, is not significant ($p=0.059$). In addition, the results also suggest that influence of aesthetics levels on

reported persuasion is not significant (F (1, 44) = 0.952, p=0.334). Hence, the second hypothesis of this study "High Aesthetics variants will be more persuasive than low aesthetics variants" is not confirmed. This is interesting as the literature analyzed and persuasion principles followed suggested H2 to be true. This finding is discussed in detail later.

Comparison of Response to Different Screens of the App

I investigated the reported persuasion levels in different screens of the app to understand if there was any difference that arises from the types of feedback, due to the implementation of aversive stimuli. The present study utilizes negative reinforcement and punishment in addition to positive reinforcement to fully benefit from operant conditioning. Figure 20 illustrates the percentages of both positive and negative reaction different screens received.

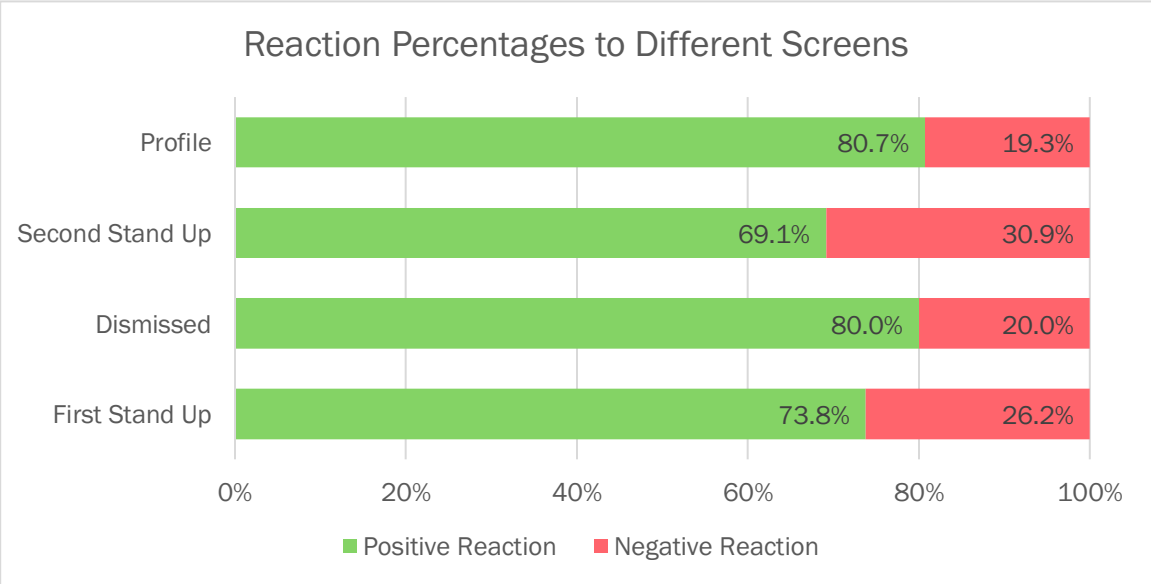


Figure 20 Reaction Percentages to Different Screens, Reported Persuasion Levels

Based on these results, there is not a distinct difference between different screens of the app in terms of reactions they got hence there is not enough evidence to conclude that one type of feedback resulted in higher levels of reported persuasion than the other.

5.2.2. Aesthetics Ratings

To understand the aesthetics ratings by participants, I used AttrakDiff questionnaire. Figure 21 and Figure 22 illustrate the results.

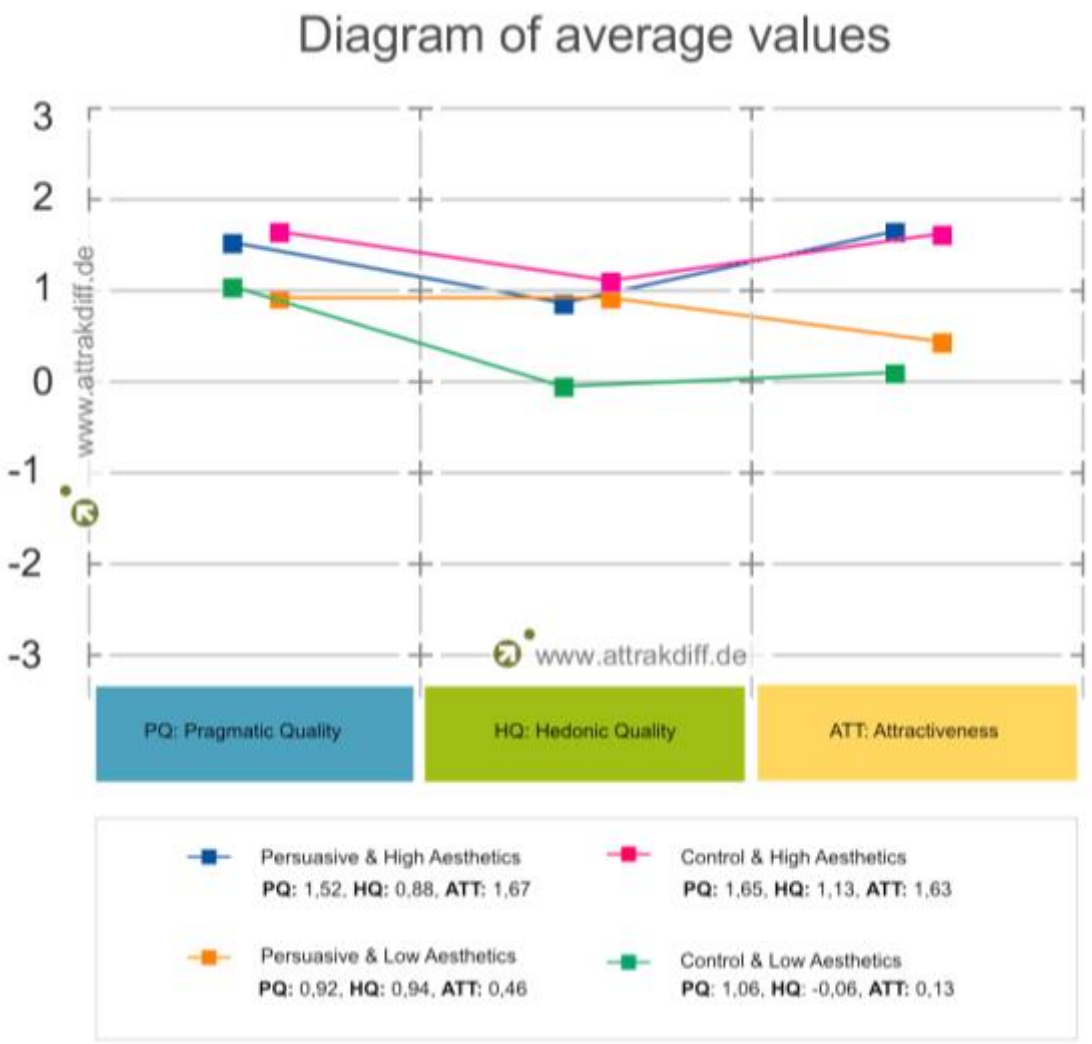


Figure 21 AttrakDiff Results, Averages of Pragmatic Quality (PQ), Hedonic Quality (HQ) and Attractiveness (ATT)

Surprisingly, despite the aesthetics manipulations and different levels, Hedonic Quality (HQ) ratings are close to each other, except for the control & low aesthetics variant, which had the only negative value among all the groups. In fact, participants of Persuasive & Low Aesthetics variant rated it slightly higher than the Persuasive & High Aesthetics variant, which is not the case in control variants.

To further investigate, we can look at the word-pair ratings for each variant, in Figure 22 below:

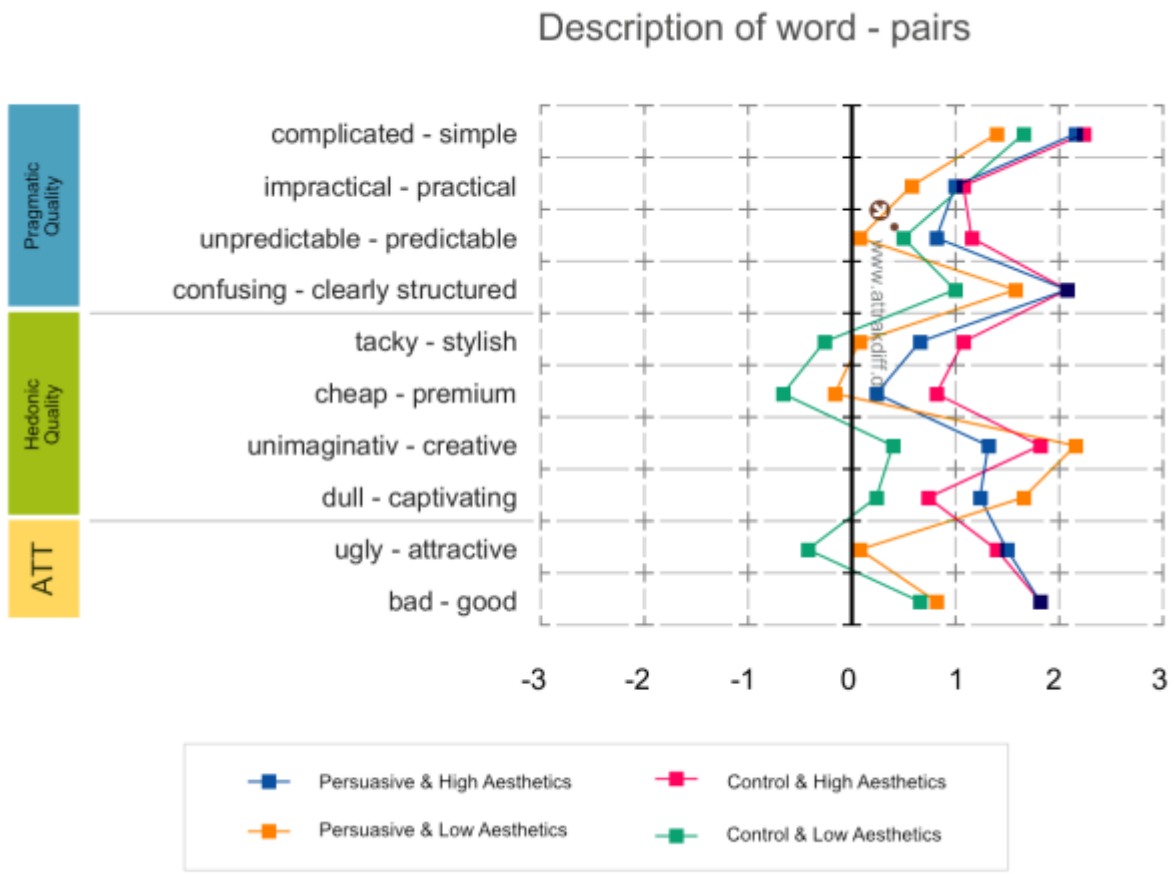


Figure 22 AttrakDiff Results, Word-pair results

High Aesthetics variants of both Persuasive and Control groups rated higher on every item on Hedonic Quality scale except for the pairs “dull-captivating” and “unimaginative—creative”. This could be due to word pairs and how participants interpreted them. For instance, some participants of Low Aesthetics variants (both in persuasive and control groups) commented app to be captivating and attention grabbing because of the colours. Moreover,

some participants in Low Aesthetics and Persuasive variant may have rated it higher in creativity for other reasons such as novelty of the app, or the potato figure utilized, based on the comments they made during the study.

Overall, Attractiveness (ATT) ratings show that participants rated High Aesthetics variants higher than Low Aesthetics variants, with only Control & Low Aesthetics variant being close to the word "ugly". This shows that manipulation of aesthetics levels was successful, but participants did not perceive low aesthetics variants to be much "uglier" or of less quality in Hedonic Quality ratings compared to high aesthetics variants. This finding is discussed in detail later.

Additional Comments on Aesthetics

Some participants made comments on the aesthetics of the app while answering questions in the study. There were participants using the low aesthetics variants who found the app to be "modern and fresh" and "innovative and creative", where some made opposite comments. Some of the interesting comments participants made on the aesthetics are provided in Table 8 below:

Table 8 Selected Comments on Aesthetics

Variant	Comment
Persuasive & High Aesthetics	"Looks like a legitimate app."
	"I like the aesthetics and clarity."
	"The graphics were genius, the happy potato and sad and falling ones, they were very explanatory."
	"Looks like a popup ad."
Persuasive & Low Aesthetics	"It is like someone had designed while ignoring all the design conventions and went opposite."
	"I want to fix the design, cannot appreciate misaligned elements."
	"If it looked better, I might consider using it."
	"I like the colours and design."
Control & High Aesthetics	"Notifications on the whole screens make it easier to focus."
	"Looks like an animation, exciting."
	"Feels energetic, looks active."
	"I don't like *(profile screen's)* dark colours."
Control & Low Aesthetics	"Too distracting, nowhere to look."
	"Graphic designer's nightmare"
	"I want to dismiss the notification, close the app and something else."
	"I like the design"

The comments support the results from AttrakDiff questionnaire, also showing the success of aesthetics level manipulations. Especially some of the comments regarding the influence of aesthetics on their potential usage is

worth of discussion, as they lie in the potential effect of aesthetics on usability.

Note on Pragmatic Quality Ratings

Participants rated High Aesthetics variants higher on the Pragmatic Quality (PQ) ratings compared to Low Aesthetics variants, where every variant is rated positively on that scale. This means manipulations on aesthetics levels did not affect usability negatively, but these results might be reflecting the similar phenomena previous literature on aesthetics and usability found: the positive effect of aesthetics on usability [52, 122, 124]. This finding is discussed in detail later.

5.3. Additional Findings

Participants provided additional information, contributing to the research questions of this study. These include comments on how they might use the app, comments on persuasive elements, in addition to their opinions about smartbands. Although some participants didn't own any device, they had strong opinions towards them, and participants who own them also revealed more about their experience and satisfaction.

5.3.1. Comments on the Couch app

Participants made comments on the app regarding the persuasive elements, graphical elements and their potential usage. A participant in the low aesthetics variant stated that even though they found the app functional and of novelty, it would not be used because of how it looks and noted "there must be better looking alternatives". 2 participants found the app to be useless, and added "My body would tell me when to stand up". Moreover, some found potato figure to be helpful, especially due to its emotional connection. One interesting comment on the figure was "Will there be a graveyard of figures I killed if I keep sitting down?". This contrasted with some other interpretations such as "It is just a potato at the end, there will be a new one if this one dies".

6 participants commented they liked the guilt factor, and 8 participants stated they would prefer it over other apps with just positive feedback. One participant even stated that they regretted their choice of sitting down after seeing the profile screen, and added they would like to use the app again and follow the instructions next time.

Participants also commented on how they might react when it may not be possible to stand up, such as when they are in a class or a meeting. A participant commented they would stand up anyway and keep doing the

tasks they are already doing where 7 participants stated they would ignore at those times but use the app and follow the notifications whenever they can. Participants also noted they were aware of the upcoming notification after the first one, and one stated they were "racing" the app to finish reading before the notification appeared again.

Lastly, 3 participants stated that they were already more conscious about reducing sedentary behaviour. 35 participants stated they would use the app, where 6 of them stated although they were motivated, they were unsure about the long-term usage.

5.3.2. Comments on Smartbands

Participants who finished reading the article before the first stand up notification made comments on smartbands such as fitness tracking devices and smartwatches. Those who own such devices stated some of their shortcomings, including inaccuracy at certain activities (such as kickboxing and pushing a stroller), or the lack of persuasion. These include statements such as "I have a fitbit but I do not think it does what it promises to, at the end it just tracks your activity" and "I wish my fitbit had this (*potato*) figure, we would walk together".

One prominent positive comment about those devices was social aspects and competing with friends, but not everyone stated using that feature. These responses provide implications for how to better design such devices.

Participants who do not own smartbands had different opinions about them. Some found smartwatches and fitness tracking devices to be useless and considered them as “expensive toys”, where some stated those devices would become as widely used and available as smartphones in the future.

Chapter 6. Discussion

Overall, persuasive variants of the "Couch" application were successful in persuading its users; motivating and informing them to reduce sedentary behaviour. Participants of persuasive variants reported significantly higher levels of persuasion than the control variants, and noted the persuasive effects in different ways, confirming the first hypothesis of this study. On the other hand, aesthetics did not influence the persuasiveness of the app as expected, which rejects the second hypothesis of this study. In this chapter, I discuss these findings and their implications, in addition to limitations of the study.

6.1. Persuasion and Aversive Stimuli

Results show the success of persuasive design principles the app utilized: Fogg's functional triad [33] and PSD framework [95], in addition aversive feedback as suggested by Kirman et al. [66], Chiu et al. [20] and Aydin et al. [6].

Compared to the persuasive group, the control group did utilize some persuasive elements, such as reminders to keep the features and the structure of the app same, but did not include the other persuasive elements

such as potato figure and operant conditioning. Yet participants of that group were significantly less persuaded than the persuasive group.

Inclusion of aversive stimuli appeared to increase persuasion, as stated by participants with comments such as “I feel obligated to stand up because of the warning” and “I feel encouraged to stand up, potato is counting on me”. Specifically, participants stated the motivation arose from the emotional connection established with the potato figure, such as “this potato wants me to stand up, I am not just disappointing myself but someone else too”, “I would stand up because someone is relying on me” and “Potato felt happy and I felt happy, I could stand up with potato together”.

Moreover, the language used also resulted in more engagement. For example, one participant stated that when they saw the profile screen and noticed they were being called “lazy” by the app, it was “not about just potato anymore”. They stated higher degree of motivation to stand up compared to just seeing a notification. This finding supports the literature on aversive stimuli and user engagement.

Although there was not a significant difference between aversive stimuli compared to positive feedback, participants appreciated being able to see both types of feedback, and felt it was up to them to make their status positive, and that it was better than seeing a constantly positive status. Such contrast

between screens seemed to have created more emotional connection, resulting in comments such as “I liked the way screens build the sense of urgency” and “… worse status made me more invested, because of my own laziness, I killed something else”.

This finding also underlines the impact of using other roles than just authority as Fogg suggests, and in this study, potato acted in the role of a friend. Participants had an emotional connection, felt responsible for their actions, and wanted to “save the potato” by standing up. Potato figure appeared to also help overcome “I do not like being told what to do” attitude 8 participants showed/mentioned in the control group; in the persuasive group, they felt like they were helping someone else rather than doing it because the app told them to do so. Considering the lack of other roles than authority in the PSD Framework, this finding shows the importance of investigating broader types of roles and their effects.

Despite the overall success of persuasion attempts, not all participants appreciated the potato figure. This choice might have impacted the results, and allowing users to create and use their own characters would probably have resulted in even higher levels of persuasion. Furthermore, giving an option to create different personalities to reflect different types of roles in addition to the friend role would probably increase the persuasiveness of the

app, as Fogg [33] suggests people are more influenced by those who are similar to them.

The choice of target behaviour, standing up more, was successful, perhaps limited in some ways. All the participants did understand what the app was trying to do, yet the perception of app's capabilities varied. Majority of participants perceived it as the "an app to get you to stand up more". Participants who perceived app this way appreciated its simplicity and focus on one simple task rather than trying to do too much at once, or being another fitness app. In addition, 5 participants perceived it as a fitness and health app, and assumed the app would display more information than just sedentary time. 3 participants wanted to utilize the app to add and complete their daily tasks while also standing up. This was especially present in the control group. This reflects the differences in users' needs and preferences, and how persuasive principles could be used in different contexts and purposes. Nevertheless, additional research to understand which strategies and how to utilize them, and how people react to those principles in different domains is necessary.

Lastly, 8 out of 48 participants felt interrupted by the notifications when they received the notification while still reading. This is in line with Fogg's suggestions on how persuasive technology should intervene at the right

moment, but it may not be always easy to detect and act on that moment. Interruption is considered to be an important topic in HCI, and McFarlene [84, 85] states that interruptions might cause people to make errors and disrupt from making good decisions. However, this is beyond the scope of this thesis. Moreover, privacy concerns might arise if an app collects vast amount of data just to detect that moment precisely. Thus, alternative approaches to minimize an app from becoming annoying is necessary. The ability to customize notification timings is a step, but as one participant commented, it may not be enough: "I would constantly snooze and at the end I would stop using it".

6.2. Influence of Aesthetics

Results from the AttrakDiff survey showed that manipulation of aesthetics levels were successful, but aesthetics did not have an influence on reported persuasion. This is an interesting result especially considering aesthetics being one of the principles both in functional triad and PSD Framework.

This could be an indication of influence by other persuasive elements on the aesthetics. For example, 10 out of 12 participants in persuasive and low aesthetics variant found potato figure to be "cute", where 7 of them made explicit negative comments about the design of the app. Such comments and perception might have reflected on the aesthetics ratings, such as the word-

pairs “unimaginative—creative” or “dull—captivating”. This could have affected aesthetics ratings overall, but might also be showing how people prioritize certain elements in an app. Results from the control group also showed similar results. Despite the lack of persuasive elements other than the notifications in the control group, aesthetics levels did not show a significant effect on reported persuasion.

Even though aesthetics did not influence persuasiveness of the app significantly, when results from the surveys and comments of participants are considered together, it is possible to argue that the app needs to have a certain level of aesthetics to be used by people. Statements that refer to the desire to look for an alternative or to change the design of the app might be demonstrating that people expect a certain level of aesthetics to start using the app, which would then determine the success of any persuasion attempt; without adequate level of aesthetics, people may not get and start using the app, even before being exposed to any persuasive element of the app. Such claim would also require a future work and investigation, and would help clarify the role of aesthetics on persuasive systems.

An interesting result, however, is on the Pragmatic Quality (PQ) ratings on the AttrakDiff questionnaire which reflects the usability of the app. In both persuasive and control groups, high aesthetics variants had higher PQ

ratings than low aesthetics variants. Similar effect is also apparent in some of the comments by participants on aesthetics of the app, reflecting no desire to use the app because it looks “ugly”, one mentioning they “would not even consider downloading”. This could be due to the similar effect some literature on aesthetics and usability has shown previously, that is aesthetics positively influencing usability ratings. As mentioned in the literature review chapter, some studies found this effect, sparking the still ongoing debate of the term “what is beautiful is usable”, which might also be found in this study, however, as it was not a focus of this study, such claim would require further investigation.

6.3. Limitations

The first limitation of the study is relatively small sample size. There were 48 participants overall, which was divided to four different variants, hence each variant having 12. Higher number of participants would better reflect the target audience and provide more accurate results. Moreover, there were more females than males, though the present study only collected sex and does not investigate any differences between sexes in results. However, as Rode [105] argues, it would be even more important to consider gender roles as an aspect of everyday life, which are social constructs and co-constructed with technological identity, rather than taking a binary attitude towards technology.

Another limitation is the results only reflecting the short-term experiment. It would be more effective to conduct a long-term study on the effectiveness of the app and persuasive principles utilized. Nevertheless, this is a first and important step to understand the influence of aesthetics on persuasiveness of the app, and fits within the Fogg's 8-step design process to "test and iterate quickly".

Moreover, as AttrakDiff results suggested, participants did not rate two levels of aesthetics as different as expected. Although this might be due to how some of the participants interpreted some word pairs in the questionnaire, this less than expected difference is a limitation for the study. Due to time constraints, it was not possible to first get users rate aesthetics and use the versions with the widest difference in ratings for the app design, which would help get a clearer result.

Last, I used participants' reactions as a measure of understanding how persuaded they felt, due to lack of a standardized approach. I believe using a qualitative approach and collecting this information from the whole experiment rather than using a single-item measure at the end of the study has been valuable as it allowed me to capture more details and insights during the interaction. However, it makes the experiment results difficult to compare to others.

6.4. Suggestions

Participants suggested some features and changes while interacting with the app such as being able to integrate a to-do list or other task management related apps, to define their tasks to do after standing up, to customize the timers, to "snooze", to include of social comparison features, to share status with friends, to have more distinctive notifications, to augment them with longer vibration, sound or animation, to change the potato figure, or create their own, tutorial screen[5], to have more information on risks of sedentary behaviour and prolonged sitting, and to have a desktop app as a companion to mobile app. These suggestions could help to build an even more persuasive app, not only just to reduce sedentary behaviour but to any system that contains similar features or utilizes the same persuasive principles.

[5] Although some participants suggested a tutorial screen, some stated they did not like tutorials at all, and that they appreciated the "simplicity" and "straightforwardness" of the app

Chapter 7. Conclusion

The aim of this research is to contribute knowledge to HCI literature on persuasive systems and aesthetics, to find out the effectiveness of persuasive principles followed and to determine the effects of aesthetics on the persuasiveness of a system.

The literature reviewed implied two things. First, the persuasive principles would make a system more persuasive, and the implementation of aversive stimuli would help fully utilize operant conditioning. Second, aesthetics is an increasingly important consideration despite the mixed results, and literature suggested that higher level of aesthetics would positively influence and increase the persuasiveness of a system.

This study utilized a mobile app in four variants, with two levels of persuasion and two levels of aesthetics. The choice of behaviour to change was prolonged sitting. I designed a potato character for persuasive variants to utilize the social role and to better use other principles in Fogg's functional triad. I used qualitative and quantitative data gathering methods to understand reported persuasion of the app and users' evaluation of its aesthetics.

The results demonstrated that persuasive principles were indeed successful and participants in the persuasive group, both in high and low aesthetics levels, felt more motivated and persuaded to stand up. However, aesthetics did not affect the persuasiveness of the app as the literature and principles suggested. Furthermore, there was not a significant difference in terms of persuasiveness of different types of feedback, positive and negative, but it would be impossible to conclude a result on the matter as this study focused on the aesthetics and its influence, not the differences between positive and negative feedback. Regardless, it is still possible to state that using a mix of two was successful based on the results. Interestingly, a potential effect of aesthetics on usability was also apparent based on the results from the AttrakDiff questionnaire. Nonetheless, as it was not the focus of the study and participants' interaction with the device was limited, there is not enough evidence to confirm that higher level of aesthetics positively influenced the usability ratings.

Overall, the present research was successful in utilizing the persuasive principles, implementing both positive and negative feedback, and reporting the influence of aesthetics on the persuasiveness of the app reported by participants. In fact, these findings could be used in other systems in the domain of physical activity for successful persuasion, although more research to validate especially in longitudinal manner is also necessary.

Future Work

The results have several implications for future work. First, aesthetics has a substantial influence overall, and although the present study did not report significant effects of aesthetics on persuasiveness of the app, future work on aesthetics and persuasion is necessary. Larger number of participants, different domains and platforms, and longitudinal studies are all important factors to consider for future research. In addition, there is a need for more research on the matter of aversive stimuli in persuasive technology. Especially reactions of and comments by the participants showed the influence of negative feedback on the participants: it helped to create a better contrast, as previous literature showed. Future work needs to implement more aversive stimuli, specifically in long-term manner, to understand its effects on reported persuasion. This is particularly important considering discussed literature mostly avoids using such feedback despite it being essential to operant conditioning.

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Appendices

Appendix A. Participant Recruitment Materials

A.1. Poster

Carleton UNIVERSITY

Participate in a study on aesthetics of a smartphone app

The study will take about 30-45 minutes to complete and you will be asked to use a prototype app on a smartphone. During the study, you will be asked questions about your experience.

Participants will be compensated with a $10 Gift Card.

To participate in this study, you must be

At least 18 years old

Comfortable using a smartphone

Comfortable speaking in English

The ethics protocol for this project has been reviewed and cleared by the Carleton University Research Ethics Board, with CUREB-B Clearance #105938. If you have any ethical concerns with the study, please contact Dr. Andy Adler, Chair, Carleton University Research Ethics Board-B (by phone at 613-520-2600 ext. 4085 or via email at ethics@carleton.ca).

Please contact the lead researcher, Arda Aydin, for more details on this study at arda.aydin@carleton.ca

Participate at: is.gd/hellopotato

Participate at: is.gd/hellopotato
Participate at: is.gd/hellopotato
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A.2. Online Recruitment Materials

A.2.1. E-Mail

Carleton UNIVERSITY

Participate in a study on influence of **aesthetics** on a smartphone app

The study will take about 30-45 minutes to complete and you will be asked to use a prototype app on a smartphone. During the study, you will be asked questions about your experience.

To participate in this study, you must be

At least 18 years old

Comfortable using a smartphone

Comfortable speaking in English

Interested in participating?

Let's schedule*

*also you will be compensated with a $10 Gift Card

The ethics protocol for this project has been reviewed and cleared by the Carleton University Research Ethics Board with clearance number 105938. If you have any ethical concerns with the study, please contact Dr. Andy Adler, Chair, Carleton University Research Ethics Board-B (by phone at 613-520-2600 ext. 4085 or via email at ethics@carleton.ca).

Please contact the lead researcher, Arda Aydin, for more details on this study at arda.aydin@carleton.ca

A.2.2. Social Media Notice

Appendix B. Consent Form

CUREB-B Clearance #105938

Consent Form

Title: Influence of Aesthetics on a Mobile Persuasive App

Date of ethics clearance: November 22, 2016

Ethics Clearance for the Collection of Data Expires: November 30, 2017

I _____, choose to participate in a study on Influence of Aesthetics on a Persuasive Mobile App. This study aims to understand the influence of aesthetics on a mobile app designed to encourage its users to reduce their sedentary behaviour using feedback mechanisms. **The researcher for this study is Arda Aydin in the Human-Computer Interaction Program, School of Computer Science. He is working under the supervision of Dr. Audrey Girouard in the School of Information Technology.**

This study involves using a mobile application prototype and performing series of tasks, followed by questionnaires and follow-up questions to better understand your overall experience, and should not take more than 45 minutes. With your consent, the study will be recorded; your audio as well as the screen of the device.

To participate, you must be at least 18 years old, comfortable using a smartphone and comfortable speaking in English. Otherwise, you will not be able to participate in this study.

Should you experience any distress during the study, you will be provided with contact information for counseling services available nearby.

You have the right to end your participation during the study, for any reason, up until the end of the session today. You can withdraw by verbally telling the researcher or the research supervisor. If you withdraw from the study, all information you have provided will be destroyed. However, it is not possible to withdraw after the study is done, as the data will be stored anonymously.

As a token of appreciation, you will receive a $10 gift card, even if you choose to withdraw from the study.

This document has been printed on both sides of a single sheet of paper.
Please retain a copy of this document for your records.

Utmost care will be taken to protect your identity. All research data will be password protected, and your responses will be stored anonymously. Hard copies of data (notes and consent form) will be kept in a locked cabinet at Carleton University. The post-study questionnaire data is provided by User Interface Design GmbH in Germany, who is obliged to act in accordance with data protection regulations and use the data for only anonymized evaluations, subject to foreign laws on data privacy and confidentiality. No one else than the researcher and the supervisor will have access to this data and no identifying information will be used at any time.

Once the project is completed, consent forms will be destroyed. Audio and screen recordings will be kept securely for two years for potential future research and will be destroyed after that period. Remaining data (results of questionnaires, findings, etc.) will be kept until once no longer useful.

If you would like a copy of the finished research project, you are invited to contact the researcher to request an electronic copy which will be provided to you.

The ethics protocol for this project was reviewed by the Carleton University Research Ethics Board, which provided clearance to carry out the research, with clearance number 155938. If you have any ethical concerns with the study, please contact Dr. Andy Adler, Chair, Carleton University Research Ethics Board-B (by phone at 613-520-2600 ext. 4085 or via email at ethics@carleton.ca).

Researcher contact information:
Arda Aydin
Human-Computer Interaction
Carleton University
Email: arda.aydin@carleton.ca

Supervisor contact information:
Dr. Audrey Girouard
School of Information Technology
Carleton University
Email: audrey.girouard@carleton.ca
Tel: +1 (613) 520 2600 x8817

Do you agree to be audio-recorded: ___Yes ___No

Do you agree to have your actions on the smartphone recorded: ___Yes ___No

_____ _____
Signature of participant Date

_____ _____
Signature of researcher Date

This document has been printed on both sides of a single sheet of paper.
Please retain a copy of this document for your records.

Appendix C. Survey on Demographics

Pre-Questionnaire

Pre-study questionnaire to collect participant information on user smart device usage and demographics. Please take a moment to answer the following questions before the study begins.

There are 7 questions in this survey

Questions

1 []Please indicate your sex: *

Please choose only one of the following:

- ○ Female
- ○ Male
- ○ No answer

2 []Please indicate your age *

Each answer must be at least 18

Please write your answer here:

3 []What is the highest level of education you have completed? *

Please choose only one of the following:

- ○ High School
- ○ Associate Degree
- ○ Bachelor's Degree
- ○ Master's Degree
- ○ Doctorate
- ○ Other

4 []What is the field of your study / background? *

Please write your answer here:

5 []Do you own and use a smartphone and/or a tablet? *

Please choose only one of the following:

- ○ Yes
- ○ No

6 []Do you own and use a device with fitness tracking capabilities? (Such as Apple Watch, FitBit, etc.?) *

Please choose only one of the following:

- ○ Yes
- ○ No

7 []Please specify the fitness tracking device you use:

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '6 [Fit]' (Do you own and use a device with fitness tracking capabilities? (Such as Apple Watch, FitBit, etc.?))

Please write your answer here:

Thank you for your time.

Appendix D. Article 1

Stupid Smart Stuff: Watches and Automation[6]

Stupid smart watches

I was deep asleep when my watch started vibrating on my wrist. Chrrr, chrrr, chrrrr, chrrrr - it kept going and going, long enough and strong enough to wake me up. It was 4:30 AM.

I looked at the watch (rather groggily): Battery is almost depleted, the symbol said. Turning off.

"Thank you for letting me know," I said (although with somewhat different words), taking the watch off and throwing it into a corner, where it still lies, a week later. Thank you Sony for your intelligent smart watch.

If the watch was so smart, why didn't it tell me at 9 PM that it was low on energy and that I should put it on the charger overnight. After all, the watch knows when it is getting low on energy - it even has a little display that shows the battery level, except it isn't on the main display - you have to push some buttons and swipe the screen to get to it. The watch knows its energy

[6] Article by Don Norman, available at http://www.jnd.org/dn.mss/stupid_smart_stuff_.html

level and time of day - if the watch were a person, I would send them back for retraining.

I was testing the watch for a company I work with. I try out a lot of technology this way. This watch, however, was a low point. Smart watch? It is really stupid. It can tell the time of day, has a nice stopwatch and timer. Also an alarm clock, although the bizarre interface on that clock had me puzzled into I realized that the way to reset it is to reboot the watch. (Reboot the watch? yeah. We live in exciting times.)

When I tried the app that gives me two time zones, the watch was not intelligent enough to display both by itself. Smart watch? It couldn't even compute the second time zone without asking for help: It had to make a Bluetooth connection to my phone, ask the phone what time it was in the second time zone, and then display the answer. This smart thing couldn't even do simple addition or subtraction.

The Bluetooth connection to the phone seemed to be the watch's main activity: It was continually connecting and disconnecting even when the phone was in my pocket, less than an arm's length away from the watch. And the Sony designers, bless them, thought that it was important to tell me every time the watch connected or lost the connection. As a result my wrist

was always being vibrated. A single powerful vibration, whether for connecting or losing the connection. First of all, why did I need to know? Second, if I really needed to know, wouldn't it have been better to signify whether the connection was being made or broken instead of using the same signal for both?

Stupid smart automation

This kind of stupidity, especially the lack of communication, is common with smart automation. In commercial aviation, the smart automated systems are also stupid. I've studied several incidents in aviation where the lack of communication to the pilot was deadly. Literally. Something goes wrong with the airplane, but the intelligent, automatic systems compensate. No need to bother the pilots. But the wrong thing gets worse and worse until the automation reaches the limit of its compensatory abilities. "OK, I give up," it says, and lets the plane start to crash.

"Huh" say the pilots, scrambling to figure out what happened and what they should do about it. (Usually they succeed because when a plane is 30–40,000 feet up in the air (9–12 KM), there is quite a bit of time - minutes. Moreover, commercial airline pilots are extremely well-trained.

Automation has now entered the automobile. Alas, the automobile industry refuses to learn the lessons from aviation automation. The automobile engineers believe that they have solved the problems: cars will drive by themselves without any incidents. Humans will monitor the driving and if there ever is a problem, they will simply take over. In fact, the requirement for people always to monitor the self-driving automobiles is now incorporated into the law in some locations.

How silly. The notion that we can have automated or semi-automated cars as long as the driver is watching over them is a dangerous myth. As soon as the car can maintain its speed and keep a safe distance from car's in front automatically (already true with adaptive cruise control) and maintain its position in the lane properly (already true with lane-keeping systems), drivers will take the opportunity to find their favorite music, to turn to the rear passengers and converse, to read their email, etc. It is a myth that people can maintain control when they have nothing to do for a long period. This myth is well understood in the military and in commercial aviation: it has been studied for well-over 50 years in the field of vigilance (a part of psychology and human factors research).

In the airplane, the pilots are not attending, but when trouble does arise, the extremely well-trained pilots have several minutes to respond. In the

automobile, when trouble arises, the ill-trained drivers will have one or two seconds to respond. Automobile designers - and law makers - have ignored this information.

It is time to for the designers and engineers of this coming automated world and take heed from the lessons learned over the years in the field of Human-Systems Integration, in studies of automation. Lots of excellent scientists working in the research labs of automobile companies know all this. Product people are notorious about ignoring the wisdom of research groups in their same company. We now have very smart devices, stupidly done. I fear the consequences will be a lot worse than waking people up at 4:30 in the morning. Pay attention, engineers: pay attention, designers. Pay attention or people will be killed.

Appendix E. Article 2

A Product Is More than a Product -- Consider the Chair[7]

EVEN SIMPLE THINGS CAN BECOME COMPLEX SOCIOTECHNICAL SYSTEMS

Today, designers think of systems, of services, and of lasting relationships. Design has moved on from things like chairs and simple systems to larger more important stuff, working to improve things like those massive, complex, bureaucratic systems that seem suited for no one. It's time for a manifesto. Hey - we have one. DesignX we called it, put together by a band of kindred souls from Delft, San Diego, Shanghai, and Swinburne. (Also see "Why DesignX.") DesignX aims at relationships that might have hundreds or even thousands of interconnections, relationships that can last a lifetime while simultaneously changing with time. It's a worthy cause.

Chairs show up frequently in this issue of CRISP, so let's consider the poor, lonely chair, once a staple of a designer's portfolio. Even chairs can take part in DesignX, because the 21st century chair might be an active, dynamic device capable of complex relationships.

[7] Article by Don Norman, available at http://www.jnd.org/dn.mss/a_product_is_more_th.html

Imagine how the 21st century chair might perk up when guests arrive, autonomously transforming itself as needed. It can become a stepstool when someone needs to stand on it, or a bed, perhaps formed by enlisting other chairs so that they can to support a horizontal body or two or three. When self-organized into neat orderly rows of its collaborators, the chair can accommodate crowds. While awaiting the crowd's arrival the chairs are a memory of the future, reminding us of the event that is to come. After they leave, the same chairs serve as a memory of the past.

Modern chairs will be intelligent, anthropomorphic, sensing, dynamic, capable of altering their shape, form, and function. Some chairs might come when called, others might lift people to reach high-up objects, and yet others might socialize with like-minded chairs, forming moving patterns across the room as they travel to wherever they might be most useful. These 21st century chairs are social, aiming to please. They will be active servants, relationship builders, and enablers of social interactions.

In the 21st century designers will produce many things besides chairs, many of which will not be objects. Some will be services and experiences, such as healthcare and wellness. Some will be ideas. Is an idea a thing, a product, a service? Whatever they are called, they need to be designed not as isolated

things but as complex, interrelated systems, as total experiences. As relationships.

We design affordances to permit and encourage some activities, anti-affordances to discourage and prevent others. Anti-affordance? Yup, a term I invented for things deliberately designed to prevent an activity, such as barbed wire, or those nasty spikes on the top of fences, or little steel pieces on the edges of walls in public places meant to inhibit skateboarders from practicing their grinds and slides along the sides of curbs and railings, preventing those acrobatic, amazing gravity-defying spins and jumps, where the skateboard miraculously follows the feet as if attached, even though it isn't.

Who designed the skateboard that makes such feats possible? I suspect the capability was discovered, not designed, but once discovered, from then on it was designed with careful attention to the details of the trucks, the curvature of the boards, and their springiness. So successful were the acrobatic behaviors these designs afforded that a new profession arose: designing against those affordances, designing anti-affordances to prevent the very activity that skateboarders love.

Sometimes it feels as if we, as designers, are in a duel, so that while we create marvelous devices capable of great intelligence, relationships, and creative expression, others work feverishly to deny these same characteristics. Creative relationships? Yes, all very good, they seem to say, but please, not in my backyard, nor front yard, nor within visible sight or audible distance.

Anti-affordances are one of the tools of the opposing designers. Imagine a chair designed to prevent sitting. Chairs, some people claim, are bad for health: killer chairs, they are called. Sitting is unhealthy, goes the new mantra: stand when you eat, stand while you work, and in the meantime, just stand. So while one community of dueling designers will create masterful, intelligent, shape-changing dynamic chairs that offer comfortable support, others will introduce anti-affordances to prevent that unhealthy comfort.

Today's designers may create ordinary chairs, but more and more we will all work on more complex things, some as radical as autonomous shape-forming chairs, but others more prosaic yet even more difficult, things such as healthcare or the way that automated cars might interact with drivers, passengers, pedestrians, bikers, and skateboarders. Even simple things can become complex sociotechnical systems.

A product is more than a product, it is a relationship that drives multiple relationships.

Post-Study Questionnaire

Below is the post-study questionnaire, AttrakkDiff3.
More information can be found at http://www.attrakdiff.de/index-en.html.

Assessment of couch

With the help of the word pairs please enter what you consider the most appropriate description for **couch**.

Please click one item in every line.

simple*	○	○	○	○	○	○	○	complicated
ugly*	○	○	○	○	○	○	○	attractive
practical*	○	○	○	○	○	○	○	impractical
stylish*	○	○	○	○	○	○	○	tacky
predictable*	○	○	○	○	○	○	○	unpredictable
cheap*	○	○	○	○	○	○	○	premium
unimaginative*	○	○	○	○	○	○	○	creative
good*	○	○	○	○	○	○	○	bad
confusing*	○	○	○	○	○	○	○	clearly structured
dull*	○	○	○	○	○	○	○	captivating

* required field

Back Continue

Appendix G. Script and Follow-Up Questions

Test Script

[INTRODUCTION]

Hello, and thank you for agreeing to participate in this study.

My name is Arda Aydin and I'll be walking you through our session today. This research study is part of my thesis in Human-Computer Interaction Master's program, where I am trying to understand the influence of aesthetics on a mobile app designed to encourage its users to reduce their sedentary behaviour using feedback mechanisms.

Your audio and screen of the device will be recorded during this study, to ensure capturing all the details of your interaction. These recordings will only be accessible by me and my supervisor. No identifying information is captured other than your voice, and the rest of the data will be collected and kept anonymously and stored securely. The consent form will be destroyed once the study is completed and recordings will be stored securely at Carleton University for two years for potential future research. Other anonymous data will be kept securely until once no longer useful.

This session will take about 45 minutes in total. If you need any break at anytime, please let me know.

Please keep in mind that you are free to withdraw at anytime during the study. If you choose to do so, the information you have provided will be destroyed. This will have no impact on you or my research.

Do you have any questions before I tell you about the study?
[Wait for the participant's response]

During our session, I will be asking you to use a smartphone and complete series of tasks using an app on the device. In addition, you will be given a secondary task to read this article. The interaction with the device will begin once you get the notification.

While you interact with the device, I will ask you to think out loud to tell us how you feel and what you are thinking. Also, please feel free to ask any questions if come to mind.

After tasks are completed, you will complete a questionnaire to understand your experience with the app, followed by several questions to reflect on your thoughts and feelings.

There are no right or wrong answers, so please be honest with your responses and opinions, and do not worry about hurting anyone's feelings or saying something out of line.

Before we can begin, I will ask you to take a moment to review and sign this consent form. Please feel free to ask any questions if you have.
[Wait for participant to sign the form and answer their questions, if any]

Please also take a moment to fill this pre-study questionnaire.
[Wait for participant to fill the questionnaire]

Thank you. Do you have any questions before we begin?
[Wait for the participant's response]

Thank you, we can now begin.

[BEGIN SESSION]

There will be several tasks that I will ask you to complete. First, I will explain a bit about the app and then tell you your tasks. You will begin with reading an article and your interaction with the device will begin once you receive a notification. This is an attempt to simulate the way we use smartphones in our daily lives.

Please think out loud once your interaction begins and you work through the tasks, by telling how you feel, what you think and any comments you might have meanwhile. This will help me to discover what is working and not working with the app and my design approach.

We can begin if you do not have any questions.
[Wait for the participant's response]

[INTRO]

Couch Is an iOS application in the prototype stage, that is designed to help its users reduce their sedentary behaviour using certain feedback mechanisms. It is planned to connect with your smartphones sensors to track your activity and give you notifications based on that to help you decrease the amount of prolonged sitting, even when you are not actively using the app.

PART 1

To better simulate how we use smartphones and its integration with our daily lives, you will be given an additional task of reading this article, and your interaction will begin once you receive a notification.

[GIVE THE ARTICLE TO PARTICIPANT AND ASK THEM TO START READING]
[Wait for the participant to start reading]

[LAUNCH THE PROTOTYPE WHILE PARTICIPANT READS]
[AFTER 5 MINUTES, NOTIFICATION APPEARS]
[INTERACTION WITH THE DEVICE BEGINS]
[Wait for the participant's response to the notification]

What to do you see on the notification? How do you feel? What would you do?
[Wait for the participant's response]

Now please choose to ignore the notification. Please tell me what you are thinking and feeling while you are working through this task.
[Wait for the participant's response]

[APP DISPLAYS ANOTHER SCREEN FOLLOWING USER RESPONSE]

Please tell me how you feel now that you have seen this screen?
[Wait for the participant's response]

What would you do?
[Wait for the participant's response]

Thank you. Please keep sitting and continue reading the article.
[Let participant continue sitting and reading]

[AFTER 3 MINUTES, ANOTHER NOTIFICATION APPEARS]

[INTERACTION WITH THE DEVICE RESUMES]
[Wait for the participant's response to the notification]

What do you see on the notification? How do you feel? And What would you do?
[Wait for the participant's response]

Do you feel motivated/encouraged to stand up?
[Wait for the participant's response]

Please feel free to decide either to keep sitting or standing up.
[Wait for the participant's response]

Thank you. This concludes the first part of this session. We will move on to the second part.

PART 2

Please go to your dashboard/profile on the app. What do you feel about your status reported by the app?
[Wait for the participant's response]

Is there anything you should be worried based on what you see? What do you think can get worse in your status?
[Wait for the participant's response]

What would you do?
[Wait for the participant's response]

How do you feel overall?
[Wait for the participant's response]

Thank you. This concludes the second part. We will now move on to follow up questions to better understand your experience.

[FOLLOW UP QUESTIONS]

How did you feel using the application?
[Wait for the participant's response]

What did you think about the feedback given by the app?
[Wait for the participant's response]

Did you feel motivated/encouraged to stand up while using the app?
[Wait for the participant's response]

How do you think this app will help you change your behaviour about prolonged sitting?
[Wait for the participant's response]

Is there anything particular you liked/disliked about this app? What is that?
[Wait for the participant's response]

Thank you. I now need you to complete this questionnaire to better understand your experience with the app.

[GIVE PARTICIPANT THE ATTRAKDIFF QUESTIONNAIRE]
[Wait for the participant to finish]

Thank you. That's it for the study. Do you have any questions to ask or any comments to add?
[Wait for the participant's response]

Thank you once more for your time and participation. Your feedback is very valuable and will help me understand the influence of aesthetics on persuasive mobile apps.

Please feel free to invite your friends or colleagues to participate in this study whom you think would be interested to do so. That will greatly help me with my research.
[Wait for the participant's response, if says yes, provide the copy of the poster for them to deliver to the parties whom they think are interested in participation]

Have a great day!