An Analysis of Guidelines for Persuasive Interfaces on Mobile Applications

by

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Abstract

Persuasive technologies in mobile applications have become more prevalent with the development of smartphones. The user being prompted to take on certain actions and behaviours as reminders that doctors, family members or friends would give is not often associated with mobile devices. The ability for this effort to succeed in some measure by applications depends on the effectiveness of the design elements on the interface of persuasive applications. What are a reliable set of design principles that make persuasive applications, *persuasive*? After realizing the gap in previous research on guidelines for persuasive interfaces, Alexandra Nemery and Eric Brangier propose a set of criteria that list the essential design elements for a persuasive interface: *credibility, privacy, personalization, attractiveness, solicitation, priming, commitment,* and *ascendency*, and divide them into two sets of criteria: *static* and *dynamic*. As a follow up research to their study, this research paper analyzes 20 persuasive applications on the guidelines of Nemery and Brangier by employing open coding. The results show that not only were Nemery and Brangier's guidelines are absent in most applications, but they also did not account for the following codes in their criteria: *Personalization/ProfileDashboard, Solicitation/RemindersNotifications, Solicitation/ProgressPersuasion, Commitment/PreliminaryAssessment* and *Community*. An autoethnographic study also finds that design elements are highly nuanced and subjective and require guidelines of their own.

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Chapter 1: Introduction

The discussion on persuasion as rhetoric reaches as far as the fathers of modern-day philosophy. Socrates, Plato and Aristotle mention different parts of persuasion throughout their historical works. As philosophers of ethics, virtue, justice, and other ideas relating to human behaviour, the study of rhetoric was a significant part of their dialogue. Rhetoric and persuasion were the means to an end in the frequent discourses that these philosophers had in their daily life. Socrates, the teacher of Plato, was critiqued by Plato on his chosen methods to persuade his counterpart on his arguments. Socrates is required that his interlocutors primarily accept the falsity of their original thesis and admit to their lack of knowledge [20]. In the arena of *persuasion*, Plato defers to laws and how they should try to persuade citizens, like two interlocutors. Firstly, the citizens should be taught, that is, be given a good argument for adopting the course of action or set of beliefs. Secondly, they ought to be receptive and learn the rationale and bring about what they obtained from the argument. And lastly, laws should not offer bad but plausible arguments to citizens, meaning that people receive sound reasoning and rhetoric [42]. The final component by Plato defers to the popularly studied area of the ethics of persuasion in modern research.

Aristotle is the most frequently cited ancient philosopher to inform rhetoric in contemporary research [21]. He claimed that the *art* of persuasion, which is a terminology other philosophers did not coincide with, consists of three parts. *Logos* refers to appealing to the logic by solidifying the argument based on how much of it is based on facts. *Pathos* is the appeal to emotions. The addresser will grab the audience's attention by reinforcing the argument by playing into people's feelings. Finally, *ethos* is the appeal

to ethics, morals and character. Here, the identity and reliability of the persuader is the drive for impact. The person delivering the message needs to be a specialist in their area of argument and back up their statements [21].

Isocrates coins a different term to describe what may be the unpleasant side of persuasion; *sophistry*, the use of fallacious arguments to prove a point. [20]. He classifies three different types of people who may present plausible defenses for implausible theses. First those who argue that falsehood and contradictions do not exist. Second, those who occupy themselves with contentious disputes, and lastly, those like Plato and Socrates who believe that all virtues are one and connected with a single kind of knowledge. The presence of sophistry in arguments, specifically in relation to persuasion, was a methodology used to convince the other party of their respective perspective. [5]. Based on the understanding of sophistry per the definition by Isocrates, persuasion as a concept is not equivalent to the betterment of peoples lives. It is a concept where certain forces drive a person to change their attitude, behaviour or action in the way that the persuader has intended. As it will be discussed in later chapters, B.J Fogg's point was in reference to his conception for his "Persuasive Technology" specifically, and that the purpose is to support users desire to change their own behaviour.

The art of persuasion, as Aristotle claims, is an inevitable phenomenon that exists around us daily [20]. From marketing pieces to basic conversations with a colleague, we are persuading or being persuaded. The motivation of this research stems from a deep and general question that the researcher of this study pondered on in the earlier years of her undergraduate degree: why am I unable to disconnect from social media, particularly Instagram? There was something that made this social media platform addicting yet

depressing. The correlation between the amount of Instagram content consumed with the level of happiness showed an apparent negative correlation. As an Human-Computer Interactions (HCI) student coming into the field with a fresh mind, the researcher spent quality time looking into what drives social media and computerized systems and the different elements of design and functionality that motivated users to consume more content. With this curiosity at bay, studying persuasive interface design was a natural next step.

1.1 Persuasion today

Over the decades, the study of persuasion has not changed but has taken on different forms. As concepts such as love, hate and jealousy have been a part of human development since the beginning of time, so has persuasion. For example, an ad for a soccer shoe on British TV features a white soccer star outmaneuvering two black defenders [42]. The same company features a black soccer hero in another ad targeted to black consumers of soccer shoes. Although the ad does not verbalize that the marketers are catering to their viewers, the latent messaging is devised to persuade the audience. Alternatively, if persuasive intent is not apparent from the context, it is made evident by what is said and how it is said [42]. Persuasion plays a role in many different societal paradigms, and a dominating area is within technologies. Technology is an ever-growing industry with more and more parts of it assisting or replacing different elements of our traditional lives based on practices from many years ago. This paper will research the guidelines needed for persuasive interfaces on mobile applications and use different research methods to test and put forth additional criteria.

A patient-doctor relationship is no different from an individual's relationship with their phone [38]. The mobile device owner has the option to download an array of applications to get reminders to stop smoking or live a healthier lifestyle. The literature review in this paper discusses three research segments about persuasive technologies. The first is on persuasive design guidelines, where the wealth of research on principles and criteria that make up a successful interface design for persuasive technologies is discussed through several studies. The most notable of them for this study is the one by Alexandra Nemery and Eric Brangier [37]. The second discussion area is how the projection of persuasive technologies that were once primarily explored in desktop computers are now represented on mobile devices. The increased opportunities for what are achievable on mobile phones create greater possibilities of persuasion in people's lives that would traditionally be fulfilled by other people. Lastly, an area that ancient philosophers inadvertently discussed is the area of ethical considerations when it comes to the fine line drawn between persuasion and coercion [32]. As Duffy and Thorson explain, people put up their defences when they feel that someone is trying to persuade them of something [32]. But what happens when the person does *not* know they are being persuaded? That presents a different tier of ethical complications, as B.J Fogg and other authors discuss in their research.

This thesis conducts follow-up research on the study titled "Set of guidelines for persuasive interfaces: Organization and validation of the criteria" by Nemery and Brangier [37] in that the model is evaluated and extended through open coding. The research question that this paper addresses is: "what guidelines are best suited to studying persuasive interfaces and elements that best support persuasion?". A list of 20 persuasive

applications are put through vigorous examination of the criteria created by the researchers to see if the criteria are reliable. However, considering the limitations and drawbacks of a study that only consists of a qualitative analysis of interfaces of the apps, open coding through ground theory is used as the fundamental research method in this study. The study reveals that not only are Nemery and Brangier's principles do not encompass the necessary guidelines of a persuasive interface, but open coding leads to several crucial guidelines that were unobserved in Nemery and Brangier's study. These findings are complemented with an autoethnography where the researcher examines 2 of the 20 applications to get a better sense of the practical interface elements. Ultimately, the collaboration between the qualitative analysis of the 20 persuasive applications and the autoethnography of 2 apps opens varying avenues to enhance the understanding of persuasive interface designs for the future.

Chapter 2: Literature Review

2.1 Persuasive design guidelines

Persuasive interface design is one of the essential elements and models of creating a successful piece of persuasive technology. Whether specific components are placed and whether they are included in an interface contribute to how users interact with the technology. This thesis's leading set of guidelines is based on the criteria proposed by Alexandra Nemery and Eric Brangier. The two associates from the University of Lorraine-Metz in France conducted a study to validate a set of guidelines to assess the persuasive characteristics of technology interfaces [37]. The purpose of their research was to fill a gap they noticed in the academic world; the lack of available tools to measure interface persuasion.

Nemery and Brangier define *persuasive interface* as "a combination of static qualities and steps that guide a user through a process to change his or her attitude or behaviour" [37]. Throughout their research, they try to answer their central question, which is to understand if the validation of the criteria says something about whether their participants can tell the eight criteria apart, and whether they can find that it captures the most critical aspects of the persuasiveness of the interfaces. Nemery and Brangier analyzed 164 documents that identified the main component of persuasion mediated by tools, organized the tools, and offered a classification framework for the guidelines. As a result, they came up with the following eight criteriums*: credibility, privacy, personalization, attractiveness, solicitation, priming, commitment,* and *ascendency*. They divided them into two sets of criteria: *static* and *dynamic* [37]. The static criteria (credibility, privacy, personalization, and attractiveness) are the surface-level criteria

necessary to help bring the user to a dynamic process of user engagement. The criteria will be discussed in more depth in future chapters as these guidelines inform the overall study and are the basis for coding in the analysis.

While persuasive design elements help developers and designers create a commendable piece of technology, some common issues arise in persuasive design principles. Thomson et al. argue that the fragmented application of persuasive design principles can negatively affect a design [46]. With the fragmented application of persuasive design principles without considering evidence-based combinations of software design features that can enhance the persuasiveness of an application, the persuasiveness of the app is unable to reach its full persuasive potential. Thomson et al. also argue that hindrances in usage, diversity of user needs, wants, preference, and issues relating to the flow and presentation of information are some of the other problems of persuasive design principles [46].

One of the newer interfaces that came into fruition over the last decade is in-car dashboard interfaces. Persuasive components are not common since this is a new area where interfaces became widely accepted. However, Meschtscherjakov et al. measure user acceptance rate of future persuasive in-car interfaces through an online survey [32]. They found that there have been several approaches from car manufacturers to include persuasive technology into cars to facilitate a voluntary change of behaviour, attitude, or both to reduce greenhouse gas emissions. After presenting prototypes in the survey, the results show an overall acceptance of the system concepts and the usefulness of the proposed methods. Ultimately, Meschtscherjakov et al. employ graphics-heavy

persuasive design principles to motivate users to comply with the prompts from the in-car interface [33].

Well-being and prevention of bad habits has been an active practice for humankind for many centuries. Buzzi et al. explore a participative design process for creating apps that help shape a healthier lifestyle and habits [10]. The participatory design approach, which enables end-users to be directly involved in the decision-making process, involves all the stakeholders of the app. Buzzi et al. defined their research with a team comprised of a cardiologist, two nutritionists, a chemist expert in statistics, four computer scientists, and a graphic designer [10]. As a result, they found that participatory design has immense potential in serving the users a holistic application with reduced application development times. They particularly found that applications in the health sector using a participatory design system is crucial for a better design.

2.2 Persuasive technology in mobile devices

Persuasion through mobile phones is a constant reality for people to encounter from their daily interactions with their phones. Checking their FitBit to see how many steps it took them to walk from their house to the bus stop, to using social media excessively, persuasive technologies are unavoidable. One of the main outlets used for these technologies is through mobile devices. With the increased capability and capacity of smartphones, the opportunity to implement and explore different tools for persuasive technologies has increased. Matthews et al. understand that mobile applications can be used to influence the behaviour of users, however, they want to specifically investigate how the available mobile technology resources can be best used to improve the wellbeing

of people. [32]. They found that physical inactivity is responsible for 6% of the burden of disease from heart disease, 7% of type 2 diabetes, and 10% of breast cancer and 10% of colon cancer [32]. Matthews et al. argue that information systems and more specifically, persuasive technologies can be used to influence the behaviour of users [32]. Hence, they chose to review the current state of mobile applications for health behavioural change with an emphasis on applications that promote physical activity. As a framework, they have adopted the Persuasive Systems Design (PSD) model to evaluate the inbuilt persuasive features of mobile applications. This model has four system features that have been developed for designing and evaluating systems that influence the attitudes or behaviours of users: primary task support, dialogue support, system credibility support, and social support. By utilizing the theory-based framework, PSD, the authors study the persuasive features of current applications available to identify the emphasis, gaps, and commonly present design features in a mobile application for motivating physical activity [32].

Legner et al. explore the use of persuasive technology on mobile devices by assessing the elements of lucrative mobile social games [30]. They found that these games not only drive gameplay but also attract and retain players. They base their research on the key Werbach and Hunter's ideas on how games can be used as a valuable tool to address serious pursuits like marketing, productivity enhancement, education, innovation, customer engagement, human resources, and sustainability [49]. Legner et al. stitch the marketing ideas presented by Werback and Hunter to understand how persuasive algorithms impact the *successes* of a game [49].

As Legner et al. suggest, among persuasive games there exists a variety of mobile social persuasive games such as managing healthy water intake, medication compliance, and fitness for all [30]. Dantzig et al. created an app that trigger people to take regular breaks from sitting [12]. They developed SitCoach, a mobile application to nudge office workers from their seats and an application that monitors physical activity and sedentary behavior and provides timely persuasive messages suggesting active breaks. After a user test, they found that users had little awareness of the risks of prolonged sitting and considered their ability to take active breaks to be highly dependent on external factors [12]. The most important component of Dantsiz et al.'s study was their experiment on a control group. The experiment group with the app would periodically receive persuasive messages on their mobile phone, advising them to take an active break from where they were sitting. The control group that did not receive these messages showed a decrease in movement and physical activity by these participants. Therefore, Dantzig et al. recommend the use of mobile applications for persuasion while noting the limitations of smart phones as a platform for reducing sedentary behaviour [12].

Most of the current mobile applications are highly functional, personalized, and interactive. However, the flipside of this technology is the potential breach of data and security concerns about the information that is being collected by organizations. In her book "*The Quantified Self",* Deborah Lupton synthesizes different kinds of collection of data that's been going on for over a millennium. People have been recording their habits and health-related metrics for many years for self-reflection and improvement even before the technological revolution [38]. Within the current decade, the term *lifelogging* or *quantified self* has taken the stage to shine light on the ways self-tracking has become

widespread and effortless. At the forefront of this is wearable technology are devices such as FitBits and other kinds of fitness and wellness trackers, as well as mobile devices that can measure heartrate through their sensors and count steps. The wealth of information that the end user can access through their fitness trackers that would usually require a visit to the doctor for tests disrupts the traditional dynamic between a patient and a health professional [38]. Lupton suggests that the ideal 'quantified patient' should take this opportunity to become experts on themselves and manage their chronic illness to prevent disease [38]. In his book *"The Patient Will See You Now: The Future of Medicine is in Your Hands*", Topol argues that the occupancy of health trackers will alter the doctor-patient relationship, shifting doctors as medical experts, to patients being more knowledgeable about their own bodies [47]. Users taking up these persuasive technologies are important in preventing diseases that are self-imposed and could easily be prevented through self-assessing personal health and fitness metrics.

While Lupton concerns herself with the culture of quantified human metrics, Ndulue and Orji expand persuasive technologies beyond traditional cultural bounds to study the development of persuasive games and mobile apps for those living in Rural African communities. With the development of cheap Android phones, more and more economic classes below middle class can now access mobile technology [35]. This development opens a window of opportunity to leverage this high penetration of mobile devices to design applications such as persuasive games to assist individuals living in these communities to change, modify or implement their behaviours and attitudes in a desirable way. Although there were positive implications in limiting risky sexual

behaviour targeted at African youth through these technologies, Ndulue and Orji notes several challenges such as internet connectivity, electricity, and low literacy [35].

B.J. Fogg, a pioneer in the study of persuasive technologies dedicated chapter 5 of his book "Persuasive technology: using computers to change what we think and do" to discuss "Computers as Persuasive Social Actors" [15]. Although his research is not specifically pertaining to mobile devices, the social cues in persuasive technologies remains relevant [15]. He claims that people respond socially to computer products, and this has immense implications in the design of persuasive technologies [15]. To evaluate how computers are slowly replacing people as social actors, he goes into detail on five primary types of social cues: physical, psychological, language, social dynamics, social rules. He describes physical cues as people who are more attractive as having more persuasive power over those that are less attractive and contextualizes this to technology [15].

The second social cue Fogg explores in this chapter is the concept of psychological cues. When the device has onscreen icons that portray emotion, such as a smiley face, it can lead people to assume that the computer has emotions. Similarly, a computer that is continuously crashing may come off as uncooperative or vengeful [15]. Third, Fogg elaborates on the power of the choice of words, hence, the language in persuading users [15]. He finds that dialogue boxes and inferences to the user with their first name were powerful ways to persuade the user to engage in the technology. As the fourth cue, Fogg explores social dynamics, the unwritten rules for interacting with others as seen in computerized technology [15]. As the last and fifth social cue, Fogg discusses social roles

as a persuasive tool. In general, people expect authorities to lead them, make suggestions, and provide helpful information.

2.3 Ethics in persuasive technologies

As described earlier in this thesis, persuasive technologies are designed to bring about changes to the attitudes and behaviours of users through persuasion and social influence. [17]. B.J Fogg addresses some ethical concerns when designing and developing persuasive technologies specifically designed to intervene in people's lives. This thesis will showcase some applications for use in areas such as healthy living and smoking cessation, and how these apps ultimately replace a social actor in a person's nonvirtual life [35]. This role comes with ethical complications that B.J Fogg addresses as early as late 1900's, a time when computers and technology were merely being introduced to society [16]. He identified four main ethical actions for those who study persuasive computers: identify artifacts and techniques, examine effectiveness and effects, disclose findings, and take social action when needed [16]. Along with these four fundamental action items, a researcher and developer should advocate for and provide education in persuasive technologies. Increased knowledge in persuasive technologies not only increases the opportunity for people to make use of the opportunities to enhance their lifestyle, but it also allows them to recognize any tactical impurities that may be used against them in the name of persuading for a better outcome.

Sullivan and Reiner describe several ethical frameworks to assess the justification of digital wellness technologies' influence on users [43]. They believe that while some technologies help user's complete tasks and satisfy immediate preferences, other

technologies encourage users to reflect on the values underlying their habits and teach them ways they can change their lives for the better in the long run. As a result, the authors analyze both the impact that individual apps can have on users' decision-making, as well as the broader social context within which these decisions are made, where ethical questions may be raised [43]. Sullivan and Reiner describe paternalism as the point where the individual's liberty or autonomy is compromised for the sake of their overall wellbeing [43]. Classical or "hard" paternalism is the most obtrusive type of paternalism. This type not only neglects taking the individuals' wishes into account, but they may also display direct opposition to their expressly stated wishes. The second kind of paternalism that the authors discuss is libertarian paternalism, or also referred to as *nudging* [43]. The paternalist in this scenario is renamed as "choice architect" who structures the environment in such a way that individuals are more likely to make the choice that the libertarian paternalist judges to be best for them, while individuals get to preserve their autonomy by choosing any outcome they prefer [43]. Personalized paternalism proposes that the paternalist may be best at acting in the object of paternalism's best interests when the means of the interference, as well as the goals, are suited to the individual's personal preferences and goals [43].

Lastly, in addition to paternalism, Sullivan and Niker discuss maternalism as a useful concept for capturing interventions that occupy the same conceptual space as personalized paternalism [43]. In "Relational Autonomy, Paternalism, and Maternalism", Sullivan and Niker suggest that "if paternalism is acting in another person's interest without due consideration for their autonomy, maternalism is acting for the benefit of another person in a way that takes that person's autonomous agency into account, despite no

explicit expression of consent or assent being given by the person on whose behalf the decision is made" [44].

As Fogg [16] and Sullivan and Reiner [43] reiterate, the initial goal of persuasive technologies is to increase the number of users and the amount of time they spend on an application. In recent years, persuasive technologies have been moving away from this notion to endorse a direction that supplements user influence which provides tangible benefits. An example of libertarian paternalism that Sullivan and Reiner provide, is the "nudge" feature on Gmail [43]. When there's an unanswered email in the user's inbox, the system will move the email thread to the top by default to remind the user to reply. Sullivan and Reiner believe that users can either reply or decide not to reply, but it makes it more likely that they will reply if the email is at the top of their inbox [43]. On the other hand, the authors use *Moment*, an app meant to help users gain control over the time they spend on their phones to exemplify personalized paternalism and maternalism [44]. The goal of the app is to be influenced by Moment's alerts towards using their phones less, so it functions as a form of feedback letting users know when they are getting close to their limit. This app uses information about the user's usage to encourage behaviour that is most likely better for them, and usually what the user wants and coincides with their initial purpose for downloading the app for [43]. It does not supersede the user's autonomy but reminds them of their autonomous choices, provides them with the opportunity to reconsider the choices they once made, thus, choose the option that's best for them.

As previously mentioned, some persuasive applications assume the roles of a social actor in a person's life. The doctors, the family members and partners who would usually be the ones giving feedback to build or break habits are now replaced with

technologies [47]. Rughiniş et a. conduct a study on smoking-cessation apps to evaluate the effectiveness the anonymous app voice with its fast-and-frugal communication [41]. They focus on identifying problematic areas when it comes to presenting facts and frames of communication in a uncompassionate and *human* way. They conclude that most smoking-cessation apps lack voices from professional environments, be it in medical, psychological, sociological, or literary ways [41]. The apps rely heavily on messages that stigmatize smoking and smokers, thus limiting the understanding people may have of themselves, thus others as smokers. The ethical dilemma over this phenomenon is attributed to the lack of consideration of the person as an individual with different sensations, but more so as a robotic figure that needs to go through a series of modules or steps to complete a linear process known as 'smoking-cessation' [41].

The revered research of B.J Fogg, though praised and referenced by many human-computer interaction researcher, has received its fair share of criticisms. Atkinson carefully dissects the concepts proposed by Fogg on persuasive technology to draw a framework to define what would and what would not be considered ethically problematic [21]. She uses nihilism to address the direction of technological development as the leading problems of some persuasive technologies. The existence of a relativism where nothing in the world has a real and objective existence and that everything is subjective leads to ethical issues over the entrapment of subjective individualism [21]. Atkinson asks the big question: Is computer-meditated persuasion ethical? She argues that anything that the user agrees upon prior to participating with the program is ethical [21]. However, anything that occludes this function is a form of manipulation which in turn can be coercion and can be associated with propaganda and information that seeks to distort the

user's autonomy or even sound reasoning. She concludes that captology requires an immediate ethical safeguard that exposes the intent and purpose of the program at the beginning of one's engagement with the program [21].

The notion of manipulation and coercion becomes particularly important when it comes to vulnerable populations. Jacobs finds this concept severely understudied since persuasive technologies are designed to help people change their attitudes and behaviours, which is specific to most vulnerable people [44]. She addresses two fundamental ethical concern when designing persuasive technologies for vulnerable people; considering users' needs and interests and securing user autonomy. She argues that taking the users' interests into account is crucial in technology design, but it poses challenges regarding vulnerable users, and that future research is needed on interest-elicitation tools specifically for people with vulnerabilities [44]. Like the suggestions by Atkinson [21], Jacobs similarly proposes the notion of consent in the domain of persuasive technologies to ensure that instances of manipulation and coercion are excluded [21]. Aside from ensuring consent is given by the user prior to engagement with the technology, the ability to rescind consent must be explicitly stated once it is given.

2.4 Summary

The three areas of literature discussed here are among the literature that are some of the most written on persuasive technologies: persuasive technologies vis a vis mobile device, persuasive design guidelines, and ethical considerations of persuasive technologies. Much like other types of technologies, persuasive computation is multifaceted and has different considerations. In 2021, the number of smartphone users in the world is 7.1 billion people, which is equivalent to 89% of the world population [40].

Mobile apps have allowed developers and HCI researchers to invest in understanding the implications of persuasive technologies on mobile applications, and the forms they could take. The ability for users to get assistance to disrupt their negative behavioural patterns, or develop positive attitudes and behaviours is detrimental to the expansion of persuasive technologies.

Similarly, one of the most disputed aspects of persuasive technologies are the ethical implications. The essence of a persuasive application or computation is to modify, change or create an attitude or behaviour. The self-autonomy to make this decision raises questions of coercion and manipulation, and what would be considered ethically unacceptable even when designed in the name of persuading the individual. Researchers including but not limited to B.J Fogg [16] and Sullivan et al [43] [44] extensively discuss and claim that being transparent with the user before they initiate the application or program, as well as allowing them to opt out of the program elements at any given time is an ethical necessity.

The focal aspect of persuasive technologies for this thesis that are discussed in this literature review are the guidelines and criteria that regulate the elements that make an interface persuasive. Along with contextual pieces of technologies that contribute to a healthy communication between users and computers, the interface of the technology plays a crucial role in determining the success or failure of its purpose. With persuasive technologies, elements such as the type of notifications, the wording used in the program, and the aesthetics define a big proportion of the persuasiveness in the application or program [10]. Researchers such as Thomson et al. [10], Meschtscherjakov et al. [20], Buzzi et al. [10], and Nemery and Brangier [37] extensively outline guidelines as well as

areas of caution when designing the interface of a persuasive piece of technology. This thesis will consider the set of guidelines for persuasive interfaces based on Nemery and Brangier's research as basis for analyzing the interfaces of 20 persuasive mobile applications, which will be discussed in more detail in later chapters.

Chapter 3: Methodology

Braun and Clarke explain that thematic analysis is a flexible data analysis method that qualitative researchers use to generate themes from qualitative data, such as interview data [32]. They argue that this approach is flexible in that there is no specific research design associated with thematic analysis; it can be utilized for case studies, phenomenology, generic qualitative, and narrative inquiry. They claim that this data analysis method is perfect for both novice and expert qualitative researchers because the steps are easy to follow but rigorous enough to generate meaningful findings from the data [32].

Before moving on to the study, it is important to understand the reasoning behind this research. Inductive reasoning is the process of making specific observations to broad generalization, and deductive reasoning is bringing broad generalizations to specific hypotheses. An example of inductive reasoning is observing that 'dogs A and B have fleas', therefore 'all dogs must have fleas'. However, deductive reasoning is starting with a theory that 'all dogs have fleas', and after data collection and hypothesizing, finding out that 10 out of 20 dogs do not have fleas [37]. The reflective and preliminary stage of this research was initiated by the curiosity of persuasive technologies, and how the interface contributes to bringing constructive change in a person. As a student of HCI, the question that the researcher proposed was "what methods are best suited to studying the guidelines of such technologies that best support persuasion?".

3.1 Coding strategy

Most qualitative research methods involve the researcher analyzing their data with a framework or theory that is used to inform their research. These methods are concerned with how theories can be more strictly tested and how accurate facts could be obtained. In HCI, thematic analysis is a method that involves systematic coding of data regardless of the study design. This research employs open coding of qualitative data while going through the interfaces of each application. Each app had several different interfaces depending on the purpose of the program, and these interfaces were recorded through screenshots onto Google Drive into their respective folder. The researcher would start by organically browsing the application and playing with the features while allowing the prompts and messages to guide the researcher into the direction that they program wanted to take the user. That way, the researcher was able to get a better understanding of the purpose of the program while simultaneously recording the interfaces to analyze the persuasive elements. This process of interacting with the application would be around 5-15 minutes, depending on the wealth of options offered by the application. The apps with fewer prompts and pages would take a shorter amount of time to browse than those with multiple options and stimuli.

This research analyzes the user interface of each page of 20 persuasive mobile applications randomly selected from Play Store. The apps that are selected are specifically relating to 'self-help and are based on the persuasive technologies that are defined by B.J Fogg. Persuasive technologies are a standard term to describe any computerized program that persuades a user to change their behaviour, attitude or actions. It is important to note that the applications chosen for this study are self-help apps that

are programed to positively motivate a user's actions, as opposed to any other dubious motives. These analyses are based on the set of guidelines in the design of persuasive interfaces proposed by Nemery and Brangier, two researchers from University of Lorraine-Metz in France [37]. Nemery and Brangier noticed and acknowledged the increase in new technologies and interactive media that can provide new opportunities to influence users. This meant that the users experience can be rooted in something more emotional and create a stronger relationship between the user and technology. Throughout their study, they try to answer their main question, which is to understand if the validation of the criteria says something about whether they can find that it captures the most important aspects of the persuasives of the interfaces [37].

Nemery and Brangier noticed and acknowledged the increase in new technologies and interactive media that provides new opportunities to influence users. This meant that the users experience can be rooted in something more emotional and create a stronger relationship between the user and technology [37]. Nemery and Brangier define *persuasive interface* as "a combination of static qualities and steps that guide a user through a process to change his or her attitude or behaviour" [37].

While the criteria supplied by Nemery and Brangier was used to inform a certain degree of guidance for the researcher, the adoption of open coding to inform areas that Nemery and Brangier may have overlooked. Oktay suggests that open coding proceeds by means of the tentative development and labelling of concepts in the text that the researcher considers of potential relevance to the problem being studied [38]. In the context of this research, gathering criterium that contribute to the persuasion of the

application were also coded as a means of open coding, and will be discussed further in later sections.

3.2 Sampling Method

As mentioned previously, although persuasive algorithms can be found in a wide variety of applications, this thesis focuses entirely on mobile applications. After a brief search in the Play Store, it becomes evident that there are millions of apps from different categories that qualify for this study. Despite having the ability to choose apps from a single category (for example, smoking cessation), the researcher chose to include applications at random, disregarding categories. In the research fields, random selection is a sample drawn from the population. More specifically, simple random sampling was the sampling method that was used to select the 20 applications. In simple random sampling, each application on the Play Store has an equal chance of being selected. However, we note that there are algorithmic limitations that cannot be prevented, such as the recommendations of similar apps that are made after installing an application [28].

While choosing the applications, no specific application was searched in the search bar, but apps were selected based on the suggestions from the Play Store algorithm. That being Per the definition of simple random sampling and random sampling, the applications were selected at random. However, it is important to note that there is no way to know why Play Store suggests the apps that they do, and according to which category of information. Hence, noting that the 'random' selection of applications could be limited by the technological drawbacks caused by the algorithm.

In the preliminary steps of selection, approximately 26 apps were compiled for assessment. However, 6 of these apps were eliminated because of the requirement to pay to use even the most basic functions. For example, a fitness application puts the user through the preliminary assessment only to conclude the welcome wizard with a request to register and subscribe for a monthly or annual fee. As previously mentioned, every application has the equal opportunity to be selected provided that basic functionalities are accessible for free. At the end of the elimination process, there were 20 applications that suited the assessment criteria.

The final element of elimination was the availability of the apps in Play Store and the application store for Android. Due to convenience and what was available to the researcher, all applications were found in the Play Store but not all of them were on the iOS application store. The limitation that arises with this exception is obvious. Most notable applications are prominently made for iOS and the Android version is often coded subsequently. This eliminates the possibility to analyze possibly some of the best engineered persuasive apps. However, the idea is to rely on the general conception that all, if not most persuasive apps will foster the same set of persuasive elements in their interface, regardless of the development quality. According to MacQuarrie, [32] it is faster, easier, and cheaper to develop for iOS. She states that one reason why iOS is easier to develop for is the code. Android apps are generally written in Java, a language that involves writing more code than Swift, Apple's official programming language. Another reason she provides is that Android is an open-source platform. A lack of standardization means more devices, components, and software fragmentation to account for. Apple's closed ecosystem means the developer is developing for a few standardized

devices and operating systems [32]. Ultimately, using Android or iOS as the operating system to develop for depends on many more factors such as the audience, the purpose and budget.

3.3 Procedure

After making the necessary eliminations and noting the limitations with the final 20 apps, the process of collecting data began. The purpose of this research is to analyze the interface of the apps, so each app was interacted with for a minimum period of time to collect sufficient data on how menu items were structured and presented. For the objectives of this research, the analysis consisted of following through the prompts and instructions of the app. While ensuing the path driven by the developers, the researcher made a note of each changing interface by taking screenshots and documenting them in the respective files for each app on NVivo. There were screenshots taken from each interface, from the landing page to the depths of the settings to unearth the different elements that may contribute to the persuasiveness of the app. The data from every app was saved on Google Drive in their respective folder. This method of organizing made the analysis on NVivo much easier when it came to uploading files. A proper and distinguished line between each case (application) was effortlessly drawn, making the analysis seamless.

The next step in the analysis methodology was to upload the files on NVivo as data. The more common use of NVivo is cases, where the researcher uploads the transcripts of interviews and searches for trends and patterns. In the case of this research, it was different. Since the interface is the element that is being analyzed, it was important

to view and examine the persuasive features in its entirety. Writing out and transcribing the words in the screenshots was an option however, this would have limited how much of the features would get analyzed. As it will be discussed in the future sections, some of the criteria are based on the graphic and illustrative components of the interface as opposed to the words. Uploading the screenshots and selecting the range and area where the criterion appears allowed for a comprehensive analysis of the guidelines. This methodology prevented potential research errors and misunderstanding, as well as the risk of missing out on significant persuasive elements.

3.4 Coding in NVivo

After the screenshots were uploaded on NVivo, the researcher went through the screenshots from each application and coded elements to different criteria where necessary. These criteria, some based on Nemery and Brangier's guidelines and some based on the researcher's suggestions through open coding were used to collect as much data as possible from each screenshot. While some apps fostered either most of the criteria or referenced few criterions, some apps lacked in incorporating any of the criterion at all (Table 1).

Criteria	Number of coding references
Privacy	20
Credibility	23
Attractiveness	21
Community	15

Personalization	43
Personalization/ProfileDashboard	5
Solicitation	59
Solicitation/Progress Persuasion	44
Solicitation/RemindersNotifications	26
Priming	19
Commitment	28
Commitment/Preliminary Assessment	51
Ascendency	4

Table 1 Total number of coding references based on all application

The final and most important stage of the methodology was to chart the outcome of the results. The apps and criteria were charted to compare, contrast, and analyse the differences and similarities between the criteria and applications. All the data that was used to reach results and conclusions were extracted from this table. Since the main element that is at evaluation in this research is the criteria, the total number of references made to each criterion was totaled. This provided the researcher with a better understanding as to which criterions had more references, and which ones were left unincorporated. (Table 2).

Apps	Credibility	Privacy	Personalization	Personalization/ProfileDashboard	Attractiveness	Solicitation
21days	0	1	3	0	3	1
Adidas Training by Runtastic - Workout Fitness App	1	2	12	1	0	6
Boosted	0	1	0	0	0	0
Charity Miles: Walking & Running Distance Tracker	0	1	0	1	1	2
Fasting App - Fasting Tracker & Intermittent Fast	1	1	1	0	4	4
Forest: Stay Focused	1	1	3	1	3	2
Happify	4	4	4	0	1	6
Headspace	7	1	3	1	3	6
Intellect	0	1	1	1	0	0
Quit it - stop smoking today	0	0	1	0	0	4
QuitNow!	2	0	2	0	0	0
Quitsure	0	0	1	0	0	7
Rootd - Panic Attack & Anxiety Relief	0	1	2	0	2	4
Simple Habit: Meditatio	5	1	4	0	0	7
Smiling Mind	0	1	1	0	0	0
Stop Smoking - EasyQuit free	0	1	0	0	1	2
The Tapping Solution	2	1	2	0	0	3
ThinkUp	0	0	0	0	1	3
Timely	0	0	0	0	1	1
Weight Loss in 30 days - Fat burning Home Workout	0	2	2	0	1	2
Total	**23**	**20**	**42**	**5**	**21**	**60**

Solicitation/Progress Persuasion	Solicitation/Reminder sNotifications	Priming	Commitment	Commitment/Preliminary Assesment	Ascendency	Communi
3	2	0	1	1	0	
2	1	1	1	2	1	
2	0	0	0	0	0	
4	1	8	1	5	0	
4	4	0	0	5	0	
3	3	1	4	0	0	
2	0	1	4	14	0	
2	1	0	1	0	0	
1	0	2		4	0	
3	0	0	3	0	0	
3	1	0	2	6	0	
1	0	0	3	0	0	
1	2	1	6	9	0	
1	4	2	0	0	0	
1	1	1	0	5	0	
5	1	0	4	0	3	
1	1	1	0	1	0	
0	2	0	0	1	0	
4	2	0	0	0	0	
1	1	1	0	0	0	
44	**27**	**19**	**30**	**53**	**4**	**1**

Table 2 Coding table

Chapter 4: Overview of Apps

4.1 Lose weight in 21 days

The first app from the 20 that were analyzed is "Lose weight in 21 days". This app was released on November 2, 2018, and currently has 500,000+ downloads. It's owned by Fitness Workout Team, which is owned and operated by a private individual. The current 1.2.6 version is only supported by Android and offers three different training sessions with a series of different exercises along with the ability for the user to plan their workouts. The app features a manual recording sheet that allows them to keep track of their weight by entering it on the tracking sheet each day. It also keeps track of the days the user attempts/utilizes the exercises available on the app on a monthly calendar as "clocked in". A persuasive feature that the app provides to the user is the ability to set reminders to exercise for a time in the future. Every exercise is structured to take 21 days before seeing noticeable differences. The countdown feature provides users with the motivation that persuades them to complete the workouts within the given timeframe.

4.2 Adidas training

The fitness app by Runtastic "Adidas Training" is an application with multiple workout videos and animated graphics to show how to complete physical exercises. Runtastic was bought by Adidas and currently provides fitness training on web and mobile applications in the name of the greater brand, Adidas. The application provides the user with control over how they want to use the program. It was released on Android on November 12th, 2015 and the most recent version, 5.7, has over 10 million downloads. The iOS version is currently at 5.8 with the release date unknown. The user has the possibility to follow

individual one-off workout videos, create their own workout plan by putting together select exercises, or integrate a workout plan for themselves using the videos published by the application. The primary objective of the application is to provide a boost in energy and fitness levels with short, quick workouts, achievable by many people seeking the motivation to get fit. One of the most notable features of this application is the forum that exists within the app to share workout accomplishments with other users. The user has the option to personalize their account with a profile photo and can follow other users and can be followed by others. These functions act as a persuasive factor that will be discussed further in this dissertation. There are a lot of persuasive functions in the application, such as positive reinforcement through notifications, competition and gamification.

4.3 Boosted

"Boosted" is an application that helps users track their activities and take control of their time. This application is only offered on Android and was released on December 10, 2018. The latest version is 1.5 and has over 500,000 downloads. Similar to the "Timely" application, the developers of Boosted, "Boosted Productivity", offer task tracking features. The main functionalities of the application are the ability to add tasks, subtasks, track the amount of time it takes to complete a task, and visual summary reports of projects in the form of graphs and charts. In addition, the user is provided with a weekly calendar where they can view their scheduled tasks anyway from a couple days or a month.

4.4 Charity Miles

“Charity Miles" is a unique application with a community where users can earn money for charity when they walk, run or bike. The Android app was released on September 18, 2013 with over 500,000 downloads. The latest Android version is 7.6.4, along with the latest iOS version, similarly at 7.6.4. “Charity Miles" is an organization that serves its vision strictly through their mobile applications. After downloading the app on their smartphones, the miles the user runs, bikes or walks is automatically detected by the application for a higher level of integrity and accuracy. The main function of the application is the counting of steps on the dashboard. The simple tracker of steps converts the miles into real currency and consequently motivates the user to take more steps to not only improve their own physical health, but to also contribute to a charity of their choosing. The additional feature that provides persuasion to users is their ability to search for a community and raise money under a specific team. The Charity Miles organizers promote workplace teams to create a community of their own as a purposeful team activity.

4.5 Fasting App – Fasting Tracker & Intermittent Fast

“Fasting Tracker” an app for people to track their intermittent fasting with the hours they can eat versus the ones they fast. The application was released on October 25, 2019 with the latest version being 1.3.4. It’s only supported by Android and currently has more than 10 million downloads. The owner of the app, Leap Fitness Group, additionally offers an array of thematic fitness and wellness applications that function as a brand, allowing users to recognize the provider in other applications. The user is able to select a fasting

plan from a selection provided by the application, ranked according to the level of difficulty. Alternatively, the user can create their own fasting plan. The application provides incentives to fasting with a toggle dedicated to learning about the benefits of fasting, and instructions on how to commit to intermittent fasting. One of the main functionalities of the application is the reminder settings which includes a customized alert system so the user can schedule reminders to 'drink water'. The main toggle includes information on the user's health, weight, how many hours they have fasted, and how many cumulative days. One of the main persuasive tools used is gamification, awarding users with select trophies as they hit different milestones.

4.6 Forest

"Forest" is a unique app that aims to help users to temporarily put down their phone and focus on other important tasks. The Android app was released on August 25, 2014 with over 10 million downloads. The latest Android version is 4.32, along with the latest iOS version, similarly at 4.32. The main and only feature of the application is the unique approach the developers, Seekertech, took to accomplish their goal; helping people focus. The moment the user starts the timer for a specific time, a seed is planted in Forest. As time goes by, the seed eventually grows into a tree. However, if the user cannot resist the temptation of checking their phone and leave the app, the tree withers. The premium version of the application offers a collaborative focusing session where users can invite their friends, fostering a community that persuades each other.

4.7 Happify

"Happify" is an application offered by Happify Inc. that strives to give meaning to its name; helping users overcome negative thoughts and stress through science-based activities and games. The app was released on April 30, 2015 on Android with over 500,000 downloads. The most recent Android version is 1.63 while the latest iOS version is 2.9. Much like other applications similar in nature, Happify offers users different self-help options to explore in an effort to bring their stress levels down and develop positive thought processes. Most exercises are available for free with exceptions to higher levels and exercises only available after the user pays a certain fee. The app offers motivational podcasts, short informative videos and articles, and games that help guide the users thought process to a certain, positive emotion. One of the main features of the app is the ability for the user to choose their 'track' among different titles such as the option to opt into lessons to learn about "Coping with Racial Stress and Discrimination". Over the span of a couple days to a week, the user will learn more about different issues and ways to address it in their own life. A progress bar is used to persuade the completion of these tracks, and the users' 'Skills' are often updated to reflect their achievements from the modules.

4.8 Headspace

"Headspace" is a multifaceted mindfulness application that includes different features to help people get into a positive mindset. The app was released on January 6, 2012 on Android with over 10 million downloads. The most recent Android version is 4.33 while the latest iOS version is 3.15. This app is meant to equip users with daily patterns to help

them develop tools to focus better, reach a state of serenity, and ultimately create balance in their lives. The main features of the app are instructor-led meditation, sleeping exercises, workouts and training modules to help the user develop better tools to focus. There is the option to customize a profile where users can keep track of their statistics (which exercises and modules they've completed), their progress that's tracked by the number of times they visit the application and attempt a module, and add 'buddies' they can interchangeably motivate. There are two main types of notification systems offered on the app. The user can opt into receiving daily notifications to stay mindful, and/or schedule reminders to meditate that can be received through the app or their phone calendar. Additionally, "Headspace" is compatible with Google fit to accurately track how often users meditate or exercise, and for how long.

4.9 Intellect

"Intellect" by "The Intellect Company" is a unique, multipurpose application intended to subdue conventional self-help servers and embark the user on an entirely new way to work on their traits, habits and behaviours. The Android app was released on April 11, 2020 with over 1 million downloads. The most recent Android version is 1.3.3 while the latest iOS version is 1.3.2. "Intellect" commits to a new form of psychological training developed by a team of psychologists and behaviorists, aiming to get the user closer to who they aspire to be. The main toggles of the application are "home", "tasks" and "profile". In the "home" toggle, the user is presented with different paths where they can learn more about the app, how it works and what is offered. They can also find "rescue sessions", which are text-based modules that walk the user through an emotion they're

experiencing at the moment, such as anger, anxiety and lack of motivation. In the "tasks" toggle, the user is presented with three buttons where they are redirected to a part of the app that either allows them to do manual check-ins, complete experiments, and view their past check-ins. The last toggle, "profile", presents the user with their streaks, a journal log, a wellbeing and psychological report based on their progress, as well as the ability to track customized goals.

4.10 Quit it

"Quit it" is, as described by the developer, Digital Sirup, is a "tiny motivating program" that aims to support and encourage smokers to quit smoking while helping prevent ex-smokers from a relapse". The Android app was released on May 22, 2019 with over 10,000 downloads. The most recent Android version is 1.0.2 while the latest iOS version is 4.7.1. The features offered on "Quit it" are similar to other smoking prevention apps. There is a toggle to view a general 'Status' of how much money the user has saved, how many cigarettes they avoided and the amount of time they reclaimed. Another toggle shows the positive symptoms that begin to appear in someone who committed to quitting their smoking habit, such as blood pressures dropping to normal and temperature of hands and feet stabilizing. Among the several motivating features, the app allows the user to set goals for themselves or see how much They have achieved on several scales. Among these options is the default goal setting where users can measure their achievements against what they can buy with the amount of money they saved, such as a Bitcoin. Gamification through achievement awards can also be unlocked as the user

avoids an increasing number of cigarettes, which contributes to the motivating factor of the app.

4.11 QuitNow!

"QuitNow!" is an application that aims to replace social actors that would assist users with a smoking habit to quit. The Android app was released on July 3rd, 2010 with over 1 million downloads. The most recent Android version is 5.148 while the latest iOS version is 5.15. It's owned by "Fewlaps", a small establishment based in Barcelona that aims to develop "high quality mobile apps that outperform expectations" [1]. The interface of this application is simple with a main page that features all the main functionalities. The main page is representative of a profile where the user can add a photo of themselves among the rest of the information that could be input. After the user commits to quit smoking on a specific day, the dashboard generates how many days it is been since they quit smoking, how many cigarettes they avoided, the amount of money they saved and the amount of time they won back. With each milestone, the user is awarded 1 of the 82 badges of achievement offered by the application. They can also track how their health improves in their journey to break free of their smoking habit. Most notably, the direct connection to a 'Community' of other users who are struggling in the same manner is one of the main features that makes this application distinct from other apps that are similar in nature.

4.12 QuitSure

This application, much like others in the same realm, attempts to motivate users to break off their smoking habit. "QuitSure" was released on December 25, 2020 and the latest version on Android, 1.4, has over 10,000 downloads. The app is supported by both Android and iOS where the latest iOS version is similarly also 1.4. The vision of this application is to change the way users think and feel about smoking, using proven behavioural science and psychological tools. This is a 6-day intensive program that not only helps users quit their smoking habit, but psychologically condition them into believing that it is no longer something that is desirable to them. The approach of this application is different from others that are similar in nature as it functions more of an educational hub rather than a tracking tool. The user must complete a lengthy module with several exercises before moving onto the content of the following day. The progress bar in the user's profile shows how much of the module they completed from the 6-day program, acting as a motivating factor. A unique feature of this application is that every user is assigned a personal 'Coach' they can directly connect to through WhatsApp for motivation or moral support.

4.13 Rootd

"Rootd" is an application that attempts to replace the social actors in a user's life in the case of a panic or anxiety attack. The application is supported by both iOS and Android and was released on Android on October 13th, 2017 where the most recent Android version, 2.2.19 has over 100,000 downloads. It's owned by "Rootd", where the main objective of the developers is to help the user overcome panic attacks and anxiety the

moment they strike. They provide lessons, a panic button, breathing tool and exercises in the application. They offer 5 different lessons that are led by an instructor who guides the user to a calm state of mind. These lessons are designed to be utilized when the user is not having an anxiety or panic attack. The red button on the main screen offers immediate audio and visual affirmations to support a person going through a mental crisis. One of the main features, in addition to the red button on this application is persuasion through gamification. The user can see their 'stat' and earn points and trophies based on how many panic attacks they 'conquered', how much time they spent engaging in the lessons, and often simply getting points for using the app. The application has unique notifications that allows users to get a reminder for a functionality of their choice such as the ability to opt into receiving a reminder to 'breathe', and opt out for other things such as journaling, doing a lesson, etc.

4.14 Simple Habit

"Simple Habit" is a wellness application that promotes mindfulness and sleep therapy sessions that offer guided mindfulness and meditation, guided sleep sessions and coaching by experts. The Android app was released on November 7, 2017 with over 1 million downloads. The latest Android version is 5.9.2, along with the latest iOS version, similarly at 5.9.2. Similar to other wellness apps, Simple Habit has a series of audio guided exercises on an array of topics, such as anxiety, stress and other nuanced subjects. The main feature of the application is the wide selection of instructors and guided modules that are made available through the app. The user can personalize a plan by adding select exercises and modules to their profile. The options on the "On the go"

toggle gives users the ability to squeeze in a guided session based on the amount of time they can allocate to the module. They are also encouraged to opt into daily reminders to maintain their mental wellness. One additional step Simple Habit has taken was linking the user's calendar to reminders, so the user has the option to schedule a calendar event as a reminder.

4.15 Smiling Mind

The application "Smiling Mind" attempts to metaphorically exemplify their vision in their name. It is one of the many mindfulness apps that aims to guide the user through different exercises to bring more awareness to their thoughts. The Android app was released on May 22, 2019 with over 10,000 downloads. The latest Android version is 3.8, along with the latest iOS version, similarly at 3.8. It is owned and operated by "Smiling Mind", an Australian non-profit organization that offers other mindfulness services. The organization is developed by psychologists and educators to help bring balance to people's lives by mindfulness meditation, eating well and staying fit. On the application, there are 20 programs offered under different categories based on your age, location and occupation. The modules are guided through audio where the user follows the steps of meditation through an instructor. The user has the option to add select programs to make their own meditation plan. They can opt into receiving reminders from the app to stay mindful during the day. One of the main persuasive functions of the application is the option for the user to enable reminders to visit the app after a chosen number of days of inactivity.

4.16 Stop Smoking – EasyQuit Free

"Smoke Free" is among the many persuasive applications that attempt to help users quit their smoking habits. The most recent version on Android, 1.4, has over 1 million downloads, and currently, the most recent version on IOS is 1.5. The application was released on December 8th, 2016 on Android and is offered by a private owner, Mario Herzberg, with 10+ other applications to their name. The application is quite simple in design. There is one main page with 14 possible features and functionalities. The main purpose of the application is to simply help users to quit smoking. There are multiple persuasive features such as displays to show the amount of money the user saved, time regained, and the amount of time that the user successfully remained smoke free. Other persuasive features are presented through gamification where a user can earn trophies and awards for the number of cigarettes they pass. They can also keep track of how different components of their health improves by staying absent from smoking. The user can additionally opt into receiving motivational reminders that they write for themselves throughout the day to prevent them from falling into a relapse.

4.17 The Tapping Solution

"The Tapping Solution" is a unique application with a distinct approach to coping with stress. The most recent Android version is 2.9.7, released on January 24th, 2019 with over 100,000 downloads on. The app is supported by both Android and iOS, where the most recent iOS version is 2.4.1. "The Tapping Solution" is a company based in Brookfield, Connecticut that aims to "bring into the mainstream a simple, effective, natural healing

method known as Emotional Freedom Techniques (EFT) or "Tapping.""[2]. Nick Ortner, the CEO, runs the organization alongside his siblings Alex and Jessica Ortner. The application does not display a prominent feature among others but supports several different features at the same level. The user who downloads this application may not know what EFT may be, so the developers provide a library that offers educational resources. Most of the activities are present in the dashboard where the user can select a session and listen to a guided instructor. The user can also personalize the application to select favorite modules and keep track of their progress. The application provides an array of notification and reminder options to keep *tapping* on the mind of the users within their day. The dashboard additionally displays tapping streaks by counting the number of consecutive days the user has practiced EFT through "The Tapping Solution" application.

4.18 ThinkUp

"ThinkUp" is a simple application that provides personal affirmations. It was released on November 12, 2016, and currently has 100,000+ downloads. It is owned and operated by Precise Wellness LLC, and the application is supported by both IOS and Android. The most current iOS version is 1.1,7 and the most recent version on Android is 5.5.6. The app offers over 1000 categories of affirmations that the user can choose from, and personalize a list for their own needs. It allows people to build their own self improvement program to develop the mindset and motivation they need to succeed using personal affirmation. The application aims to assist users to develop a habit of a positive mindset for the sake of self-care and help. One of the primary functions this application

offers is the ability for the user to record their affirmations to listen at a time when they feel the need a mental boost. Whether the user writes an affirmation of their own or selects one of the 1000+ phrases provided by their database, they have the ability to record themselves saying the affirmation for an increased level of persuasiveness caused by familiarity in the voice; their own. The user can set a reminder/notification to remind them to repeat their affirmations by syncing it to their morning alarm clock. That way, as they are preparing to get their day started, they are persuaded to use the app as a morning starter.

4.19 Timely

"Timely" is a time management tool offered by Rising Apps with simple and clear features. This application is exclusively offered on Android with no equivalent app on iOS. It was released on July 27, 2019, with the most recent version being 1.2 with over 10,000 downloads. The main and only feature of the application is the ability for the user to add one or more projects to track. Once the user begins a task, the application starts to count the seconds, minutes, and hours it takes for them to complete the task. The second toggle on the app allows the user to see a report of the tasks they worked on during the day, as well as a "Duration report" that visualizes the amount of time spent on each task in the form of a graph. The user can choose to see as recent as what they did during that day, or the visualization of all the tasks they ever did using the app. Each individual project can also be reviewed and statistically summarized, and the same task can be repeated at a different time. In addition, each major task can support subtasks that can be tracked within the main project. The user can set customized reminders to complete tasks

within their day, along with the option to choose which days they would like to receive the notifications.

4.20 Weight Loss in 30 Days

"Weight Loss in 30 Days" by Visionary Labs is a fitness application that has a similar motive to other fitness. It was released on January 22nd, 2019 Android on and the most recent version, 1.5, has over 100,000 downloads. The app is only supported by Android and not offered on iOS. The main feature of the application is the gradual increase of workout intensity for users to easily stick to a daily workout program without getting overwhelmed and dropping out. There are three basic levels of difficulty; easy, medium and hard, with the option given to the user to add their own exercises to create a custom workout plan. Along with providing over 20 exercises, the application offers casual workout tips to help enrich the users' experience. The simple settings offer the user to set daily notifications for a specific time to stay active by using the "Weight Loss in 30 Days" application.

Chapter 5: Data Analysis

The main component of the data analysis is the criteria used to evaluate the user interface of each persuasive application. As a basis, the criteria that was outlined in "Set of guidelines for persuasive interfaces: organization and validation of the criteria" by Alexandra Nemery and Eric Brangier was used for the quantitative analysis for this research [42]. This study specifically attempts to research a set of guidelines to assess the persuasive characterizes of interfaces. It is important to note the motive of this study and why it stands out among others. Nemery and Brangier were motivated to address the lack of consideration for the time as a structural element of social influence in existing criteria and believed that persuasion is linked to a temporal process that includes a beginning, followed by modifications towards behavioural change [42].

Each step in the persuasion process is supposed to effortlessly lure the user into the system, thereby following the persuasion with more prompt options, such as upgrading the application or buying the premium version. As a result of their research and analysis for a better set of criteria to measure the persuasiveness of interfaces, Nemery and Brangier came up with 8 different criteria: 4 *static* criteria and 4 *dynamic* criteria. These two categories address and mitigate the gap of the temporal process that the authors identified as a motive for their research. Static criteria include *credibility, privacy, personalization,* and *attractiveness* [42]. These are the surface elements that are necessary to help launch a dynamic process of user engagement and the prerequisites that the user needs to accept before engaging in the process. These criteria are easily identifiable in user interfaces, if present, and foster comfort and acceptance before moving the user on to engage with the software, web, application, etc. entirely. However,

dynamic criteria are where most of the enticing happen when it comes to establishing persuasiveness. Among these are *solicitation, priming, commitment* and *ascendency*. These criteria include the user in an interactive process that progressively engages him or her with the interface [42]. (Figure 1)

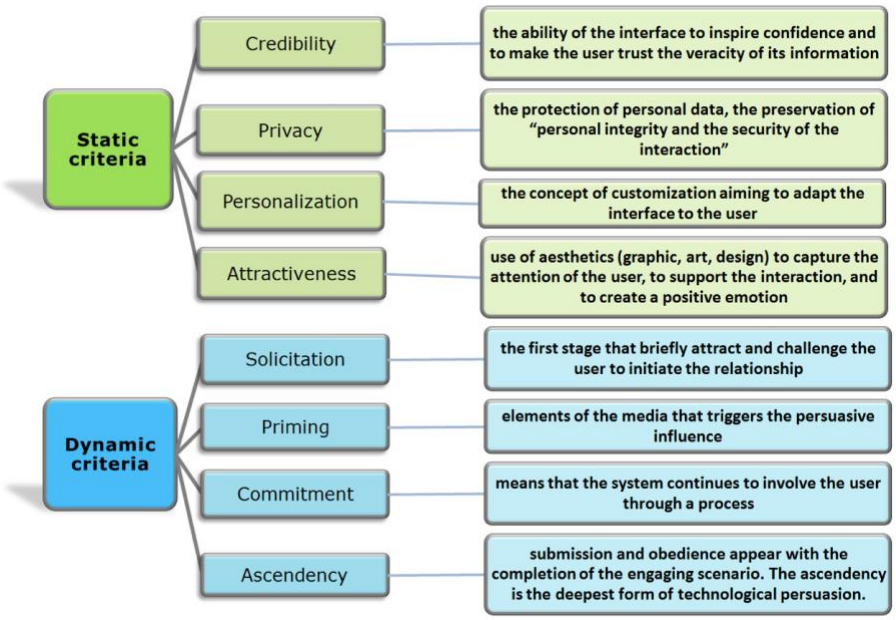

Figure 1. The set of guidelines to analyze persuasive interfaces by Nemery and Brangier

While analyzing the interfaces of the 20 applications, more themes and criteria began to emerge as a pattern through open coding. One of the prominent criteria that is not listed by Nemery and Brangier is *community*: the inclusion and sense of belonging to the purpose of the application along with other people. In his book "Trust and Community on the Internet: Opportunities and Restrictions for Online Cooperation", Lahno expresses that the act of trust has an important motivating aspect for the trustees [29]. It makes it clear to them that they enjoy the good opinion of the trustor, and that

they will lose the confidence of the trustor if they let the trustor down. The ability to join a community, a forum, or a group chat with other, real people who are on the same journey as aa user gives another user the strength for persuasion and thereby encourages them to reach their goals. As social networks start to grow and social platforms begin to take on a greater role as main modes of communication, then as B.J Fogg claims, people will respond to computer systems as though the computers were social entities that use principles and influence [17]. In other words, connecting real people through persuasive interfaces as social actors, much like a friend who encourages you to eat healthy, and a doctor that tells you to quit smoking, the impact to persuade others reach their end goal can potentially double.

In addition to *community* emerging as one of the static criteria that could be added to Nemery and Brangier's list, certain sub-criteria began to surface as the analysis continued. Most applications fostered a personified dashboard/profile interface that allowed the user to view their account information, statistics, progress, favorited components, etc. This sub-criterion was included under *personalization* among the ones created by Nemery and Brangier and was coded as *Personalization/ProfileDashboard.* A prominent and repeated component in most applications that helps solicit the user to initiate a relationship is the presence of progress bar or statics based on the user's engagement and usage. This sub-criterion was added under *solicitation* in the coding sheet as *Solicitation/ProgressPersuasion.* Another *solicitation* that assumes the role of a social actor are notifications and reminders. Majority of the applications gave users the option to enable and create notifications and reminders for themselves to either use the app or participate in the purpose of the application. This sub-criterion was coded under

solicitation as *Solicitation/RemindersNotifications.* Lastly, there was a pattern of the user going through a welcome wizard or a preliminary assessment before the main interface of the application was launched. As Nemery and Brangier noted, *commitment* is one of the dynamic criteria that continues to involve the user through a process [37]. Therefore, this sub-criterion was coded under *commitment* as *Commitment/PreliminaryAssessment.*

5.1 Applications and Codes

In this analysis of persuasive interfaces, 20 applications were randomly pulled from the Play Store from an Android device (Table 3). It is important to note that the applications were not picked based on their availability on the two main operating systems, IOS and Android. They were chosen at random through an Android device and later verified to see if they were available on iOS. If they were only available on Android, they were not eliminated since this did not hinder the study in any way.

Category	Number of Applications
Smoking	4
Time Management	3
Mental Health	8
Charity	1
Fitness	3
Fasting	1

Table 3. The number of applications in each prominent category

The primary analysis was figuring out the percentage of applications that contained references to each code. Establishing an understanding of how prominent each code is in an overall perspective informs the reliability, applicability, and significance of the criteria (Table 4).

Criteria	Percentage of apps that mention x code
Privacy	75%
Credibility	40%
Attractiveness	55%
Community	40%
Personalization	75%
Personalization/ProfileDashboard	25%
Solicitation	80%
Solicitation/Progress Persuasion	95%
Solicitation/RemindersNotifications	75%
Priming	50%
Commitment	45%
Commitment/Preliminary Assessment	45%
Ascendency	10%

Table 4. An analysis of each criterion and percentage of applications that made references to it

As mentioned previously, Nemery and Brangier categorizes their criteria into two categories, static and dynamic criteria [37]. Identifying the static criteria in an application is a simple process, much like checklist items. For example, if there is an option available for the user to view the privacy terms in the application that they are using, meeting this prerequisite of acceptance in the engaging process allows the user to prepare to get involved in the dynamic criteria. However, this isn't to denounce the importance of user privacy and safeguarding of personal information that the user entrusts with the app. In his book "Privacy in Location-Based Applications: Research Issues and Emerging Trends", Bettini addresses the dire need for privacy regulations in technology. They argue that in today's scenario, concerns about the protection of users' privacy represent one of the main reasons that limit the widespread diffusion of mobile services [29]. According to the analysis of the 20 persuasive applications, 75% of them displayed some level of information on privacy and/or addressed privacy concerns of users (Figure 2 and 3). The graph demonstrates the number of times references to privacy were made in each application. It is common to see one reference as most apps have a section designated to privacy and policies. In some instances, some apps reassured or addressed privacy concerns to users multiple times in their interface, much like Happify and Weight Loss in 30 Days.

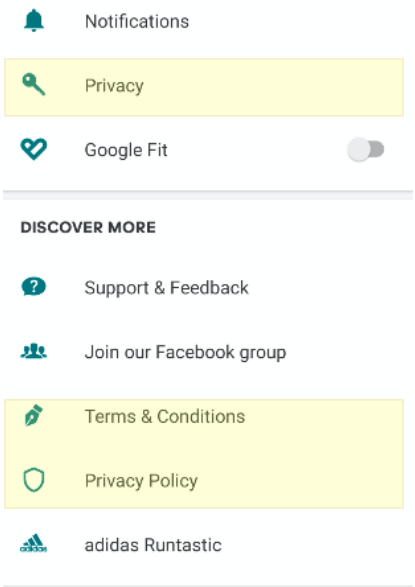

Figure 2. Privacy options in Adidas Runtastic

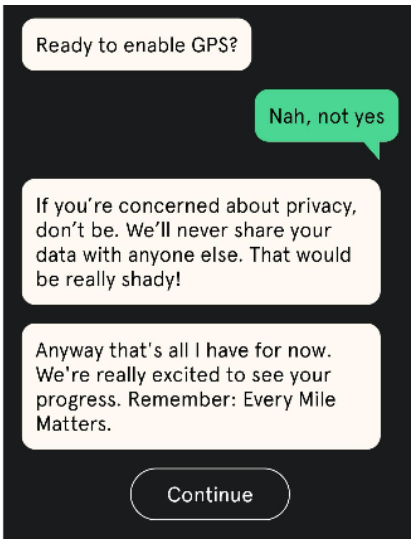

Figure 3. Charity Miles addressing privacy user concerns

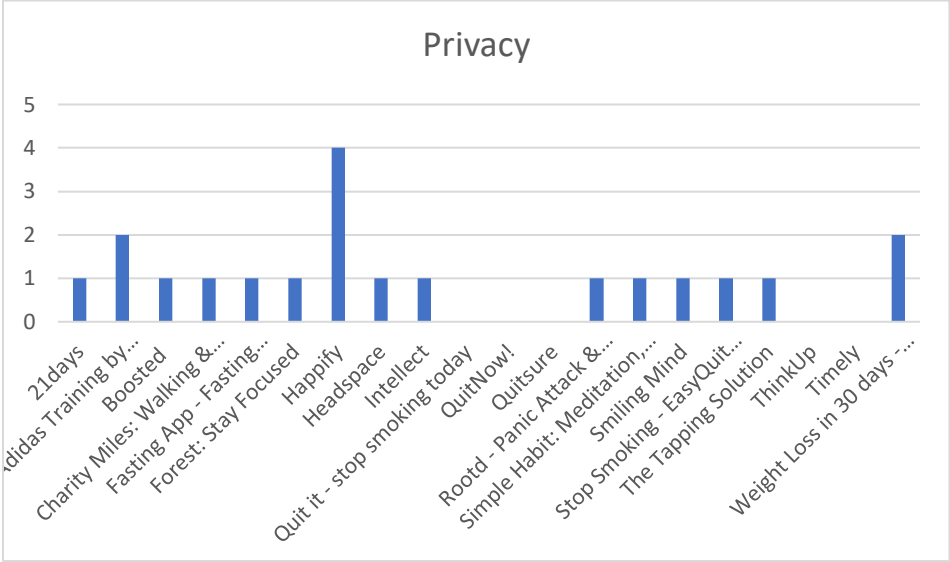

Table 5. Privacy Criterion

As Nemery and Brangier explain, credibility is the ability of the interface to inspire confidence and make the user trust the veracity of its information [37]. The

example the authors give in their research is www.cooper.com providing a list of famous clients to inspire trustworthiness and legitimacy in their field of design. Similarly, certain applications foster a level of reinforcement that comes with the inclusion of research-based information, guidance from professionals, famous figures as well as prominent and well-known brand names (Figures 4 and 5). The graph shows that Headspace used the most references that alluded to a credible application, followed by Simple Habit. The presence of the notable figures, like Kevin Hart in Headspace, and brand names boosts the credibility of the app. In comparison, some applications did not make any references to suggest that they are a credible application. Some setbacks to this are the user feeling insecure while using the application and avoid taking any advice or suggestions out of fear of lack of reliability.

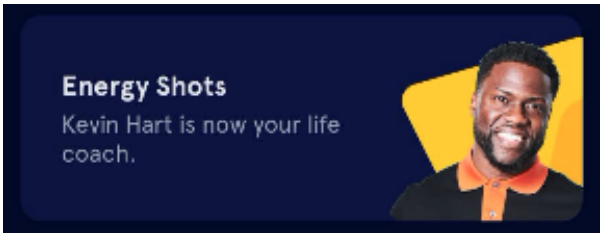

Figure 5. Kevin Kart leading meditation session in Headspace

Figure 4. Research and evidence based results in Happify

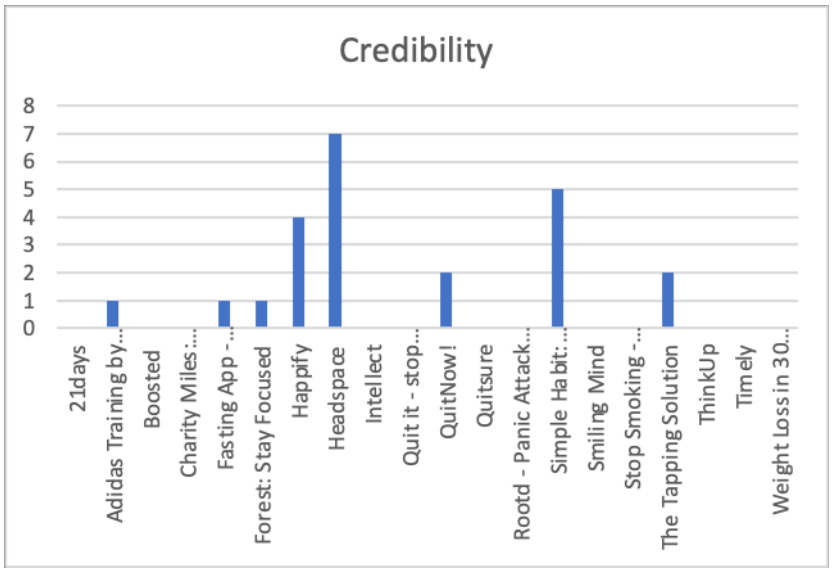

Table 6. Credibility Criterion

Only 40% of the applications referred to evidence and research-based data, included prominent figures, or made references to brand names. Though not all users may find all of these options as credible, the ability of the interface to inspire confidence and to make the user trust the veracity of its information is what Nemery and Brangier define as *credible* in their study. The possible explanation to this phenomenon could be the lack of veracity of certain applications. Every individual with the right tools and skills can create an application and list it among others in Apple store, for iOS, or Play store, for Android users. However, as Kalmanek and Misra state in their book "Guide to reliable internet services and applications", supporting reliable networks and networked application services involves some of the most complex engineering and operational challenges that are dealt with in any industry [41]. Although notable brands like Adidas launch applications, making them credible by default, there are other applications fighting for the same market that may be coded by anyone from students to professional software developers.

One of the dubious and uncertain ways of determining credibility is through the mere attractiveness of the user interface. When it comes to graphics, alignment of elements and buttons, it becomes subjective to the viewer as to what they may find attractive in the application, and what they may find confusing. However, Nemery and Brangier attempt to make this process easier by defining what would be considered 'attractive' as the use of aesthetics (graphic, art, design) to capture the attention of the user, to support the interaction and to create a positive emotion [37]. According to the researcher, merely 55% of the applications were considered 'attractive', particularly because their personal preference is a minimalistic and uncrowded interface that does not overwhelm the user (Figure 6 and 7). As Sutcliffe explains in his book "Designing for user engagement aesthetic and attractive user interfaces", attractiveness of an interface and the beauty of it is in the eye of the beholder, but it depends on who the beholder is and what they are doing. Therefore, he concludes that user judgement of user experience is a complex process that requires research than one may anticipate [37]. The graph illustrates the number of interfaces that were deemed 'attractive' by the researcher. While some apps did not have any attractive interfaces, some like the Fasting Tracker had multiple pages with aesthetic elements.

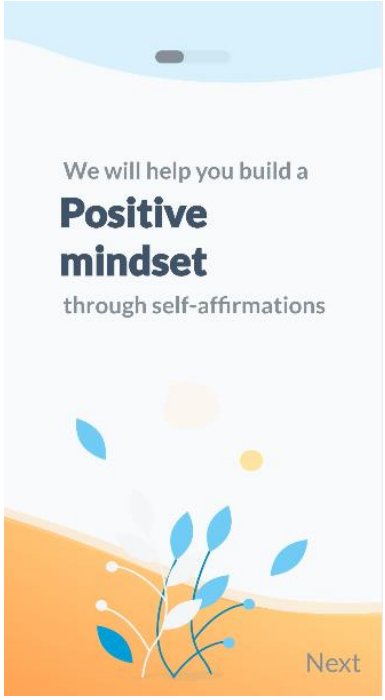

Figure 7. Uncrowded interface from Thinkup

Figure 6. A simple and attractive page from Forest

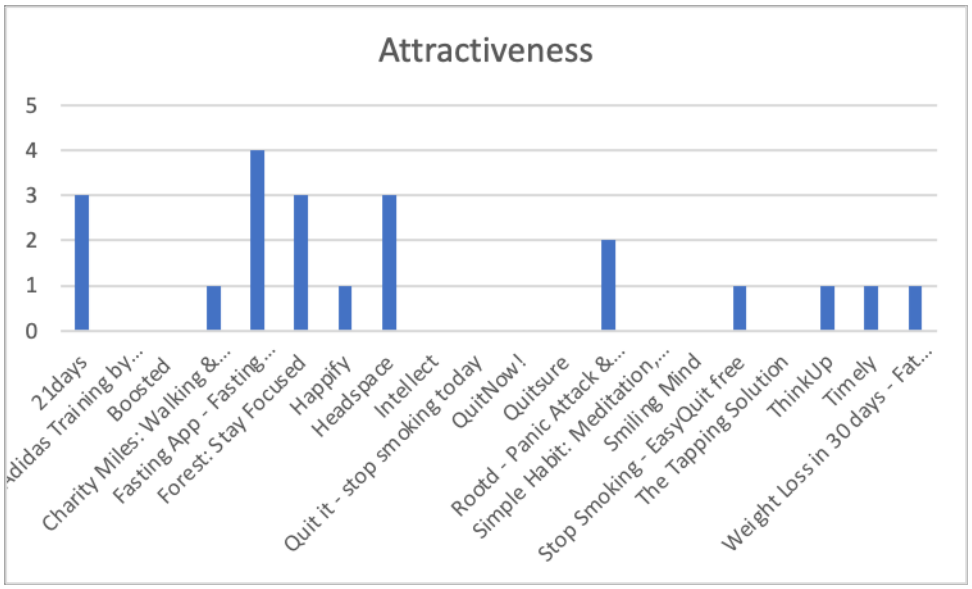

Table 7. Attractiveness Criterion

One of the main persuasive elements in an interface is the ability of the user to connect to the application at a personal level. This requires the interface to truly emit and act as a social actor. According to a study conducted by Carmody and Lewis, several regions of the human brain light up when someone sees their name in print or on a screen. People are intrinsically tied to their self-perception, which makes up a massive part of their identity. As a result, a person becomes more engaged and even more trusting of a message in where their name appears [33]. In the analysis of the 20 persuasive applications, an impressive 75% of them used personalized elements, from the option to favorites to the use of personal pronouns. As mentioned previously, *profile/dashboard* was a suitable sub-category that was identified in the trajectory of the data collection process. Aside from the results of all the other personalized elements, 25% of applications specifically presented the user with a profile interface. In this page, they are presented with statistics relating to their usage, their progress and occasionally the awards they've unlocked and the rewards they granted (Figure 8 and 9). The graph on *personalization* shows how many times there was an attempt to engage the user through personal references. The Adidas Runtastic application was heavily personalized with twelve attempts to engage the user, whereas some apps like Headspace remained general without any personal elements in their interface. One of the types of personalization was a profile page or a dashboard catered to the user. Only five applications had this feature.

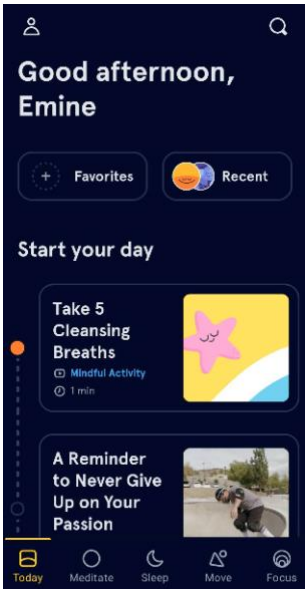

Figure 8. Profile interface from Headspace

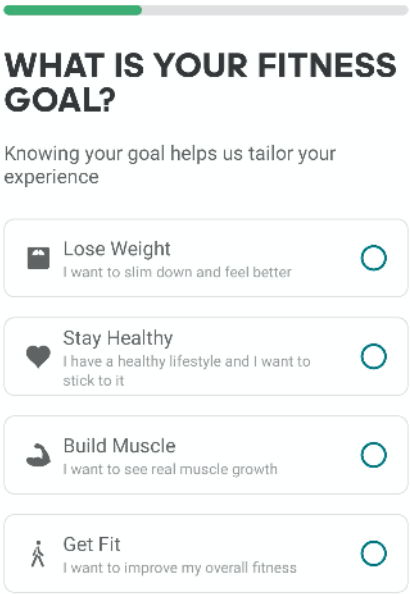

Figure 9. Welcome wizard from Adidas Runtastic using personal pronouns

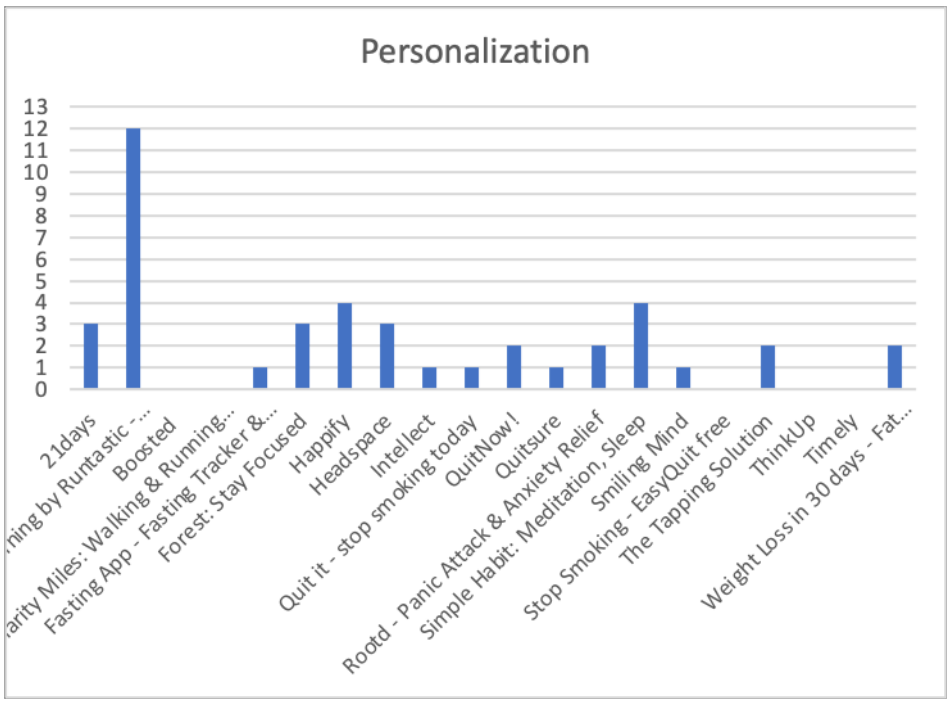

Table 8. Personalization Criterion

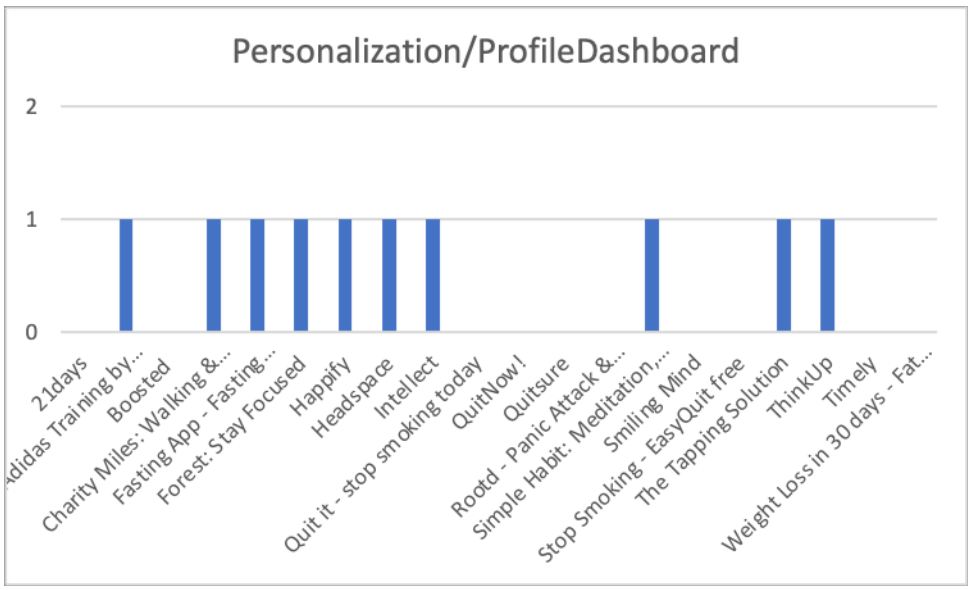

Table 9. Personalization/ProfileDashboard Criterion

Earlier in this analysis, the sub-categories added to *personalization, solicitation,* and *commitment* were mentioned. These additions to the list are not revolutionary since they are patterns among the criteria that Nemery and Brangier suggest in their research. The outstanding criterium that was added to the guidelines by the researcher is *community*. The analysis showed that 40% of the apps provided a community connection for the users. As Lahno speaks into the effects of trust and community on the internet, it is especially a growing phenomenon with the increase in persuasive applications and simply the use of technology [29]. As the world has seen from the events of COVID-19, people are not only choosing to connect on the web but are being strained to continue their communications through technology-supported platforms. When it comes to persuasive applications as social actors, it becomes even more important for the presence of communal support to create or break a habit, whatever purpose the app is there to serve. Embedding a forum, group chat, or the ability for the user to contact a personal trainer or coach is a part of the elements that support the persuasiveness of the application

(Figure 10 and 11). The graph is very telling of which applications fostered a community environment, how many times they referenced it, and in how many ways. Happify was leading the rest of the apps with four references to a communal element, while most of the other applications did not integrate such feature.

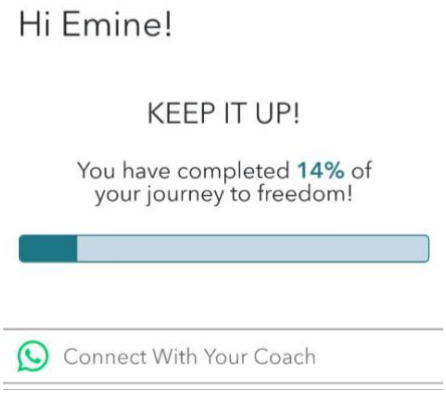

Figure 11. QuitSure offering users access to a personal coach

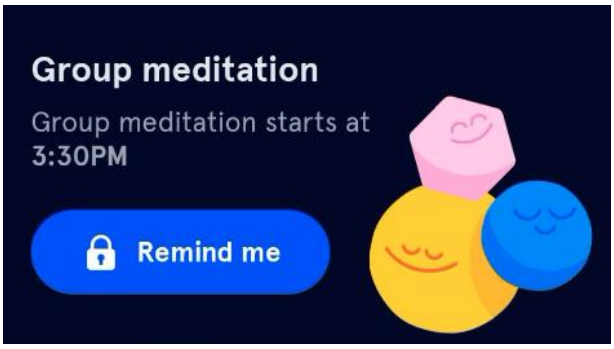

Figure 10. Headspace offering group meditation

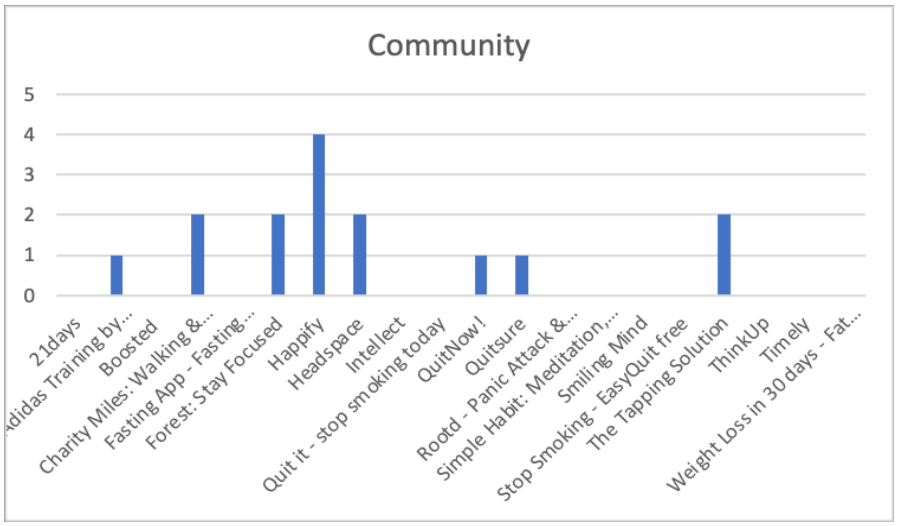

Table 10. Community Criterion

As one of the leading dynamic criteria, *solicitation* was impressively mentioned or implied in 80% of applications. As Nemery and Brangier explain, this is the first stage

that invites the user to initiate a relationship with the application. The interface attempts, by words, graphics, or any forms of dialogue, to suggest a behaviour followed by action [37]. They distinguish three elements for this “invitation” stage: allusion, suggestion, and enticement. Whilst studying the 20 persuasive applications, different forms of these elements emerge from the user interfaces. For example, some of the applications that were studied attempt to persuade the user to either pick up or quit a habit. Providing tips, tricks and information is used to trigger the user to initiate a relationship with the application and further engage in the different features and components (Figure 13). Another solicitation is positive or negative reinforcements that pop up after completing or being unsuccessful in a task or challenge, replicating much of what a social actor would say (Figure 12). In terms of the number of apps that referenced or alluded to a criterium, solicitation is in the lead. While only a few applications did not have any solicitated elements, most of the apps did with multiple references.

Figure 13. Tips and tricks from QuitSure

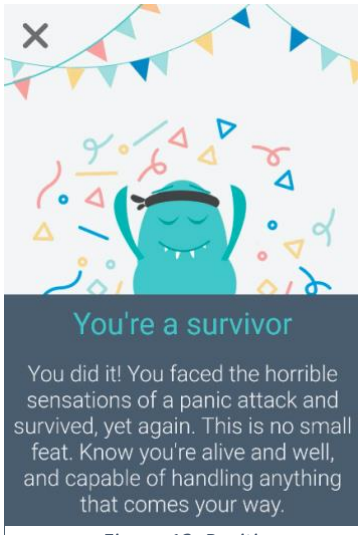

Figure 12. Positive reinforcement after the completion of a task in Rootd

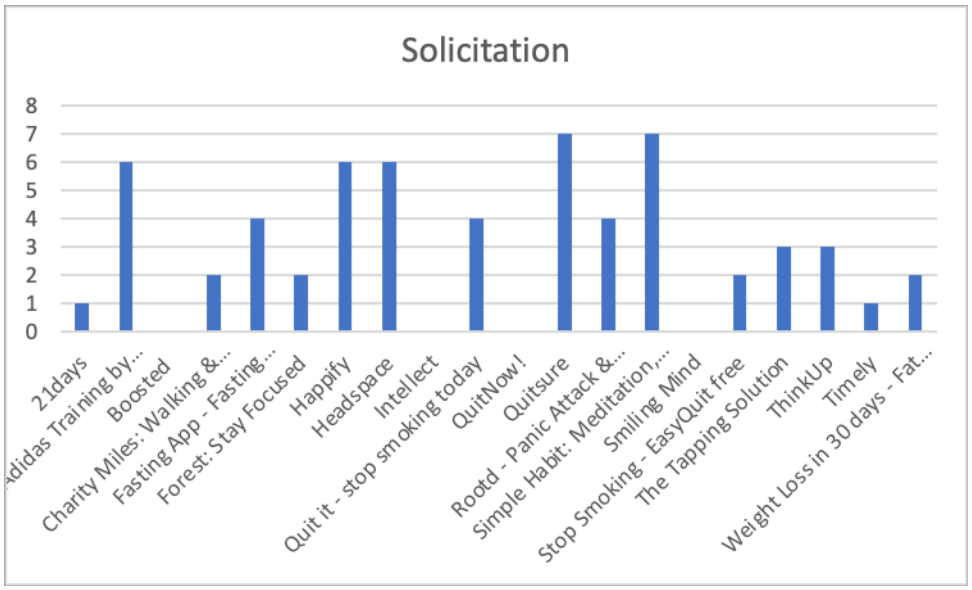

Table 11. Solicitation Criterion

Much like the *personalization* criterium, solicitation fosters two sub-categories: *progress persuasion*, and *reminders and notifications*. As the criterium with the greatest percentage, 95% of the applications had a feature that presented the user with their progress (Figure 14). Amabile and Kramer conducted a study to understand the influencers of 'good days' and 'bad days' of employees. They found that on the days the employees made progress, they were more motivated and experienced positive emotions. Upon reading thousands of diary entries by participants, they noticed that those that made progress within their workday had more-positive perceptions, a sense of accomplishment, satisfaction, happiness, and more progress [6]. Progress persuasion as a sub-criterion to *solicitation* yielded significant results of its own. Majority of the apps had progress bar or statics, with Stop Smoking – Easy Quit free leading the chart with five references. The only application that did not implement this feature was ThinkUp.

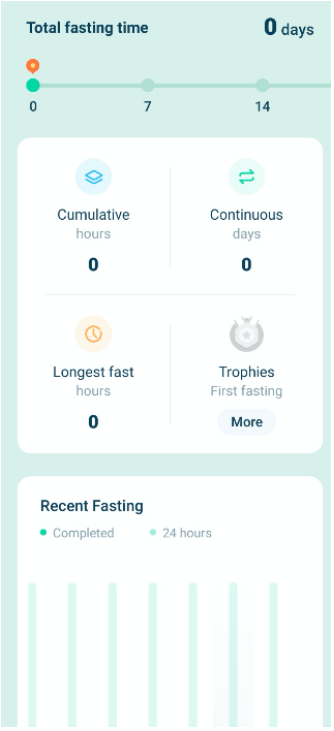

Figure 14. Progress bar, chart, and graph from Fasting Tracker

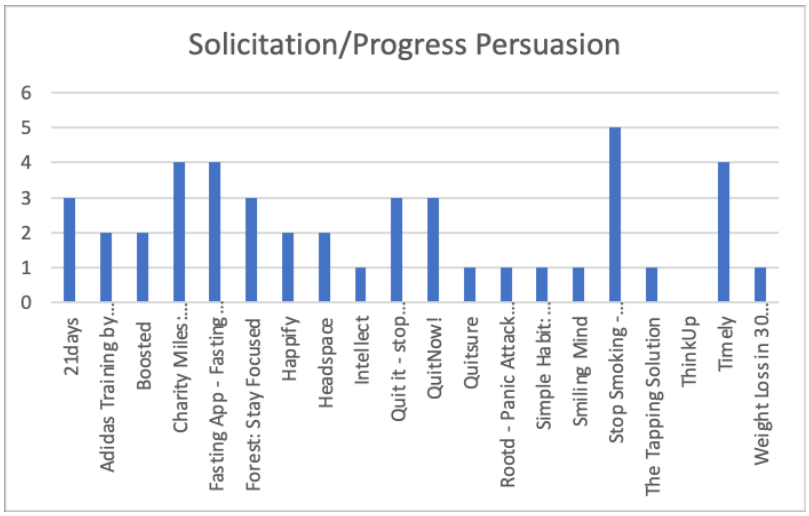

Table 12. Solicitation/Progress Persuasion

The second and final sub-criteria in solicitation is the ability for the user to set or enable reminders and/or notifications in the application. According to the analysis of the 20 persuasive applications, 75% of the apps have this feature. A study by Yousuf and Conlan indicate that the use of push notifications is followed by action, hence persuading the user to engage with the application [18]. As previously mentioned, positive and negative reinforcements incite action and engagement but have different levels and circumstances in which reinforcement will be best suited. None of the applications studied employed negative reinforcements, but there are studies that argue the exponential growth in completion of tasks and persuasion when negative reinforcements are used as opposed to positive reinforcements (Figure 15 and 16).

The second and final sub-criterium of solicitation that the researcher found significant was *Reminders/Notification*. This was identified as a notable feature in most apps such as Fasting Tracker and Simple Habit leading the chart with four references.

However, some applications such as Happify and Intellect did not include this feature in their interface.

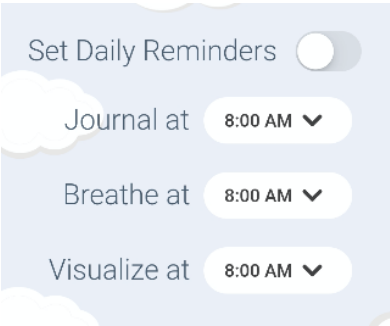

Figure 16. A set of reminder options from Rootd

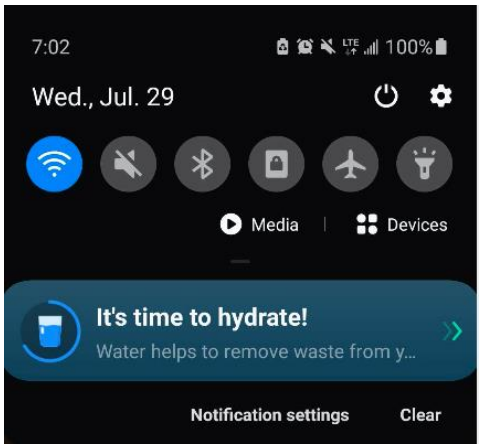

Figure 15. A notification bar, reminding the user to drink water

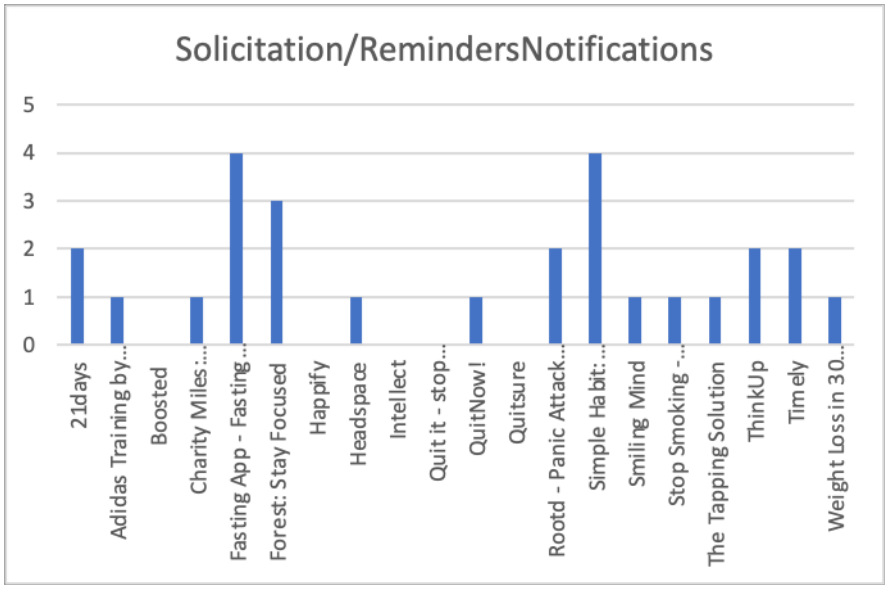

Table 13. Solicitation/ReminderNotifications Criterion

As the user gets more comfortable with the application, and after they have initiated a relationship with the application, they accept the basics of the interface and are presented with *priming* elements. Nemery and Brangier describe this criterium as the

elements of the media that trigger the persuasive influence. While the first action was carried out without coercion or awareness, the following train of actions lead users to get caught in a process that gradually draws them in [37]. The analysis showed that 50% of

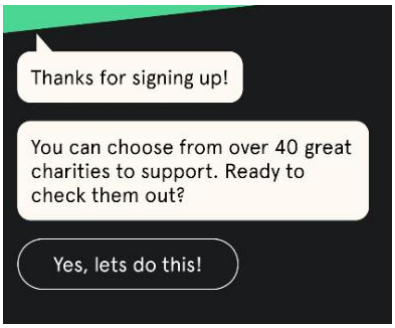

Figure 18. Charity Miles using motivating language

Figure 17. Rootd going the extra mile with the use of persuasive language

the apps used priming in one form or another. The authors reference the change of words from "Add to cart" to "It's perfect!" in www.thefutureperfect.com to illustrate the persuasive influence that the words incite in the user [37]. The use of words, graphics, and models to persuade and excite the user over something that could otherwise be said in plain language or illustrative elements is fundamental to *priming* (Figure 17 and 18). The graph shows a significant discrepancy between Charity Miles and other apps with little to no references to priming. Charity Miles made references to priming or alluded to the criterium with words or illustrations eight times. The rest of the applications either referenced it one to two times, or not at all.

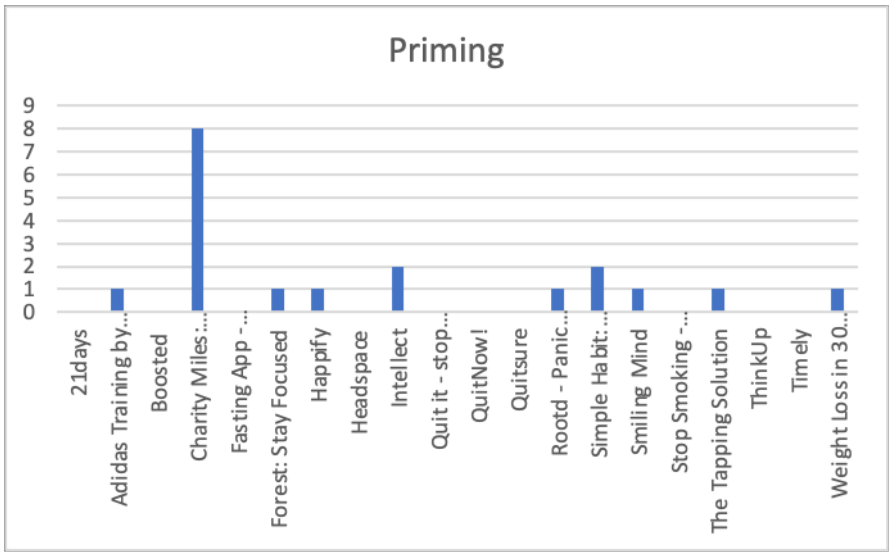

Table 14. Priming Criterion

The next dynamic criterium followed by priming according to Nemery and Brangier's guidelines is *commitment*. This is the stage where the interface continues to involve the user through a process while using actions, sequences, or predetermined interactions to gradually involve the user [37]. However, the highlight and the feature that leads to *ascendency*, the final criterium in Nemery and Brangier's list, is awarding and rewarding the user. The successful completion of the queries and actions is followed by praise, encouragement, reward, and continued interaction, which induces more intensive and regular behaviour from the user [37].

In a study, Khoshkangini et al explore the challenges and limitations of gamification in persuasive technology [26]. Gamification is a strategic attempt to replicate the experiences similar to those experienced when playing games to motivate and engage users [43]. 45% of the applications from the 20 that were analyzed employed gamification by giving users awards, rewards, and praises for the completion of a series of tasks or queries. According to Khoshkangini et al, game element of challenges, which

propose a demanding but achievable goal and rewarding completion, has empirically proved effective to keep players' interest alive and to sustain their engagement overtime [26] (Figure 19). The graph presents the number of times features alluding to commitment were mentioned in each application. There is a significant polarization between apps where some such as Rootd referenced awards, praises, and encouragements with a leading number of six times, while some such as Timely did not integrate this feature to their interface.

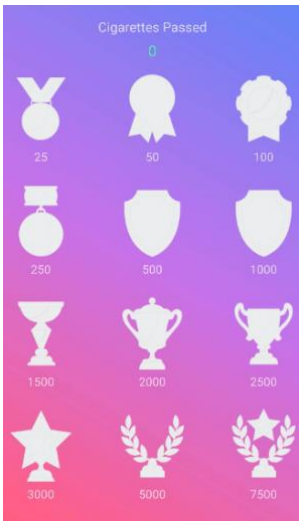

Figure 19. Awards wall on EasyQuit

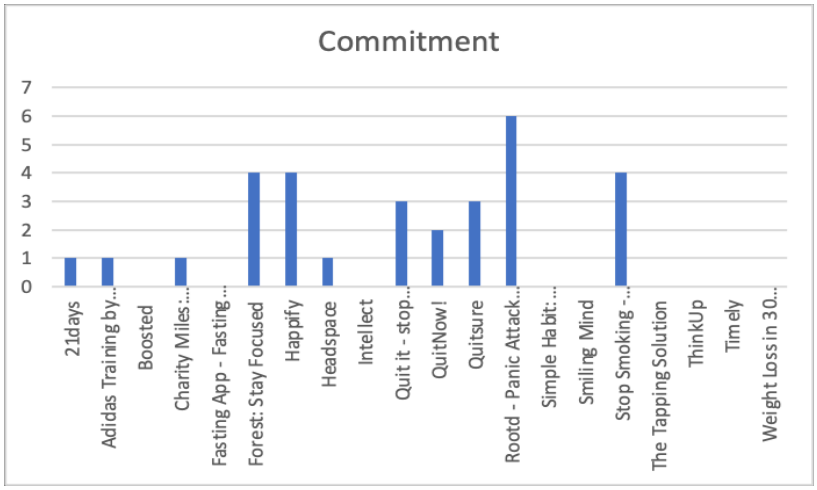

Table 15. Commitment Table

A prominent example of *commitment* Nemery and Brangier included in their research is a welcome wizard. The person is asked to follow an assistant through a tunneling process, and the idea is to maintain the user's attention [37]. During the analysis, it became clear that there was a welcome wizard trend among some applications. As a result, a sub-category titled *preliminary assessment* was created. 45% of these apps walked the user through an introductory page, asked several questions as a preliminary assessment, or an established welcome wizard before launching their main interface (Figure 20). Preliminary assessments and welcome wizards were identified by the researcher as a significant element within the commitment criterium in the trajectory of data collection. While Happify was leading the chart with fourteen pages to their welcome wizard, some apps such as Forest did not include this feature in their application. The explanation to these differences could be as simple as the functionality of the application. While some apps require more guidance from the developers, others can be straightforward enough to allow the user to discover the idea and goal without guidance.

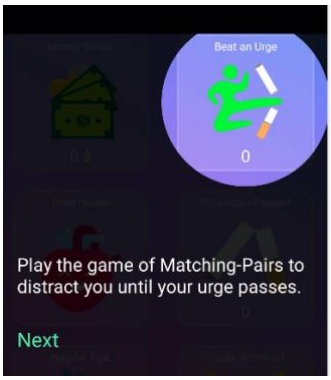

Figure 20. One of the steps of the welcome wizard on EasyQuit

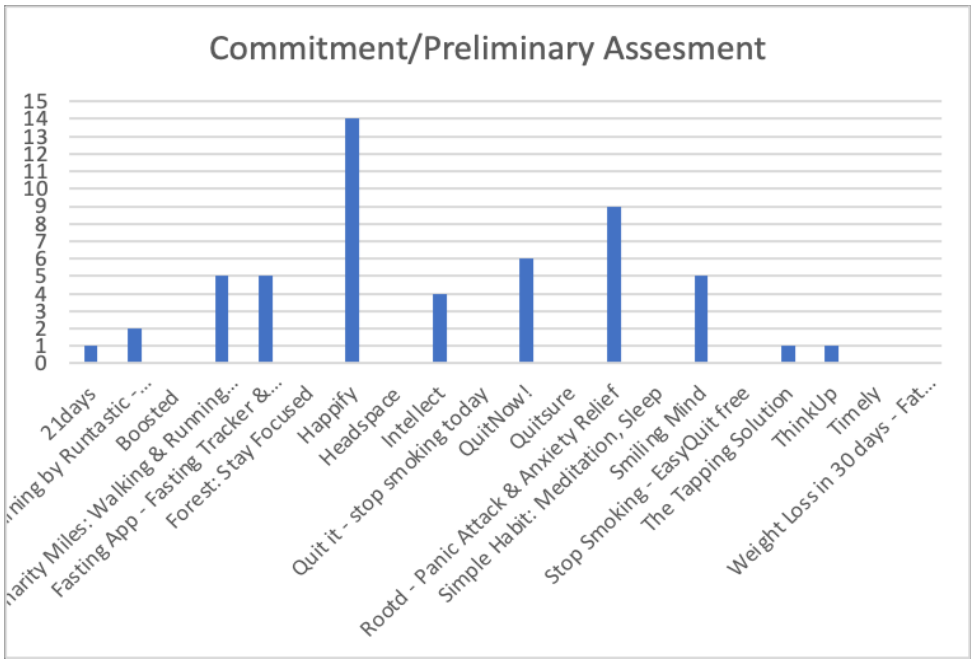

Table 16. Commitment/Preliminary Assessment

The final criterium based on Nemery and Brangier's study on a set of guidelines for persuasive interfaces is *ascendency*. This stage is the indicator of the completion of the engaging scenario. Once a user enters this stage, they have certainly accepted the logic and goals of the application. The "grip" or hold that the technology has on the user's attention is the deepest form of persuasion [16]. According to Nemery and Brangier, this is the stage where obsession, addiction, and over-consumption of the technology becomes a risk [37]. This is where the thin divide between persuasive technology as social actors, and technology that becomes persuasive becomes prevalent.

This analysis showed that only 10% of the apps employed ascendency. The kind of apps that were studied in this research are the ones that help users build or break a habit. The ones that have a higher potential of reaching the ascendency stage are those that carry the risk of addiction and over-consumption. Although persuasive technology made to be a social actor can bring about positive change to the user's life, it is unlikely

for the user to become addicted to the app or over-consume to a hazardous point. For example, someone who wants to quit smoking is going to need higher levels of pull factors from the application to merely stay connected to their goal, let alone get addicted. However, there may be cases where a user who is employing a persuasive technology as a social actor to reach a goal or habit get "carried away". For example, a user may reach a level of ascendency while using a workout app to reach their fitness goal and use the app more than the app was intending to engage the user. This level of engagement is seldom caused by the outstanding persuasive design of the interface, but because of the strong intrinsic motivation the user has to get fit and healthy.

Social media platforms are often used at a level of ascendency. According to research conducted by Ponnusamy et al, Instagram users feel obliged to respond to social requests from others, meaning they tend to spend more time on Instagram for the purpose of social relationships and consequently become addicted to Instagram [39]. Consequently, the motivation to repeatedly meet social needs through Instagram may lead users to develop a sense of belonging to this platform and subsequently becoming addicted [39]. The graph shows the only two applications that included an element that alluded to ascendency. Every other application other than Adidas Runtastic and Stop Smoking – EasyQuit Free did not have any elements that could be categorized with the ascendency criterium (Figure 21).

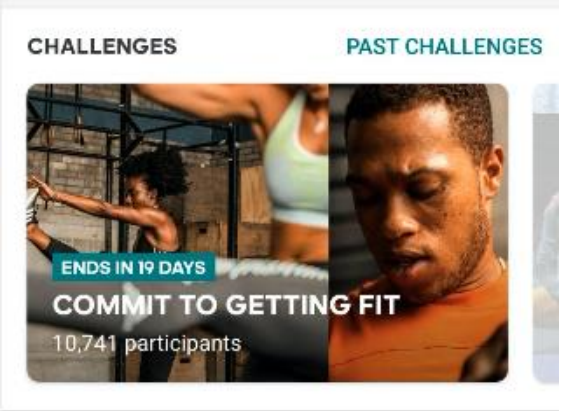

Figure 21. Adidas Runtastic challanging users

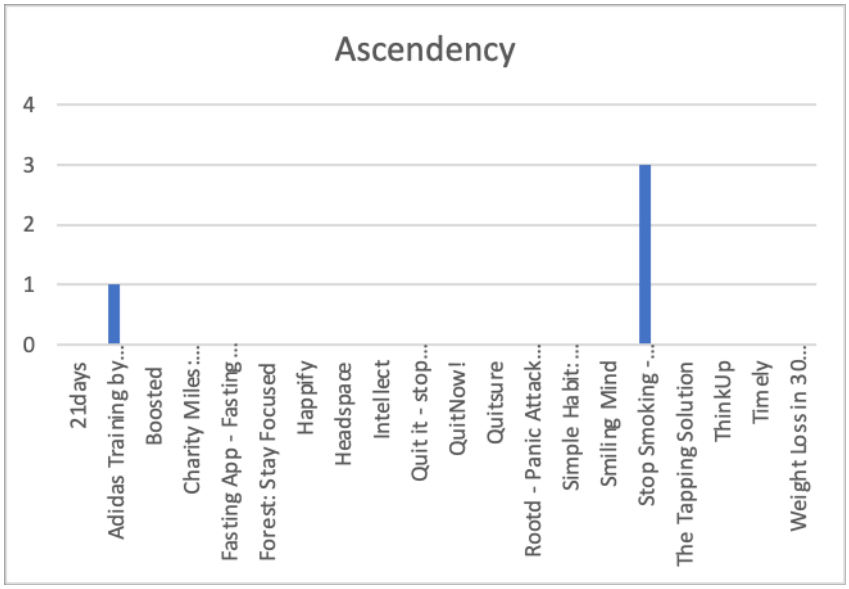

Table 17. Ascendency Criterion

To exemplify the findings, the graph below enumerates the percentage of the criteria that each app satisfies (Table 18). These results include every criterion and sub-criterion in the list. Each sub-criterion belongs to an overarching criterion, so if the sub-criterion is not incorporated in the application, employing the main criteria still counts as satisfying the criterion. Regardless of this leeway, none of the applications were able to

satisfy all the main criterion, excluding the sub-criterion. Nemery and Brangier used kappa, a statistical coefficient for assessing reliability to conclude the validity of their exhaustive research. The nature of this research does not require the employment a statistical coefficient since the results can be easily observed from the data output. As previously mentioned, the more prominent purpose of this study is to do a follow-up study of Nemery and Brangier's work and evaluate their set of guidelines against a set of applications. The results build on existing evidence of the lack of reliability of Nemery and Brangier's criteria, as well as the *community* criteria supplemented by the researcher.

Apps	**Percentage of criteria each app satisfies**
21days	61%
Adidas Training by Runtastic - Workout Fitness App	92%
Boosted	15%
Charity Miles: Walking & Running Distance Tracker	77%
Fasting App - Fasting Tracker & Intermittent Fast	69%
Forest: Stay Focused	85%
Happify	85%
Headspace	77%
Intellect	46%

Quit it - stop smoking today	31%
QuitNow!	54%
Quitsure	38%
Rootd - Panic Attack & Anxiety Relief	69%
Simple Habit: Meditation, Sleep	61%
Smiling Mind	46%
Stop Smoking - EasyQuit free	54%
The Tapping Solution	77%
ThinkUp	38%
Timely	31%
Weight Loss in 30 days - Fat burning Home Workout	54%

Table 18. Percentage of criteria each application satisfies

5.2 Autoethnography

The contribution made by the app analyses while reflecting on the set of guidelines by Nemery and Brangier helped to see the implications of the criteria, as well as identify criterium that may not be accounted for. The objective observation of the apps not only subjugates biases of the researcher, but it also becomes a practical way to understand the elements on each user interface. However, for a study on the interfaces of mobile applications, there is a considerable amount of value in the subjective contributions of the researcher. While ethnography tends to be understood as a qualitative method in the social sciences that describes human social phenomena based on fieldwork,

autoethnographers are themselves the primary participant/subject of the research in the process of writing personal stories and narratives [30]. As a part of her book on ethnography, Carolyn Ellis introduces autoethnography as something that is part *auto*, self, and part *ethno*, culture. She distinguishes the difference between traditional ethnography and autoethnography by describing it as a story that is waiting to be told [30]. Autoethnography embraces and foregrounds the researcher's subjectivity rather than attempting to limit it as it would be in empirical research.

The discovery of other criteriums that play into the effectiveness and success of persuasive interfaces undoubtedly contributes to academia, opening doors for follow-up studies. However, one of the most effective ways of evaluating the look and feel of an interface is through human usage and experiment. For this reason, I actively engaged and used 2 out of the 20 persuasive applications chosen for this research and recorded my experiences. I had to deliberately choose the applications based on my own needs, wants and lifestyle. As a non-smoker, I would not be able to accurately use a smoking cessation app since I am not the targeted user, therefore I chose “Simple Habit” and “Lose weight in 30 days” to conduct the autoethnography. I uninterruptedly used these apps for two weeks to experience the persuasive elements of the interface discussed in the qualitative research following Nemery and Brangier’s study.

5.2.1 Simple Habit

This app provides users with personal development content, primarily audios. I had some experience with the app when I was collecting data for my coding, but I did not finish any of the prompted audios. I finished the video recording on “setting personal

boundaries" that I found as one of the first options on the landing page/dashboard. It was only 4-5 minutes in length and it was motivating. I felt good about myself and felt a sense of accomplished when I was redirected to the next page where a big green check box that read "Nice Job, Emine!" were in the middle of the page. There is a special sense of connection I feel every time someone or something refers to me by name, especially because I know my name is not common, making the experience feel truly personalized.

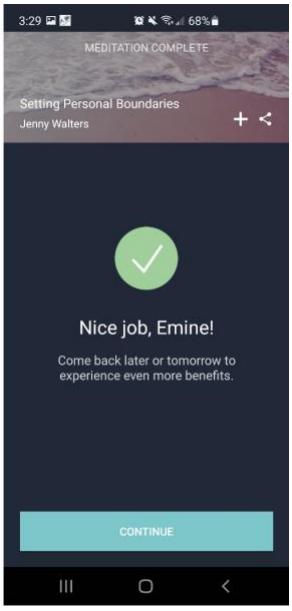

Figure 22. Personalized page at the end of a module in Simple Habit

With the spur of motivation and the intensive I received from the brief and to-the-point audio lectures, I began to search for more content I can fit into my day. I browsed and though didn't listen to more audios, I found the titles to be engaging and motivating with their short lengths instead of them putting me off with extensive jargon. For the next couple of days, I continued to explore different audios and listen to them according to what I was feeling. The profile section added a special incentive to going back and listening to more audios. I was motivated by the number of audios that I listened being

counted, but also the day streaks that were recorded on my personalized page. After just a few days of regular usage of the app, the system nudged me to set reminders.

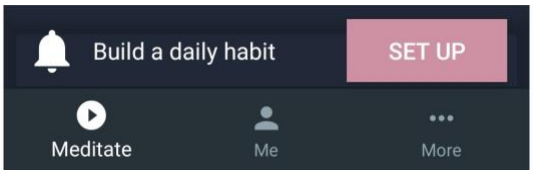

Figure 23. Nudge to set reminders from SimpleHabit

Knowing that I was using this application every day, I decided that there would be no harm in setting up notifications for myself. The interface of the application was very inviting with the attractive, simple time picker and two options to add to my calendar.

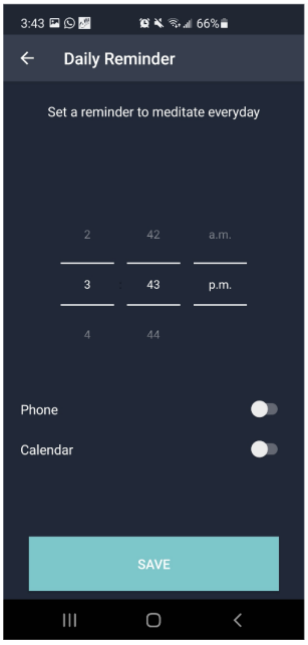

Figure 24. Minimalistic calendar from SimpleHabit

On one of the last two days of my 2-week experiment with the application, I decided to explore the “On the go” tab. I was satisfied with the meditation content that I didn’t feel the need nor want to go and explore other functionalities of the app. However,

I found the “On the go” application to be resourceful. There were several day-to-day situations such as “morning”, being “at work”, a “big event” or “on the bus”. The wheel that looks like a spinner looked familiar, but it was not a spinning wheel like those often seen in game shows or online games. I would select my condition or situation and the wheel would present me with a more precise condition which I would select and be redirected to a meditation audio.

Figure 25. Meditation wheel from SimpleHabit

I liked the simplicity of this page but the use of the wheel for this functionality misguided me, leading me to believe that it was a game. Being able to select the amount of time I have at my disposal reassured me that I was going to have more control over how much time I get to dedicate to the task.

5.2.2 Weight loss in 30 days

The second app that I simultaneously used for 2 weeks along with “Simple Habit” was “Weight loss in 30 days”. As a person without a gym membership who tries to work out regularly, I was a target user for this application. The motive of the app is within the name – losing weight in 30 days. When I first clicked the app, I was confronted with three levels: easy, medium and hard. The categorization of the workouts in this fashion was universal, so I could anticipate an easier series of workouts if I clicked “Easy”, a slightly challenging series of workouts if I clicked “Medium”, and a more challenging series of workouts if I clicked “Hard”. I clicked “Easy” and was shown a chain of cards with each of the 30 days.

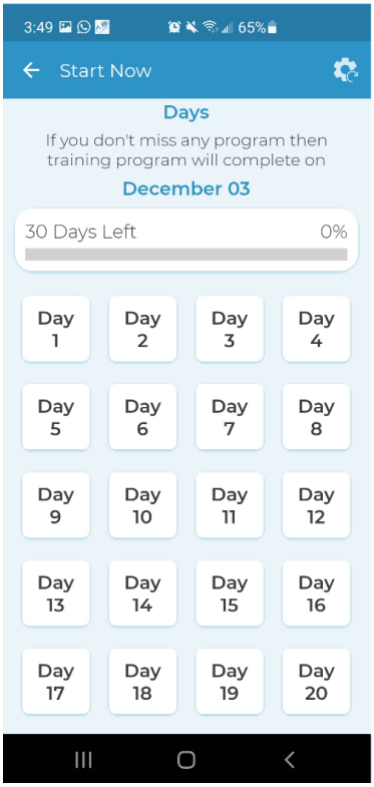

Figure 26. Calendar countdown in Weight Loss in 30 Days

The prediction of when the workout would be completed gave me motivation and an end goal to look forward to, playing into *priming* that Nemery and Brangier outline in their study. Once I click the specific day I am trying to do the workout for, I am presented with a series of exercises compiled into a workout. Clicking "Start" takes me to an active workout session that has a timer for each exercise. At the end of the workout, there was a big red text at the top saying "Congratulations!" to show that I have accomplished something.

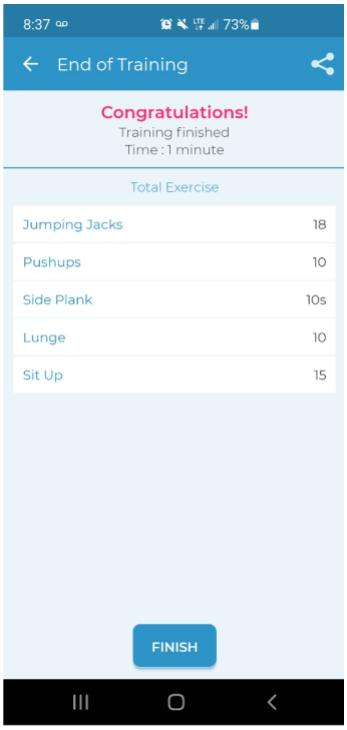

Figure 27. Greeting at the end of a workout in Weight loss in 30 days

I was motivated by the positive reinforcement but felt a little estranged from the app because I have become accustomed to personalization with other computerized programs and applications. However, going back to the calendar and seeing the number of days left for the collective workout along with a progress bar gave me intensive to come back just to visualize my progression. The simple and unsophisticated interface

design made it easy to follow suit with the sole purpose of the app, but also became boring overtime. Going onto the app just to see and be told the same things was demotivating after week one, and the only persuasion I had to use the application was intrinsic motivation to be healthier.

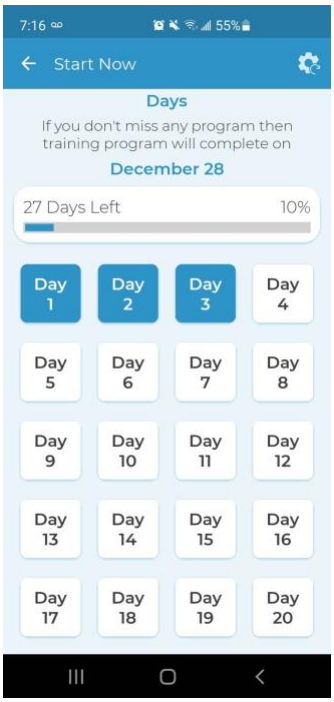

Figure 28. The calendar countdown after a couple days of workout in Weight loss in 30 days

5.2.3 Analysis

The contributions of autoethnography on any interface analysis brings great value to the research. By analyzing my own experience with a select few applications yielded valuable findings about the design elements on persuasive applications. One of the main motivators for me was simplicity (i.e., aesthetically pleasing) and personalization. Without considering the guidelines outlined by Nemery and Brangier in my analysis, I was able to identify what made me persuaded to change my habits, behaviours and

continue using the app, versus what deterred me from going back to the application or tempt me to discontinue my usage. For example, I had an easier time getting motivated to launch “Simple Habit” than “Weight loss in 30 days”, and this is a finding worth mentioning. Although the motive of an autoethnography is not to compare two study subjects, it is important to note what worked and what did not in contrast of both apps.

“Simple Habit” and “Weight loss in 30 days” both had an aesthetically pleasing interface, and by that I am referring to a simple and minimalistic design. However, the difference between the two apps was the wealth of options in “Simple Habit” versus “Weight loss in 30 days”. While the simplicity is what persuaded me to use “Simple Habit” with more enthusiasm, it was the same element that discouraged me from using “Weight loss in 30 days”. The autoethnography revealed that when it comes to the interface of persuasive technologies, there is a fine line between a *persuasive* simplistic interface versus *discouraging* simplistic interface.

Personalizing the messages prompted to the user are bound to be persuasive because of the direct engagement with a user’s essence. When I read “Nice job, Emine!”, I read it through the voice of a psychotherapist or a close friend who is rooting for my wellbeing. Despite knowing that this is a computerized system, I still feel a sense of connection to the app since the system in the application is what initiates the connection. However, the “Congratulations!” at the end of my workout on “Weight loss in 30 days” feels generic. It feels less personalized and more automatized, hence lacking that sense of connection. While both of these applications have their pros and cons, the autoethnography yields areas of effectiveness in similar criteriums that may seemingly be present in both interfaces. Even if both apps have simplistic designs and some degree of

personalization that could be identified in coding, the sensation that is driven from experiencing both apps are significantly different.

Chapter 6: Discussion

As Kientz et al. transparently claim, despite the appeal of persuasive applications for study, the evaluation of these technologies remains a challenge [40]. There are many publications and studies on different to studying, evaluating, and testing persuasive technologies. Matthews et al. adopted the Persuasive Systems Design model to evaluate the inbuilt persuasive features of mobile applications. This study was ultimately the basis to many other studies similar to it in nature. They define a thorough guideline with four system features and multiple postulates to further define the similarities in persuasive technologies [32]. While the functionalities and persuasive elements are studied by other researchers, Sullivan et al. ruminate the ethical considerations that may arise with the employment of persuasive technologies. They argue that while some technologies help the user complete tasks and satisfy immediate preferences, other technologies encourage users to reflect on the values underlying their habits and teach them ways they can change their lives for the better. Therefore, Sullivan et al. study paternalism as possible influencer, which is the liberty of the individual and autonomy being compromised for the sake of their overall wellbeing [43].

Kaptein et al. take on a more personalized approach to persuasion. Through their study on explicit and implicit personalization, they demonstrate their interest in customizing persuasion profiles according to 'personas'. They explore ways persuasive technologies can be made adaptive to users and how these technologies can adapt to how the users are persuaded to increase the effectiveness of technological interventions [25]. The pioneer of persuasive media, B.J. Fogg, provides a fundamental understanding on what persuasion looks like when it meets technology. His focus in chapter 5 of his

ground-breaking book, “Persuasive technology: using computers to change what we think and do” is to define social actors. The doctor who tells you to stop smoking, and the friend who motivates you to workout are all social actors in our lives. Fogg believes that computers and computerized technologies are slowly replacing people as social actors [15]. As an effort to evaluate this phenomenon, he outlines and explains five primary types of social cues. His early study on persuasive technologies become a basis to most, and almost all future studies on this field.

The final and most important piece of literature for this research paper is the “Set of guidelines for persuasive interfaces: Organization and Validation of the Criteria” by Alexandra Nemery and Eric Brangier. Nemery and Brangier dive into the world of persuasive technologies and discover a gap in other studies [37]. They find that while most studies outline a series of guidelines or criteria to evaluate the functionalities of persuasive technologies, there is a lack of available tools to measure persuasion impacted through the interface. Additionally, in comparison to other criteria available to test interfaces, the authors acknowledged the lack of consideration for time as a structural element of social influence. They argue that persuasion is a temporal process that does not merely consist of a momentary occurrence, but gradual progress of motivation [37]. To fill these gaps in the academic studies on persuasive technologies, they analyze 164 documents linked to technological persuasion and come up with 8 criteria that correspond to a classification of framework for guidelines [37].

Throughout this paper, multiple areas of possibility in relation to persuasive technologies and varying guidelines and criteria are explored. The data collection process demonstrates how some applications, though considered persuasive in goals and

purposes, may not employ certain criteria subjected to testing. Based on background research and literature review, the anticipation was that the 8 criteria will reveal themselves in each persuasive application through different means such as words, illustrations, or implications. The researcher was ultimately persuaded to take on this approach for the study based on the recommendations of Nemery and Brangier to conduct a follow-up study on their proposed criteria. After validating these principles, Nemery and Brangier invite other researchers to use their guidelines to evaluate the persuasiveness of interfaces for technological tools. Therefore, the overarching purpose of this paper is to do follow-up research based on Nemery and Brangier's study and explore their criteria per their recommendation.

Although all the criteria in Nemery and Brangier's guidelines were used for evaluation, there are other elements in this study that make it distinctive. While collecting data through open coding, certain persuasive themes began to reveal themselves to the researcher. These themes and patterns were repetitive and significant enough to consider the analysis against Nemery and Brangier's criteria. The most distinctive revelation was the presence of a *community* feature in some of the apps. This gave the user the ability to connect with other users who are in the progress of trying to either build or quit a habit. They came in the form of forums, personal chats with coaches, and 'wall posts' similar to those on Facebook. This functioned as another persuasive feature among others. In addition to the other 8 criteria, the researcher found this element significant enough to note throughout the data analysis process.

Aside from the emergence of the 9th criterion in the list, there were the occurrences of 4 *sub-criterion* that supplemented and engrossed 3 criteria. Similar to the

materialization of the *community* criterion, the researcher noticed the pattern of personalization of the application through the use of a profile or a dashboard of the user's most significant information. This sub-criterion was included under the personalization criterion and every time an application had a profile or dashboard interface. It did not take away from noting other customized elements in the app, but the presence of this sub-criterion showed the kind of specific and frequent features that some apps used to persuade users through personalized or customizable elements.

As previously mentioned, *solicitation* is the first stage in the dynamic criteria that briefly attempts to attract and challenge the user to initiate a relationship [37]. The vague nature of this definition yields many ways solicitation can appear in an interface. Evidently, this could come in a pattern of elements that are easily distinguishable. As the data collection began, the researcher noticed that incorporating a progress bar, graphs, or tables to show how the user is advancing was prominent in a majority of the apps. Considering that 95% of the applications employed this feature leads the researcher to believe its effectiveness and distinction. When it comes to relating this sub-criterion to its main criteria, *solicitation*, it may appear to be unrelated. However, in a more thorough explanation, Nemery and Brangier distinguish three elements for the solicitation stage, which they refer to as the "invitation" stage: allusion, suggestion, and enticement [37]. They suggest that to achieve these goals, the interface will attempt by words, graphics, or any form of dialogue, to suggest a behaviour followed by action. There is no doubt that features that display the progress of the user are persuasive. It is then understood that by displaying these features, the developer is enticing the user to act in a certain way (behaviour), which is naturally followed by a set of actions.

The user visualizing their advancement towards their goals will persuade them regardless of their progress. If a user sees that they are doing a good job keeping up with their goals, perhaps by even going beyond what they anticipated was within their capacity, they will be motivated to achieve more. As Bogost mentions in the chapter titled "Procedural Rhetoric" from his book called "Persuasive games: videogames and procedural rhetoric", human behaviour is fundamentally motivated by some sort of incentives [38]. The intrinsic satisfaction that a user could achieve from pursuing a higher sense of self can even trump over any extrinsic elements of persuasion. On the contrary, if a user is finding themselves behind their goals after viewing their progression, they will be persuaded to work up to what they believe is their potential. Similarly, this will yield greater feelings of success and increase the effectiveness of intrinsic motivation [38].

The second sub-criterion in solicitation was the presence of reminder and/or notification settings in the application. This was one of the major persuasive elements in all applications and often, when there is a dialogue on persuasive elements, the main component people mention are notifications. This sub-criterion was noted in the coding process in a similar fashion to others. This feature specifically embodies the role of a social actor perhaps more than some of the other criteria. If imagined, receiving a push notification to 'keep on going' could resemble similar reactions, feelings, attitudes, and actions that arise when their doctor communicates a similar message.

Similar to the *profile/dashboard* sub-criterion in solicitation, the *reminders/notifications* suggest a behaviour followed by an action in the form of words, graphics, or other types of dialogue. This is supported by a study conducted by Freyne et al. which concludes that push notifications and user tasks are appropriate mechanisms to

engage users with mobile technology [19]. Much like the persuasive elements associated with a progress bar, the tone used in notifications can have a similar effect on the user. If the push notification has a positive tone, the user can be enticed to act and work hard towards their goals. This could be something such as "Oh no…Better luck next time!" to let the user know that they did not complete the task this time, but they are invited to keep trying. On the contrary, a sturdy tone could be used to send the same message. For example: "Oh man, you're going to have to work harder!" gives the user the same message as the previous note, although introduces different emotions in the user [48]. The latter example is often seen used by the social actors in their life that the user knows very well and trusts. To build this relationship with the user, the application must incorporate the static criteria by Nemery and Brangier in their interface. In any case, the effectiveness of the tone used in the reminders and push notifications depends on different factors that are not mentioned in this paper.

The final sub-criterion that was added by the researcher is a category that captures the preliminary assessment and welcome wizard walkthrough that some apps incorporated into their design. This sub-criterion is noted and coded under the *commitment* criterion based on the example that Nemery and Brangier mention in their study. They define this criterion as the process that the user is walked through, where they are gradually involved with sequences or predetermined interactions [37]. The welcome wizard or the preliminary assessment (mostly in the case of fitness apps) illuminate the requirements in the commitment criteria. This allows the user to stay motivated and prepare to engage with whatever the interface is presenting for their interaction. The completion of this assessment was often rewarded with praise,

encouragement or awards which played a fundamental role in establishing a commitment to the application.

Chapter 7: Conclusion

After a thorough and in-depth analysis of Nemery and Brangier's criteria, supplementing the analysis with additional guidelines and evaluating the 20 persuasive applications, it becomes apparent that these guidelines are not universal in each mobile application. The results primarily indicate that very little to none of the applications reach *ascendency*. This is the final stage of persuasion per Nemery and Brangier's guidelines, and it is where the user is in the deepest form of technological persuasion and runs the risk of additions or overconsumption of the electronic media [37]. As a matter of fact, there was not a single application with all 9 criteria and all of the sub-criteria, nor the 8 criteria from Nemery and Brangier's list. The results suggest that a set of guidelines that accompany each persuasive interface is not manageable. The autoethnography also suggests that while a criterion may exist in an application, there are intricacies that are noticed with careful examination. Both apps analyzed in the autoethnography had an aesthetic interface that was clear, minimalistic, and smooth. However, the overly simplistic look and lack of options of "Weight Loss in 30 Days" eventually became a limitation instead of a persuasive element. These findings contribute to the academic world and provide future researchers with a baseline to further explore a set of elements that are consistent on all persuasive technologies.

The research question that was posed at the beginning of this research was "what guidelines are best suited to studying persuasive interfaces and elements that best support persuasion?". The analysis of Nemery and Brangier's guidelines show the lack of consistency compliance of each criterion in each application, as well as the occurrence of other criteria noted from open coding show the different methods that could support

persuasion. Studying these methods alongside conducting an autoethnographic study show that not only are Nemery and Brangier's guidelines and the new codes inconclusive, but the criterion also subjective to the viewer and have nuances that need to be noted. One user may have an understanding of what they consider aesthetic that may be entirely different than the one considered by another user. The findings from this study not only shed light into the possibilities with guidelines that may best assist studying persuasive interfaces but presented a perspective that may not have been otherwise known with the autoethnography study.

Limitations

On a par with other research in any area of academics, this research study also has limitations. The most notable limitation is the selection of applications. Firstly, all the apps were not supported by iOS. This made the reliability and credibility of the application dubious. Additionally, the selected apps were only analyzed on an Android phone and not viewed on iOS. It is important to note the possible differences that may exist between different operating systems that may have been missed. As previously mentioned, the apps were chosen at random from the Play Store, meaning they were not chosen based on a category. Although the number of apps in each prominent category was formerly mentioned, the applications were not chosen based on their category (refer to the figure in data analysis). Additionally, it is important to note the algorithms that were at play when the Play Store made suggestions for other applications. As previously mentioned, though random sampling was the intended sampling method, there are algorithms that accumulate log data to make suggestions according to what the user is

downloading. This limits the ability to truly employ random sampling as suggestions is something that cannot be avoided without making a search for specific applications.

Along the same lines of the limitations caused by operating systems, the methodology of this research can be taken under scrutiny. Another way to evaluate the interface of persuasive applications is to recruit volunteer participants to use, inspect, and identify the persuasive elements under study. This was not made possible due to the sudden need for self-isolation and quarantine with the rise of the COVID-19 pandemic. The unpredictable nature of this phenomenon only allowed for researcher-only or online research to complete the study on time. With a more thorough study with participant input, the research design could have been structured differently, and more generalizable information could have been collected to support the research.

The codes in this study were tested in a binary fashion. As in, the occurrence of a criteria (e.g., privacy and terms statement) was enough to say that the application met the requirements of including the "privacy" code in their interface. However, if a scale were used to evaluate the nuances in each occurrence of the code, a more accurate understanding of each code may have been examined. In addition, the study of the guidelines through the researcher indicates that there was no inter-coder reliability. If there were multiple researchers/testers conducting the same study, there could have been a greater level of confidence in the findings through inter-coder reliability.

The sample size for a study with great claims can be considered far too small. Analyzing 20 persuasive apps from the same operating system will inevitably have its drawbacks. An analysis of a greater number of apps could provide a more accurate view of persuasive elements. With the small sample size, the current study is prone to

inaccuracies and a less generalizable outcome. A stronger study could explore technologies within different categories with a higher number of apps in each category. This would allow for a thorough understanding of not only the persuasive elements at play in persuasive applications but the potential differences that may exist across different categories. The final limitation that hinders this study is the lack of previous studies in this area. There are several research papers and models to evaluate the functionality and structure of persuasive technologies. However, an insufficient amount of research has gone into studying the role of the interface when it comes to persuasive technologies. Nemery and Brangier's study is a prominent study with a clear and concise set of criteria dedicated to persuasive interface assessment. Further studies need to be conducted to reach a deeper understanding of persuasive technologies, and follow-up research on criteria that accurately project the persuasive elements in technologies need to be explored.

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