Designing
Behavioral Nudges for Increased Participation in Recycling as a Social Movement

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Abstract

This thesis project is exploring and investigates the applications of different methods of reward and nudging strategies and their potential effect on motivating and directing people’s behavior to be more engaged in recycling as a social movement within the society of Saudi Arabia. By creating sustainable behaviors, we contribute to the solutions and help minimize the potential damage of plastic pollution. The designs created throughout this thesis as prototypes of different concepts test the effectiveness of the different strategies on the behaviors of the population in Saudi Arabia. The main findings demonstrated that for people to steer their behavior toward recycling, they need to be financially rewarded. Testing other nudging strategies showed that these strategies might not be as powerful as the traditional system of reward and punishment. Therefore, this project needs to be further investigated and iterated in cooperation with other stakeholders and designers from different fields.

Keywords: Nudging Strategies, Interaction Design, Plastic Pollution, Behavioral Change, Behavioral Change Technology (BCT), Sustainable Behaviors, Sustainability, Society, Technology.
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1 Introduction

1.1 Context

Plastic has always been an essential part of everything around us. Its increasing popularity is resulting from the fact that plastic is considered cheap, light weighted, and practical to use compared to its alternatives. As cited by Thompson et al. (2009), the three Rs strategy might help in reducing the damage done by plastic pollution. This strategy includes reducing, reusing, and recycling plastic. Further suggestions include redesigning plastic molecules to be environmentally friendly and to be used in generating energy. The three Rs can be done by directing people’s behavior to be more responsible toward their plastic waste. De Ridder (2014) pointed out nudging as a strategy to alter people’s behavior to make what is seen as the right decision that would achieve greater benefits for society. There are nudging systems that have been created and implemented in technology which supported behavioral change by presenting the desired choice to the user as the convenient one. Caraban et al. (2019) pointed out that there are not enough resources on the principles of designing a successful nudge that would effectively change people’s behavior. Reward and punishment systems on the other hand have also been tested for their powerful and positive influence on cooperation among members of society (Balliet et al., 2011). Moreover, the two systems are mainly used to integrate positive habits and support cooperation for the sake of the collective outcome. Different studies have been done on the effectiveness of these techniques. Studies cited by Caraban et al. (2019) showed that applying nudging techniques to user interaction helped in increasing the chances of users acting as predicted. Previous efforts have been done in Saudi Arabia to suggest sorting systems that would create sustainable behavior regarding how people are handling their waste. The results from these attempts were unsuccessful therefore, there is no public sorting system applied yet.

1.2 Aim and Research Questions

This thesis aims to investigate and explore possible nudging and motivational strategies and employ them to increase participation in recycling as a social act. This is done by exploring and investigating the effectiveness of these strategies by conducting different design activities within Saudi Arabian society. Based on this research, the results indicate that applying these strategies will help integrate the recycling culture and motivate members of society to be more engaged in this social act. The outcome of this study is evaluated to identify their possible effects on people’s behavioral change as a way of minimizing the damage done by plastic pollution and creating sustainable behaviors in society.

Research questions
• How might we design a successful nudge?
• How might we nudge people into participating in the social movement of recycling?

These questions are answered through design exploration of the different nudging and reward systems by creating and testing three different concepts. The tested concepts are focusing on the effect of these strategies on people’s behavior and motivation. Then, the results are evaluated to assess their potential benefits when these strategies are applied as nudging tools in the context of recycling.

1.3 Contribution

This thesis is a contribution to the future development of nudging technologies to be used as a tool for increasing participation in social causes, such as environmental damage of plastic. This research is done to report the results of the motivation and nudge strategies and demonstrate their effect when implemented in technology behavioral change.

The contribution to the interaction design field includes developing nudging and motivating strategies as a digital tool that is tested and evaluated to help in future research and implementation regarding behavioral change. This research could be relevant for governments and stakeholders when integrating and adapting new habits in their society.

1.4 Limitation

The main focus of this thesis is steering people’s behavior in the desired direction and encouraging habits that would positively contribute to creating better behaviors. Nudging strategies are argued by de Ridder (2014) to be a low-cost strategy that depends on understanding the predictability of human actions. Saudi Arabia is one of the countries that has no sorting system implemented regarding waste, especially plastic. Therefore, there is no current system to compare the findings of this research for further development. However, it is publicly stated that the country’s new vision will be focusing on recycling projects that would decrease environmental damage worldwide. The thesis will be user-testing nudging and motivation strategies, but the design will not be possible to implement. Due to the complexity of the application and time constraints, I chose to limit my research to test the effectiveness of four principles which include education, reward, automatic enrolment, and suggestion of alternatives.

This research is done based on the feedback and experience of a random sample of the public members of the society between the age of 19 to 50 years old which excludes children and miners due to access difficulties and that they require different consent and permission procedure.
1.5 Motivation

This thesis highlights how sustainable behaviors can be integrated into society and the strategies and tools that can be used to nudge and motivate citizens and encourage participation in social movements. I further compare the effectiveness of the reward methods with the suggested nudging strategies on users’ motivation and behavioral change. The goal is to integrate habits that would adopt the three Rs strategy suggested by Thompson et al. (2009).

The research topic of this thesis was inspired by the increasing damage of plastic pollution that has been affecting the environment, sea, and other creatures including humans. Based on the public statements of the Saudi government, the reason why only 7% of the generated waste is recycled is that there is no sorting from the source system applied to citizens. To contribute to the solution, a new sorting system along with nudging and motivating strategies should be applied to encourage public citizens to sort their different waste materials for them to be easily recycled.

1.6 Thesis Structure

Chapter 1 Introduction

The introduction presents the base of this research. It contains the context of this thesis, the aim, research questions, my contribution to the interaction design field, and the motivation behind conducting this research.

Chapter 2 Background

The background section is a representation of the background theories, literature, and research done about the topics discussed in this project. This chapter also includes related work regarding digital nudging tools and examples of their applications.

Chapter 3 Methods

This chapter presents the methods used in this design process which includes the design activities conducted to explore and gather data and the prototyping phase of the nudging and motivation strategies.

Chapter 4 Design Process

In this chapter, I discuss analysing utilized data and finding design opportunities. These data are then applied in multiple prototypes where the nudging and motivation strategies are tested before reaching the final design concept.

Chapter 5 Results

In this chapter, the results of the exploration phase are presented and discussed. In addition, research questions are answered and insights into future work are suggested.
Chapter 6 Discussion

This chapter presents a discussion and reflection on the main findings, methods, and approaches of this thesis. In addition, challenges and self-critique on the design project will be highlighted at the end of this chapter.

Chapter 7 Conclusion

2 Background

2.1 Reward and Punishment

Concerning problems is usually difficult to manage especially when it is on a universal scale. Governments and organizations represent a major facilitating role in making that change that will have mutual benefit for all creatures. Applying a traditional reward and punishment system to citizens has several limitations (John et al., 2009). According to John et al. (2009), this traditional method has failed in creating good communication between the people in higher authorities with the public citizens. In addition, reward and punishment rules sometimes can be very difficult to apply and might not be seen as acceptably appealing to incorporate into one’s lifestyle. Moreover, following crude instructions might need further encouragement and interventions to motivate citizens to follow these rules and embrace the system. Harmful and beneficial actions are easily judged and adding the traditional elements of reward and punishment might result in information overload.

Governments are aware that issuing instructions is not the way to reach a direct engagement with citizens which in return produces a better-shared outcome. This effective engagement is difficult to achieve through deliberative ways. Instead, it might be useful to incorporate nudge and think methods that will be discussed in section 2.2 to establish a connection with the public citizens. Balliet et al. (2011) argued that the reward and punishment concept has shown a positive effect on cooperation between the solidarity of the members of society. The authors further mentioned that the effect is even stronger when it has a cost incentive. These incentives are usually a representation of the strong beliefs and views of public policy. Conflicted opinions have been cited in Balliet et al. (2011) about the effectiveness of this system. Some opinions supported the concept for the reason that it is a good tool for encouraging people to overcome their interests for the sake of the collective one. Others suggested that punishment and reward encourage people to make a business out of an ethical decision. In contrast, some people look at punishment and reward as a way of suppressing people’s autonomy and as a result, people could resist cooperation for the
collective benefit. Additionally, enforcing such strong incentives to encourage cooperation may result in negative psychological effects whereas these incentives might not be feasible or desirable for application in daily life.

This concept might not represent the ultimate solution for social and universal dilemmas that require constant cooperation and focus on the collective outcome which might not be alien to self-interest. Instead, facilitators need to adjust this tool with the circumstances and conditions where incentives are most effective.

2.2 The Idea of Nudging

The nudging concept has been used as a way to change behaviors among communities. Nudging is defined by de Ridder (2014) as making people behave in a desired way through a gentle direction. Nudging can be done in so many ways therefore, to sum this term up, we could say that nudging is about presenting the desired choice to the user as the easy choice while still keeping the other alternatives possible (de Ridder, 2014).

Nudging could be similar to parenting in some way. It is about respecting the liberty of one while suggesting a logical decision. The nudging concept is used primarily to solve important and concerning issues that involve habitual change on a community level. These concerning issues are usually difficult to solve individually and require a solidary gesture to achieve the desired change. An example of these problems could be organ donation, charity donation, and lifestyle behavior. The author also pointed out that psychologists have been optimistic about the nudging principle and see potential in its way of inviting people to have healthier choices. Psychologists described the results of persuasive communication as disappointing and suggested that nudging could have a better chance of convincing people to act desirably.

De Ridder (2014) cited an experiment done to evaluate the effect of education on healthy eating habits. The results of these efforts were reported to be disappointing since people’s eating habits are usually linked to their minds, habit, or impulsive manner. These results are reasoned with research evidence that people’s intentions and educational efforts are not necessarily linked to habit. An individual might intend to have a healthy lifestyle and a good diet but the habit of eating unhealthy food might be the easier default option hence, most people do not resist when exposed to unhealthy choices.

Is nudging a way of manipulation? The author Wilkinson (2013) questioned in his paper if using people’s predictable behavior for nudging is considered a way of manipulation. Wilkinson (2013) considered that nudging is seen as benign since it is used to encourage people to make healthier decisions that will benefit a greater portion of society without deliberating people’s free will. Manipulation on the other hand is argued to be done by drifting one’s way of
deciding so it best suits a personal benefit. It is not about interfering or deliberation but rather using decisive methods to sell the desired option.

It is arguably difficult to prove that altering people’s behavior through nudging is not an ethical way of convincing people to act in a specific way therefore, it is justified to be done with good intention to guide people to a better, healthier action. Moreover, John et al. (2009) argued that it is difficult to make a difference in people’s behavior without involving the ‘Thinking’ aspect. The authors defined the thinking concept that it involves educating people about the problem and offering the preferable decision and promoting it as the better one. The author further explained the strengths and weaknesses of the nudging concept compared to the thinking one.

On one hand, thinking’s strength is that it is more efficient when large societal action is needed to expose the origins of the problem. It is also beneficial in spotting the light on problems that require serious recognition from large popularities. Such problems include changes in the lifestyle of individuals to reduce the damage of climate change, pollution, etc. It relies heavily on the amount of effort that is put into providing a suitable environment to facilitate that change and encourage commitment by recognizing it as a meaningful case to relate to on an emotional scale as well.

As argued by de Ridder (2014), nudging is on the other hand, considered a sustainable and low-cost alternative that relies on the predictability of human behavior. It offers easy and comfortable cooperation for users to participate effortlessly. De Ridder (2014) also pointed out that nudging is considered autonomous in a way that respects people’s right to choose when the other alternative is still possible. Furthermore, people have a sense of awareness that they are being nudged by making the desired choice attractive and presenting it as the default and convenient option. The weakness of these small nudges is that they fail to achieve major differences in problems that require solving from their roots. The authors argued that nudging fails in addressing the problem and getting recognition hence, it may promote false assurance for individuals about the change related to the bigger problem.

Making certain choices easier is a difficult task, therefore, further research needs to be done to understand the strategy of nudging to promote positive behaviors as the easy default options.

2.3 Nudging and Technology

Researchers in the field of HCI (human-computer interaction) have introduced the concept of nudging through technology to increase users’ engagement. Despite these efforts, researchers still don’t have the full resources to design a successful nudging technology that contributes to altering people’s behavior in a predictable way based on human psychological studies. According to Caraban et al. (2019), behavioral change technology (BCT) researchers noticed repeated results of users’ relapse back to their old
habits as soon as they stop monitoring them. The authors cited that most BCTs are functioning as information centric. It is designed based on the assumption that users don’t have the required knowledge to change their behavior. Furthermore, these technologies are offering three main services which are logging, monitoring, and reporting users’ behavior. The authors reported that nudging systems have been designed to guide the users’ behavior by presenting the information and choices as the desired decision. The limitation that the researchers have is that they lack the resources on how to design effective nudges that succeed in guiding users to behave as planned.

While designing the nudging experience, researchers noted that two types of systems cooperate before resulting in actions. The first system is based on automatic thinking which is represented in our skills and repeated action throughout the day. This system relies on reflex decisions and requires less thinking effort. The second system is called the reflective system which requires a process of rational thinking before reaching a decision. This system is described as slow and requires more consciousness and mental effort before the decision (Caraban et al., 2019). As a result, the authors classified nudges into four categories based on their aim. Nudges are classified as nudges that are aimed at influencing people’s behavior, nudges that stimulate reflective thinking, nudges that manipulate choices, and nudges that manipulate behavior.

Caraban et al. (2019) suggested that different nudging mechanisms are used to utilize users’ behavioral change such as facilitation, confrontation, decisiveness, fear, social influence, and reinforcement. A summary of each method will be presented in the section below to demonstrate the differences between each one of them.

Facilitation is used to minimize mental and physical effort. This technique depends on people’s intuition to complete a set of actions with a minimal amount of effort needed. This method includes setting the desired option as the default one which increases people’s tendency to keep this choice instead of looking for alternatives. This method also supports the concept of ‘not choosing’ which also means that people will most likely keep pursuing the action without making any changes to the default option. Making an automatic enrollment to the desired nudge is also similar to default option the is and known as assuming users’ prior consent to the action. Users must roll out of the procedure to refute going through the action which increases the chance of participation. We can also alter users’ choices by changing the position of the options making the desired option the top and most visible one. Researchers found that nudging by positioning needs to be associated with other factors to be effective. Moreover, hiding undesired choices is another way reported to be successful by positioning which is about making the least favorite option out of users’ reach. Additionally, suggesting possible alternatives is a way of drawing users’ attention to consider swapping their choices for better ones.
The confrontation method is another form of nudging people’s actions by pausing and doubting its continuation. For example, users are confronted with a buffering timer to give the users a chance to question his/her actions. This technique’s goal is to stimulate reflective thinking and is effective in pausing unwanted actions. Moreover, pausing the user’s unwanted decision could also be done by asking for confirmation before pursuing further the action or by reminding the user of the consequences of their action. This method helps users to revise their choices before going through them which may prevent the undesired action. These deceive nudges strategies are aimed at altering users’ interpretation or experienced activities to promote specific outcomes.

Social influence is another nudging strategy that is found to also be effective in altering people’s behavior into choosing the option that suits their social beliefs and societal expectations. This method is applied by making people more likely to go with the choice that equals what they have received or seen from others. This method highlights people’s actions among their peers which in return applies pressure on the user to make the decision that is expected to benefit their social and self-image.

Installing fear and uncertainty feelings in the users’ experience can also be an effective nudging technique to make the choice desired by users. This could be done by making the desired option seem to be rare or difficult to find in the future. As a result, people may tend to provide more value to the option that is perceived as limited in terms of quantity or time. It is also common in this category to nudge people into participating in activities that benefit them for the long term by demonstrating their goals and progress in the interface. This method creates a feeling of shortening the time and distance of reaching the desired goal.

Reinforcement methods are also used as nudges by confronting the user with simple feedback to draw their attention to changing their behavior. The light feedback is usually intended to be conjunctional with the action but not in a disturbing way. Another mentioned way by Caraban et al. (2019) is to enforce the desired action by twerking users’ environment to provide hints that stimulate action in a non-intrusive way. Stimulating the action by provoking emotions such as empathy can also nudge people to act in a desired way. Commonly, feelings of sympathy trigger users to act in the intended way. It is also possible to stimulate users to act in a specific way by stimulating behaviors that are below users’ consciousness. This can be done through an exposure technique such as reading/writing words that triggers people to behave accordingly.

On the other hand, there are factors pointed out by the authors that inhibit these nudges from being successful in directing users to actions. When designing nudges, it is important to implement the effective type of nudging technique according to its context. Hence, some nudges fail in directing people’s behavior when the effective mechanism is not employed according
to the purpose. In addition, it is important to include the educational aspect behind these nudges. Providing users with the reasoning can help people to maintain their behavior even after the nudging disappears. Moreover, studies on the sustainability of nudging theories have been limited. Therefore, this limits designers’ understanding of which nudging technique is more likely to last.

On the contrary, some nudges may cause unexpected behavior to occur that might have a backfiring effect. Another factor that may cause the failure of a nudge is when users feel that the nudging mechanism is taking away an individual's autonomy which in turn causes users to act against the nudging option. As a result, these unexpected behaviors may accidentally increase the damage instead of decreasing it. It is important to note that nudges work best when users’ preferences and choices are not based on strong beliefs and habits that have been established over a long period.

### 2.4 Plastic Pollution

Plastic is found everywhere around us. It is known as the cheap and convenient material that replaces other naturally found materials such as wood and metal. Plastic is a synthetic material that is made by polymerizing monomers which are derived through a synthetic process from oil and gas (Thompson et al., 2009). According to Thompson et al. (2009), Many properties of plastic make it the most used material in our everyday life such as its durability whereas its strong and lasts for a long time without corrosion. The authors also added that plastic is cheap to produce, and it is lightweight with high insulation to electricity and thermal exposure. Due to these properties, plastic has been used heavily in many industries such as in cars and airplanes. As a result, using plastic in heavy machines gives them lightweight which therefore reduces gas consumption. Plastic has also helped in minimizing infection via using sterilized single-use medical tools such as gloves, syringes, etc. Authors cited that over a third of plastic production is labeled as disposable plastic which is most likely to be discarded in a year of production. Disposable plastic includes plastic wraps, food packages, and single-used utensils. These items represent over 10% of the overall waste that we generate. We would like to think that most of it is recycled but on the other hand, a good amount of the waste ends up in the environment. The marine environment is mostly affected by this phenomenon. Thompson et al. (2009) cited a discovery of entangled sea creatures all over digital platforms that showed animals suffer the consequences of plastic pollution. Sea animals are ingesting plastic and microplastic in their guts which is affecting their metabolism in so many ways. The most alarming effect was that these animals end up starving due to filling their stomach with mini plastic particles that leave no place for food. In addition, sea animals are part of the human food chain which could have a possible impact on humans as well. Furthermore, there is evidence that added chemicals that give plastic unique
properties are found to be endangering humans who consume these products such as food packages and children’s toys that are directly and indirectly entering our bodies.

With the massive production of plastic, it is important to see the problem and generate creative solutions. Thompson et al. (2009) cited suggested strategies that could help with plastic pollution which are called the three R’s. Three R’s stands for reduce, reuse, and recycle. Another two Rs are added later on that represent possible solutions for energy recovery and molecular redesign. The first three Rs are applied through individuals’ efforts. Using the nudging concept, it is possible to provide guidance and directions for people that in return help in implementing these strategies that will eventually result in the desired outcome.

Abdul-Rahman (2014) described the three Rs as a comprehensive approach to managing waste. The author describes the first R which stands for reduce suggesting that waste can be managed by reducing the number of items a person can buy. The more control a person has over their purchased products the better outcomes it will have on reducing new raw resources, manufacturing new products, and using shipping wraps to deliver the goods to consumers. Reducing the waste generated will result in reducing the problem. Reusing which is reparented by the second R is another approach adapting the idea of giving second chances to old, broken, and useless material to be used in new forms. This concept is driven by creativity and extending the life of a product before it is categorized as trash. The last R stand for recycling which is done by sorting and dropping waste materials in their proper places so they can be easily picked up by industrial stakeholders. Recycling can also serve society by generating job opportunities for citizens and reducing unemployment.

2.5 Understanding Human Psychology

Plastic pollution is a global problem that should be concerning everyone around the world. To solve this problem, people should be a part of a social movement that guarantees the participation of all groups to make the desired change. In this section, I suggest possible reasons that could prevent one from being a part of social movements.

To design a successful nudging, it is important to understand the psychology behind the interaction and response. Emotions have the main role in controlling actions and reactions. They act as the source of information that drives one’s response. Therefore, how we feel about certain news could either inhibit or activate any kind of movement including social movement (Norgaard & College, 2006). Global issues such as climate change and plastic pollution, etc. are usually classified as negative and disturbing news that could trigger unpleasant emotions. A cited study by Norgaard and College (2006) made to show the effect of discussing climate change in Norwegian society demonstrated that people avoided thinking about the addressed
problem because it triggered negative emotions such as fear, guilt, and helplessness.

Fear emotions are triggered by thinking that the climate change problem is threatening human life’s existence. It can also come from the fear that a person’s self-image would be affected by thinking that their actions are making him/her a bad person. In addition, the fact that this is a problem that requires societal change, a single individual might think that her/his change will not achieve any difference. Hence, people would feel that the problem is beyond their control and that countries and governments would have to cooperate and reach an agreement which triggers feelings of helplessness.

Feeling guilt usually accompanies the feeling of helplessness in a way that when they feel that their contribution alone will not make any difference, they feel guilty also for not being able to help or to influence the overall result. Additionally, emotions of guilt may also come from feeling guilty over their actions that might be against the recommended solutions. As a result, people would want to protect themselves and their emotions by being in denial and preferring to not get new information and avoid going into a discussion about it with other peers. The authors argued that this phenomenon was not affected by how much information was published about the topic or governmental efforts to spread awareness among their society. Instead, it was more about people choosing to isolate themselves from the occurring events. Norgaard & College (2006) pointed out that during their research, people were aware of the problem and frequently expressed their concern when the topic of climate change was brought up. On the other hand, these concerns were not translated into actions and people seemed to be ignorant of those serious problems and their consequences. Furthermore, people found their way of normalizing these disturbing and uncomfortable feelings when discussing such concerning topics. Therefore, people continued living their everyday life as if they did not know about that serious problem.

As cited by Norgaard & College (2006), Implicatory denial is when people both have access to information and believe that this event is true but do not process this information and translate it into actions. The case here is not with the availability of the information nor interpretation, it is rather about failing to integrate the right thing into their everyday life accordingly. The authors also suggested that implication denial can also be related to the failure of social movements. Interaction design efforts should focus on establishing small nudges that will trigger positive impressions that their actions are contributing to the bigger social movement which in return might increase their active participation.

### 2.6 Nudging Tools

This section will present some nudging tools that are aimed at changing people’s behaviors and integrating healthier habits on a personal and
community scale. These tools also are implementations of the different nudging strategies that have been previously mentioned in this paper.

Recycle Coach (Hooper, 2001) is an app that contains all information about recycling. As shown in Figure 1, the app has multiple features such as a calendar, and information about what goes where category. The calendar feature helps people stay informed about pick-up hours, setting reminders so it is easier to track and remember their waste collection day. It focuses on bringing the community together to be part of a social movement. It is an educational platform that raises awareness of what is considered a good habit in the context of recycling. This app is functioning currently in Canada and USA and provides a search engine for people to know more about the recycling system in their municipality. This app uses the social influence nudging mechanism to nudge people to act according to what they expect from other members of society. The app cooperates with the local government, businesses, and residents to create a successful social movement and integrate the sustainability aspect into their society. Since Recycle Coach is only available in Canada and the US, it was difficult to analyse the efficiency of this concept and see the influence that it has on society.

![Figure 1: The interface and features of Recycle Coach (Retrieved in April 2023 - https://recyclecoach.com/)](https://recyclecoach.com/)

Huawei Health (Huawei Health, 2023) is a self-quantified app that visualizes people’s physical activity and monitors their sleeping hours, heartbeats, stress level, exercise level, etc. With the help of a wearable device, users get to visually see their daily physical performance as shown in Figure 2. It is an app that is installed on Huawei smartphones by default and without users’ consent. In addition, the app provides goal customization according to users’ health choices. This app uses nudging by automatic enrolment which is by assuming users’ consent to start calculating their daily steps and physical activity rates. Users can decide to uninstall the app to cancel monitoring their physical activity. In addition, the visual demonstration of their physical
activity progress is a nudging strategy that encourages participation by creating a sense of shortening the time and distance required to reach their activity goal. The app also reminds users for example to move and stretch and drink water when the users sit for too long which is another nudging technique to use reinforcement to draw users’ attention into changing their current behavior to a better one in a non-intrusive way. This app is effective in encouraging people to raise their activity rate and grow healthier daily habits by providing accurate details about a person’s activity throughout the day and popping up suggestions on how to do better in the future.

Figure 2: Huawei Health interface visualizing physical activity (retrieved in April 2023-https://consumer.huawei.com/sa-en/mobileservices/health/)

2.7 General Knowledge from the Publicly Published Information

In this section, I will be reviewing the available information published on the internet for public citizens regarding plastic pollution. To design a better behavioral nudge, I will be looking at the published information about the problem and try to apply the suggested solutions in my nudging strategy. Additionally, since my research was done within the context of plastic waste and recycling within Saudi Arabia, this information is not taken from the research paper rather it will be demonstrating general knowledge that is published on digital platforms and publicly published government statements regarding the topic.
Saudi Arabia is one of the countries that has a level of internet access up to 99.0% of the population at the start of 2023 (KEMP, 2023). This means that the influence of social media is very high in discussing major issues that have a huge impact on our lives. Furthermore, Saudi Arabia is one of the countries that does not have a sorting system for trash from the source. This means that trash ends up buried in landfills and almost less than 10%, specifically 7% only is recycled which is considered very low. Moreover, Saudi Arabia is an oil country and plastic is one of the derivatives of oil which should make recycling plastic a good investment.

According to statistics stated by government’s public conferences, the reason that most garbage is not recycled is that there’s no sorting from the source system that would make it easier to recycle. Additionally, the citizens need to see the problem to come up with creative solutions. One of the most suggested solutions is the three Rs strategy which suggests for example avoiding single-use plastic that has less than one year of life from production until it is discarded. People prefer to use plastic because it is cheap, useful, and easy to replace and throw away. On the other hand, it is hard to get rid of the environment. Research showed that a single plastic bottle takes about 450 years to break down. What has been done so far is educating people about the serious risks via educational videos, posters, and cleaning campaigns of the sea. During the years of the Covid-19 pandemic, people have increased their average use of plastic since hygiene was playing a major role in limiting the spread of the infection. A study pointed out that almost half of the world’s plastic waste that entered the ocean in the Covid-19 era was just from gloves and masks that were used then. Once plastic waste enters the ocean, taking it out would be like solving one problem by creating another. Furthermore, the plastic that will be extracted from the ocean or sea will be too contaminated to be recycled. In addition, recycling single-use plastic will only result in creating more single-use unrecyclable plastic stuff.

It is important to note that solving this global problem is not up to individuals. Instead, governments and countries should also create a system that will support these strategies to change our plastic future. On the other hand, many solutions were cited and suggested by Thompson et.al (2009) which are the three Rs’ strategy. As a result, this strategy could be integrated into society using the nudging concept. This strategy aims to reduce the usage of plastic, especially single-use plastic. Moreover, people could be nudged to use other single-use alternatives that are made of other materials such as wood and paper. Additionally, people should be encouraged to sort their plastic waste in addition to other waste materials to be able to easily recycle them. Promoting and marketing eco-friendly products that use recycled materials in their products could be another way to integrate the culture of the three Rs strategy into different societies.

My research showed previous attempts that Saudi Arabia has done to create a system to sort trash. An experiment was done in 2019 that included two
neighborhoods in the capital city of Riyadh to make people practice sorting trash (Riyadh Environment, 2019). Another aim was to eliminate the existence of public trash containers in the neighborhood which in return will result in solving the problem of visual pollution. The system consisted of two containers shown in Figure 3 were placed inside every building one is the color green which was for sorting plastic, cardboard, paper, glass, and metal cans. The other container was black and was only for organic trash such as food waste. Moreover, the black container was picked up and taken to be used as organic fertilizer. The other one which is now indicated the dry trash was taken to the sorting center and placed on rails to be sorted using smart technologies into plastic, cans, cardboard, etc. These materials were then sold as raw materials to factories that recycled them into new products.

![Figure 3: Results of implementing trial period of recycling translated by Me (Retrieved in May 2023-https://bit.ly/42GVj1r).](image)

To promote this system, there were educational brochures to increase the awareness of public citizens about the importance of sorting and the huge impact that will have on our environment. In addition to spreading the knowledge via SMSs, WhatsApp messages, billboards ads, campaigns, and multiple signs on the streets. The outcome of this project indicated that people were committed to recycling at first then after a while, the commitment towards sorting decreased which indicated that people needed constant reminding to keep the sustainability of the sorting movement. It is an opportunity for interaction design that uses nudging strategies to make a difference and change recycling behavior through nudging tools.
3 Methods

3.1 Research Methods

In this thesis project, I wanted to explore how to nudge people to sort and recycle plastic trash in Saudi Arabia. To investigate this problem, I have done research, literature reviews, interviews, and observation to design a nudging technology that would help in creating a sustainable habit in people’s everyday life. Testing multiple concepts resulted in prototyping the final design concept and iterating it according to users’ feedback. In the sections below, I present the different methods that were used throughout my project.

3.1.1 The Double Diamond Design Model

For this project, I am using the double diamond that is shown in Figure 4 (Design Council, 2007) method because I want to research this topic from different perspectives and in a wide format first. Then, I will focus on users’ problems and take creative actions to make the users’ experience an encouraging and inviting experience to strive towards a sustainable lifestyle.

![Double Diamond Design Model](https://www.designcouncil.org.uk/our-resources/framework-for-innovation/)

In the first diamond, during the discovery phase, I started user research to generate data about nudging and nudging tools through literature reviews to understand the theoretical work that has been done in this field by other researchers. I explored the different perspectives on plastic pollution and recycling. In addition, I want to look at what is published by the government and related work that has been done and the resulting outcome. Furthermore, I conducted interviews with users to collect people’s feedback and observations about their perception and general knowledge of plastic
pollution and recycling. Continuing with the user research, I collect data using stimulus materials to demonstrate and learn more about the present and future scenarios that involve users’ interaction with nudging technologies (Design Council, 2007).

In the define phase, I analysed, filtered, and made sense of the data and insights that have been collected in the previous phase by using an affinity diagram and further narrowing down my research and seeing hidden design opportunities.

In the second diamond of the design model, in the development phase, I developed design opportunities and solutions and implementing them through prototypes and engaging future users in the testing sessions. These sessions helped in assessing and iterating the suggested methods. In addition, it also helped minimizing the technical problem before reaching the final concept.

Reaching the final phase, the delivery of the final concept is made by suggesting interaction design methods to enhance the qualities and encourage people’s participation in social actions.

3.2 Interviews

The nature of my interviews was according to the suggested criteria by Brinkmann & Kvale (2015). I conducted my interviews using mixed media in both digital and in-person forms. The digital interviews were done both synchronously and nonsynchronous through voice calls and voice note messages. The interviews were recorded for future reference.

3.3 Observation

Interaction Design Foundation (2021), suggested that there are two types of observations, controlled and neutralized. Controlled observation is where the environment of the observation is controlled by the observer to measure a certain outcome. The neutralized one is where the observation is taking place in the observant’s normal environment and less control is applied to the environment. I conducted my observation in a controlled environment adding stimulating materials to further facilitate the session. The users were shown a series of different materials such as a storyboard, pictures, and a video about the effect of plastic pollution on marine life. The intended outcome was to observe how people would see plastic before and after presenting related information. The users were later asked to report their insights and to confirm on which scale the presented information matched their prior knowledge about the subject. The aim of this was to evaluate the knowledge aspect to understand if knowledge is the reason for non-participation. I wanted to also test the educational effect before and after introducing the relevant information. In the case of this thesis project, it was more convenient to conduct a controlled observation where the researched
environment and materials were preidentified to equally measure the general knowledge of the society.

3.4 Brainstorming

The brainstorming method has been used as part of the ideation process where multiple ideas were generated over a specific time frame. According to Interaction Design Foundation (2021), brainstorming can be done at any phase in the design process to generate ideas, solutions, services, or products. In addition, it can be performed individually or with a group of people to be engaged in discussions and build on others’ ideas. During this thesis, the brainstorming method was used to generate creative nudging solutions with the participation of users' insights. A diagram was created according to similar criteria that the users provided during interviews.

3.5 Sketching

Bilda & Demirkan (2003) identified sketching as an integral part of the design process. It is the designers’ tool to visualize ideas and concepts, iterate them, define future conflicts, and implicate problem-solving. During my design process, I used sketching to storyboard future scenarios and create a visual representation of my concepts which was later used as a low-fidelity prototype to test the efficiency of the concepts on people's behavioral change. Moreover, sketching serves as a communicational language between a designer and the potential users to understand how the design is visioned inside the designer's mind to provide them with their feedback and insights accordingly. Furthermore, sketches can also provide the designer with results on the efficiency of the concept that was created and targeted toward a specific problem.

3.6 Prototyping

In this thesis project, two types of prototypes were used in two different stages of this research and for different purposes. A prototype is a tool that designers use to test, evaluate, and iterate a design (Lim et al., 2008). According to Lim et al. (2008), there are two types of prototypes low and high-fidelity prototypes. In this project, I used low fidelity prototype to test my three concepts of nudging people to be more actively engaged in the recycling movement. Additionally, when reaching my final concept, I used a high-fidelity prototype to test the iteration of the final design and to test functionality, user experience, and the overall look and feel. Prototypes are used as a stimulation tool in user testing sessions to help users get close to the experience they will have as a part of their everyday life.

According to the authors, a prototype is a way to critically examine a design to test its qualities before building the higher fidelity version which is a cost-effective way that would also save time and effort.
3.7 User Testing

Data collection and data analysis according to Kairuz et al. (2007) is mainly dependent on the methods that were used to structure the sessions whether it was done in person, via phone calls, etc. In addition, the type of data collected is also associated with the nature of the conducted method for example, in my project I gathered data through interviews, observations, and user testing. With these methods, I wanted to discover and unpack the addressed phenomena of why people are being disconnected from being an active part of the social movement of recycling. There are some limiting factors to each method that limits gathering data (Kairuz et al., 2007). For my project, there were many limitations to conducting data-gathering activities such as people’s willingness to contribute synchronously to the session which led to shifting to an asynchronous session that was either recorded by voice or reported in written text.

Data analysis was done by sorting the qualitative data that was collected through interviews and observations into similar categories in a framework called an Affinity diagram. Affinity diagram according to the interaction design foundation (2022), an affinity diagram is a great way to synthesize data, feedback, insights, and ideas to design opportunities based on common subjects of interest.

Using Post-it notes on Miro, I was able to define patterns in my gathered data and cluster it under a simple topic according to my interpretation of users’ answers and feedback. Based on the results, I was able to define problems and see hidden design opportunities that could help in designing a potential nudging strategy to build a sustainable recycling behavior.

3.8 Data Collection and Analysis

Data collection and data analysis according to Kairuz et al. (2007) is mainly dependent on the methods that were used to structure the sessions whether it was done in person, via phone calls, etc. In addition, the type of data collected is also associated with the nature of the conducted method for example, in my project I gathered data through interviews, observations, and user testing. With these methods, I wanted to discover and unpack the addressed phenomena of why people are being disconnected from being an active part of the social movement of recycling. There are some limiting factors to each method that limits gathering data (Kairuz et al., 2007). For my project, there were many limitations to conducting data-gathering activities such as people’s willingness to contribute synchronously to the session which led to shifting to an asynchronous session that was either recorded by voice or reported in written text.

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3.9 Ethical Considerations

According to The Swedish Research Council (2017), a researcher needs to follow ethical and moral rules that will help protect the researchers and the subjects participating in the research activities from any crucial illegal harm. Users participating in this project will be informed beforehand that they are the subjects of this research. They will also be handed an informational form to explain the purpose of the project and the design activities that will be held throughout the design process. Users will also be asked to sign a consent form that allows the researcher to conduct and document the research and to use their input in developing the final result of this project. When conducting research, materials, and documentation will be safely stored as hard copies which will guarantee the privacy and safety of the participant’s personal information. This research will conduct legal design activities that will guarantee no harm to users participating in the research, animals, or the environment. It is the researcher’s responsibility to be transparent about the outcomes of the research and be fair in the judgment of other researchers’ work. This research will be done for the thesis project for Malmo University and will not be used for other commercial or associational interests. The information and materials of this research will not be used for any other unauthorized purposes. Participants will have the right to withdraw at any stage of the research and all information collected should be safely discarded from the research and the results.

4 Process and Exploration

4.1 Participants

Since my project is a concerning global problem that includes all members of society, my research was done with nine participants that were in the age group between 19 to 50 years old. The participants were coming from different backgrounds studies. Some of the participants had studied chemistry as a part of their education which helped them in having a better understanding of the toxicity of plastic as a chemical component. Other
participants who studied in other fields and did not have plastic or chemistry knowledge provided a good representation of the larger group of citizens. Moreover, these participants had the general knowledge that was gained through being exposed to the information displayed on digital platforms and other forms of media. Participants were engaged in different activities such as interviews, observations, and user testing of the different aspects of the designs.

4.2 Affinity Diagram

An affinity diagram that is shown in Figure 5 was used to cluster interviews outcome and observation activities based on similar topics that were brought up during the different events. The answers were categorized based on what I received as the problem that was preventing people from coming a part of the recycling social movement. These categories were knowledge, motivation, and emotions. Since I started this research to explore potential solutions that would nudge different members of society to integrate the recycling culture as a part of their lifestyle, the affinity diagram helped me see common problems that will be presented in section 4.4 and turn them into design opportunities such as education and motivation and on how to design a nudging technology that would encourage users to participate in recycling as a social movement.

![Figure 5: affinity diagram](image)

4.3 Storyboards

Storyboards were used as a part of explaining both current and future scenarios of sorting plastic. It also helped me visualize my three concepts and present them to users and get feedback on what scenario they can integrate into their everyday life. Storyboards were a helpful tool that stimulated the discussion of the current behavior that people are currently performing of throwing plastic without thinking of the consequences of this simple action. The storyboard shown in Figure 6 also manifested the damage that has also...
reached humans and not only animals and the environment. In a later stage, the storyboard also helped in explaining the future scenario where plastic is properly sorted in a specially designed container and the process of turning this behavior into a reward.

![Image of plastic storyboard showing common behavior leading to plastic pollution.]

### 4.4 Framing Challenges

In this section, I will be presenting users’ challenges that were reported or interpreted from interviews and observation activities that were conducted during this project. During the interviews, users reported that they are aware that plastic is bad for the environment and their health, but the knowledge varied between users. Most users referred to their current knowledge as part of their school education as children or as part of the chemistry-related information that they studied in university. Some individuals reported that they got their information from a vague memory of a poster or marketed campaign that they saw somewhere. The problem seemed to not be the lack of information about the topic since the internet is a rich resource. Instead, people did not have an interest to do research and educate themselves about the occurring problem. The accuracy of the information reported was very low and most people thought about the damage they might cause from using plastic when in direct contact with food. The indirect effect of the plastic pollution cycle starting from the environment and ending on our plates was something they reported as new information.

A user reported that she purposely avoids this kind of information because it triggers her negative emotions. As mentioned in section 2.5, people tend to protect themselves from disturbing news because it triggers their sense of guilt, fear, and helplessness. These negative emotions could be the barrier that prevents people from researching concerning topics and participating in the solution. Furthermore, some participants reported a negative reaction
toward recycled materials and argued that recycling meant using poor-quality plastic and described it as a hazardous material especially if it involved food packaging which affected their knowledge and their behavior. In the observational session, users were properly educated about the damage that single-use plastic can cause to marine life and exposed to images, videos, and storyboards. Moreover, users reported that they now received plastic and recycling differently and realized that it is a must to avoid bigger damage that will eventually affect human health. Additionally, users were asked to suggest ways and alternatives as their way to contribute to solving the plastic pollution problem. The most commonly mentioned solutions included replacing single-use plastic with alternative materials such as wood, glass, and paper. Recycling was also mentioned as an important solution that would help in reducing plastic production. Users also mentioned that there should be some kind of reward that motivate people to be more included in recycling as a social movement.

Based on the collected information and analysis of the previous activities and after applying the affinity diagram, I was able to see that users had problems with education and motivation. The problem with education was that it triggered negative emotions hence people tend to avoid being confronted with frustrating news. Furthermore, motivation is another key point to becoming more engaged in the social movement of recycling. As a result, I decided to focus on these two aspects and design a nudging technology that would motivate people to be active members of the recycling social movement in addition to minimizing the negative emotional effect.

4.5 Design Opportunities

How might we design a successful nudging that would increase participation in recycling as a social movement? More specifically, how might we build a sustainable behavior that would integrate applying suggested solutions to plastic pollution? According to Thompson et al. (2009), the three Rs strategy is the most effective way to contribute to solving plastic pollution. Moreover, I started brainstorming for three potential concepts that involved one or more of the nudging strategies which implemented the concept of the three Rs strategy. The concepts will be mentioned briefly and reflected upon their nudging strategy in addition to the users’ feedback in the upcoming section 4.6. To visualize future scenarios to participants, the concepts have been sketched and shown in Figure 7.

concept 1: gamification

A game that consisted of a virtual world village that needs to be built using virtual money. The player usually completes tasks to unlock a new stage or item. Recycling missions are integrated as a part of the required tasks that should be completed in the real world. The recycling task is accomplished when the player reaches a recycling container and scans a QR code which verifies that the waste is dropped off where it is meant to be for recycling.
concept 2: financial rewards

The second concept uses reward as a motivation for sorting and recycling all kinds of plastic trash including plastic bottles. It is an app that functions by simply dropping off the garbage in the special container, scanning the QR code, and getting rewarded according to a weight unit such as a gram, with real money that can be used for example, groceries.

concept 3: quantified-self app

An app that tracks and measures users’ steps, exercise, activity, and heart rate in addition to other health-related activities and recycling rates. It uses the steps tracker in encouraging users to walk to the recycle container which will motivate them to get physically active and get closer to achieving the goal of 10 000 steps/per day. In addition, the app rewards users with points that could be later traded with real-life items in an online store.

Figure 7: a storyboard demonstrating the three concepts.

4.6 Experiencing Concepts

To test the efficiency of each nudging concept, I wanted to test each of the three concepts and get initial feedback on their efficiency. Furthermore, I have conducted a low-fidelity user experience prototype. The main focus of this session was on building a recycling habit using different nudging methods and strategies.

4.6.1 Gamifying

A gamified app as sketched in Figure 8 is demonstrating the interaction where simple tasks in the game are nudging people to recycle their plastic
waste in the real world. This app uses a reward system that would result in nudging people into recycling. The environmental effect of this concept is that people would start to recycle, which in return is achieving one of the three Rs strategy. Other recycling-related missions are also possible to be integrated into the game as part of the tasks. The motivation here is presented in the reward system. An educational commercial video is also a part of the game which is expected to enhance the general knowledge about plastic problems and trigger the thinking aspect that was argued in section 2.2 by John et al. (2009).

Figure 8: The gamifying concept low-fidelity prototype demonstrating user interaction.

4.6.1.1 Conclusions and Feedback

While testing the gamified concept, users’ feedback was that the concept was easy to understand and that adding the reward concept would be a great feature. On the other hand, most users felt that the gamified concept will not be motivating for all age groups of users with different interests. The gamified concept will motivate gamers and people who are interested in this kind of game and would not influence other user groups to build a more sustainable behavior. In addition, user testing as shown in Figure 9 was done using a low-fidelity prototype. A user reported that the educational video aspect could be very useful if it was mandatory to watch without skipping it after a few seconds. On the other hand, users reported that people tend to ignore or skip this kind of video whenever they appear. Hence, the educational goal of these videos would not be met. However, users tend to feel like these kinds of commercial ads are in the way and the method used to offer information is considered intrusive.

The gamified concept was tested on users with the age range of 19 to 50 years which might be a factor that this concept could be a motivating strategy for smaller children or teenagers who are in the process of learning about the importance of sorting and recycling.
4.6.2 Financial Rewarding

The financial rewarding concept as sketched in Figure 10 implicated in an app is using reward as the main nudging method that would motivate people to recycle. This concept is inspired by the recycling system of plastic bottles that is implemented in Sweden and other European countries. This app aims to apply the concept of recycling which is part of the three Rs strategy as a way of reusing plastic. The motivation for this concept is the financial reward that people would receive in return for their recycled materials. The app follows a traditional reward system that has been referenced in section 2.1.

Figure 9: user testing the gamified prototype.

Figure 10: The financial reward application which demonstrates the line of interaction between showing the profile QR-code until receiving the financial reward to be scanned in grocery stores.
4.6.2.1 Conclusions and Feedback

During the user testing shown in Figure 11, people reported positive feedback for this concept and thought that financial reward is the best motivation that could get people to recycle more for their benefit. On the other hand, it might be difficult to implement since it needs government approval to issue these financial rewards or apply a tax system for individuals in return for their recycling materials. As argued in section 2.1, the downside of this way was that it encouraged people to do business instead of looking at recycling as an ethical decision that would support society’s collective outcome.

![User testing the financial reward concept.](image)

**Figure 11: User testing the financial reward concept.**

4.6.3 Self-quantified App

A quantified-self app as shown in Figure 12 is a health tracker that helps users quantify their steps, activity, exercise rate, heart rate, sleep... etc. In addition, this app has a recycling record tracker that allows users to track their recycling activity. As a side note, this app is nudging and presenting an infrastructure of recycling as a part of maintaining a healthy lifestyle. It is creating a vision that recycling is equally important to one’s physical and mental health which in return enhances the quality of life. This app uses the automatic enrolment nudging that was mentioned in section 2.3 by assuming users’ prior consent. It also uses nudging by visualizing progress and shortening the time and distance of the final goal to encourage participation. Additionally, the app is promoting eco-friendly products in a built-in online store as a nudging method that was suggested by Caraban et al. (2019) in section 2.3 which is suggesting plastic alternatives to users as a way of nudging them to swap to environmentally friendly items.
Figure 12 is the quantified-self app that visualizes progress, provides locations for recycling containers, and collects rewards.

4.6.3.1 Conclusions and Feedback

The user experience of this concept in Figure 13 showed positive feedback from users. Furthermore, users reported that what is nice about this concept is that it is rewarding in multiple ways. On one hand, participants thought that physical activity is a good motivation as it turned a boring house chore into a healthy beneficial activity. On the other hand, users thought that supporting plastic alternatives and eco-friendly products is a great way of promoting healthy choices. Users added that they would prefer to have the financial reward instead of the coupons because it would give them more freedom and more variety of products to choose from. In addition, they stressed that trading their points with real money is a stronger motivation than the physical health benefit that this app is promoting.
4.7 Feedback and Analysis

Looking at the results and feedback on each concept, I developed a concept that combines all the nudging theories that users reported to be successful. The big highlight of the new design should include a reward because it was the one that all users reported to be successfully motivating. This method showed that people were ready to commit to recycling and integrate it into their lifestyle and behavior. According to the referenced experiment in section 2.7, people’s motivation to recycle decreased when there was no reward involved. On the other hand, constant reminders would have been a must to keep people engaged in that behavior. Physical health could also be a motivation as people reported in section 4.9 that their perspective on recycling has changed when the app reminded them of the gained health value. This new vision of promoting recycling as a healthy behavior seemed to be positively motivating people to make the effort that would benefit their overall health.

4.7.1 The New Design’s Prototype

Health tracker as shown in Figure 15 is a design that is created to track people’s health which includes steps, weight, physical activity, active hours, calories, and sleep quality in addition to the new feature which is the recycling record. The new feature is created to help users calculate how many steps it takes to get to the recycling container. Therefore, the total steps are then added to the physical activity record. The design has a reward system that
rewards users based on their physical activity and steps count to the recycling container with points. These points can be later traded with users’ favorite choice of valuable coupons which include discounts and financial rewards.

Figure 14: a sketch showing the interaction of dropping recycled waste and suggesting the product design of the recycling container.

The design consists of a drop-off container as sketched in Figure 14 that contains a screen to show feedback and scan a QR code from the user’s phone, so points and steps are added to the tracker. It is created using the reward system in addition to three nudging theories that have been discussed earlier in this paper in section 2. These theories are argued to be effective in altering people’s behavior to act in a desired way. This design offers the nudging concept using reward, automatic enrolment strategy, visualizing the progress of recycling and physical activity, and suggesting alternatives to plastic products. This is argued to result in a good chance of making them more motivated to score progress and swap to the offered choice. The final prototype was user-tested and results will be discussed in the upcoming section.

Figure 15: Health Tracker app showing the recycling record.
5 Results

Based on users’ statements, the app is motivating them to recycle. Users have reported that the physical activity aspect of the app is considered a good motivation to walk to the recycling container. In addition, being rewarded with a variety of coupons which include real money rewards was also the big highlight of this application. A user reported “I like it I think it is useful and people would download it since they are getting points in return” (Participant, 2023). Another participant (2023) added, “You are not only integrating recycling, but it also supports walking as a physical activity and that is good”. Participants mentioned that they preferred seeing an instructional guide on the recycling and reward system before using the app for the first time. Otherwise, they thought that the interaction is easy enough to navigate through the app and be guided by the icons. This design was prototyped, and user tested in English so users brought up that the app should support multiple languages other than English and Arabic.

Additional comments on the accessibility of the app for older user groups by suggesting that the app should also support changing the font size, so its readability can be adjusted to suit different user groups. Users liked the colors and graphics of the app and thought that it was soothing for the eyes. Moreover, applying different color codes to each category of the tracker was reported to feel good and organized.

A health tracker is a tool that was designed to help the user who strives toward a healthy lifestyle to track and quantify their normal daily activities. The design is adapting recycling as a part of healthy behaviors that will help users achieve better physical and mental health.

5.1 Research Question 1

How might we design a successful nudge?

This thesis project has been looking at ways for designers to create designs that would direct people’s behavior in a specific direction. To answer this question, I created multiple concepts to test what a good nudge should be like. The results from my experiments indicated that people’s mind is not necessarily represented in their actions. Participants in this project expressed their concerns and sympathy for plastic pollution as a problem but their actions remained the same.

Multiple nudging methods have been tested in this project to help people act according to the way they think about a certain problem. After testing these multiple strategies, people showed that they would be motivated if the reward was for their own sake and not for a collective outcome. When comparing concept 2 with concept 3, all participants reported that although they care and see plastic pollution as a problem but they admit it has serious
consequences, they preferred concept 2 and showed that their target was to recycle for the financial reward and not to contribute to the solution. In this experiment, the reward system showed to have the highest effect on people’s motivation.

Triggering the thinking aspect that was mentioned in section 2.2 was also tested in concept 1 by introducing a small amount of information in the form of educational videos to the user after performing recycling actions. This method is argued by John et al. (2009) to provide reasoning after the nudging effect disappears. Users have reported that these videos would probably be skipped or ignored because gamers will be focused on the game. Users reported that they feel confronted when forcing information on them and this could be because this information triggers negative emotions that have been previously discussed in section 2.5.

In concept 3, the aspects of automatic enrollment, visualizing progress, and suggesting alternatives were tested to see if people’s behavior would change when applying these nudging strategies. People had prior knowledge about the aim of this project hence, they reported that the automatic enrollment might be effective in altering people’s health behavior. Since this aspect was not possible to put to the real test, it was not clear if this strategy will result in promoting recycling. In addition, visualizing progress was reported to be motivating to score more steps and raise the recycling rate by promoting physical activity and recycling. However, this strategy should be tested over a longer period to properly monitor its effectiveness. Suggesting alternative products to plastic was shown to be less effective compared to the financial reward. Users reported that they would prefer to be rewarded with money instead of offering coupons for plastic alternatives as a reward.

My final concept demonstrated two rewards that users reported as motivation to participate in sustainable behaviors that would have a positive effect on the environment. Based on the presented results, there is an argument about whether this design is demonstrating a successful nudge or not. When looking at the motives of recycling, people show that they are only interested in their benefit when performing a recycling habit. On the other hand, the intended outcome which is steering people’s behavior toward a more sustainable recycling habit seems to be achieved.

5.2 Research Question 2

*How might we nudge people into participating in the social movement of recycling?*

Through the research and experiments done in this project, the results demonstrated that people’s opinions and concerns about the plastic pollution problem are not translated into their actions. Therefore, motivation is necessary to guarantee their participation in a social cause. This is because people tend to avoid disturbing news as a way to protect themselves from
negative emotions such as fear, guilt, and helplessness. Hence, introducing the information to members of society as a way to educate them about the damages that plastic has proved to be not a successful way to create sustainable behavior. A traditional system of reward is tested to be effective in motivating people to be more engaged in recycling as a social act. Moreover, experiments with different nudging theories have proved to be slightly effective compared to the reward system. Further research and experiments should be done to test the effectiveness of the other nudging strategies presented in section 2.3 and their effect on behavioral change. To motivate people into participating in social movements, it will be effective to further test the possibility to combine multiple systems such as reward and punishment with nudging strategies to get the best results and succeed in steering people's behavior toward a sustainable lifestyle.

5.3 Future Work

For future work, I would like to test further integrating the health aspect with social behaviors. For example, I would like to test the possibility of social services with active hours where users get rewarded according to the calories they burn during community services. Furthermore, I would like to also test more nudging strategies in the same context and with other activities associated with weight loss records to help create healthy eating and lifestyle behavior. These nudges would help users and communities in promoting health-related habits that would decrease obesity and diabetes, especially in Saudi Arabian society. Based on users’ suggestions, they suggested that this app is developed to support other languages other than English and Arabic so it can be used by multiple nationalities living in Saudi Arabia. More studies and experiments should be done through the cooperation of multiple stakeholders in addition to other designers to create an effective infrastructure of a recycling system and test the effectiveness of nudging strategies on behavioral change through longer periods of trials.

6 Discussion

Caraban et al. (2019) suggested that nudging systems are designed with the purpose of logging, monitoring, and reporting users’ behavior as a way to prevent users from relapsing to their old habits. These nudges are designed to guide users’ behaviors by presenting good behavior as the desired one. Nudging is beneficial to be implemented to trigger certain effects among bigger groups of people such as societies. These implementations include changing behaviors related to the environment, health, and by companies marketing their products. My project researched nudging people to change their behaviors that affect the environment negatively. This research was
done to explore the general knowledge of the people and understand the reasons behind the lack of participation in recycling as an environmentally friendly behavior. Ridder (2014) suggested that people’s intentions and education are not linked to their behavior or habit. In addition, Norgaard and College (2006) argued that emotions control people’s behavior to either inhibit or activate their actions for a certain cause. My findings support both claims when participants from my study reported that they know about plastic pollution, yet they did not educate themselves further about the topic because it was triggering unpleasant emotions. Therefore, their actions that would contribute to the solution were inhibited and instead, people chose to live in a state of denial as a defense mechanism from bad emotions and saw that contributing requires overcoming their daily plastic usage and discarding habits.

In my design, I tested integrating the social act of recycling with positive emotions such as health and reward to increase people’s participation. The results were that people’s behavior would change if aligned with their benefit. Users reported that the aspect of reward especially the financial one was rather encouraging. The aspect of nudging by assuming enrollment in all the activities that this app is supporting is a strategy that is suggested by Caraban et al. (2019) to be effective in increasing participation since users must roll out or refuse participation. This strategy has been difficult to report since users were asked for consent before they participated in this research. Visualizing users’ progress is argued by the author in giving the users a sense of accomplishment and encouragement by shortening the time and distance until the final goal. The users reported being encouraged by seeing the physical activity and reward tracker showing progress. However, this strategy should involve additional tests on a longer experimental period to observe its effect on users’ behavior.

On the other hand, the suggesting alternatives strategy was reported by the users to be effective in making the better alternative more visible and convenient to reach out to. Adding an educational factor is argued by Caraban et al. (2019) to keep users aware of the purpose of their nudged behavior even after the nudging is gone. In my project, participants were interviewed before and after educating them about plastic pollution which showed that education has a positive effect on providing purpose for the proposed behavior. However, this strategy failed in affecting users’ behavior and the results will be further discussed in section 6.1.

On the other hand, further iteration and research could be done to test the efficiency of other nudging strategies in the context of environmental behavioral change. Multiple nudging systems could be studied on larger scales to set guidelines and create fundamentals for designing a successful nudging tool to help governments and designers create the cooperation they wish to accomplish which would contribute to decreasing environmental damage among other issues.
6.1 Critical Reflection

This thesis project and the topics it discussed are a contribution that could benefit many stakeholders such as interaction designers, behavioral change technology researchers, business owners, and governments. Since this research was conducted in Saudi Arabia, it was difficult to be tested since there is no sorting system implemented to be compared for improvements. Therefore, this research is offering an infrastructure of a new system that could be adapted by the government and business owners to be further experimented with, iterated, and adjusted in cooperation with product designers and other stakeholders according to the results of a trial period. 

Another problematic aspect was combining the two aspects of reward with nudging strategies when prototyped which according to Lim et al. (2008) enabled users to focus on the aspect they liked the most. Therefore, the results of the nudging strategies might have been affected by the fact that users were comparing the two aspects and voting for the one that would be more beneficial for them. This may have caused the nudging strategies to not be tested properly for their effectiveness and resulted in an unreliable outcome.

Due to time constraints, other nudging strategies were not tested for their effectiveness in the context of recycling social movements. According to Caraban et al. (2019), to design a successful nudge, different nudging strategies should be selected and employed based on the context. Therefore, additional nudging strategies should be tested to be able to provide the best possible nudging mechanism that would help direct people’s behavior. In addition, the aspect of automatic enrollment as a nudging strategy was not accurately tested since participants were offered a consent form that required their approval to participate in this research. The visualization of progress was reported to be effective yet, the results of this nudging strategy should be observed rather than reported to get a reliable and realistic outcome.

The education aspect showed no effect since users’ daily activities remained the same even after their knowledge about the topic increased. When a small educational video was introduced as a part of the gamifying concept, participants reported that they usually choose to skip or ignore advertisement videos. The outcome of experimenting with different nudging systems indicated that changing people’s behavior through nudging cannot be done through interaction design alone. The infrastructure of a new recycling system needs to be created through cooperation between stakeholders, interaction designers, and other designers from different fields. Applying nudging theories through interaction design alone might not be as powerful as we hope. This might be a result of people choosing not to feel or show sympathy for any disturbing situations as a human natural defense mechanism for any topic that would threaten their peace of mind. Instead, people might prefer to be nudged about these concerning topics in an unconscious way as in the traditional reward and punishment systems. The reward and punishment system can only be applied through governments
and interaction designers and developers might contribute to developing the technical aspect of it.

7 Conclusion

This thesis project was done to investigate and explore different nudging methods for their benefit and effectiveness in motivating people to contribute to solving the problem of plastic pollution. The investigation of the reward and nudging strategies was done by creating three different concepts to test the most effective one that would steer people’s behavior toward creating and integrating sustainable recycling habits in society. The three aspects were further tested with nine participants from different age groups between 19 to 50 years old who represented different members of society. The outcome of the user testing demonstrated that applying nudging strategies did not have a powerful effect on people’s behavior. Instead, users reported that the reward system was a bigger motivation, and it would have a stronger effect on their recycling behavior and increase their participation in social movements. Altering people’s behavior by applying different nudging strategies should be done on a bigger scale and in cooperation with urban designers and other stakeholders to be beneficial in solving environmental problems and helping create a sustainable lifestyle among societies.

8 References


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