CHALMERS
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Is Engagement the Key to Reduce Empty Snus Containers in Nature?

Comparing Motivational Strategies for Reducing Snus Container Plastic Waste

Master's thesis in Interaction design and Technologies

Taofik Arnouk
Julia Giaro

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
CHALMERS UNIVERSITY OF TECHNOLOGY
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www.chalmers.se

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Taofik Arnouk
Julia Giaro

 Supervisor: Jasmina Maric, Senior Lecturer, Interaction Design and Software Engineering, Computer Science and Engineering
Examiner: Sara Ljungblad, Senior Lecturer, Interaction Design and Software Engineering, Computer Science and Engineering

Master's Thesis 2026
Department of Computer Science and Engineering
Division of Interaction design and Technologies
Chalmers University of Technology
SE-412 96 Gothenburg
Telephone +46 31 772 1000

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Abstract

Plastic waste continues to pose a significant environmental challenge. With incorrect disposal contributing in pollution in both urban and natural environments. In Sweden, disposable snus containers represent a recurring plastic waste stream due to high user consumption rates and their frequent disposal in combustible waste or incorrectly in public spaces. Existing recycling systems often rely on digital applications and additional user effort, which could result in unnecessary mental load, which can cause friction and reduced participation. This thesis explores how interaction design and behavioral motivation strategies can be used to encourage more engaging recycling behaviors for empty snus container recycling in public spaces.

The research was grounded in research through design and followed an iterative design process which involved literature studies, surveys, prototyping, testing, and public deployment. Two different motivational strategies for recycling were explored: gamification and nature-based, which resulted into two high-fidelity prototypes: the Snus Ballot Voting prototype and Gacha Machine prototype.

User feedback and field observations indicated that playful, physical, and socially visible interactions contributed to user engagement and participation during recycling activities. Indicating that the importance of intuitive and tangible interactions could have an impact in public recycling systems. Due to the practical constraints and limited research duration, the monetary and charity based incentive could not be fully implemented or evaluated. Future work should further investigate long term deployment and the motivational strategy that this thesis did not cover to be fully implemented within the scope of this research.

Keywords: Interaction design, tangible interaction, installations, gamification, low technology interactions, snus container recycling, motivational strategies

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Taofik Arnouk and Julia Giaro, Gothenburg, May 2026

List of Acronyms

Below is the list of acronyms that have been used throughout this thesis listed in alphabetical order:

HCI	Human-Computer Interaction
IxD	Interaction Design
LED	Light-Emitting Diode
PLA	Polylactic Acid
QR	Quick Response
RfD	Research for Design
RtD	Research through Design
SDT	Self-Determination Theory
TPB	Theory of Planned Behavior
UX	User Experience

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1
Introduction

Plastic waste from single-use packaging is one of the most pressing environmental challenges of our time, with impacts on oceans, wildlife, and human health [1]. 79% of all plastic waste ends up in landfills or in nature, while 12% gets incinerated and an even smaller percentage is recycled [2]. Single use plastic packaging is a major contributor to this problem, and small lightweight items such as cigarette butts, food wrappers, lids and bottle caps are among the most littered plastic items globally [3]. Although awareness within these topics has grown and recycling solutions exist, small single-use packages are still being disposed of incorrectly. These items are found two to three times more often than plastic bottles in natural environments [4].

In Sweden specifically, snus plastic containers represent a high volume of that waste stream [5], which ends up in either combustible waste or as litter in public environments (see figure 1.1).

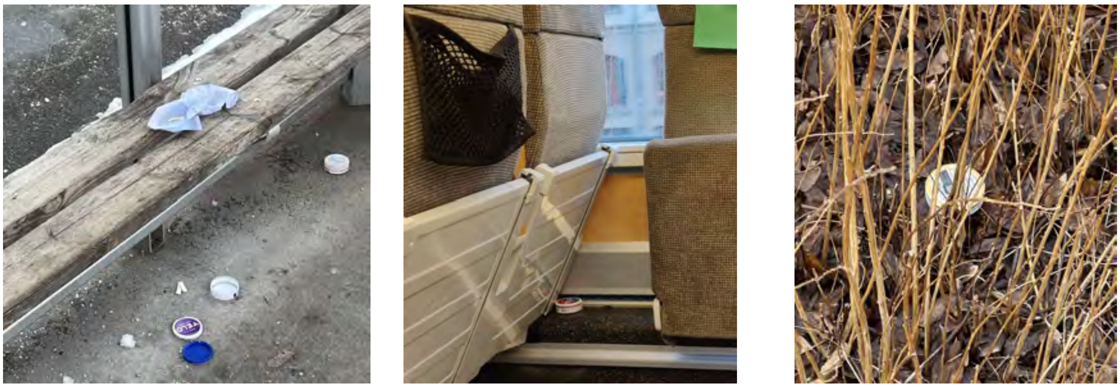

Figure 1.1: Snus containers being disposed of incorrectly: at a bus stop (left), in trains (center), and found in nature (right). Images taken by the authors.

While recycling systems exist, participation depends on convenience and location of the recycling infrastructure [6]. Combustible waste containers are plentiful in urban spaces, in contrast to source sorting bins for plastics. Research has been exploring incentive based recycling interventions, although less attention has been given to how different motivational strategies are materially constructed and experienced through interaction design.

Today most modern recycling solutions rely on mobile applications to track usage, deliver rewards, or provide user feedback or on screen-based systems. While the mobile applications can offer personalization and convenience, they also introduce friction by requiring installation, creation of an account and familiarizing oneself with the application [7]. Together with the screen-based systems ability to malfunction or break, this adds to the complexity that may reduce participation, particularly when recycling should be a habit. Furthermore, such systems risk to exclude users who are reluctant about app usage or have technological difficulties.

The purpose of this thesis is to re-frame recycling systems from a behavioral approach, together with exploring how low-tech solutions can impact user experience. The goal is to see what differences in engagement patterns and the perceived effectiveness for disposal of snus containers is.

1.1 Research Problem

This thesis approaches snus container recycling as an interaction design problem rather than purely a waste management issue. Recycling is not only about providing a bin or a collection system. The design, placement and usability factors greatly influence on how engaged people are in its usage [6]. Therefore recycling systems must provide an easy-to-understand user interface, be conveniently placed and be able to sustain user engagement to ensure continued recycling effort.

The research will explore recycling behavioral habits, focusing specifically on the disposal of empty snus containers. This is approached from a perspective in interaction design and the creation of specific, targeted user experience. In order to test these systems, high-fidelity prototypes will be used as tools to simulate design concepts for research purposes and data gathering, rather than fully implemented systems. These will also be used to evaluate how and if tangible, low-technology interactive concepts can motivate recycling of snus containers in public spaces. By comparing motivational strategies, the thesis aims to illuminate how interaction design can impact the efficiency and user engagement of recycling behavior in urban environments.

1.2 Research Question

Positioning recycling as an interaction design problem, investigating how different motivational strategies are embodied in physical artifacts and how users respond to these designed interactions was decided to be the focus of this thesis. With the main research question as:

> *What motivational strategies can be applied through interaction design to encourage reduced plastic waste from snus container disposal in Gothenburg?*

In order to develop the main research question, it was decided to include the following sub-questions:

> **RQ1:** How do users interpret and experience the different motivational strategies expressed through each of the two prototypes?

RQ2: How does spatial placement interact with the designed interaction to influence recycling engagement?

1.3 Scope

This project investigates behavioral and motivational strategies to enhance plastic recycling, focusing specifically on the disposal of snus containers in Sweden. Grounded in behavioral theory and drawing on case-specific intervention models, the study explores the potential of two user-oriented recycling prototypes incorporating nature-based reciprocal rewards and gamified/artistic incentives. The intended user base includes snus consumers as well as bystanders who may engage in litter collection. The prototypes are designed with broad public accessibility in mind, including considerations for individuals with disabilities, although certain visual elements may present challenges for colorblind users, but do not affect the usability due to high contrast between the chosen colors. The study aims to identify feasible and inclusive approaches to increase source separation rates and reduce plastic waste in natural environments.

This project is focused on empty snus containers for simplicity, although further research could include small plastic packaging to broaden the impact. The scope is limited to the early-stage design, testing, and behavioral assessment of these prototypes within a specific geographical and cultural context. Limitations include the inability to address long-term maintenance requirements such as machine refills, vandalism, waste collection logistics, and system integration into existing infrastructure. The technological implementation avoids screen-based interfaces in favor of simpler low-tech tangible interactions and excludes personalized data tracking. Ethical challenges such as public trust in donation transparency and unintended encouragement of nicotine use among minors are acknowledged but fall outside the project's operational scope. Recommendations will be made for addressing these concerns in future development and deployment phases.

2
Background

Plastic waste in nature poses a significant issue, this problem stems from the increasing plastic packaging production and the remaining difficulty of correct disposal. A Swedish mapping of plastic packaging recycling combines widely cited global estimates, indicating that between 1950 and 2015 approximately 8,300 million tonnes of plastic were produced, of which around 6,300 million tonnes became waste. This implies that only about 24% of all produced plastic materials were recycled during this period [5]. And from a local perspective, Olovsson's and Hein's master's thesis raises the issue of plastic waste in the city of Gothenburg, emphasizing the continued disposal of plastic in nature and in urban areas [8]. With backcasting, a literature review, data of a material-flow-model of Gothenburg, waste and litter statistics for the city and semi structured interviews they proposed several city-level interventions aimed at reducing plastic. It is unknown if the city has implemented these solutions but this study raises interesting data about the plastic waste stream in Gothenburg.

The environmental concern surrounding plastic waste is not limited to the volume of waste, but also its persistent appearance and continued dispersion into ecosystems. A systematic literature review published in *Reviews on Environmental Health* covers the evidence on plastic waste pathways and environmental fate, emphasizing that plastic pollution constitutes a substantial environmental threat and requires improved management strategies [1].

Currently, a large share of plastic waste is disposed of through landfills or incineration. While incineration allows for partial energy recovery, it effectively ends the material life cycle, resulting in a loss of material value. Source sorting and recycling material is therefore considered a key strategy for reducing demand for virgin fossil-based plastics and lowering life-cycle emissions [5].

In addition, social-scientific research highlights how public perceptions, attitudes, and psychological factors influence plastic-related behavior, which in turn affects the feasibility and uptake of recycling initiatives [9].

2.1 Recycling Practices and Their Limitations

Contemporary recycling systems depend on a sequence of actions performed by the consumer. These include recognizing which materials are recyclable, sorting waste into appropriate categories, and depositing it to the correct waste stream. For recycling to be economically viable, the collected material must also be sufficiently clean and homogeneous.

In Sweden, a major barrier to effective plastic recycling is that large quantities of plastic still end up in combustible waste rather than being source-sorted. One identified reason for this is a mismatch between the supply and demand of recycled plastic materials [5]. The same research also notes that mixing of plastic types can reduce material quality, creating a need for more structured and reliable waste flows.

From a user perspective, qualitative research shows that recycling behavior is often hindered by practical and cognitive “friction”, even when environmental concern exists [6]. Friction in this case means confusion about what can be recycled, unclear labeling, and the effort required to dispose of waste correctly are recurring factors that limit participation [6]. These barriers contribute to a gap between intention and behavior, particularly in everyday situations where disposal decisions are made quickly and habitually.

Some of this friction may also stem from the app-based structure of many sustainability interventions. Hynes and Fahy note that eco-apps frequently employ Persuasive System Design strategies to influence behavior, and that digital behavior change technologies can intentionally introduce forms of positive “friction” to disrupt habitual routines and stimulate reflection [7]. However, they also highlight significant attrition rates, with many users uninstalling apps due to technical issues, limited local relevance, excessive notifications, or lack of perceived value and concerns regarding privacy and data use [7].

2.2 Snus Consumption in Sweden and Reduction of the Generated Plastic Container Waste

Snus, a nicotine product placed under the upper lip, is widely consumed in Sweden and is commonly sold in disposable plastic containers (see figure 2.1). Snus can be classified into tobacco and tobacco free pouches, the difference is that the former is produced with tobacco leaves providing a longer and mellower nicotine release, and the latter has the nicotine extracted from the leaves and other additives leading to a faster release of nicotine when consumed. The containers themselves vary in sizes, but most commonly they are classified into "regular" and "mini" sizing. The regular, provide the most common size pouches and are usually stronger and the mini are of lower nicotine values and come in smaller pouches and a smaller container. The regular containers are 6.9 cm in diameter and vary in width (2.1 - 2.9cm) depending on the brand, there are also some regular containers that explore different shapes and those have the same width but differ in diameter (7.5 cm). The mini containers are more uniform, with the diameter of 6.6 cm and the width of 2 cm.

According to consumption data reported by Snusjournalen, an average snus user consumes approximately 4.4 containers per week [10], corresponding to around 229

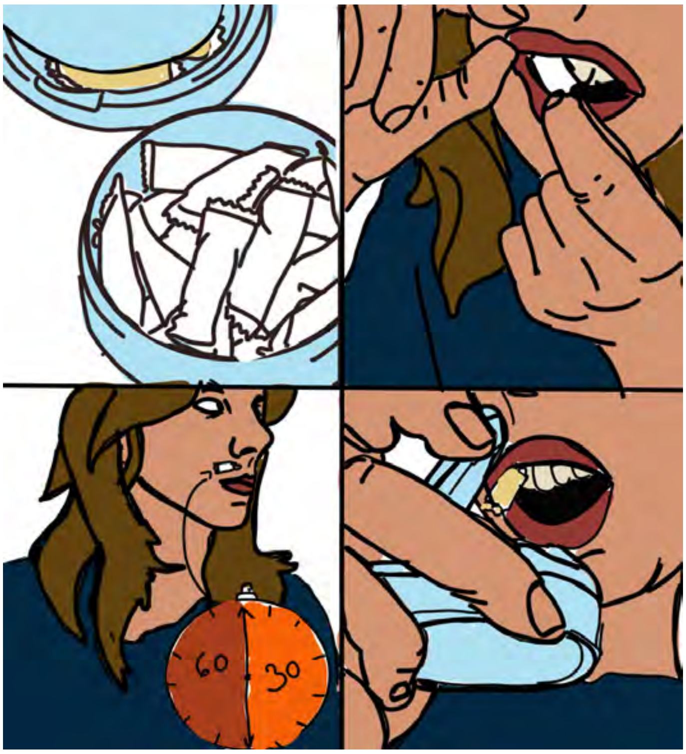

Figure 2.1: How snus is consumed, usually it is kept under the upper lip for 30-60 minutes. Illustration by the authors.

containers per user per year. As many of these containers are disposed of as combustible waste or littered, snus packaging represents a relevant and addressable plastic waste stream. This disposal behavior is often attributed to limited awareness, engagement, and motivation among end users regarding recycling practices. Although some recycling solutions for plastic packaging exist, many are perceived as inconvenient or require additional effort, which may discourage consistent participation.

Several different approaches have also been tested to reduce the impact of snus containers on the environment, although in different fields than interaction design. Pant machines were deployed in 2019 by Swedish Match in an effort to reduce the combustible waste contributions [11]. The initiative was based on charity incentives, each plastic container recycled gave 1 krona toward "Håll Sverige Rent" and if a user entered their email they would donate 2 kronor per container. Although they vanished shortly without a publicly stated reason, suggesting that maintenance or the approach posed an issue.

Continuing along similar lines, a bachelor's thesis in sustainable production development explored the growing incorrect snus container disposal issue through the conceptual design of dedicated sorting installations [12]. This study proposed 5 different solutions derived from market analysis and statistical data, with one concept undergoing a more detailed analytical risk assessment and component specification. However, the work remained theoretical in nature and did not include the development or physical testing of a functional prototype, meaning no empirical data on user interaction or behavioral outcomes was collected. Despite this limitation, the thesis provides a relevant point in our research stating that snus container disposal is a sustainability challenge to be addressed.

A master's thesis conducted at Chalmers University of Technology presents a Life Cycle Assessment (LCA) of snus containers and identifies the packaging as environmentally significant. The study notes that manufacturers such as Swedish Match have taken steps to reduce the environmental footprint of snus container materials [13]. The thesis further demonstrates that end-of-life pathways have a substantial impact on total environmental performance, particularly recycling versus incineration. The researchers used a scenario-based analysis to show how those changes in consumer disposal behavior influence outcomes. The thesis also mentions that due to regulatory constraints related to food-contact materials, recycled plastic from snus containers is unlikely to be reused in new snus packaging. Instead, correct sorting enables open-loop recycling, allowing the material to be used in other products.

With that being said there do exist solutions that try to solve these recycling concerns, a mobile application called "Plovie" [14] focuses on recycling different material waste not specifically only for snus containers. This application uses the phone's camera feature to scan the barcode of an item to retrieve information about it, display it to the user, and register it. With every scan that the user does, it adds points to their account that when collected can be exchanged for cashback, donations, and coupons. To further understand this application, it was downloaded and explored, which revealed some potential issues and drawbacks with it. As by the time of writing this research, the application does not confirm whether the user ends up recycling the scanned products properly, or allow users to recycle in bulk for an item potentially causing frustration for the users, which can lead to incorrect disposal as the end result, leading to the opposite outcome than the app intended.

2.3 Behavioral Approaches to Recycling

Research on recycling and broader pro-environmental behavior commonly explains action as the result of both internal and contextual factors. Behavioral models such as the Theory of Planned Behavior (TPB) emphasize the role of attitudes, subjective norms, and perceived behavioral control in shaping intentions and actions [15]. Recycling has been approached as a behavior that can be influenced through interventions. Recycling has been approached through behavioral programs aimed at increasing recycling participation, identifying incentive-based approaches as one commonly studied strategy. One such approach was applied in a study on household waste disposal, where a performance-dependent system resulted in increased amounts of recyclable material among participating households [16]. Building on this foundation, several motivational strategies have been explored in relation to recycling behavior, including monetary and prosocial incentives, gamification, and nature-based reciprocal rewards. These approaches form the basis for the motivational strategies examined in this project.

2.3.1 Monetary Gain and Charity

Monetary incentives are a commonly used strategy for encouraging recycling, particularly through deposit-return systems where users pay a fee when buying a product and receive it back for returning it. In Sweden, this is called the pant system (Deposit-system), and it has contributed to high collection rates of beverage containers, demonstrating that direct economic incentives can positively influence recycling behavior and material recovery [17].

However, the relatively low monetary value per item may not always be sufficient to motivate individuals to actively seek out recycling stations, especially when effort or travel distance is involved [18]. As a result, recycling often occurs indirectly through informal actors such as "pant retrievers", who collect discarded bottles for financial reasons. Research on informal recycling highlights the importance of these actors for material recovery, while also noting the social stigma associated with such practices [18].

In addition to personal financial incentives, prosocial and charity-based initiatives have been used to motivate recycling behavior. Organizations such as the Sweethearts Foundation collect plastic caps and bread tags, which are recycled to fund the production of wheelchairs for children [19]. This approach re frames recycling as a contribution to a social good rather than an act motivated by personal gain.

2.3.2 Gamification

Gamification is an approach that introduces game elements into non-game contexts, such as recycling, to increase engagement and motivation. By incorporating elements like achievements, points, and rewards, gamification systems aim to create interactions that encourage participation [20]. A study published in 2025 examined a gamified recycling intervention where households participated in an app-based system that provided missions, achievements, and progress feedback related to recycling activities. The results indicate that such an approach can contribute to a more engaging recycling experience and support continued participation [21].

As mentioned previously, gamification research, largely focused on app-based systems, has shown various results regarding the lasting effects on user engagement over time. Although research in Sustainable Human-Computer Interaction (Sustainable HCI) and urban interaction design has demonstrated that physically embedded, playful installations can create engagement in public space [22]. Complementing this, robotic interactions experimentally showed that a physically embodied robot increased actual recycling accuracy compared to a tablet computer, an effect mediated by anthropomorphism and empathy [23]. These two suggest that embodied tangible systems may be advantageous for increased user engagement over purely screen based interfaces in recycling solutions.

2.3.3 Nature-Based Reciprocal Rewards

Nature-based reciprocal rewards represent an alternative incentive approach that focuses on ecological or prosocial outcomes rather than monetary gain. These systems allow users to perform a “good deed” while recycling, linking waste disposal directly to positive environmental or social effects. Although peer-reviewed documentation of such systems is limited, existing implementations indicate potential. One documented example is the Pugedon “smart recycling box,” which allows users to dispose of recyclable materials in exchange for triggering food and water dispensers for local stray animals. This example illustrates how recycling interactions can be framed as reciprocal actions that benefit living beings or ecosystems, rather than as purely transactional exchanges [24].

3
Theory

This chapter covers the theoretical foundations behind the design and analysis of the research in this thesis. In this study, the Interaction Design field is regarded as the overarching field of the research, and fits well as an opening of the design space for introduction of fields like HCI, Tangible Interaction and Low-tech design, which present the material and disciplinary domain of our work. The specific research interest is covered by behavioral design, followed by theory about the Research through design method, to help the reader understand the research direction.

3.1 Interaction Design

Interaction Design (IxD) is the discipline that covers how people engage with designed systems, artifacts, and environments [25]. Interaction design emerged through Human-Computer Interaction (HCI) and industrial design, when interaction became a point of design interest. While much HCI research focused on screen-based systems, IxD includes physical, embodied, and socially situated interactions [26]. The IxD field asks how interactions feel, what they mean, and how they shape behavior over time [25]. Using interaction design allows us to understand how user interaction in public spaces can be redesigned to foster favorable behaviors.

The interaction that occurs when a user disposes of an empty snus container is underdeveloped. This thesis considers it as a missed design opportunity, due to the current means of disposal being a bin or the plastic recycling station. A relevant older system proposed the pant machine solution, which is mentioned in chapter 2. Although their design implemented an already established system for PET-bottle recycling, it did not sustain engagement and disappeared. A likely factor could be the added friction of users inputting in their email each time they recycled a can to donate a bigger sum to charity. This interaction was neither quick nor habitual which recycling actions should be.

Interaction design allows us to build an encounter that is legible, engaging, and meaningful in the few seconds a user spends near the prototype. This matters in public space, where interactions are spontaneous, and unguided, so the design of the encounter without relying on instructions or prior knowledge. IxD also spans a range of technological complexity. Much contemporary work involves digital systems, but there is a significant strand of IxD research that concerns low-tech and analogue interaction, where the artifact itself communicates its usage without the need of a screen or software [26].

3.2 Sustainable HCI

As mentioned prior, this study focuses on incorrect disposal of empty snus containers which is a sustainability problem that could be addressed through design of interactive artifacts. Sustainable HCI is a sub-field of Human-Computer Interaction that uses interactive technologies to address environmental and sustainability challenges. The field has grown around two broad strategies: eco-feedback systems, which visualize a user's environmental impact in the hope of prompting behavior change, and persuasive systems, which apply principles from behavioral science to guide users toward more sustainable choices [27]. Most work in Sustainable HCI has assumed a digital interface, a systematic review by de Almeida Neris et al. found that the majority of Sustainable HCI solutions rely on interactive technologies to show users their environmental impact [27]. Even when these systems are physically placed, the interaction tends to operate through digital information and feedback structures [27].

Almeida Neris et al.'s study identifies that Sustainable HCI has two limitations within its technological framing within recycling solutions, first it is the technological friction, app-based sustainability interventions require installation, account creation, and continued attention [27]. Although the apps are meant to be helpful, attrition rates are high, a significant amount of users uninstall when notifications become intrusive, the local relevance fades, or the value is unclear [7]. The second is exclusion, digital interventions assume digital literacy, therefore excluding users who lack the resources or who simply prefer not to interact with technology especially when it comes to recycling. By examining how Sustainable HCI has been utilized in design research and its shortcomings, this research covers a specific positioning in the field: a low-technology tangible alternative to the digital solutions that currently dominate this field.

Low-tech design removes barriers tied to digital literacy and app use, avoids the failure modes of screen-based systems in uncontrolled environments, and supports immediate, intuitive engagement that does not require learning an interface. Tangible interaction for example, has shown that physical systems can sustain engagement across user groups in ways screen-based equivalents often cannot [26]. This study positions itself within the low-technology domain of the Sustainable HCI field to explore screen-free alternatives to recycling. This is not a new position, as low-technology has been an emerging practice in this field. Designs that prioritize simpler artifacts, user autonomy and reduced environmental impact, serve as an evolving field in HCI sustainability research [28]. Designers working in this sub field argue that not every interaction problem benefits from added digital complexity, and particularly for habitual and low-effort actions in shared physical spaces, the most appropriate response is to design an artifact with greater care, rather than introducing a digital layer on top of it. Despite this growing interest, low-tech design practices in HCI remain largely undocumented. In their study of 14 low-tech designers, they found that practitioners working in this field often operate without the methodological usage that conventional design research provides, leading to their processes, motivations and reflections not being recorded in a form that can be engaged with by the broader HCI community [28]. The authors argue that documenting these processes through concrete examples and completed projects is itself a contribution to the field. This thesis builds on that direction by applying a conventional research methodology to low-tech design practice. The prototypes are framed as tangible interaction pieces that will be investigated through Research through Design, allowing for contribution within this sub-field of Sustainable HCI.

3.3 Tangible Interaction

Tangible Interaction is the design and study of user interfaces that link physical objects with meaning, action, and information [29]. Tangible interaction can treat a physical object itself as the interface, rather than placing the interaction behind a screen [29]. Users touch, move, hold, or manipulate the object directly to make something happen. This approach draws on the idea that human cognition and engagement are not purely mental processes but are shaped by the body, the hands, and the material environment in which interaction takes place [26].

In the context of this thesis, tangible interaction offers several practical advantages over screen-based alternatives. Recycling is a fast, habitual action. A physical interaction does not require the user to read instructions, learn an interface, or hold attention on a screen. The form of the object itself communicates how it should be used; a handle invites pulling and a crank invites turning, which makes the interaction intuitive regardless of digital literacy or language.

Research on the limitations of digital interfaces supports this orientation [30]. Gesture based touchscreen systems have been shown to create ambiguity and confusion for older users due to hidden interaction patterns and unclear icon meanings, producing barriers that physical interfaces do not have [30]. By contrast, tangible interfaces draw on familiar physical actions that require no specialized knowledge to perform.

Hornecker and Buur also argue that tangible interaction is not only about objects but also how they shape the social space around them [26]. Their position is that the artifact, its placement and the interactions it invites produce the conditions for users to interact with the object and with one another. This is directly relevant to the approach taken in this research, where the prototypes are intended to foster discussion that can lead to continued interaction with the recycling artifact. Tangible interaction is used here as both a usability and a social strategy, allowing for low cognitive load and provoking interaction in shared physical spaces. Combined with a low-tech framing, this allows the prototypes to mitigate friction some people have with digital recycling solutions and support immediate, intuitive engagement without requiring prior digital literacy, app installation or complex interface navigation.

3.4 Behavioral Design

The central question of this thesis revolves around the motivational and behavioral aspects of design when creating artifacts for recycling. Rather than informing users that recycling matters, which most already know, the aim is to design systems that prompt habitual and brief recycling behaviors. As covered in chapter 2, behavioral interventions have been shown to influence recycling behavior, although much of this work relies on screen-based solutions, which can introduce friction and exclude certain user groups. In order to evaluate which recycling artifact can be used by a larger user group, low-tech and behavioral design have been applied as guiding design domains. Behavioral Design applies behavioral science to the design of products, services, and environments [31]. It draws on psychology and behavioral economics, fields that have shown most decisions are made quickly, out of habit, and under the limits of attention rather than through careful rational thought [31].

Behavioral science studies how behavior is shaped, finding that context, cues, and motivation matter more than knowledge or intention. People may know recycling matters, and yet drop a container in the nearest combustible bin. Behavioral researchers have studied the gap between intention and action for decades. The Theory of Planned Behavior says intention depends on a person's attitude toward the behavior, the social norms around it, and how much control they feel they have over performing it. Actual behavior then depends on intention combined with situational factors of the moment [15]. The theory is widely used in environmental research to explain why people who genuinely want to recycle often still do not. Behavioral design responds to this gap by working on the situation itself, not on the user. The question shifts from how to convince someone that recycling matters to how to make recycling the easiest or most appealing thing to do in the moment.

Empirical research on recycling supports this orientation. A recent systematic review of 44 studies on observable recycling behavior found that the design of waste bins has measurable effects on whether people use them, and that bins with features that stand out attract more use [32]. This shows that some bin designs influence behavior more than others, supporting a behavioral design approach that targets user motivation rather than relying on their environmental knowledge.

3.4.1 Motivation in Behavioral Design

Motivation is the central concept underlying behavioral design and the focus of this study. In its broadest sense, motivation refers to the internal and external forces that initiate, direct, and sustain behavior. The most influential framework for understanding it is Self-Determination Theory (SDT), which distinguishes between intrinsic and extrinsic motivation [33], [34].

Intrinsic motivation refers to engaging in an activity because the activity itself is rewarding. Play, curiosity, and the satisfaction of mastering a skill are intrinsic motivators. Extrinsic motivation refers to engaging in an activity for an external outcome, a reward, a payment, recognition, or avoiding a penalty. SDT argues that intrinsic motivation tends to sustain behavior over time, while extrinsic motivation can drive short-term action but may erode intrinsic interest if it is overdone. This is called the over-justification effect, where adding external rewards to an intrinsically enjoyable activity can reduce the activity's appeal once the rewards stop [35].

A third motivational category, which lies in-between, is prosocial or moral motivation. This behavior is driven by concern for others or by ethical commitment. The Norm Activation Model, the most cited framework in environmental behavior research, explains that pro-environmental action is triggered when individuals are aware of the consequences of their behavior and feel personally responsible for them [36].

These three motivational orientations: intrinsic, extrinsic, and prosocial, form the theoretical basis for the three motivational strategies investigated in this thesis:

- **Monetary and charity-based incentives** work primarily through extrinsic motivation, offering an external reward for the behavior. Charity-based versions add a prosocial layer by framing the reward as benefit to others.
- **Gamified and artistic engagement** works primarily through intrinsic motivation, framing recycling as play, curiosity, or aesthetic experience rather than obligation.
- **Nature-based reciprocal rewards** work primarily through prosocial and moral motivation, linking the act of recycling to a direct ecological or living benefit and activating the norm-based reasoning Schwartz describes.

Empirical findings on these strategies show mixed results. **Monetary incentives** work for behaviors like beverage container recycling [17] but can crowd out intrinsic and moral motivation when applied to behaviors that were already driven by personal values, an ethical act becoming a transactional one. **Gamification** can sustain engagement when well designed but risks superficiality and novelty effects when reduced to points and badges [20]. **Prosocial framings** tend to support more sustained behavior change, although they may have lower immediate appeal than direct rewards [24]. No single strategy can be universally applied, what succeeds depends on user group, context and how the strategy is materially embodied.

The decision to examine three motivational strategies rather than one is itself part of the research aim. SDT and the Norm Activation Model together predict that these three motivational orientations should produce qualitatively different forms of engagement, as well as different participation rates. By comparing how users respond to extrinsic, intrinsic and prosocial framings of the same underlying recycling task, the study can measure motivation and engagement. Each prototype embodies a theoretical prediction, and the comparison between them is what tests those predictions in real-world settings. In this sense the prototypes themselves become research instruments, used to study the effects of a design on user motivation and behavior.

3.5 Research through Design

The methodological structure of this study is based on Research through Design (RtD), an approach in which designing prototypes and using them as research instruments is the primary mode of inquiry. RtD was selected because the research questions are exploratory and design-oriented, requiring the knowledge to be generated through iterative designing rather than through theory alone. The use of RtD in this thesis is both a structural framework and a method, framing the study this way allows the reader to understand its findings, as it does not follow a conventional IxD process such as the Double Diamond.

Design and research were regarded as separate practices, the former placed in industrial practice and craft, the latter in academic experiments and reflection [37]. RtD emerged from the recognition that these do not need to be separated, and that design activities can play a formative role in the generation of knowledge, instead of only serving as the outcome [37]. The distinction exists between **Research for Design** (RfD), where existing knowledge informs a design process; and **Research through Design**, where the design process produces new knowledge [37]. In RfD, theories and user research are gathered and applied to inform design decisions. In RtD, the act of designing is itself the primary mode of inquiry, meaning that the knowledge produced could not have been generated without the process of making and deploying designed artifacts (figure 3.1).

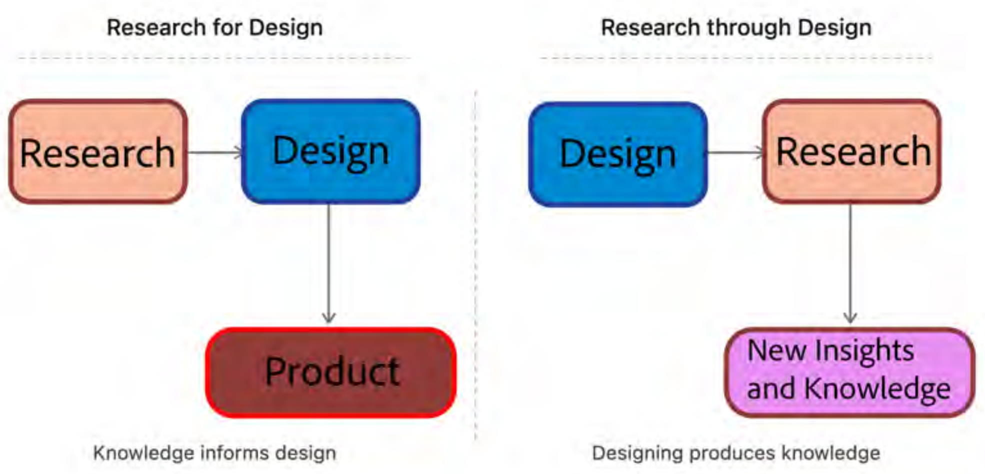

Figure 3.1: The distinction between Research for Design and Research through Design. Illustration by the authors, based on the concept in [37]

In the HCI and interaction design communities specifically, Zimmerman, Forlizzi and Evenson define RtD as a research approach that employs methods and processes from design practice as a legitimate method of inquiry, with the explicit intent to produce knowledge rather than inform the development of a commercial product [38]. This positions RtD as a distinct and valid epistemological stance, where the objects of study are experiential, situated, and difficult to formalize through metrics alone [37].

Central to RtD is the role of the prototype. Cross argues that design knowledge resides in the product itself, that the artifact is not an outcome of reasoning but instead a carrier of it [39]. Building on this, Stappers identifies that prototypes play several roles within an RtD process: they are unfinished and open for experimentation; a means of experiencing a future situation before it exists; a way of connecting abstract theoretical concepts to concrete material experience; and a carrier for interdisciplinary discussion between researchers, designers, and participants [40]. Unlike a product prototype, which is evaluated against a pre-existing specification, an RtD prototype is simultaneously a designed artifact and a research instrument [37].

As Stappers and Giaccardi note, the creation of prototypes itself is a generator of knowledge, provided that its insights are fed back into disciplinary and cross-disciplinary platforms rather than disappearing into the prototype [37]. Because the process structure of RtD is iterative rather than linear, RtD projects progress through cycles of making, testing, and reflection, with each prototype informing the next [40]. Stappers describes this as a research spiral (figure 3.2): a process driven by an overarching design goal, along which iterative prototyping progresses, with knowledge entering at each stage and insights being spun out for sharing with the research community [40].

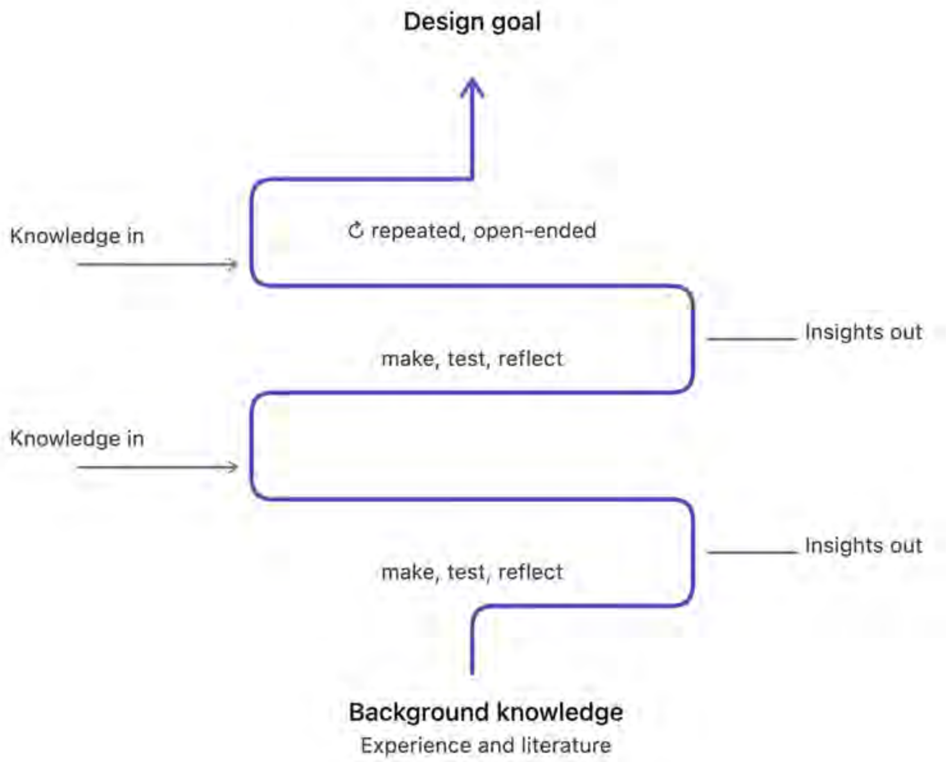

Figure 3.2: Research through Design as an iterative climb. Prototyping cycles build on a base of background knowledge and repeat, open-ended, toward the design goal; along the way, knowledge is drawn in and insights are spun out for sharing. Illustration by the authors, based on the concept in [37]

Koskinen et al. situate this iterative process within three broad research orientations [41], with two of which are relevant for this study: **Lab** and **Field**, distinguished by the context in which prototypes are developed and studied [41]. **Lab** research evaluates prototypes under structured and controlled conditions with recruited participants, allowing for focused examination of specific interaction qualities. **Field** research deploys prototypes in real-world settings, studying how people encounter and engage with artifacts within their everyday social, spatial, and situational context. Field acknowledges the complexity of real environments as a necessary condition for understanding how a design actually functions when placed in the world [41].

4
Methods

This chapter covers the methods applied throughout the different stages of the research process. RtD was selected because the central research questions could not be answered through observation or theoretical reasoning, but required the construction and deployment of prototypes as instruments of inquiry [37]. The research follows the RtD methodology **Lab** and **Field** artifact evaluation methods which was mentioned in Chapter 3, and an added generative phase for early idea generation.

The Lab research orientation was especially useful for evaluation of the alpha versions of the prototypes. Alpha testing refers to the controlled evaluation of a prototype with a limited internal participant group, where users interact with the prototype while being observed by the researchers to identify usability issues, errors, and patterns of use [42]. The aim is to surface problems while the design remains flexible enough to be adjusted before public deployment. To accommodate the different interactions of the two prototypes, two variations of alpha testing were applied in this research: passive alpha, where the researcher remained uninvolved during interaction, and full alpha, where the researcher observed closely and facilitated when needed. The choice between the two depended on the complexity of the prototype and the degree to which the interaction could be expected to be self-explanatory. A limitation of alpha testing is that the controlled environment may not fully reflect real-world conditions, meaning that issues emerging during public use may not surface during the testing session. The testing was done under the structured research conditions during the IxD studio deployment mentioned in section 5.3 which employed **prototyping, surveys, qualitative** and **quantitative questionnaires** in the early stages. **Semi structured interviews** and **think-aloud** methodologies were used during the alpha tests, which were later evaluated by a **thematic analysis** in Chapter 6.

The **Field** evaluation, was used during the last deployment of both prototypes and was tested across different locations across central Gothenburg. The entire process of design rework after the alpha Testing data and process can be seen in Chapter 5. The methods that complemented this RtD research within this field were **field study observations, unstructured interviews** and **thematic analysis** which also will be covered below in detail.

The other methods fall more within the iterative practice of RtD methodology which includes an "idea-refinement" used in early ideation to open the design space phase before building a research artifact. The *Generative phase* included literature studies and relevant fields which are covered in Chapters 2, 3, and market research of the users opinions in the current recycling systems which is covered in Chapter 5, section 5.1. The methods that supported this phase were idea generation and refinement methods such as **brainstorming, mind mapping, surveys** and **qualitative and quantitative data** research.

A limitation with RtD is that the knowledge it produces tends to be particular rather than universal, defined by the artifacts, settings and interpretive choices of the researchers. Therefore it cannot be generalized beyond the immediate study context.

4.1 Qualitative and Quantitative Data Gathering Methods

This methodology is divided in three parts, mainly because the qualitative and quantitative data can be derived from **Surveys**, **Interviews** and **Observations**. All three were essential to the process stages and evaluation stages of this study. Each of the motivational strategies for gathering such data has their own interpretation of qualitative and quantitative and their use in research, but in a broad sense, Quantitative data provides counts, statistics and comparability of categories by user response count, while Qualitative data is broader and can include more information that can be evaluated to answer "how" or "why" an artifact has succeeded or failed.

4.1.1 Surveys

Surveys, which included both types of data were useful when drawing conclusions about what would motivate people in the generative stage. Surveys are a data collection method that allow researchers to gather responses from a broader group of participants than interview based methods alone can [43]. Surveys can include quantitative or qualitative questions, or a combination of both, to receive statistical data and rich user feedback.

Qualitative and Quantitative Questionnaires
Qualitative and quantitative questionnaires are tools to gather both numerical and categorical data from the participants to get a better understanding of a topic [44], [45]. Qualitative and quantitative methodology served as a tool when drawing several decisions about design decisions and user motivation in this research.

The qualitative questions included SDT (which is covered in Chapter 3, section 3.4.1) by asking users about their recycling motivations and what drives them to recycle. Qualitative questions, invite the user to write open ended responses to questions, capturing reasoning, nuance and concerns that would be difficult to obtain through quantitative data. The quantitative questions served mainly for determining what concept within the motivational strategies would be most effective to research. During this research the quantitative questions, such as Likert scales and ranking items allow for participants to share statistical data which can be analyzed across participant groups.

A combination of both proves effective in RtD and behavioral design research, where the goal is to both measure preference and understand the reasoning behind it. Limitations are that predefined categories in closed questions can constrain participant responses, and as with surveys generally, the data collected may not accurately reflect actual behavior. Especially regarding sustainability contexts where recycling carries positive social associations. This can lead participants to report more pro-environmental intentions than their actual behavior reflects [9].

4.1.2 Interviews

In this subsection both semi structured interviews and unstructured interviews will be mentioned. Each of them was used in different stages of this study, semi structured interviews were used during the Lab phase and unstructured interviews during the Field phase. Both of them were accompanied with an observational method, which allowed for more structured testing in Lab and to gather observational quantitative data in Field.

Semi Structured Interviews
For this research the semi structured interviews were used during the Lab phase, more specifically during the alpha testing of the Gacha Machine prototype. The semi structured interviews complemented the think aloud method to gather more qualitative data which was relevant to the evaluation. Semi-structured interviews are guided conversations that follow a prepared set of questions while allowing flexibility for the interviewer to pursue emerging themes [46]. In interaction design research they are well suited to post-interaction contexts, where the goal is to understand how a participant experienced a specifically designed encounter. The format balances consistency across participants with the openness needed to capture individual responses. A limitation is social desirability bias, where participants moderate criticism to avoid embarrassment or conflict, which is particularly relevant when the researchers are also the designers of the artifact being evaluated.

Unstructured Interviews
Unstructured Interviews were conducted during the Field research phase. This method was used to allow the user to express their feelings about the prototypes in general without any leading questions, which resulted in more qualitative data. Unstructured interviews are open-ended conversations guided by broad research themes rather than a fixed question set [47]. They are appropriate when the researcher cannot predict in advance what a participant will find prominent, or when the interaction context makes a structured approach impractical. In public space deployments particularly, unstructured conversation is often the only realistic format for engaging passerby who interact spontaneously rather than as recruited participants. A drawback of unstructured interviews is that conversations can drift from the research focus, requiring the interviewer to actively manage relevance without

imposing structure that constrains the participant.

4.1.3 Observations

In this subsection both Think-Aloud Method and Field Study Observations will be mentioned, as both were used throughout different stages of this research. The Think Aloud method was primarily used during the Lab phase, while the Field study observation were mainly conducted during the Field phase. Both of them were accompanied by their own Interview method as mentioned in the previous section to gain a broader and richer set of data to analyze. When the data from an observation session was too limited or unstructured for formal thematic coding, naturalistic observation [48], referred to in this thesis as observational interpretation, was used as the primary analytical approach. In contrast to thematic analysis, which works through coded categories across a structured dataset, the researchers recorded what was observed in the field and discussed those observations in narrative form to identify patterns and recurring behaviors. This approach relies on the researchers' contextual judgment to make sense of what happened during a session, and was applied where direct interaction was limited but observational data still offered meaningful insight.

Think-Aloud Method
The think-aloud method was primarily used in the alpha testing phase of the Gacha Machine prototype but also became an unintended tool in the alpha testing of the Snus Ballot Voting prototype. The method allowed the researchers to immerse the user into a staged scenario in which the prototype was intended to be used, but the difference being that it was conducted in a controlled environment. The think-aloud method involves asking participants to verbalize their thoughts continuously while performing a task or interacting with a product [49]. It is a well established method in usability research for making cognitive processes visible, revealing how users interpret interface elements, where they hesitate and what mental models they bring to an interaction. In the context of tangible prototype testing, think aloud is valuable because physical interactions are often rapid and habitual, meaning that post-hoc interview data alone may not capture the moment-to-moment reasoning that occurs during the first contact with an unfamiliar object. A limitation is that verbalizing can disrupt the natural pace of interaction which is a particular concern when the interaction being studied is designed to be quick and intuitive.

Field Study Observations
Field study observations directly correlate with the RtD research section Field, which was used as a last testing session in this research. As the intended function of the prototypes was to test whether the behavioral motivational strategies were effective, testing non-biased users generated more accurate data than the alpha tests which commented more on the level of usability and the design choices. The Field testing method was paired together with the unstructured interviews to get a broader view of the user feedback for each of the prototypes. Field study observation involves a researcher watching and recording behavior as it occurs naturally in a real-world set-

ting, without the experimental controls that define laboratory-based methods [48]. In interaction design research, field observation is valued for its ecological validity, it captures how users actually behave in context, including the environmental, social and spacial factors that influence interaction, rather than how they behave in artificial conditions of a controlled test. This is particularly important when the artifact under study is designed for a public space, since the physical and social character of that space is not incidental but constitutive of the interaction itself.

A concern and limitation of field observation is that participants who are aware of being observed may modify their behavior, more commonly known as the Hawthorne effect [50], while purely covert observation raises ethical concerns around informed consent. In practice, public space design research commonly navigates this tension through a combination of naturalistic observation of incidental passerby (who interact with the artifact as they would in any public context) and disclosed observation of recruited or consenting participants. The uncontrolled nature of public environments also means that external factors (weather, crowd density, competing stimuli) cannot be isolated, making it difficult to attribute observed behavior solely to design features.

4.1.4 Thematic Analysis

Thematic analysis was used to discover themes from the qualitative data gathered during the Lab and Field testing phases. This method allowed us to generalize the data into themes that could help us better understand the user feedback. Thematic analysis is a qualitative method for identifying, analyzing and interpreting patterns (themes) across a dataset and carefully examining user responses [51]. This study follows the framework established by Braun and Clarke, the most widely applied approach in qualitative design research. The process involves iterative cycles of familiarization with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes and producing the report [52]. A strength of thematic analysis is its flexibility, by not being tied to a specific theoretical framework, it can be applied across different types of qualitative data, such as interview transcripts and field notes. A limitation is that theme identification is inherently interpretive, meaning that different researchers working with the same dataset may produce different thematic structures. Additionally, having little data or data that is very spread out could result in weak or less relevant findings and contributions.

4.2 Prototyping

Prototyping is the practice of producing partial or complete physical or digital realizations of a design concept at various stages of development [53]. In the (RtD) practice however, prototypes serve two purposes: being design artifacts that embody decisions about form, interaction and material as well as serving as research instruments where hypotheses can be tested. While prototyping in commercial product development primarily aims at validation of a predetermined design rather than knowledge generation through making, both commercial prototyping, and RtD in this project share two things in common: the iterative design process and the use of Low-Fidelity and High Fidelity prototypes. Both forms are covered in the following sections.

4.2.1 Low-Fidelity Prototyping

Low-Fidelity prototyping was used in the early stages of the design process to understand how some of the complicated mechanisms worked before using valuable materials. Especially when working on Prototype 2, the gumball mechanism benefited from this method as it could be iterated upon, while remaining cost effective. Low-Fidelity prototypes are rough, quickly produced representations that prioritizes speed of iteration over accuracy of detail [53]. They are most appropriate in early design phases where the goal is to explore and communicate ideas rather than to test specific interaction qualities. Their disposability is a feature rather than a limitation, because they require low investment to produce, they can be discarded or radically revised without the cost pressure that accompanies more developed artifacts.

In RtD context Low-Fidelity prototyping is more of a generative tool in the early phase of the study, this is to communicate design decisions before construction. In terms of Stappers and Giccardi, these early representations function as artifacts rather than prototypes, they communicate and document ideas but not well enough to be studied [37].

4.2.2 High-Fidelity Prototyping

The final iterations of this projects prototypes were High-fidelity prototypes, making them great research instruments as they had the functionalities an approximate feel of a finished prototype. The high-fidelity prototypes were vital in the Lab and Field tests to generate accurate results regarding our research questions, being more reliable and credible than their earlier iterations. High-Fidelity prototypes closely approximate the final artifact in terms of form, material and interaction behavior [53]. In user research contexts, a higher level of finish is important for validity: participants interact differently with a polished artifact than with a rough model, and the social context of a public deployment demands a level of credibility that low-fidelity prototypes cannot provide. A limitation is the significant time and material investment required, which constrains the number of iterations possible within a given project timeline.

In RtD context, this phase of the artifact served as a research instrument, as the prototype itself was developed enough for users to interact with and to generate knowledge for this study [37].

4.2.3 Brainstorming

Brainstorming was used in the generative phase of this thesis, more specifically when the initial survey was built and the options for each of the motivation categories were iterated upon. This was complemented with Mind Maps for a more structural approach to the ideas. Brainstorming is a generative ideation method in which participants produce as many ideas as possible within a set time frame, without judgment, to encourage creative exploration [54]. In design research it is commonly used in early-stage inquiry to surface a wide solution space before narrowing focus. A known limitation is the risk of convergence around familiar ideas, dominant researchers/ authorities taking the lead and the team straying off the research focus [55]. This risk was mitigated in the present study by combining brainstorming with mind mapping as a structuring tool.

4.2.4 Mind Map

Mind maps were a useful tool for organizing the and weighing the viability of the options for each one of the motivational categories. The ideas for each research prototype were weighted and clustered for similarities, with the lesser ideas being scrapped from the survey entirely. Mind mapping is a visual organizing method that arranges ideas around a central concept, showing connections and hierarchies between ideas [56]. In design research it is useful for clustering and identifying groupings that can inform design directions. Used in combination with brainstorming, it eases the simplification of unstructured themes and topics when moving from a large set of ideas, toward more well-defined ones.

A limitation with mind maps is that they can become unwieldy when the volume of ideas is large, making it difficult to navigate and identify clusters without active facilitation.

4.3 Digital Tools

This section describes the digital tools used to support the design process, ideation and prototype construction throughout the project and could not fit within the interaction design methodology but should be mentioned regardless. The digital tools below had a significant impact on the work, in terms of organization of the generative phase, design and iteration of the prototypes.

4.3.1 Miro

Miro is an online collaborative whiteboard tool that supports real-time co-creation, visual planning and teamwork [57]. It is widely used in design thinking and UX research for activities such as brainstorming, affinity mapping, and organizing survey results. In this project, Miro served as the primary shared workspace for brainstorming sessions and mind mapping, as well as for clustering and grouping initial survey categories ahead of concept selection.

4.3.2 Autodesk Fusion 360

Autodesk Fusion 360 is a cloud based Computer-Aided Design (CAD) and engineering platform that integrates 3D modeling, simulation and manufacturing tools within a single environment [58]. In design research contexts it is used to produce precise component models that can be prepared for physical fabrication. In this project, Fusion 360 was used to design and model the mechanical and structural components of both prototypes prior to production.

4.3.3 Trotec Ruby

Trotec Ruby is a software platform for controlling laser cutting and engraving machines, allowing 2D designs to be cut or engraved into a range of materials [59]. This software was used to prepare and process the designs for the pine plywood and plexiglass panels that form the physical structure for both prototypes.

5
Process

The research focus was on creating prototypes to evaluate if recycling of empty snus containers could become more effective on the perspective of users and recycling. It was decided that this would be done with prototyping as it is a valuable and suitable research method as it allows for testing of key interactions and functionalities. The users would also be able to give early insight on usability and other deciding factors. This process included an initial survey to decide on what prototypes would be most engaging, then the prototype iterations going from low- to high-fidelity and then into deployment.

5.1 Planning and Idea Generation Phase

To achieve the first ideas used in the initial survey brainstorming and mind mapping methods were used to iterate through options on interaction design solutions. The snus container was studied and re-imagined as a design component, to investigate how the users can engage with it in different uses and contexts. The initial ideas were grounded in the literature research done on relevant projects and the current state of plastic recycling efforts. The generation of ideas for the initial survey were done through brainstorming and mind-maps in Miro along with discussion with peers and the supervisor.

Some of the proposed ideas in the survey included stakeholders and contact with other organizations, therefore it was decided that in order to create a groundwork for later testing and potential stakeholder collaborations, emails should be sent out to Gothenburg city, charity organizations and recycling facilities.

5.1.1 Initial Survey

To decide on which prototypes would be implemented, a survey, composed of qualitative and quantitative questions, was conducted and distributed. This survey contained three motivational factors for recycling empty snus containers: Monetary/Charity incentives, Nature-Based reciprocal rewards and a Gamification/Artistic engagement. Each category had 3-6 different incentive alternatives to choose from. Users were also asked about their age and recycling habits to get a broader view into the current market. The survey was done to aid, capture, and understand the users engagement motivation on what they would interact with.

The survey was sent out and stayed out for longer than anticipated (approx. 2,5 weeks in total). The survey was sent out to students and teachers within the Chalmers University of Technology and other departments outside Chalmers that share courses with the interaction design department. The entire initial survey can be found in appendix A.1.

15 answers were received for the initial survey, the entire survey can be seen in appendix A.2. The result of each one of the motivational strategies can be seen in this list:

- (Money/Charitable) There was a point based system to give discounts at stores if you recycle snus containers. (11 votes)
- (Nature Based Reciprocal Rewards) There was a ballot voting system where you could give your opinion on eg: “pineapple on pizza?” With slots where you could put your empty snus container for the yes and no box (11 votes)
- (Gamified/Artistic Engagement)There was a pant machine that allowed you a chance to win prizes in exchange for recycling your snus container. (9 votes)

The users also agreed on the placement of the prototypes with the placement being: Central of the city (4 votes) and Social events and gatherings (festivals, bars, parks) (4 votes).

The users also answered some questions about their recycling habits, why and which incentives drive them to source sort in the first place. Some people do it out of a sense of duty, some people don’t due to the convenience and composition of several source sortable materials in the same packaging (milk and juice cartons due to the new European Union regulations).

Improvements that have been mentioned for the current recycling systems include making them more convenient, with several mentioning the issues they have in their own homes (lack of space for source sorting in the first place). Most users also reported being less likely to sort trash on the go (while outside the home), affirming our hypothesis that source sorting is a low priority in urban spaces.

5.2 Concept Selection and Design Direction

After gathering data from the initial survey (appendix A.1), the data was discussed and evaluated within the research team to determine the outcomes. Further discussion led to the decision to exclude the Money/Charitable incentive due to financial, time and sponsorship constraints, which prevented adequate testing within the research time frame. Establishing partnerships with stores, restaurants, and transport agencies proved to be too time-consuming, especially within a limited project time frame and without prior evidence of the prototypes effectiveness or benefits. This could later be revisited in future research, where sufficient evidence may be available to provide a trustworthy basis for stakeholders.

Similarly, the charitable incentive was also excluded, as support from multiple sectors was required to generate funds for donation to organizations when the users disposed of Snus containers through the prototype. The Sweethearts Foundation was contacted and gave a response to contribute, although their attached pamphlet for new collectors did not specify our plastic type. Due to the fact they were not accepting of any other plastic than stated in their document, the communication did not proceed further.

It was decided that two prototypes out of three were eligible for research, one for the Nature based incentive being Prototype 1 (Snus Ballot Voting prototype), and one for the Gamification incentive being Prototype 2 (Gacha Machine prototype).

5.2.1 Prototype Construction

Snus Ballot Voting Prototype

The goal of the prototype was to make it as simple, intuitive to use, and easy to replicate. The construction process began with creating initial sketches of the features and appearance that the ballot voting body would have, as shown in figure 5.1.

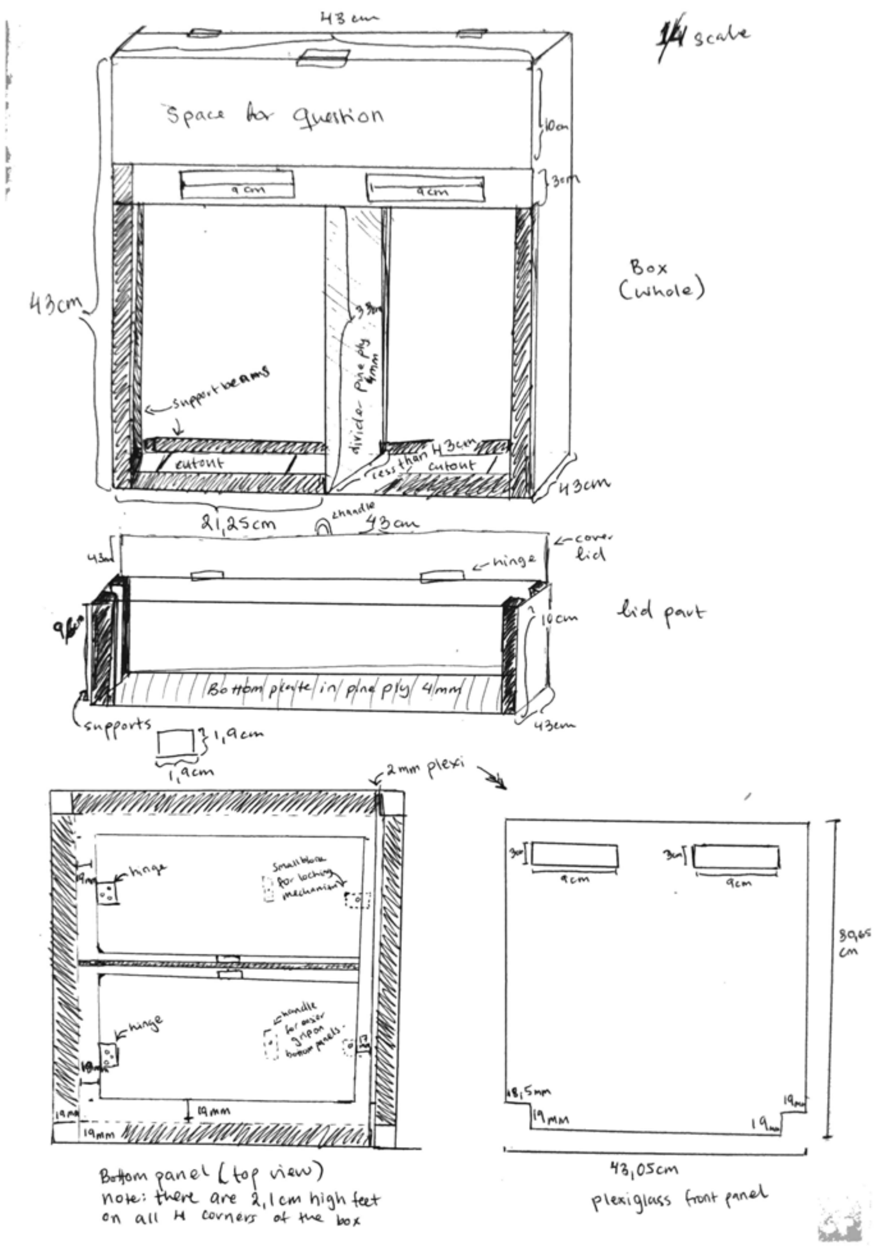

Figure 5.1: Sketch for the Snus Ballot Voting prototype. Image made by the authors.

To ensure easier question changes during the testing phase, a board with attached Velcro dots was added to the front. The questions themselves were printed with the plotter and laminated, for more durability and for easier attachment of the Velcro on the backside. In addition it was decided to contain a clear plexiglass sheet with cutouts for Snus containers, to create transparency with the voting and a immediate visual curiosity component. The top compartment was made so it can be accessed by the users to dispose of their used Snus portions before using the container to vote, this was later scrapped due to sanitary concerns, and the top compartment became storage for the non-used question plaques. The size and shape of the box was decided to fit a large quantity of snus containers to reduce frequent waste disposal.

Materials for this prototype were chosen by the selection of materials available in the FUSE workshop spaces on Chalmers Johanneberg Campus. These included a sheet of 1 cm plywood for the outer body structure, a board of thicker variety for the question space, 2 x 2 cm wooden beams for internal and external support, a plexiglass sheet, four hinges, and screws of varying lengths. The plexiglass sheet was cut using a laser cutter for simplicity and time. The hinges used were 3D printed with PLA filament as it was more cost effective and less time consuming to get within the construction process.

Once the prototype was assembled, a question was added to the front board, making it functional for alpha testing. Initial survey feedback indicated that the prototype should remain inconspicuous and blend into its surroundings, therefore it was decided to leave the plywood "as is".

The prototype was then placed at Chalmers University of Technology within the Interaction Design and Technologies (IxD) department to gather thoughts and feedback from designers/ classmates regarding its visual appearance and user experience, and to assess whether further alternations were needed before deployment, as shown in figure 5.2.

Figure 5.2: Snus Ballot Voting prototype deployed in the IxD department. Image taken by the authors.

In its current deployment within the department, the prototype has been used, and both IxD students and staff provided positive feedback, expressing appreciation that such a prototype has been developed and is being investigated. Although some comments were made that were against the unfinished look, halting some users from interacting with the prototype due to its appearance. They mentioned that the prototype in its current stage "looks like a student prototype that is being worked on and should not be used".

Gacha Machine Prototype

Similar to the Snus Ballot Voting prototype the goal was to make it as simple and intuitive to use by the user. It also began with sketching down the features and visual appearance of the machine would have, as shown in figure 5.3. As this prototype takes inspiration from the mechanism of gumball machines [60] together with a custom coin dispenser mechanism, it requires a large number of custom moving parts to make it work for the Snus containers. These parts were designed using Autodesk 360 and 3D printed with PLA, it consisted of gears, bearings, spacers and other components (see figure 5.4).

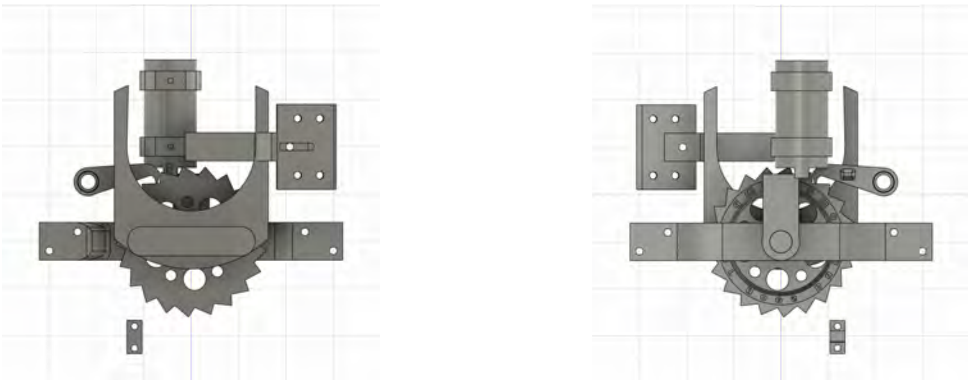

Figure 5.4: (Left) Front view of the internal moving mechanism for the Gacha prototype. (Right) Back view of the internal moving mechanism for the Gacha Prototype. Image by the authors from the 3D modeling software.

The material used for this prototype was similar to the previous prototype, one 1 cm sheet of plywood for the outside body structure, 2 x 2 cm wooden beams as inner support, plexiglass sheet to create a window, and 0.4 cm wide pine wood sheets. The main difference is that this prototype is heavily dependent on 3D printed components. It could be easily replicated if the files are shared but this may not work as different variables can play a role such as different tolerances of 3D filament materials, brands, and 3D printers. In this case, PLA plastic filament RS PRO was used, the 3D files were complied using PrusaSlicer, and was later printed using a Prusa MK4S 3D printer.

As there was a similar housing structure built for the previous prototype, this part was relatively straightforward to build. However, the 3D printed components, specifically the "gumball machine" mechanism, required fine tuning and multiple iterations to function smoothly and reliably. One example is the turning mechanism (which included the crank, stopper gear and the sizing stopper), this required three iterations before functioning as intended, as shown in figure 5.5 of versions 1 and 2 of the turning mechanism, while the final shown in figure 5.6. Version 1 of the crank consisted of all 3D printed components, to test out if such a mechanisms can be used for the Snus containers. In Version 2 wood was used for the outer housing of the mechanism to provide more structure and function better than the 3d printed one. Version 3 was the final iterations that included better structure and was smoother

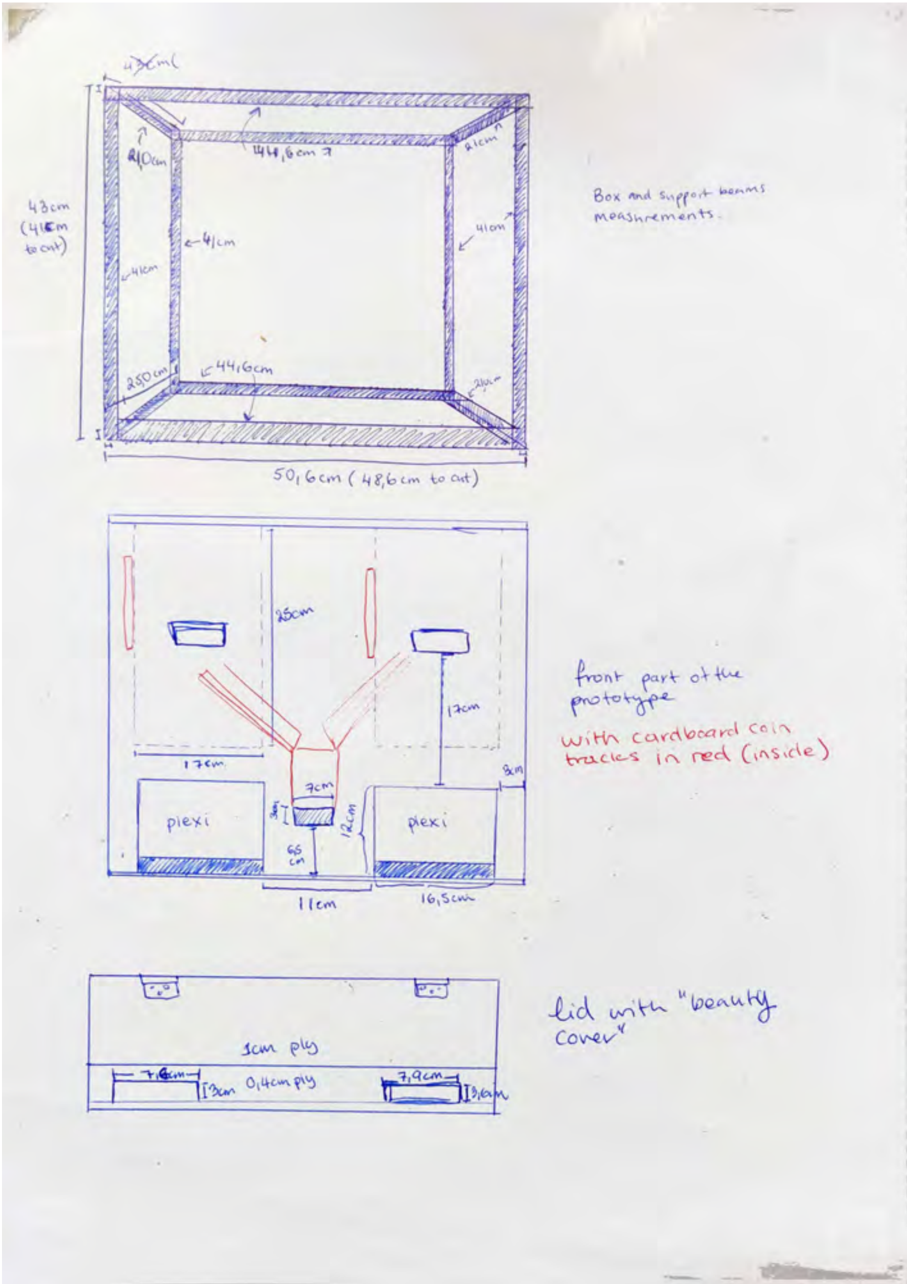

Figure 5.3: Sketch of the Gacha Machine prototype. Image made by the authors.

and easier to handle when interacted with. This version included and an improved token dispenser, better held components, and service holes

Figure 5.5: Version 1 (right) and Version 2 (left) of turning mechanism for Gacha Machine prototype. Image taken by the authors.

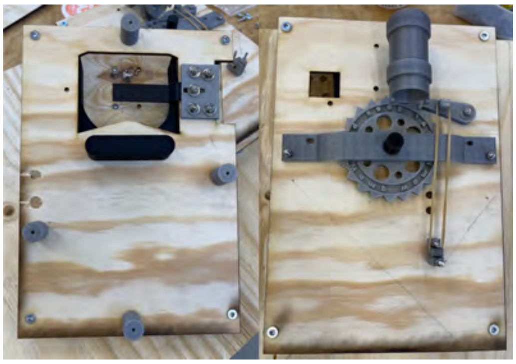

Figure 5.6: Final iteration of turning mechanism for Gacha Machine prototype: front panel (left) and back panel (right). Image taken by the authors.

In the final iteration of the prototype, two separate slot mechanisms were implemented, one for the smaller size Snus containers and one for the standard sized containers. This decision was made due to the limitations of the gumball machine mechanism. The "sizing stopper" which stops users from turning the mechanism without anything inserted, had specific measurements for the width of the container, therefore using a single slot for both sizes proved difficult and was therefore scrapped before the development of later iterations and versions. The outer body was then painted pink to make it more eye catching, with design accents in silver and white while maintaining minimal text, as shown in figure 5.7.

Figure 5.7: Gacha Machine prototype ready for alpha testing. Image taken by the authors.

5.3 Alpha Testing

Once the prototypes were built and their functionality was tested by the authors to ensure they worked as expected, the alpha testing stage was initiated. These alpha testings took place in campus Johanneberg Gothenburg, in the IxD department. After each of the prototypes deployments, the collected interview responses, field notes, and participants comments were organized by both researchers to use during thematic analysis. The collected data was read repeatedly to achieve familiarization, where initial codes were then assigned to requiring observations and statements. Similar codes were grouped into candidate themes, which were reviewed and refined collaboratively by both researchers before being reported in the results chapter.

5.3.1 Snus Ballot Voting Prototype

The Snus Ballot Voting prototype was deemed self explanatory, so passive alpha testing was decided to be the best option. It was placed in the IxD department studio at Chalmers University of Technology for two weeks and a half totaling 18 days, during which feedback was received through a form together with verbal communication if the researchers were present regarding potential points of improvements for the prototype. However, participants were asked to provide feedback on the questions themselves, especially the regarding the range of topics which varied from normal question, location specific ones (Gothenburg city/ culture), and attention grabbing ones.

5.3.2 Gacha Machine Prototype

The Gacha Machine prototype required a more extensive alpha testing session due to higher complexity in the internal mechanism, where ten participants took part in the testing. The structure of the testing session was as follows:

The users were given a digital consent form (Appendix A.3), which included a very brief testing session description, they were informed that no personal data would be collected but only their feedback and comments about the prototypes will be and they were informed they had the right to withdraw from the testing session at any time.

Before starting the session the participants were asked whether they are Snus users, this was made to further understand our potential users and compare to the previously found statistics relating to the average Snus user consumption in Sweden. As this testing session took place in the IxD department, it was decided that the participants that would take part in this session would vary in age, backgrounds, and experience levels to minimize bias and get a varying outcome of results from all different potential users.

After checking if they are snus users or not, participants were provided with an empty Snus container and instructed to interact with the prototype as they would if encountering it in public setting. They were encouraged to verbalize their thinking throughout the interaction, following the think- aloud method. Following the interaction they were asked follow-up questions about the prototype, which can be seen in appendix A.4. Participants were also informed that they could ask questions at any point if clarification was needed.

5.3.3 Prototype Adjustments

The adjustments made to the prototypes following feedback from the alpha testing session are shown below:

5.3.3.1 Snus Ballot Voting Prototype

The appearance of the Snus Ballot Voting prototype was updated in accordance to the feedback received in 6.1.1. A black leather stain was applied to the exterior body, as shown in figure 5.8,

Figure 5.8: Updated Snus Ballot Voting prototype. Images taken by the authors.

English and Swedish text was added on either side of the prototype to improve accessibility and understanding, as shown in figure 5.9.

Figure 5.9: Image a: English language side of the Snus Ballot Voting prototype, displaying the text: "Hi! Do you have an EMPTY SNUS CAN? and an OPINION, LOOK HERE" and Image b: Swedish language side of the Snus Ballot Voting prototype, displaying the text: "Hej! Har du en tom SNUSDOSA? och en ÅSIKT? KOLLA HIT". Images taken by the authors.

Additionally, blue and pink colors were added to the voting chambers to make it easier to distinguish. Lights were installed into the bottom panel of the lid, going into each chamber to improve visibility during nighttime, as shown in figure 5.10. Finally straps were attached to the prototype so it could be worn as a backpack while in town, as shown in figure 5.10.

Figure 5.10: Additional alternations made to Snus Ballot Voting prototype. Integrated Night lighting (left) and Attached straps for backpack use (right). Images taken by the authors.

5.3.3.2 Gacha Machine Prototype

Similarly, the feedback received from the Lab evaluation phase seen in 6.1.2 guided the design changes for this prototype. Adjustments for the Gacha Machine prototype were simpler as the only addition was adding signage and a paper on the sides of the prototype displaying the possible drink rewards, as shown in figure 5.11. As for the rewards, they would be drinks or a star prize which were custom made waist bags, taking inspiration from snus brands 5.13.

In addition to the alterations, a website was created with a brief project description, 3D models of each prototype and a short description for each. This was made to inform people that have interacted with one or none to learn more about them. The website also included a survey link if the users would want to share their thoughts and feedback. The website can be accessed through this reference link [61]. The QR code was displayed next to each prototype so the users could easily access it. Once these adjustments were completed, the prototypes were deployed for public testing.

5.4 Deployment

The field user tests were conducted after the prototypes had gone through Lab stage testing and received changes according to that data. The field studies intention was to test the prototypes with users outside the IxD department, which would result in data more representative of the wider public.

5.4.1 Snus Ballot Voting Prototype

Testing for the Snus Ballot Voting prototype was conducted in a public setting, as the updated prototype was designed with the straps allowing it to be worn as a backpack. The testing took place on a Friday, this was selected due to increased pedestrian activity as people typically leave work and travel to the city center and to restaurants at the end of the work week. Favorable weather conditions further contributed to high foot traffic, maximizing opportunities for observation and feedback collection. The prototype was deployed on two occasions, once during the afternoon and once later in the evening. During these testing sessions, the questions were changed depending on the area and what the authors believed would be best for engagement in that moment.

5.4.2 Gacha Machine Prototype (Attempt 1)

As per the alpha testing feedback received, the signage was created and placed on top and the both sides of the prototype, as shown in figure 5.11. The figure seen was taken outside the time frame of the first attempt, as the area was crowded and was difficult to gather consent from the users during the Cortége event as they may appear in the image. Figure 5.11's only purpose here is to display how the signage was during the event, the image seen was taken at Chalmers university. The rewards given from this prototype were 48 soft drinks cans of varying brands and sugar content with half being sugar free.

Figure 5.11: Old signage displayed on Gacha Machine prototype, front view (left) and side view (right). Images taken by the authors.

Similar to the previous prototype, the goal was to go into locations with high foot traffic, therefore it was decided that the testing will commence on a Thursday during the Cortège event that is hosted every year by Chalmers. The Chalmers Cortège is an annual event, student organized carnival parade held on Walpurgis Night, it features satirical and technical floats built by students [62]. Due to it being a known event people usually stay put for a few hours before the event starts, bringing food and drinks, therefore it was assumed that they may possess snus containers. The prizes for this time were the soft drinks due to production difficulties of the star prize. Which included technical difficulties of the vinyl printer and its software. The "star prize" was decided to be two cans of drinks of the user’s choosing for this field test.

5.4.3 Gacha Machine Prototype (Attempt 2)

The first attempt was deemed insufficient and was attempted again within the Student Union building at Chalmers University of Technology on a Friday between 10:00 and 15:00. The signage meant for the top of the box as an engagement/explanatory aid was printed larger and mounted to a nearby table for stability, as shown in figure 5.12. The "side" posters were also reprinted and reworded, as shown in figure 5.12 as they got torn during the last outing. The "Star" prizes were displayed next to the prototype along with the possible drinks the participants could win. The Star prizes, as shown in figure 5.13 and 5.14. A detailed view of the Waist bags shown from all angles, shown in figure 5.15, With the base translating to "This product illustrates nicotine products which can cause addiction". The waist bags as a concept were chosen to have a reward that is functional, and is able to spread awareness on recycling and the addictive nature of Snus products.

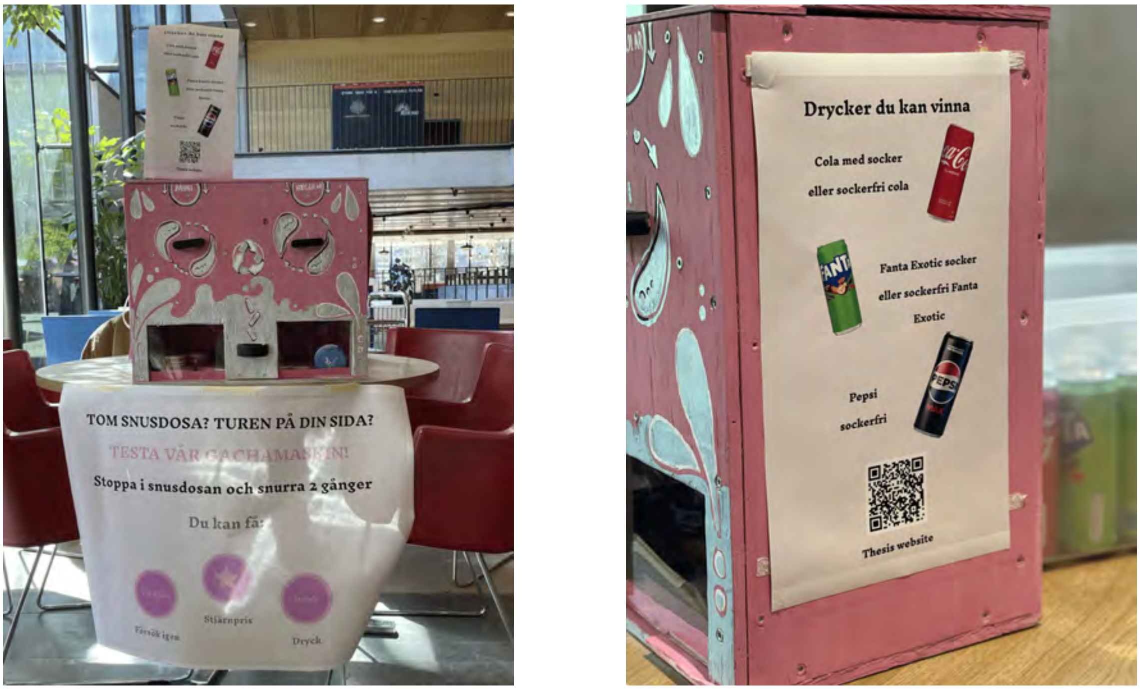

Figure 5.12: Updated signage displayed on Gacha Machine prototype, front view (left) and side view (right). Images taken by the authors.

Figure 5.13: Star reward waist bags. Image taken by the authors.

GöteborgsRapé Aprés sprits Loop

Figure 5.14: The three star prize waist bags and their packaging inspirations. Images taken by the authors.

Figure 5.15: Waist bag shown from all angles. Images taken by the authors.

5.5 Data Analysis

Once the Lab and Field phases had concluded, the qualitative data collected throughout the project was analyzed following the six-phase framework described by Braun and Clarke [52] introduced in 4.1.4 The analysis was carried out collaboratively by both researchers. First, the researchers familiarized themselves with the data by re-reading the field notes, transcribed verbal feedback, and survey responses from each session. Second, initial codes were generated independently, noting repeated phrases, behaviors, and observations across the dataset. Third, the two sets of codes were compared and clustered into preliminary themes through collaborative discussion. Fourth, the themes were reviewed against the original data to ensure they were coherent and well-supported. Fifth, the themes were named and described, with representative quotes selected to illustrate each theme. Sixth, the themes were written up in chapter 6, organized by deployment session. Where the data from a session was too limited or unstructured for formal thematic coding, observational interpretation was used instead, as described in 4.1.3. This was the case for the Cortège deployment of the Gacha Machine prototype, where only one container was collected and the limited interaction volume did not lend itself to thematic coding, and for parts of the daytime Snus Ballot Voting session, where passersby observed the prototype but did not engage directly.

6

Results

In this chapter, the results from the two different stages of the research are presented (Lab and Field), Lab including the results from the alpha testing sessions and Field being the final public deployment. The findings include observational, qualitative, and quantitative data collected through the deployments and testing session. The qualitative material was analyzed primarily through thematic analysis conducted collaboratively by two researchers. When thematic analysis was not suitable, observational interpretation was instead applied. During all deployments users were asked for consent in verbal or written depending on the situation regarding partaking with the prototypes for a thesis research paper, and were informed that data will be gathered anonymously and they were informed that they could leave the interaction when they wish.

6.1 Lab Evaluation Phase

The data presented and analyzed here is from the Lab evaluation phase which consisted of alpha testing.

6.1.1 Snus Ballot Voting Prototype

During the alpha deployment of the Snus Ballot Voting prototype qualitative data was gathered, the data was from 2 survey responses and 12 instances of verbal feedback to the researchers when they were present. This data was analyzed using thematic analysis, in which four themes were identified.

Positive Reception of Usability and Design
The prototype frequently received positive feedback relating to its ease of use and visual appeal. Nine participants described the prototype as

"nice and easy to use"

and four commenting on the design with statements such as

"I like the design of it"

These responses suggested that the prototype's core interaction, of dropping an empty snus container into the chambers to vote, was intuitive and required minimal instruction.

Appeal Beyond the Target Group
One participant, who was neither a snus user or had an empty snus container on

hand, stated

> "I don't have a snus container, nor do I use snus, but if I saw this outside I would use it"

Although this response came from a single participant, it suggests that such concept or prototype may resonate with users beyond the target demographic. This indicates that the interaction has the potential to engage both snus and non snus users.

Unfinished Appearance and Visibility Concerns

In regards to the positive feedback received during the deployments there were several feedback points for improvements regarding the appearance and visibility. Two participants described the prototype's body as unfinished stated by

> "The box looks unfinished"

with one stating that

> "The prototype looks unfinished, like a student project just being in the studio"

In reference to the appearance two participants stated that

> "The prototype should stand out more"

and while one mentioned that the

> "the signage and question text should be larger"

All of these feedback points were mentioned as the participants believed that doing such improvements will make the prototype appear and gather more user attention to lead to more interactions. Which was further addressed and noted by one participant's statement that

> "The background color of the questions could be better, it is hard to see"

identifying the importance of readability being an issue. Taking all of these feedback points into consideration, the prototype and concept was well received, but further improvements to its appearance such as making it look finished and improve the readability may have a great effect on capturing attention when tested in public spaces.

Question Content and Difficulty

The question displayed during the alpha testing received mixed feedback. While eight participants considered the questions acceptable and made no negative comments about it, three found it to be overly broad and difficult to answer with them stated that

> "The question was very broad (hard to answer), I don't know what to answer, I will go with the majority"

Another participant mentioned that although the question was engaging, it required additional time and thought before answering. A further participant commented that

> "the question was fine, but could be changed to something else"

These feedback points suggests that while the question were perceived as acceptable, some users may have felt excluded or uncertain to participate due to the questions broad nature. Therefore this highlights the importance for the questions that will be displayed to be both engaging and easily answerable within a short time frame for all. Improving these questions could make it easier for participants to participate with the prototype on the go, without causing any hesitation or making the interaction feel cognitively demanding.

Overall, the alpha testing feedback indicate that the core concept and prototype were well received, but further improvements were needed in the appearance, visibility, and question formulation before field deployment to make it more usable and engaging for all users.

6.1.2 Gacha Machine Prototype

The alpha testing involved participants with different levels of familiarity with Snus products. Out of the 10 participants, 3 were active Snus users, while the remaining participants were either former users or non-users (see Appendix A.5). This therefore provided feedback from users with varying experiences to Snus products. The active users reported consuming 3-4 Snus containers per week, which aligns with previously presented statistics (see Chapter 2). Below are the themes identified through thematic analysis of the qualitative data collected during the interviews conducted after the alpha testing sessions of the Gacha Machine prototype:

Insufficient Introductory Impression and Communicative Clarity
The most prominent theme across the dataset concerned the participants' difficulty in understanding the purpose and usage of the machine without prior contextual knowledge. Nine participants, indicated some level of uncertainty about what the machine was, what it was for or what behavior it was designed to elicit. This finding is consequential, highlighting that an absence of clear instructions or signage acted as a barrier to comprehension. Non-users were unable to interpret the size labeling "regular" and "mini" as the container size is not apparent when a user does not consume nicotine pouches. Several participants also reported that without accompanying signage they would not have identified the device as a recycling machine at all. One participant stated:

> "Nobody would know it's for recycling — state the obvious. "(P10)

Another noted:

> "I wouldn't know what it was — you need to introduce this to the user, and explain how it works, like: now you can recycle snus containers here." (P8)

Even participants who successfully completed the interaction acknowledged the importance of the contextual framing:

> "No idea what should happen, but I was impressed that I still managed to use it." (P6)

These findings suggest that the machine in the current state used during the alpha testing relied heavily on prior contextual understanding, making the interaction less accessible and appealing for first time or non-targeted users. The machine was not perceived as fully self explanatory during initial testing. A key design implication based on the feedback would be the development of clear signage to communicate the purpose of the prototype and how to use it. This will be implemented prior to the field deployment, to improve the users understanding and facilitate the prototype.

Aesthetic Appeal and Attention-Capturing Design

Nine participants responded positively to the visual design of the machine, particularly its color pallette. The design was widely described as attention grabbing, fun and distinctive. But it was also mentioned that the design is a deliberate contrast to the conventionally green aesthetic associated with the recycling infrastructure. This reception is directly aligned with the gamification strategy aim, which is to make the recycling experience an engaging desire driven behavior.

> "It's eye-catching — which is positive. It's supposed to be fun and modern, so it's nice." (P8) "The colour scheme is amazing — happy, cool, fun." (P9) "Usually recycling is green, but this color is nice because it stands out." (P1)

One of the participants mentioned that the visual aesthetic of the front produced visual noise that competed with the functional legibility. Emphasizing on the fact that there was 'a lot' happening on the exterior and advocated for 'more structure, less stuff' (P10). This suggests that the current visual hierarchy prioritizes decorative elements over communicative ones, which could affect usability in future iterations. Another participant remarked confusion about the coin design for the token dispenser, mentioning:

> "The coins look like something you'd insert into the machine yourself, rather than receive as a reward." (P3)

The findings from this theme suggest that future iterations should improve the visual hierarchy by reducing unnecessary visual appeal and the choice of a distinctive bright pink color to better balance aesthetic appeal with functional legibility to minimize visual load on the user. Finally, the token system should be redesigned to more clearly communicate its role as a reward mechanism rather than being able to receive user input to reduce user uncertainty during the interaction.

Token Reward System- Usability and Perceived Value

Nine participants commented on the physical token, which functions as the material output and the exchangeable currency for rewards for the machine. The token's visual and physical similarity to a real coin created confusion among participants regarding whether it should be inserted into the prototype or received as a reward. In addition the token size and weight conveyed a low perceived value of it, which may reduce its effectiveness as a reward mechanism and weaken user motivation due to the token being seen as cheap. The redemption pathway for the token was also described as unclear, as the participants expressed uncertainty about how or where they can be exchanged. Furthermore, concerns were raised regarding the environmental aspect of the tokens as mentioned by participant 8 (P8), that due to size and being physical they may be discarded in nature, which could undermine the sustainability and purpose of the prototype.

> "They feel light and not very valuable. Heavier would feel better. (P10)"
>
> "It might be a bit thin — easy to pocket and walk away with. (P7)"

On the environmental risk:

> "People don't like loose change. The thinness is nice, but they risk ending up in nature — which defeats the purpose." (P8)

Several participants offered constructive redesign suggestions, including making the token larger, shaping it to resemble a snus container as a thematic callback, increasing its weight to enhance tactile value and printing the odds and tokens that could be dispensed on the machine itself. These redesign suggestions indicate that participants associated physical weight and materiality with perceived value and legitimacy. The tactile qualities of the token therefore appeared to influence not only the usability of the reward system, but also the emotional perception of reward significance. Overall the findings and suggestions indicate that a desire for a more materially substantial token that conveys higher perceived value, rather than a lightweight or low cost impression, as well as improving the clarity regarding how the tokens should be used after being dispensed. These changes could enhance and make the interaction feel more polished which may contribute for better engagement and participation.

Gamification as a Behavioral Motivator - Reception and Reservations

Seven participants engaged substantively with the gamification mechanic as a motivational proposition, and the majority expressed that it constituted a meaningful improvement over conventional deposit-return. Responses about the interaction were that it was fun and attention grabbing, and compared it to similar playful interaction to the ones found in gumball machines. The higher value drink and star prizes were consistently cited as a compelling incentive, with several participants explicitly framing the comparison in terms of reward magnitude to standard pant systems.

> "A free drink is so much more motivating than getting a few kronor from a regular deposit machine." (P8)
>
> "If I walk by and see an empty one I would recycle because I get free stuff." (P2)"
>
> "If you understand there are better prizes available, you'd want to keep playing." (P4)

However a minority of participants were dissatisfied with the gambling framing of the machine. The "try again" outcome was identified as potentially demotivating and one participant raised the ethical concern of gambling associations in the context of a product already adjacent to a regulated substance:

> "The gambling element might make some people feel bad — maybe don't display the drinks if you can't always win one. Write out the odds." (P9)

While these findings indicate that the gamification was effective as a behavioral motivator and brought engagement to the users, they also highlighted potential ethical concerns related to gambling dynamics and addiction. Given this prototype is chance based and tied to physical rewards, there is a risk that users may be encouraged to finish their snus container prematurely in order to participate. This should be considered carefully in future iterations and during field deployment as the interaction may increase engagement, it may also introduce ethical tensions related to compulsive participation and consumption behavior when applied within nicotine related contexts.

Physical Interaction - Crank mechanism and Tactile Experience
Seven participants commented on the physical act of operating the crank mechanism. The tactile non-digital nature of the interaction was broadly valued as a distinctive design quality, with one participant explicitly contrasting it favorably with touchscreen interfaces:

> "The tactile feel is nice — I'm happy it isn't a touchscreen."(P7)

However, the interaction also generated the usability friction in several aspects. Participants reported uncertainty about the direction in which the crank should be turned, anxiety about exerting excessive force, and a lack of feedback indicating that the interaction had been successfully completed. A mechanical jam encountered by one participant, where the container ended up in the internal coin chute mechanism instead of the container chamber, further highlighted the need for a redesign of the container insert at the top of the machine.

> "I was scared of breaking it. It would be nicer if there were no resistance when spinning it back — that would make it more intuitive to spin it all the way through." (P7)
>
> "Clearer arrows on which way to spin would help. The interaction also needs to include some feedback for when the token drops." (P3)

These findings suggest several areas of improvements that could be done to the prototype to create a smoother overall user experience during the interaction. As the crank mechanism was valued but ran into some issues as stated by participants 7 and 3 (P7 and P3), further improvements as lubricating the crank for smoother experience, as well as adding clearer visual indicators the rotational direction. The addition of a beauty cover to cover the insertion areas to eliminate the chance that the user may slot their container in an incorrect pathway. Implementing these improvements in future iteration could improve both the reliability and clarity of the interaction while maintaining the tactile qualities that the participants valued positively.

Deployment Context and Spatial Placement
Eight participants gave feedback on placement where they would expect or wish to encounter the machine in real world deployment. Responses clustered around two spacial placements: proximity to the point of purchase (co-location with tobacco retail outlets such as Pressbyrån or campus kiosks), and proximity to high-traffic transit infrastructure (tram stops, bus stations, central public squares). Both spacial areas reflect an understanding that the recycling must be intercepted at the moment of discard, reaffirming behavior change literature on contextual cues and convenience. Suggesting that the effectiveness of the prototype may depend on its integration into existing disposal practices locations rather than requiring the users to seek it out intentionally to use.

> "Next to shops like Pressbyrån, major squares and stations, malls — places with a lot of foot traffic." (P5)
>
> "On campus, at kiosks, at clubs — where people go through a lot of containers." (P3)
>
> "By trash cans, in combination with trams, or in the centre of Gothen-

burg." (P1)

Several participants also raised the issue of the machines installation height, noting that its current position made it difficult to observe the container dropping through the mechanism, which was noted to be a moment of visual feedback that appeared to contribute satisfaction with the interaction.

"The placement should be higher — I didn't see the snus can drop." (P2)

The findings suggest that future deployment of the prototype should priorities placements in high traffic areas public environments where snus consumption and disposal are likely to occur, such as near tobacco selling store or public gathering spaces. In addition the height of the prototype is placed at should be reconsidered to ensure that the prototype and its interaction remains both accessible and be visible for all potential users to interact with. Implementing these suggestions could improve the visibility, accessibility, and overall engagement potential that the prototype could have by making it easier for users to notice, understand, and interact with it.

Digital Redemption and Alternative Reward Systems

A smaller but noteworthy cluster of four participants raised the possibility of a digital layer to complement or replace the physical token. The suggestions included a QR-code based system, linked mobile application with an linked account and a points-accumulation model that would reward repeated recycling behavior over time. The participants reasoning for a digital layer implies that the novelty of a physical exchangeable token machine may diminish over time and to conserve long term motivation a digital component might be more convenient.

"A QR code or an app with an account system — that would make it more accessible and eliminate the physical token problem." (P8)

"Consider alternative reward systems — like points."(P10)

"If used in multiple places, it would be nice for the token to be usable elsewhere too." (P5)

While these findings present an alternative path that these prototypes could implement through the integration of digital rewards. The current research intentionally focuses on low technology systems/ interactions in order to minimize visual complexity and reduce the reliance on smartphones and mobile applications. While this alternative path may provide advantages or perform better long term, this path falls outside the scope of the current research. Future research could further investigate whether the addition of a digital layer or hybrid approach would improve user engagement compared to the current approach.

Used Nicotine Pouch Disposal and Machine Hygiene

Three participants, whereas two were active or ex snus users, raised the practical issue of the container and prototype cleanliness. Snus containers typically retain moist used nicotine pouches or tobacco at time of disposal, which contaminates the plastic and reduces its recyclability. These participants identified the absence of a dedicated nicotine pouch waste compartment, as a functional gap in the machine.

"Most concerned about the snus dump — make that a feature so the plastic container comes out clean and ready for recycling". (P9)

"Maybe a place to put the used snus — a dump compartment on the side." (P9)

This concern was mentioned exclusively by the snus user group, along with the issue of the coin chute being misinterpreted as the disposal point for used nicotine pouches. Along with this, a non-snus user mentioned that implementation of automation would be beneficial for users that have an issue with non-sanitary devices in public, suggesting an automatic crank for more sanitary coin retrieval. These findings suggest that hygiene and disposal behavior are important considerations for real world deployment. Future iterations of the prototype should consider implementing a separate waste compartment for the snus pouches for easy disposal and reducing direct contact with interaction components to improve hygiene and user comfort, potentially creating a better user experience.

The findings from thematic analysis suggest that the prototype was well received during the alpha testing session, with users enjoying the interaction and appreciating the concept behind it. Several improvements can be implemented based on the analysis of the users comments, such as addition to and refinements of the prototype's visual language, as well as improving the tactile experiences when using the crank and handling the tokens. Users also mentioned the implementations of digital layers, which could be worthwhile to investigate in order to determine whether they would perform and generate a better user experience. However, this falls out of the scope of the present research and therefore not be investigated further. This could instead be explored in future research.

6.2 Results from Field Evaluation Phase

In this section presents and analyzes the field testing data collected during the research. The finding are based on both observational and qualitative data gathered through the unstructured interviews and field observations conducted while the users interacted with the prototypes. As this research follows an RtD approach, active and passive states of the prototype testing emerged as significant research outcome. These states and their implications will be discussed in the following section.

6.3 Active and Passive

Following the Field prototype evaluation mentioned in Chapter 3 and beginning of Chapter 4 observational data showed that the configuration in which a prototype is placed significantly influences how it is encountered and engaged with by users. During the field study observations and in-the-wild research, both prototypes were deployed under two distinct states, here termed *Active and Passive* states. These differ in terms of two combined dimensions: the degree of researcher involvement in initiating interaction and the mobility of the prototype during deployment. The differences between these states and their respective applications are explained below.

6.3.1 Active State Approach

During an active state deployment, the prototypes themselves are not the primarily factor attracting user attention. Instead, the researchers or project member conducting the study would be responsible for engaging users. For example, researchers may actively ask users to participant or interact with the prototype. In this approach, the prototype is also mobile rather than static, meaning it will be continuously moved between locations. While the prototype may still attract attention, the researchers play a role in initiating interaction. This approach is most suitable when the prototype needs to be tested in different locations rather than remaining in a fixed position.

The active state approach was used during the field testing session of the Snus Ballot Voting prototype and the first deployment of the Gacha Machine prototype. In both sessions, the prototypes were moved around by the researchers, and active effort was made to attract user attention

6.3.2 Passive State Approach

In contrast, the passive state deployment approach is the opposite, as the prototype itself becomes the main factor attracting user attention rather than the researchers. In this approach, the prototype is placed in a fixed location and left to operate independently, allowing users interact with it on their own without requiring researchers to manually engage them. This static placement of the prototype is beneficial because it increases visibility and allows users to return and interact with it at a later time. This behavior was observed during the prototype deployment.

This approach was used during the alpha testing session of the Snus Ballot Voting prototype and the second field testing session of the Gacha Machine prototype. During the second deployment of the Gacha Machine prototype, its static location enabled users to notice the prototype and later return with their snus containers to dispose of them. This demonstrated that the passive approach was particularly effective for that prototype.
Choosing the appropriate deployment state largely depends on what is being investigated and how the study is intended to be conducted. In the context of this research, the passive state approach proved more effective, as the static placement allowed users to notice, remember, and return to the prototypes, supporting sustained engagement.

6.3.3 Snus Ballot Voting Prototype - Daytime Deployment Session

During the daytime session, the route began from Chalmers University of Technology Johanneberg campus through Heden and onward to Brunnspaken and Nordstan. Although the prototype was not directly approached or used during this period, it did gather attention from passersby, particularly young adults and adults. As the prototype was carried through the city, spontaneous reactions were observed, including individuals commenting on it while passing by or discussing it within them and others. During this period the questions was changed every 15 - 20 minutes to see if it influenced the engagement, and that the list of all questions could be seen in A.6.

Due to people not approaching the prototype, a thematic analysis was not possible. However, observational data still could be analyzed, particular regarding the distribution between younger and older adults who stopped to read the prototype from a distance. From the observed passerby 55% (20 individuals) were older adults, while 45% (15 individuals) were younger adults.
These observations suggest that people were interested in the prototype but were uncertain or unwilling to approach it directly during its deployment. This may be explained by three possible reasons: a lack of time to interact due to the prototypes constant movement, users lack of an empty snus container on hand, or social norms that may discourage spontaneous interaction in public settings. The higher level of attention from older adults indicates that the prototypes design caters more strongly to an older audience, which aligns with the intended target group in this research.

6.3.4 Snus Ballot Voting Prototype - Nighttime Deployment Session

During the nighttime session, the route that the prototype was carried began from Heden passing through Avenyn and Haga onwards to Andra Långgatan. During this deployment session the prototype received the most interactions during Andra Långgatan, which is a location with pubs, using an active state. On the route to Andra Långgatan, verbal feedback was heard as a group of people shouted stating "what is that" across the street when walking to the destination. These verbal feedback are not going to be included in the thematic analysis as the users did not come, interact with the prototype, or given feedback, therefore it will be exuded. During the deployment only users that interacted with the prototype and came forward to the researches to ask what it was were counted as users.

During Andra Långgatan the question was changed during the deployment when seen fit, to maximize the participation and feedback gathered. Although many users engaged verbally with the prototype, only two participants ultimately deposited two snus containers to vote, as the rest of the participants did not have any empty on hand. Below is the qualitative observations and verbal feedback gathered during the nighttime deployment session, which were analyzed using thematic analysis. Three themes were identified.

Confusion at First Approach
The most frequent observation during the deployment was the initial confusion when eleven users approached the prototype from the front view while it was being carried and walked with. Because the prototype was being mounted as a backpack and the voting chambers facing forward and were primarily visible when walking behind the prototype, the intended function of the prototype was not immediately understood at first glance. As a result, users often required a closer look, additional content,

or a brief explanation before understanding how to interact with it. However this was not always the case. As two participants approached the prototype from the side and were able to read the textual information displayed on either sides. In those instances, no further explanation was required and purpose of the prototype immediately understood.

Despite the initial confusion, the prototype did successfully attract attention and curiosity from passerby. Nevertheless, the finding suggest that the purpose and functionality of the prototype were not self evident from its frontal view, particular in low light conditions where the textual information on the side panels was less visible and became difficult to read.

An instant of misinterpretation occurred, when one snus container was deposited in the prototype by one participant with the expectation that it would dispense something in return for his snus container. After interacting with the prototype the participant stated

> "what do I get?"

When informed that the prototype functioned as a voting and collection system rather than a reward dispenser, mild frustration emerged as the participant discussed with a companion that the disposed snus container had not been fully emptied. Highlighting that unclear communication may lead to user misunderstanding and dissatisfaction.

These findings suggest that future deployments should improve the communication clarity of the prototype during first encounters. Adding signage to the frontal view explaining the prototype further could immediately help users understand the purpose of the prototype and improve the interaction experience. In addition the textual information found on the sides could be lit by lights or painted with glow in the dark paints to make it more visible in darker light condition. These implementations could make the prototype be understandable on the first approach and reduce user confusion without requiring additional explanation.

Engagement With the Questions
A significant portion of the users (ten users) engaged with the questions that were displayed in the prototype, commenting them verbally with the researchers or in discussion with companions. The provocative framing and attention grabbing nature of the questions appeared to transform the interaction from a purely recycling activity to a socially performative encounter, where the users became tied to humor, curiosity and group discussion rather than solely environmental motivation. Questions such as "Femboys or Ladyboys?", with several explicitly praising those "clickbait" style approach and the inclusion of socially loaded topics such as through on abortions. Five participants asked about the meaning behind specific questions, indicating that these questions functioned not only as voting prompts but as well as conversion starters.

These finding support the earlier findings from the alpha testing session, suggesting that question formulation plays a central role in driving participation and user engagement, this observed seen when the provocative questions tended to outperform the neutral questions. Having questions that relate to current trends and are of a "clickbait" style brought the most interaction and gave the most verbal feedback. These finding suggest that using socially engaging or "clickbait" style questions may increase both interaction with the prototype and social engagement between users.

Positive Reception and Participation Barriers
During the deployment several users reacted positively to the prototype once the purpose was understood, responded included statements such as:

> "oh that is fun"

and

> "it is a cool initiative"

, along similar expression of approval of the concept from both snus users and non-users. Indicating that the prototype generated both curiosity and engagement across both snus users and non-users, and perceived as a novel and welcome addition in public environment and everyday life. In addition a recurring pattern emerged in which users expressed interest in participating and voting but lacked an empty snus container at the moment of the encounter. This typically occurred after the users understood the purpose of the prototype by either reading the sides panels or after receiving further explanation as one user commented:

> "oh thats fun, but I do not have a container, does anyone here have one I can take?"

These observations indicated that the prototype was successful but due to its limited deployment and users lacking an empty snus container many were not able to participate.

These finding suggest that the prototype was well received by all users that encountered it, being both snus users or non-users. To increase engagement and gather broader feedback, future deployment over longer periods should be done in order to allow more users to participate allowing more users to accumulate a snus container to use to vote and interact with the prototype.

The findings from thematic analysis, suggest that the prototype was well received, and was met with great positivity when encountered by the users. Further improvements could be done, such as the addition and improvement of the signage for easier understandability and visibility. In addition a further improvement that could be made is a longer deployment periods to gather more diverse feedback and data, to further investigate the concept/ prototype,

6.3.5 Gacha Machine prototype - Cortége deployment Session

During the first deployment session at the Cortége event, the prototype was displayed at an elevated height to ensure visibility for passersby and people at the event in an active state. As to get the peoples attention during the event, the prototype was made visible to everyone in the area by using wolf whistles, which caused the majority of passersby to turn around, while an accompanying sign encouraged people to try their luck with the prototype, as shown in figure 5.11. During the deployment only one snus container was collected, with the user not winning anything. The verbal feedback and behavioral observations gathered during the deployment session were analyzed using thematic analysis, following the same framework of the previous sections for data analysis. Four themes were identified **Container Availability as a Barrier**, **Misinterpretation of the Prototype's Function**, **Positive Reception From Non-Snus Users**, and **Inclusion and Scope Suggestions** explained below:

Container Availability as a Barrier
A significant portion of approached participants (12 participants) expressed genuine interest in the prototype but were not able to participate as their snus containers were not yet empty. Seven users stated with some variation the statement of

> "Oh I have a full snus container but I'll definitely come by once it's empty"

indicating that the concept/ prototype itself resonated and generated interest for potential future engagement. Five users stated that they had recently purchased a new snus container and therefore could not participate at the moment, with comments such as:

> "Oh I just bought a new one, sorry"

indicating that the timing of the purchase of the snus container was an obstacle that prevented the interaction.

These interactions suggest that participation in the prototype was strongly dependent on the timing of the users consumption. While the prototype received genuine interest and traction from users, the single deployment session struggled to capture participation that resulted in snus container collection. As many of the users have already disposed of their empty containers elsewhere or have recently bought and still have a full container. The prototype would benefit from longer term or repeated deployment in public spaces, allowing users to encounter the prototype at a more appropriate moment in their consumption cycle. This allows for further investigation on the users behavior and feedback on the concept and prototype.

Misinterpretation of the Prototype's Function
During the deployment two users approached the prototype and asked

> "Are you selling drinks here?"

the users misinterpreted the prototype as a commercial vending machine unit. This misunderstanding may have been based on factors such as: the square shape, gumball-machine aesthetic, and the visible list of the possible drink rewards available displayed on either side of the prototype being misunderstood as a sell list of drinks.

Although only these users interpreted the prototype as a commercial unit, this observation highlights that the visual language of the prototype could introduce ambiguity about the system's actual purpose in a busy event context. The findings align with the alpha testing result, where the prototype's visual identity was perceived as playful and attention grabbing, but occasionally may introduce uncertainty to the actual purpose of the prototype.

These suggest that while playful interaction can successfully attract attention, it must be balanced with clear communication regarding participation and prototype purpose. Improving the signage and cues explaining that the prototype collects empty snus containers in exchange for chance based reward could reduce confusion and improve usability. Further emphasizing the importance of clear communication, as unclear communication may discourage engagement or create frustration among users.

Positive Reception From Non-Snus Users
Six users approached the prototype and expressed their interest and support of the initiative that is being taken, despite not being snus users themselves. Several comments such as:

> "I don't snus sorry, but cool initiative!"

demonstrated that the prototype generated positive reaction to users beyond the intended user target group. These responses could also be interpreted as the prototype can have a broader environmental initiative aimed at reducing nicotine related waste in public spaces.

These findings with the observations from the earlier snus voting ballot prototype, where both snus users and non-users expressed positive attitudes towards the concept and its environmental impacts. Many expressed their interest in seeing such a prototype or device be implemented throughout the city, to minimize incorrect disposal of snus container waste in nature or public spaces.

Inclusion and Scope Suggestions
Three users approached and raised questions about whether the prototype could be used to accommodate broader forms of participation or different waste streams. Two snus users commented

> "I don't have an empty snus container, can I still participate?"

suggesting that there is still interest in engaging with the prototype is some other form regardless of snus container availability. Another user suggested expanding the prototype's scope to collect cigarette butts, as another form of nicotine waste commented by

> "Oh you should collect cigarette butts instead if we are here collecting nicotine user waste!"

These interactions indicate that prototype and concept generated reflection beyond snus containers only and that users saw the potential for the prototype to address adjacent waste streams not only be a single purpose system. The findings indicate opportunities for future iterations of the concept to explore more participation models and accommodate additional forms of commonly associated litter associated with nicotine consumption.

The findings from the thematic analysis indicate that while the prototype was perceived positively from both snus and non-users, further improvement to signage and the visual language could be adjusted to reduce frustration and increase usability. The addition of alternative methods of participation and expanding the collected waste streams could further improve the prototype's usability and impact on the environment as stated by the users comments. During the deployment it was observed that some users squinted when looking at the prototype to read the signage and try to understand what it is, this will be resolved within the improved signage seen in the second deployment session.

In addition the goal of reducing the incorrect disposal of snus containers was successful, as a few hours after the event had concluded, the area was revisited and no litter was found in the locations where that the prototype had been visible in. In contrast, areas where the prototype had not been present contained several discarded Snus containers on the ground. This suggests that individuals that encountered the prototype were less likely to dispose of empty Snus containers improperly and would have used the prototype.

6.3.6 Gacha Machine prototype - Chalmers Student Union Building Deployment Session

A second deployment session took place as the first was deemed insufficient, this session took place at Chalmers Johanneberg campus Student Union Building by the main entrance for the increased foot traffic, where a different approach was taken, the prototype with the improved signage was left in a passive state. During this session, the prototype attracted the attention of passersby and was discussed and approached by both snus and non-snus users who wanted to better understand its purpose. During the testing session, the prototype was interacted with resulting in the collection of empty snus containers and the distribution of the prizes. This deployment resulted in the collection of 31 empty snus containers, representing the highest number collected during the course of the research.

Requiring themes were observed during this deployment, similar to those identified in the previous sessions. Themes such as: **Container Availability as a Barrier**, **Positive Reception From Non-Snus Users** and **Inclusion and Scope Suggestions** were repeatedly mentioned by users. The unstructured interviews conducted after the user interacted with the prototype generated positive feedback. Users made comments such as

"oh what a cool incentive"

and

"will you be here tomorrow and should I scan the qr code to learn more?

"cool that I could pant my container and get something out of it"

This feedback indicates that users responded positively to the interaction and expressed interest in returning for repeated use. Users appeared to value both the opportunity of disposing their container responsibly and the rewarding nature of the interaction. Further emphasizing that the users would like to see the prototype developed into a more permanent public installation.

Although from the observational data revealed several positive aspects of the prototype, a number of underlying issues could be reported. These findings will analyzed below by grouping them according to their "field of failure":

Disrupted Engagement Experience due to Prototype Failure
From a user experience perspective, it was observed that users had difficulty understanding that the crank mechanism needed to be turned twice in order to fully reset the system. Most of the users only turned the crank once after seeing their snus container fall into the prototype and stop. As a result, the mechanism required manual resetting after several user interactions. This caused some users to wait until the prototype was reset and ready to interact, potentially disrupting their interaction flow and creating mild frustration.

Prototype not prepared for several containers at once
Another design related issue concerned the size and internal capacity of the prototype. It became apparent when participants disposed of their snus containers, the containers accumulated and stacked on top of one another, eventually causing blockages within the prototype. This required manual intervention to level and reposition the container in order to clear space within the prototype. Similar to the previous issue, these interruptions negatively affected the user flow and overall engagement experience.

Token reliability and limited token count leading disruption of recycling action
Finally, the token distribution mechanism which was responsible for dispensing tokens when users disposed of their snus containers, proved to be unreliable in certain situation. In several cases, token became stuck along the token track and required manual assistance to function correctly. Additionally, the token supply ran out during the user interaction, requiring manual reloading and temporarily interrupting the experience.

All these issues stemmed from the structural limitations of the prototype itself, the plastic internal components and the sizing of the dimensions of the enclosure, which emerged as two main problem points. Despite these limitations the prototype was successful in fulfilling it purpose of creating a fun and playful interaction experienced by the users when disposing their empty snus containers.

The findings suggest that this prototype and the overall approach resulted in the highest number of participation and snus container collection. Users expressed interest in returning to use the prototype again. Furthermore, these finding empathize that the continued deployment and further development of the prototype could be beneficial for gathering additional insight and potentially developing the concept into a finished product.

7

Discussion

This chapter answers the main research question and its sub-questions, discusses the findings from the two prototypes and the engagement they produced, and reflects on limitations and issues that could not be addressed in earlier chapters. Recommendations for future work are also presented

7.1 The Unpredictability of RtD

Using RtD as a research method generated new and unpredictable results which we have not encountered during a predictable and predefined design process. RtD knowledge is generated through the act of making the artifact (see section 3.5) which means that the research direction shifted as the prototypes were deployed and evaluated. The distinction between active and passive states that surfaced from the Field phase in section 6.3, is an example of this. Active and passive states were not an object of study, but surfaced as one during the Field phase and became one of the more significant finds in this thesis.

This unpredictability is both a strength and a risk, as the study remained open to emergent findings, although at the cost of overall research structure. Design decisions were made iteratively and often in response to problems during the building and testing stage (see chapter 5). The two prototypes also evolved unevenly, with some concepts being scrapped entirely (such as the monetary and charity-based strategy) and some mechanisms reworked late in the process. The research process became more exploratory with richer results and findings, but also more difficult in terms of planning and fixed thesis deadlines.

The unpredictable nature of RtD made it difficult to fit the work into a predetermined thesis structure. That structure does not fully reflect the iterative design process and the findings that emerged across iterations. In practice, many parts of the earlier chapters 3, especially 4, 5 and 6 had to be restructured after the evaluations were completed. Because the prototypes also being low-tech artifacts exploring motivation in recycling, this difficulty mirrors the findings of Duhamel et al. (see section 3.2), which states that the low-tech design practices often follow another structure of presenting their contributions. In retrospect, this unpredictability was not taken into consideration early enough, which made framing the process and the report more difficult within the timeframe of this thesis. Nevertheless we hope the reader is able to extract the contributions made here, and that the future work sections provide a useful starting point should this topic be explored further.

7.2 Answer to RQ and Discussion of Findings

Based on the discussion of the results and findings from each of the prototypes tested throughout this research period, the research questions below will be answered using the findings of this study.

7.2.1 RQ1:

> *How do users interpret and experience the different motivational strategies expressed through each of the two prototypes?*

The analysis of both prototypes in the Lab and Field stages (seen in Chapter 6) shows that the overall experience was regarded as positive. Both prototypes generated interest and enjoyment among the users suggesting that both gamification and nature/ socially engaging interaction strategies could possibly reduce incorrect disposal of snus containers and encourage sustainable recycling practices. The gamification side of this reflects what Deterding et al. [20] describe, where game elements applied to non-game contexts can keep users engaged when meaningfully embedded. The nature-based and socially engaging side connects to Schwartz's Norm Activation Model [36], where pro-environmental behavior is triggered by a sense of personal responsibility for the consequences. The fact that both strategies generated engagement, but in qualitatively different ways, reflects the intrinsic and extrinsic split that Self-Determination Theory [34] describes, with each prototype activating a different mix of motivational drivers. However some users reported difficulties with the prototype functionality, this got resolved with additional clarification.

7.2.2 RQ2:

> *How does spatial placement interact with the designed interaction to influence recycling engagement?*

Spacial placement of the prototypes clearly influenced user interaction and engagement. Locations with higher visibility, accessibility and consistent foot traffic appeared to encourage more participation. This connects to the Theory of Planned Behavior [15], actual behavior depends not only on intention but also on the situation. The same users who were positive toward recycling did not always act on that intention, and the situational factors of the deployment, like visibility, accessibility, and ease of approach, influenced whether intention turned into action. Högberg and Sörqvist [32] found a similar pattern in their systematic review, where waste bins with features that made them stand out from their surroundings consistently attracted more use. Additionally, passive state placement may support sustained engagement more effectively than active placement (section 6.3), as users are more likely to remember and revisit the prototypes if they were placed in a static and consistent environment.

7.2.3 Main Research Question

What motivational strategies can be applied through interaction design to encourage reduced plastic waste from snus container disposal in Gothenburg?

This study suggests that gamification and socially engaging nature-based interventions, both expressed through tangible interaction, can effectively motivate more responsible disposal of snus containers.

The results indicate that motivational strategies implemented through interaction design could contribute to reducing the incorrect disposal of Snus containers. This connects to the motivation theory introduced in Section 3.4.1, where Self-Determination Theory [34] separates intrinsic, extrinsic, and prosocial motivation. In practice, the Gacha Machine prototype worked through a mix of extrinsic reward and intrinsic enjoyment of the tangible mechanism, while the Snus Ballot Voting prototype worked through social participation, which is itself an intrinsic form of engagement that emerged from the design rather than from the prosocial framing it was built around. In particular during this research, the gamification based prototype generated stronger engagement among the users, where several expressed interest in seeing a similar system being implemented in the real world. During alpha testing, users suggested a reward based recycling system, where points could be collected and exchanged in stores as a method that could further encourage sustainable disposal habits. Notably, this points toward exploration of the monetary/charity motivation strategy that was scoped out of this study (section 5.2), suggesting that approach may also hold potential in Gothenburg and would be worth exploring in the future.

Snus and Non-Snus User Engagement

Other results of the observations that should be considered and link back to the Background chapter, especially section 2.3.1 where "pant-retrievers" are mentioned. Although both snus and non-snus users expressed positivity toward the prototypes, this did not always translate into participation. During the daytime session and early nighttime session of the snus ballot voting prototype, numerous empty containers were observed on the ground but not recycled by passerby. This points to what Ajzen [15] describes in the Theory of Planned Behavior, where a positive attitude toward recycling does not always lead to the behavior itself. What changed at the later Andra Långgatan session was the context: participants actively sought out empty snus containers, both from strangers and looking for those laying on the ground in order to participate. A similar pattern was observed before the second field deployment of the Gacha Machine prototype (therefore it not being mentioned in the result), where classmates who had seen the rewards, collected snus containers from other users to gather enough to guarantee a star prize. This shows that if the prototypes are deployed and remain as engaging in their design and purpose, the pant-retriever dynamic may appear for empty snus containers.

Behavioral Framings in Real-World Contexts

Regarding the behavioral data gathered during the Lab and Field phase, users did not always engage with the prototypes in the way their motivational framing intended. This observation connects directly to the motivation theory introduced in 3.4.1. For the Gacha Machine, which was intended to be a Gamification motivator, it also drew on extrinsic motivation which falls into the monetary category mentioned in section 2.3.1 and section 3.4.1. Although the reward was perceived as a high value item compared to the material value of the recycled object, combined with the reported enjoyment of interacting with the tangible components and gamified traits of the prototype, this made it an effective engagement tool on its own. Self-Determination Theory [34] separates intrinsic and extrinsic motivation, but in this case the prototype's engagement came from both at the same time, the playful interaction and the appeal of the prize. Deterding et al. [20] also make the point that gamification can fall flat when it is reduced to rewards alone. This high-reward value surfaced some concerns about real-world implementation, with one Lab phase participant noting that in a deployed system the reward would outweigh the recycling value, tilting the incentive structure in favor of the reward rather than the act of recycling and interaction with the gamified system itself. This is something Deci, Koestner and Ryan [35] describe as the over-justification effect, where a reward that becomes the main motivator can take away the intrinsic interest the gamification was meant to provide. This therefore raises questions about viability that led the monetary strategy to be scoped out, as the gamification was effective partly due to the rewards being genuinely desirable but also the aspect of chance, which may be difficult to maintain outside a research context.

The Snus Ballot Voting prototype showed a more pronounced gap between its intended and actual motivational framing. It was designed around a nature-based and prosocial incentive drawing on Schwartz's Norm Activation Model [36], while becoming a conversation point and an intrinsic motivator especially during the Field phase. Rather than engaging with the ecological or reciprocal benefit of recycling, users were drawn to the question and the design of the prototype. This outcome might have differed had the prototype been tested in a passive state, but as for this study the motivation came primarily from social participation rather than the moral duty of recycling which nature-based incentives are intended to frame. The prototype's material and interactive form introduced a motivational dimension, social expression, that was not part of its original framing. Hornecker and Buur [26] make this point in their work on tangible interaction: the material form of a designed artifact shapes the kind of engagement it produces, which means there is rarely a clean mapping from a chosen motivational strategy to user behavior. Suggesting the importance of materially grounded analysis when designing for behavior change.

7.3 Limitations

In this section, general issues and drawbacks will be explained that have had an effect on the progress of the research and possible results.

7.3.1 Validity of Results

As explained above, the limited sample size used within this research can have an effect on the validity and reliability of the results due to the restricted amount of collected data. In addition the data was only collected within a few areas of Gothenburg, which limits the geographical scope of the study. Finally, the limited duration of the prototypes deployment could have prevented the collection of long term behavioral patterns and observation. All these issues may mean that the findings are not directly applicable to other cities, countries, or deployment in environments with different conditions and user behaviors.

Although this research scope was regarding empty snus containers in Gothenburg, Sweden, several findings may be transferable to other sustainable and recycling contexts. The importance of visibility, playful engagement, and tangible interaction is not unique to snus recycling, and similar principles could potentially be applied to other small-format waste streams such as food packaging, bottle caps, or takeaway containers. That said, the study took place in a Swedish cultural context and used prototype-based interventions, which means the findings should not be read as statistically generalizable results but as transferable design insights and processes that other projects can adapt. The active and passive deployment distinction, the role of material form in shaping engagement, and the motivational mechanisms identified are all likely to be relevant in similar contexts, but their specific outcomes will depend on the cultural and material setting of each deployment. This fits with the situated nature of Research through Design knowledge discussed in chapter 3 and 7.1.

7.3.2 Cultural Norms in Sweden and the Effect on User Engagement

During the Field phase, the active and passive deployment state was observed to affect the quantitative data (section 6.3). One factor that may explain the low engagement rates during certain sessions is the cultural reservedness which is commonly associated with Swedish public behavior. Swedish social behavior in public space is characterized by a reserved demeanor and a strong respect for personal space. This includes refrainment from interaction with strangers unless they have a specific reason to do so [63].

This is directly relevant to a public recycling intervention that depends on users approaching an unfamiliar object, and in the case of the Snus Ballot Voting prototype, on users engaging socially around it. This reserved behavior tends to soften in social settings involving consumption of alcohol, which may have contributed to the observed engagement during the nighttime session in section 6.3.4. This may help explain why the active state produced lower and more hesitant engagement: it required the user to approach the moving prototype. The passive state may have aligned better with Swedish norms by removing the social pressure of direct approach, allowing the users to engage voluntarily and out of curiosity.

7.3.3 External Collaboration Constraints

During the course of this study, several stakeholders and potential sponsors were contacted to support the research, as their support could have contributed to gathering additional feedback and data. Stakeholders such as Gothenburg City and Stena Recycling were approached to explore possible collaborations. Due to their involvement in waste management and recycling, collaborations with these stakeholders could have provided valuable insights into waste handling practices and enabled the deployment of the developed prototypes at stationary locations in the city. Due to a lack of support, it was difficult to deploy the prototypes within the city as that required permits and external connections. The opportunity to have deployed the prototypes in public spaces for extended periods may have resulted in the collection of more valuable and representative data.

In addition, several food and beverage companies were contacted regarding potential sponsorship opportunities, as the Gacha Machine prototype distributed prizes when the users recycled an empty snus container. Unfortunately, none of the contacted companies responded, which limited the variety of prizes available to the users. This also resulted in delays of the deployment, as the soft drinks had to be purchased through connections available at Chalmers University of Technology. Establishing collaboration with stakeholders and sponsors could have strengthened the research process, as these organizations possess greater public reach and marketing capabilities. Increased visibility through these trusted organizations may have encouraged more users to engage and interact with the prototypes, potentially leading to a larger amount of collected data and user feedback.

7.3.4 Workshop Access Delays

The main delays were related to the construction of the prototypes and public deployments phases. These issues arose due to the IxD department relocating from Lindholmen to Johanneberg, which resulted in restricted access to workshop facilities, including the wood, laser cutting, and 3D printing workshops which were vital for the construction. The safety sessions which were required for the access, were also delayed, further extending the project timeline. Once these training sessions were completed, access to the bookable 3D printers never got resolved, which required the use of the shared 3D printers located in the IxD studio, which operated on a first come first serve basis. This limitation restricted when the parts could be printed, leading to delays of the Gacha Machine mechanism.

These delays may have influenced the results of the thesis, as they have reduced the available time to conduct user testing and public deployment. If the prototypes would have been completed according to the original schedule, additional testing sessions could have been conducted, potentially leading to different outcomes.

7.4 Ethical Considerations

A major ethical consideration in this research concerns the relationship between gamification and nicotine consumption. As the Gacha Machine prototype incorporated game like mechanics and rewards, there was a risk that this experience could encourage unintentional increased nicotine usage to participate. During the second deployment of the Gacha Machine prototype, several participants expressed a desire to finish the rest of their pouches in their snus containers in order to participate in the experience, highlighting how gamified systems may reinforce potentially addictive behaviors. This was due to the prototype being deployed for one session only, longer deployment periods may resolve this issue as the users may revisit the interaction once they had finished their container. Due to nicotine products being inherently addictive, careful consideration was required to ensure that the prototype did not actively promote unhealthy consumption habits or normalize nicotine use.

The visual design of the Gacha Machine prototype also raised ethical questions. The vivid pink color and gumball machine aesthetic were chosen for visibility and playful appeal, but these choices risk further glamorizing a product that delivers nicotine. The same visual language that draws users in to recycle could be read as appealing to younger or unintended audiences. This tension between visibility (which the prototype needed to succeed) and visual responsibility (which any nicotine adjacent design must consider) was acknowledged throughout the design process and remains an open question for future iterations.

Another ethical concern involved the design of the waist bags that were given during the deployment of the Gacha Machine prototype. The waist bags resembled snus containers, which carried the risk of unintentionally glamorizing or marketing nicotine related products. To address this concern, the design was intentionally framed to be critical rather than commercial, with the resemblance functioning as a reflection of nicotine being addictive rather than endorsement. The base of the bag had the text "This product illustrates nicotine products which can cause addiction". The decision of why the bags resembled the themes and colors of existing brands was to create a conversation starter, as users may ask where and how they received the bag, which can result in more users deciding to recycle their empty snus containers properly. However, the possibility that users may interpret the aesthetic differently remained an important consideration throughout the research.

Informed consent and user autonomy were prioritized during the research process. Before participating in interview, testing sessions, or evaluations, all the users were informed about the purpose of the study and how the collected data would be used. Users were also informed and made aware that their involvement was entirely voluntary and that they could withdraw from the study at any stage without the need to provide a reason to do so. All collected data during this research, was handled confidentially and used solely for academic research purposes within the scope of this thesis.

Given the sensitive nature of nicotine products and topic, it was important to maintain a critical and reflective perspective on the implications of nicotine consumption during this thesis. This research did not aim to encourage nicotine use, but rather explore how interaction design and different motivational strategies may promote users to recycle their empty snus containers correctly rather than being disposed of incorrectly, such as in nature. Ethical implications of designing such engaging experiences around such products required continuous reflection throughout the development and evaluation of the prototypes.

7.5 Future work and Recommendations for Future Iterations

In this section issues with the prototypes will be described and possible solutions to resolve them. This is beneficial to know for anyone replicating or building these prototypes. Future work will also be mentioned in the later parts of this section, which will cover research and deployment improvements.

7.5.1 Snus Ballot Voting Prototype

This prototype did not present any issues that required resolution, however two improvements could be considered for future iterations. The first recommendation is the addition of signage on the front of the prototype, as the current design only includes text on the sides. Front facing signage would be particularly be beneficial if the prototype were to be deployed using a passive approach, as it could improve visibility and user awareness.
Another possible improvement would be the addition of a small disposal box where voting and non voting users could discard their used pouches. This could contribute to a cleaner user experience while also helping reduce the chance of used pouches discarded in nature. In addition, it could facilitate easier handling of plastic waste at waste collection facilities, as the plastic would already be organized.

7.5.2 Gacha Machine Prototype

Due to the moving parts and being more complex than the other prototype, there are areas of improvement that can be done to create a smoother user experience.

Dispensed Tokens

The first issue revolved around the tokens dispensed when users recycled their snus containers. The initial problem concerned the track on which the token slid on. Some of the tokens became stuck on the edges, fell off the track into the prototype, or failed to slide out to the user properly. To address these issues, the track could be constructed using a more robust material than cardboard and be enclosed to prevent tokens from bouncing out of place. Additionally, creating a steeper and smoother track, would provide a more reliable dispensing experience for the users.

The second issue related to the weight of the token itself. Since the tokens were 3D printed using PLA plastic, without any additional weight additions, the tokens dispensed inconsistently. Depending on the speed the user turned the crank, sometimes the token would fail to drop or cause multiple tokens to be dropped simultaneously. To resolve this issue, the token can be created using a heavier materials such as wood, metal or by adding weights to the 3D printed tokens, which could improve the reliability of the dispensing mechanism. And as the user feedback stated; using higher quality material and making the token larger could enhance the overall user experience and increase satisfaction compared to the current version.

Snus Container Issues

The first issue revolved around the empty snus containers getting stuck and failing to drop properly into the prototype. This issue became more apparent after more empty container accumulation in the prototype. In some cases the containers stacked vertically on top of one another when dropped into the prototype, causing a blockage when the users attempted to fully rotate the crank mechanism. To address this issue, a possible solution would be to empty the prototype more frequently or increase the storage size to minimize the chance of a blockages occurring.

The second issue involved snus containers becoming stuck between the panels of the crank mechanism, which prevented the containers from dropping correctly and therefore leading to blockages. This was partially due to users having the containers full with discarded pouches in the top compartment of the snus container, and due to the storage area being overfull. This resulted in the token mechanism malfunctioning as the now dropped containers would fill up the token slide as the containers would be redirected to the side. This issue can be resolved by increasing the spacing between the panels to reduce the chance of containers getting lodged between them. Similar improvements as for the Snus Ballot Voting prototype could be implemented, such as the addition of a small disposal box for the used pouches and including explicit signage explaining that the crank must be turned twice to fully activate and reset the prototype. Since a single rotation did not completely reset the mechanism, it had to be manually reset after some of the users. The design of the front panel could also be updated overall, as some of the alpha testing feedback mentioned the need for it, but it was solved temporarily with the external signage for the second field testing session.

Build materials

Build materials were not a major issue during the development and deployment of the prototypes during this research. However, several improvements could be implemented to minimize the risk of component failure and increase the reliability long term of the prototypes. In their current state, both prototypes contain 3D

printed PLA plastics parts. While this material was sufficient for the purpose of this research, their structural integrity has a higher chance of failing during long term deployment and repeated use.
To resolve this issue, all plastic parts could be replaced with metal replacements, to provide greater durability and resistance. The metal components also improve reliability of the prototypes, and could also enhance the overall tactile quality and robustness during user interaction, potentially contributing to a better user experience.

7.5.3 Research and Deployment Improvements

Several aspects of this research could be further improved and explored if future studies about this topic would take place. One major improvement being to evaluate the prototypes with a larger sample group in order to gather more diverse feedback and perspectives. Future research could also involve testing the prototypes in a wider range of locations or in different cities to investigate whether user responses could vary depending on the location and local context.

In addition, longer deployment periods could further strengthen the research findings. Extended deployment periods would allow more users the opportunity to interact with the prototypes. This is important as some users may encounter the prototype for the first time with no empty snus container available. By keeping the prototypes deployed for longer periods, users may have the possibility to return and participate at a later time. Furthermore, longer deployment may result in the collection of larger amounts of data, potentially increasing the reliability and validity of the research outcome.

Additional improvements may include refining the appearances of the prototypes to more resemble finished products that may be found in public. This could increase user trust and engagement, as the prototypes would appear to be more professional and credible. These improvements could be further supported through collaborations with established stakeholders, who may have the reach to help in gathering permits for longer term stationary public deployment of the prototypes.

Although, it is important to note that the prototypes developed in this study were purely research instruments, designed to investigate motivational strategies through interaction. They were not intended as finished products. Rather, the findings and design directions described here could serve as guidelines for future implementations of recycling systems that might be developed into finished public installations.

Implementing these improvements would allow the prototypes to be tested in more realistic settings and over extended periods of time, which may potentially lead to more authentic user interactions, feedback, and behavioral data compared to the shorter and more limited deployment done in this research. Having these consideration into future research may therefore strengthen the overall validity and reliability of the findings.

Further research could investigate how low technology tangible systems compare to more technologically complex systems in terms of sustained engagement. During the alpha testing of the Gacha Machine prototype, users highlighted several qualities associated with low tech interactions, suggesting that these factors may influence user preference and long term engagement. Future studies could therefore investigate which specific design qualities users value the most such as simplicity, reliability, and accessibility. Such investigation could provide valuable insights into how one can create a hybrid system combining both low-tech and high-tech qualities may increase usability, adaptability, and engagement compared to only relying on one technical approach.

8

Conclusion

The purpose of this thesis was to explore how different motivational strategies expressed through tangible interaction design, could potentially influence users' recycling behavior of empty snus containers in public spaces. The final prototypes developed using the research through design approach, demonstrated that physical and playful interactions were able to spark engagement, curiosity, and participation among users. The Snus Ballot Voting prototype encouraged social participation, while the Gacha Machine prototype generated excitement and anticipation through gamified rewards and playful interaction.

The research showed that the different motivational strategies did produce different forms of engagement. The Snus Ballot Voting prototype encouraged users to participate through expression, opinion sharing, and curiosity towards others' responses, while the Gacha Machine prototype created engagement through reward driven interaction and the excitement of chance. These findings suggest that recycling behavior is not only influenced by environmental awareness and accessibility, but also how the motivation is shaped and interactively designed. The use of tangible interaction appeared to reduce the friction in the recycling process by creating engaging and unique interactions that do not require digital literacy, application downloads, or complex instructions.

The low-technology nature of the prototypes became an important aspect of the research, as it does not rely on applications, digital systems, or any peripherals, demonstrating that physical interactions can encourage engagement in public environments. Some users appreciated the simplicity and directness of the interactions, while others expressed a desire for more features and clearer on-boarding. This highlights the importance of interaction clarity in public installations, especially when users encounter them spontaneously and without guidance during their day.

Although the prototypes successfully generated engagement, several limitations became visible through the duration of the research. The limited time frame and scale of deployment restricted the possibility for conducting long term behavioral change, as the novelty effect of the prototypes may have influenced some of the users responses. Additionally, monetary and charity based motivational strategies, which were initially intended to be a part of this research could not be fully explored due to practical constraints in relation to sponsors, stakeholder collaboration, and implementation feasibility within the project's timeline.

Beyond these findings, the thesis also shows that interaction design methodology, applied through Research through Design and low-tech tangible interaction, can be used to prototype environmental awareness in public spaces. The two prototypes did not function as finished recycling systems but as research instruments, which surfaced design knowledge that would not have emerged from theory alone. The material form of an artifact shaped which motivational mechanism actually engaged users, deployment configurations affected engagement as much as the artifact itself, and low-tech physical interactions did the motivational work that digital sustainability interventions usually rely on screens to do. This positions tangible interaction design as a useful approach for engaging citizens with environmental behavior change without the cognitive disruption of digital systems, and contributes documentation of low-tech design practice in a research area where such documentation has been called for.

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A
Appendix 1

A.1 Initial Survey

Initiatives for recycling Snusdosor

Hello and thank you for taking the time to take part of this survey!

We are a group of two students conducting our master thesis from the Interaction design and methodologies program. We would like to ask you a few questions regarding your recycling practices for Snusdosor and what would entice you to begin to do so. Below there is a checkbox list with options that you can choose from, in which you engage with when having an empty dosa!

Our goal is to reduce snusdosor being disposed improperly and create an engaging experience for all!

Thank you for taking the time to answer this survey!

If you have any questions regarding the study or other questions for us contact us:
Julia Giaro : giaro@chalmers.se
Taofik Arnouk: arnouk@chalmers.se

* Indicates required question

1. In which age group are you from? *

Mark only one oval.

- 18 - 24
- 25 -34
- 35 - 44
- 45 - 54
- 55 - 64
- 65+

2. Do you often struggle with accessibility issues?

3. Can you tell us what makes you recycle in the first place? *

4. What incentive drives you to source sort and recycle? And if you don't, then why and what could be improved with the current recycling systems?

5. Do you buy Snus/ Tobacco products? *

Tick all that apply.

- [ ] Yes, white portion pouches
- [ ] Yes, tobacco snus
- [ ] Yes, cigarettes
- [ ] No
- [ ] Other: ____________________

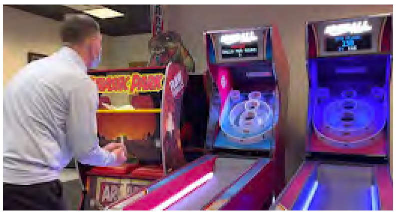
Different incentives/ motivations

Below are 3 categories for the different incentives to recycle snus containers, please selected the options/ choices that you would like to see in the real world.

6. Gamification incentives *

Tick all that apply.

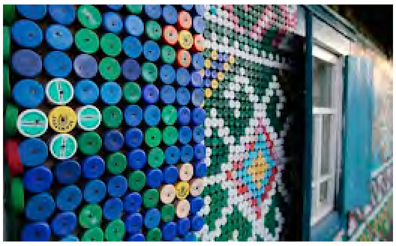
- [ ] There was an air hockey table that you could play for free in exchange for an empty snusdosa



- [ ] There was an arcade game that would use old snusdosor as " balls" for you to hit point holes and then you could win plushies or something other

- [ ] There was a round slot in bar tables that would allow you to play "shoot the dosa in the hole" and only if you get it right the empty snusdosa would then be disposed.

- [ ] There was a board game station for exclusively round playing pieces that would allow you to play a game and then get rid of the pieces afterward



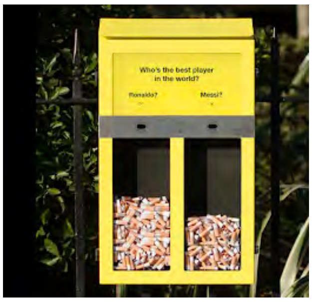
- [ ] There was an interactive pixelart snusdosa art installation that you could contribute in with disposing your snusdosa to create an artwork?
- [ ] There was a pant machine that allowed you a chance to win prizes in exchange for recycling your snusdosa.
- [ ] Other: ____________

7. Environmental incentives *

Tick all that apply.

- [ ] There was a fine that you had to pay if you disposed of your snusdosa incorrectly.

- [ ] There was a free device that you could use that would help you to cut out beads out of the snusdosor to create bead art



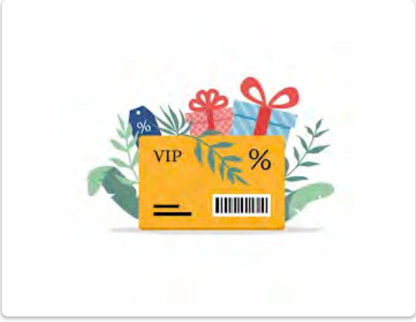
- [ ] There was a ballot voting system where you could give your opinion on eg: "pinapple on pizza?" With slots where you could put your empty snusdosa for the yes and no box

- [ ] There was a bird seed dispenser in parks that took snusdosor, instead of coins.

- [ ] Other: ____________

8. Money/ Points incentives *

Tick all that apply.



- [ ] There was a point based system to give you discounts at stores if you recycle snusdosor.

- [ ] There was an incentive by the city of Gothenburg when there is a festival, you would pant your empty snusdosa and gain either a discount or if panted enough an entire food voucher you could use

- [ ] There was a community engaging cause to collect snusdosor to make wheelchairs for children
- [ ] Other: __________

9. Where would you like to see these recycling solutions (see above) in your city? *

10. How often do you sort out plastic waste while on the go? (while outside the home) *

Mark only one oval.

	1	2	3	4	5	
Nev	◯	◯	◯	◯	◯	Always

11. **By ticking the box below, I confirm that:** *

I have received information about the purpose of this study.

I understand that participation is voluntary.

I understand that only my age and survey responses will be collected.

No personally identifying information will be stored.

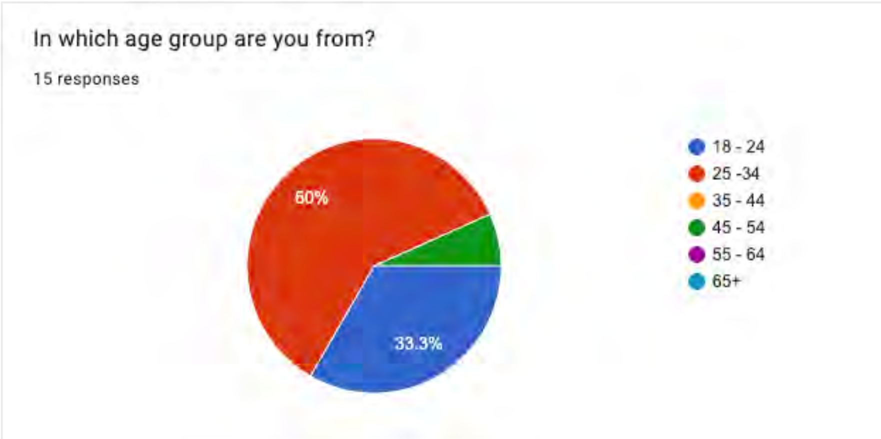
The data will be used solely for academic research for Chalmers University of Technology and stored securely.

I may withdraw at any time before submitting the survey.

Mark only one oval.

◯ Yes, I agree

A.2 Initial Survey with Answer Data



Do you often struggle with accessibility issues?

15 responses

No

no

Nope

For recycling, maybe half of the time

Recycling these are not incentivised thus having limited living space and without a car means trashing them is the most effective way for getting rid of these empty cans.

nope

Can you tell us what makes you recycle in the first place?

15 responses

I recycle because I'm "supposed to", also pant on bottles is a good incentive

Honestly I don't recycle as much as I "should". But when I do it's mostly because it's easy to do and doesn't cause me any extra work.

The glory of Kazakhstan

My want to keep the environment clean and have a good conscience

Duty and honor

Money or deposit, otherwise convenient access to recycling services and some kind of reassurance that what ever I given in for recycling is really recycled instead of being burnt or sold again.

Convenience, environmental impact

For the environment, but honesty also because were supposed to

It's easy, especially when we prepare it beforehand

Peer-pressure

A sense of obligation. I like to follow rules. Also I know some it is beneficial to the environment, though for plastics this is lower than people might think or hope but it is still better to do so than not do so.

Habit from growing up and being forced to. (that's a good thing)

its good for the environment

ethical and societal norms, as well as saving energy and reducing personal carbon footprint

Good for the environment, duty to my fellow and future humans

What incentive drives you to source sort and recycle? And if you don't, then why and what could be improved with the current recycling systems?

14 responses

I source sort when it is convenient and not overly complicated. Stuff like cardboard boxes are easy, while say a milk carton that is mostly made from paper but has a plastic lid that's stuck on it is more difficult cause you would have to seperate them, so those I end up putting in the "normal trash".

Making it as easy as possible

They make it so easy with different containers for different things. But I think that in my own soprum at Chabo it is the wild west, no sorting allowed.

At home it's more of a space issue, being as I live in a smaller appartment. In public it is all about accessibility and how soon I can find someplace to recycle. Half of the time I'll resort to simply using a trash can because I know I won't come past a recycling station for a while and don't want to carry around trash for extended periods of time.

No incentives, just a feeling of duty for the environment and planet

I need a recycling bin near regular bins outside and more space to store sorted waste at home.

Convenience, good space to dispose of garbage

That it is easy to do so mostly, but it can be hard to if you live in a small space.

Rewards and shame

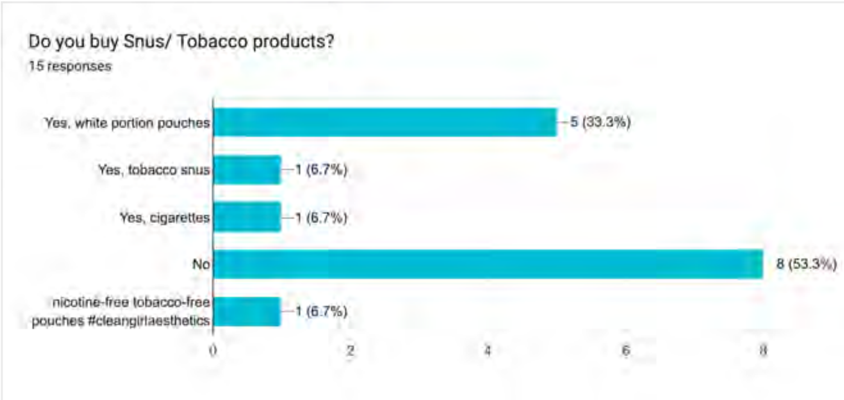
Pantbrev is an incentive and also the recycling bins are so close to where people live that it is as easy as taking out the trash so it reduces the inconvenience of separating the rubbish.

I recycle the most when it's easy and convenient. If i'm not at home and the recycling bins are far away, I often throw trash that could be recycled into burnables instead, when the other option is carrying it with me.

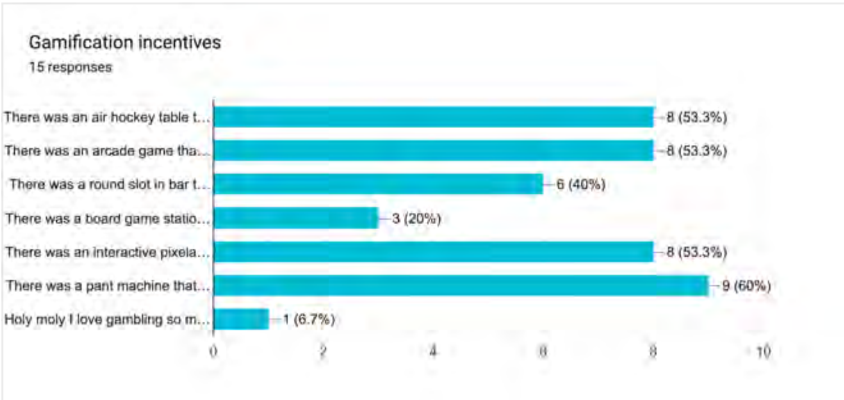
because its good for the environment to recycle

improving sustainability

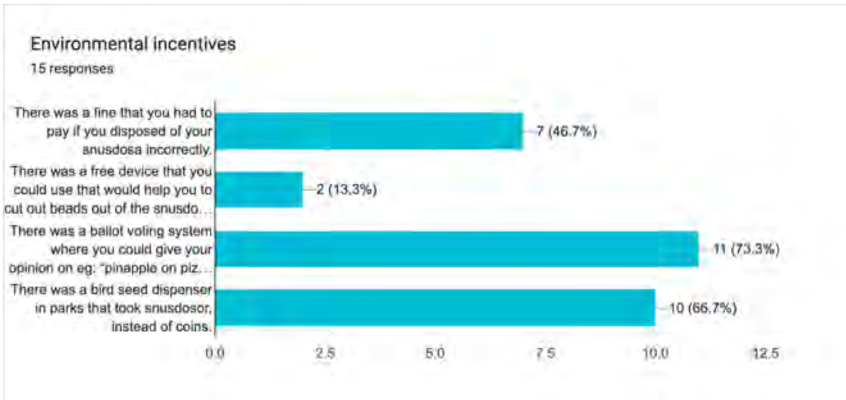
Duty and responsibility. We need to recycle to make the world a better place for everyone



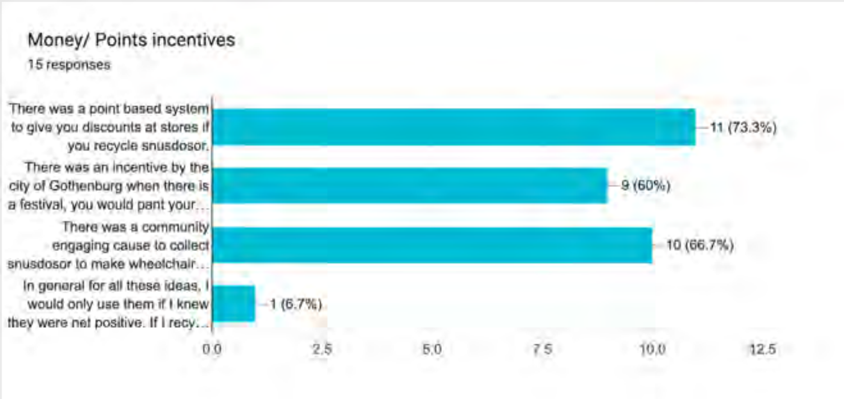
Do you buy Snus/ Tobacco products?
15 responses
Yes, white portion pouches
Yes, tobacco snus
Yes, cigarettes
No
nicotine-free tobacco-free pouches #cleangirlaesthetics
5 (33.3%)
1 (6.7%)
1 (6.7%)
8 (53.3%)
1 (6.7%)
0
2
4
6
8



Gamification incentives
15 responses
There was an air hockey table t...
There was an arcade game tha...
There was a round slot in bar t...
There was a board game statio...
There was an interactive pixela...
There was a pant machine that...
Holy moly I love gambling so m...
8 (53.3%)
8 (53.3%)
6 (40%)
3 (20%)
8 (53.3%)
9 (60%)
1 (6.7%)
0
2
4
6
8
10



Environmental incentives
15 responses
There was a fine that you had to pay if you disposed of your anusdosa incorrectly.
There was a free device that you could use that would help you to cut out beads out of the snusdo...
There was a ballot voting system where you could give your opinion on eg: "pinapple on piz...
There was a bird seed dispenser in parks that took snusdosor, instead of coins.
7 (46.7%)
2 (13.3%)
11 (73.3%)
10 (66.7%)
0.0
2.5
5.0
7.5
10.0
12.5



Where would you like to see these recycling solutions (see above) in your city?

15 responses

Everywhere / anywhere it is appropriate depending on what it is. Central in the city, like Avenyn etc

Not sure. But somewhere central.

In public places with lots of people, but especially outside of bars etc

Close to stores where you would go to buy a new dosa or at recycling stations in apartmentcomplexes and other living spaces

Close to grocery stores or the bar street

Near big supermarkets or pharmacies

By stores, maybe bus and tram stops (for a good distribution)

Depends a lot on which one, where they "blend in" or fit

Gothenburg

At festivals and large events

At the regular recycling stations, or maybe in high (foot) traffic areas where a lot of people hang out and drop snusdosor such as the square at Brunnsparken

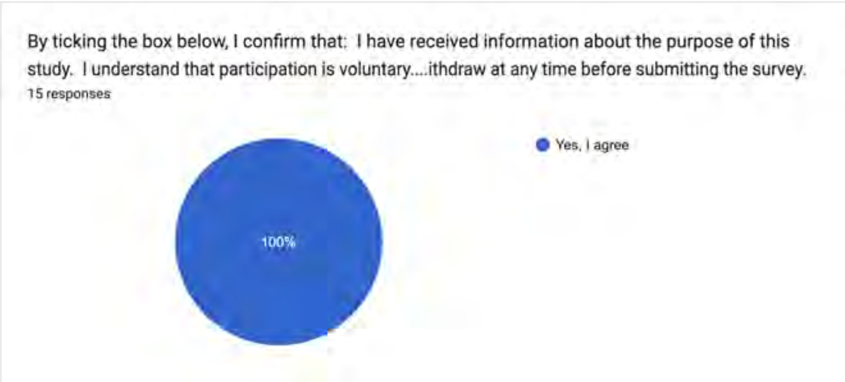
A great place to collect snusdosor would be at PANT stations. I could see myself saving the dosor and bringing them with me when i go grocery shopping just like i would with PANT

in parks maybe?

in the city center so there is actually something interesting there

Accessible but out of the way so you don't have to think about them if you're not a snus person yourself


How often do you sort out plastic waste while on the go? (while outside the home)
15 responses
6
4
2
0
3 (20%)
5 (33.3%)
3 (20%)
3 (20%)
1 (6.7%)
1
2
3
4
5


By ticking the box below, I confirm that: I have received information about the purpose of this study. I understand that participation is voluntary....ithdraw at any time before submitting the survey.
15 responses
Yes, I agree
100%

A.3 Alpha Testing Gacha Machine Prototype Consent Form

Consent form alpha testing

By participating in this alpha test, you agree to take part in a user evaluation of our prototype application.

During this session, you will be asked to interact with the prototype and share your opinions, impressions, and feedback. After testing the prototype, you will be asked a series of follow-up questions regarding your experience.

We will only collect your responses and opinions related to the prototype. To protect your privacy, your name will not be recorded in full; instead, it will be abbreviated or anonymized in any notes, reports, or publications.

Your participation is voluntary, and you may choose to stop at any time without providing a reason. The information collected will be used solely for research and development purposes to improve the application.

By proceeding with the test, you confirm that you understand the purpose of the study and consent to the collection and use of your feedback as described above.

* Indicates required question

1. I agree to the statement above *

Mark only one oval.

( ) Yes

A.4 Questions for the Alpha User Testing of the Gacha Prototype

Below are the questions that were ask to the participants during the Alpha testing session of the Gacha Machine Prototype.

- How do you feel about the prototype in general?
- How easy was it to use?
- Was the usage intuitive?
- How do you feel about the color?
- How do you feel about the design?
- Would you use it if it was deployed in public (and where in public)?
- What else would you like to see/ implemented?
- What do you think about the tokens?
- Or what do you believe can be approved of this prototype would become a real product?

A.5 Answers from the Alpha User Testing of the Gacha Prototype

Gacha Alpha — User Testing

Compiled & Translated User Feedback

10 participants • Mixed snus-user and non-user sample

Note: This document contains lightly cleaned and translated user-testing notes. Swedish responses have been translated to English. Minor clarifications are added in square brackets [ ] where context was needed.

User 1

[Researcher note: Non-snus user.]

How do you feel about the prototype in general?

It is fun. Even if I don't use snus, it would catch my eye. I like the aesthetics. An additional explanation on the box would be better, as it would explain what the prototype does. If I don't have a snus container it's hard to use.

How easy was it to use?

It's easy to use. It's nice to have mini and regular on the box. Once you put it in, it's easy and intuitive — you can hear the coin drop when you spin the mechanism.

Was the usage intuitive?

(Covered in previous answer.)

How do you feel about the colour?

It's Barbie-esque, which is appealing. Usually recycling machines are green, but this colour is nice because it stands out.

How do you feel about the design?

(Covered in previous answer.)

Would you use it if it was deployed in public? Where?

By trash cans, in combination with or near trams, or in the centre of Gothenburg.

What else would you like to see implemented?

(No specific answer recorded.)

What do you think about the tokens?

Tokens could be a different colour — the inside of the coin-drop dish is silver so the token could be camouflaged. The 3D printing is a bit rough but you can still read the text.

What do you believe can be improved if this prototype became a real product?

A sign to indicate what it is — maybe on top — so people understand what it does. Bigger windows so people can see their recycled snus containers inside.

User 2

[Researcher note: Non-snus user.]

First Impressions

"That's kinda nice."

How do you feel about the prototype in general?

It would be nicer to have just a slot since it's see-through. The mechanism jammed a bit — I was scared to spin it more in case the prototype broke. More indication for how/when to spin would help.

How easy was it to use?

It was easy.

Was the usage intuitive?

Yes, but the vertical placement of the prototype should be higher — I couldn't see the snus can drop.

How do you feel about the colour?

I like it. It's fun. As mentioned, recycling is usually green but this works.

How do you feel about the design?

(Covered in previous answer.)

Would you use it if it was deployed in public?

If I walked past it with an empty snus can, yes — it's a rare occurrence, but people still drop theirs on the ground. If I walked by and saw an empty one, I would recycle because I'd get free stuff.

What else would you like to see implemented?

Public transportation hubs — bigger stations. Also the student union building and similar places.

What do you think about the tokens?

The token drop was expected and satisfying. The text is a bit hard to read, but this is a prototype. The token should be bigger — it should feel like a token, not a coin.

What do you believe can be improved if this prototype became a real product?

Increase the height so you can see the snus can drop. Close off the top so containers only go through one slot. Add a tunnel/funnel for the containers. Signage helps if the windows are too small to give context on their own.

User 3

[Researcher note: A snus container fell down the wrong hole and blocked the coin chute. The user got frustrated when they didn't receive a token, but the blockage eventually cleared itself. Snus user.]

How do you feel about the prototype in general?

I have a problem with it, but the concept itself is fun — when it works, it works well. Question: is the intention to always have someone present with the machine?

How easy was it to use?

Clearer arrows on which way to spin would help. The coins/tokens look like something you'd insert into the machine yourself rather than receive as a reward. Consider removing that ambiguity. As an interaction designer — include more feedback for when the token drops. Otherwise, easy to use.

Was the usage intuitive?

Yeah, I would say so, but I'm biased. Good that the mechanism spins correctly.

How do you feel about the colour?

Eye-catching. I like it. Would be good to display what you can win rather than just letting people toss a container without knowing what the machine does.

How do you feel about the design?

(No specific additional answer recorded.)

Would you use it if it was deployed in public?

As a snus user, yes. On campus, at kiosks, for buying new snus, and at clubs/venues where people go through a lot of containers.

What else would you like to see implemented?

Apart from the gap issue, I'd like to redesign the coin-drop area — maybe make it longer so the token rolls out more satisfyingly.

What do you think about the tokens?

It looks like a coin. It would be nice if it looked more like a snus container. The text should be larger. General consensus is that bigger would look better.

What do you believe can be improved if this prototype became a real product?

A cleaner path for the snus containers — maybe a visual guide or plastic window. The box should be larger and freestanding so it could be moved around.

User 4

[Researcher note: Non-snus user.]

How do you feel about the prototype in general?

It's nice. The lid/top part isn't finished. It would be nicer with a slot. The turning mechanism feels a bit dry/rough compared to the colour of the 3D print.

How easy was it to use?

(No specific answer recorded.)

Was the usage intuitive?

Yes, it was intuitive.

How do you feel about the colour?

(No specific answer recorded.)

How do you feel about the design?

Don't like the three coins drawn falling into the token disposal — that felt non-intuitive.

Would you use it if it was deployed in public?

Not out of my way, but if it was somewhere along my regular route I would use it. Bus stations, tram stops, or somewhere close to where someone would buy snus.

What else would you like to see implemented?

Unsure about the windows — they don't currently convey meaning. Wants it positioned higher, maybe at eye level or slightly above.

What do you think about the tokens?

A bit hard to pick up from the dispenser tray. If you get a 'try again' token you wouldn't want to — you want to win actual prizes. Having prizes listed on the side would motivate continued play if you understood there were better rewards available.

What do you believe can be improved if this prototype became a real product?

Clearer communication of what the windows/score display means to the user.

User 5

First Impressions

"Wow, that's cool."

[Researcher note: Non-snus user.]

How do you feel about the prototype in general?

I like the colour, it's very nice. No familiarity with snus and typical user behaviour. A bit confused about what to do with the tokens.

How easy was it to use?

Highlight the key interactions a bit more — otherwise easy to use. In another context I've seen something similar where you put in an old product and get something smaller in return.

Was the usage intuitive?

Yes — old gumball machine vibes.

How do you feel about the colour?

Colour is nice. The mini/regular distinction in the design doesn't make sense to me as a non-snus user.

How do you feel about the design?

Similar to a recycling ('panta') machine. Maybe an explanation would help.

Would you use it if it was deployed in public?

Next to shops like Pressbyrån, major squares and stations, malls — places with a lot of foot traffic.

What else would you like to see implemented?

Maybe add the recycling logo, or highlight it more — some lights or something.

What do you think about the tokens?

Sufficient as-is. If used in multiple places, it would be nice for the token to be usable elsewhere too.

What do you believe can be improved if this prototype became a real product?

The design and concept are nice, but needs lights, some explanatory text, a bigger and taller box. Maybe a sign indicating an age restriction.

User 6

First Impressions

"Woah!"

[Researcher note: Non-snus user.]

How do you feel about the prototype in general?

It's cool. No idea what regular vs mini means as a non-snus user. No idea what was supposed to happen, but impressed that I still managed to use it.

How easy was it to use?
Got lucky using it.

Was the usage intuitive?
Could be more intuitive — it wasn't immediately obvious that you need to spin it.

How do you feel about the colour?
It's a lot happening visually. Now that I've used it, it makes more sense, but it could be clearer.

How do you feel about the design?
(No specific additional answer recorded.)

Would you use it if it was deployed in public?
If I were a snus user, why not. Depends how far out of my way — 5 minutes out of my way, I might even save up containers and use them all at once.

What else would you like to see implemented?
Make the coin graphics on the design look more circular/money-like. More explanation of how the tokens and drinks reward work — probably on the box itself.

What do you think about the tokens?
Tokens are fine but need more explanation of how they work, on the box presumably.

What do you believe can be improved if this prototype became a real product?
Maybe make it automatic — touchless would be more sanitary. Automatically dispenses the token without needing to handle it.

User 7

[Researcher note: Snus user.]

First Impressions
"Very pretty! Oh, I won the grand prize! Fanny packs are nice."

How do you feel about the prototype in general?
The tactile feel is nice. Happy it isn't a touchscreen. The colour is attention-grabbing. Perfect amount of personality.

How easy was it to use?
(No specific answer recorded.)

Was the usage intuitive?
I was a bit scared of breaking it. It would be nicer if there were no resistance when spinning it back — that would make it more intuitive to spin it all the way through.

How do you feel about the colour?
(No specific answer recorded.)

How do you feel about the design?
(No specific answer recorded.)

Would you use it if it was deployed in public?

Yes, absolutely. Somewhere people walk a lot and visit regularly. Needs a sign. At the top like a recycling machine. Bus stops, central areas, construction sites.

What else would you like to see implemented?

(No specific answer recorded.)

What do you think about the tokens?

Tokens are nice but I don't currently understand what to do with them. They might be a bit thin — easy to pocket and walk away with.

What do you believe can be improved if this prototype became a real product?

More instructions — more text and explanation of what the function actually is.

User 8

First Impressions

"I recognise this is a regular snus container, so I put it in and spin."

[Researcher note: Familiar with the product concept. Ex snus user]

How do you feel about the prototype in general?

Obviously this is the interactive part of the product. I'm biased since I know it well. If I didn't know what it was, I wouldn't understand it — you need to introduce this to the user. Once you know what it is, it's fun and easy to use. The symbols make sense.

How easy was it to use?

Yes — as long as you know what it's for. You need to introduce the concept and explain how it works, e.g. 'now you can recycle snus containers here.'

Was the usage intuitive?

(No specific additional answer recorded.)

How do you feel about the colour?

Debate topic: there's a question of whether snus containers should look too fun and attractive given ongoing policy discussions around packaging (similar to cigarette packs). That said, the design is fun, modern, and eye-catching — which is positive here. It's obvious where to turn due to the design. The recycling logo should be more prominent. Fun to have them in different colours, just to make them pop.

How do you feel about the design?

(No specific additional answer recorded.)

Would you use it if it was deployed in public?

Yes, definitely. Why not.

What else would you like to see implemented?

Very excited about the fact that recycling earns a free drink — that's much more motivating than getting a few kronor from a regular deposit machine.

What do you think about the tokens?

A receipt or a screen linked to an account that accumulates points would be nice. The token-as-coin format feels a bit 'meh' — people don't like loose change. The thinness is nice but they risk ending up discarded in nature, which defeats the purpose.

What do you believe can be improved if this prototype became a real product?

A QR code or an app with an account system — that would make it more accessible and eliminate the physical token problem.

[Additional researcher note: This user dislikes the gambling aspect but noted that their empty snus containers currently end up in plastic recycling anyway.]

User 9

[Researcher note: Snus user.]

First Impressions

"Woah, oh my god, so cool! Tokens? For me?"

How do you feel about the prototype in general?

In general it's great. The colour scheme is amazing. The tangible feel is good (though it feels like it might break). Needs a cover — the mechanism seems to drift right.

How easy was it to use?

The illustrations make it easy to understand, but didn't expect to receive anything from the coin chute — that was a pleasant surprise. Made me wish I used snus more so I could use it more.

Was the usage intuitive?

(No specific additional answer recorded.)

How do you feel about the colour?

Happy, cool, fun, girl-power energy.

How do you feel about the design?

(No specific additional answer recorded.)

Would you use it if it was deployed in public?

Definitely. People not sorting their waste makes me mad so I'd encourage everyone to use it. Best placed where litter is most common and near trash cans: bus stations, around pubs/pub streets.

What else would you like to see implemented?

Sprite (as a prize). Maybe a place to dump used snus (the moist tobacco inside) — a dump compartment on the side.

What do you think about the tokens?

Great, didn't expect them. The prizes felt almost too good. The gambling element might make some people feel bad — maybe don't display the drinks visibly? And consider printing the odds on the machine.

What do you believe can be improved if this prototype became a real product?

Most concerned about the snus dump — make that a feature so the plastic container comes out clean and ready for recycling.

User 10

[Researcher note: Non-snus user.]

First Impressions
"Wohoo!"

How do you feel about the prototype in general?
Hard to know what you're looking at. Nobody would know it's for recycling — state the obvious more clearly.

How easy was it to use?
Could be easier. The wavy design elements make interface sense, but there's a bit too much happening visually.

Was the usage intuitive?
Not without a sign — without signage I wouldn't understand it. Needs a more intuitive design.

How do you feel about the colour?
More structure, less clutter. A bit too much going on on the box. Needs a more intuitive design overall.

How do you feel about the design?
(No specific additional answer recorded.)

Would you use it if it was deployed in public?
If I knew what it was for, yes — and if there's something on the box that communicates the purpose. Appeal to emotions.

What else would you like to see implemented?
Make it more emotionally engaging and fun. For example, turn it into a kind of music box, or have it play a sound when you complete the action. More playfulness in the interaction.

What do you think about the tokens?
They feel light and not very valuable. Heavier would feel better.

What do you believe can be improved if this prototype became a real product?
Consider alternative reward systems — like points. Wants to avoid the gambling associations.

A.6 Questions Displayed on Snus Ballot Voting Prototype During Field Testing

Below was the list of questions that were displayed on the prototype (and their translation to English):

- Who has the creative rights to AI content? The user or The creators of the database its using.
- Ladyboys or Femboys.
- AI på arbetsplatsen eller inte? (AI in the workplace or not) Ja AI (Yes AI) or Nej man borde göra det själv (No one should do it themselves).
- Vad är bäst? (What is best?). Crypto or Aktier (stocks).
- Vilken dryck är bäst? (Which drink is best?). Pepsi or Coca Cola.
- Är du beroende av snus? (Are you addicted of Snus?). Ja (Yes) or Nej (No).
- Är du för eller emot Abort? (Are you for or against abortion?). Mer bäbisar åt folket (More babies for the people) or My body my choice.
- Borde kollekivtrafiken vara gratis? (Should public transport be free?) Ja (Yes) or Nej (No)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden
www.chalmers.se

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