Product care agency:

Stimulate consumers to perform product care behaviors with optimal balance between user control and product agency

Master thesis

Stimulate consumers to perform product care behaviors with optimal balance between user control and product agency

Master Design for Interaction

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Exclusive summary

The environmental impact of our current consumption pattern on the earth is growing. The linear economy is accelerating the environment pollution and increasing the use of resources. If we want to be able to gradually move towards a circular system it is vital to include in this strategy the way products are being cared for, which is Product care. Product care is an approach to use a product as a means to catalyze consumers' care behaviour change. It does so in a user-in-control way (you wash your coffee machine regularly without any reminder), but also in a product-in-control way (the coffee machine will stop working if you don't wash it on time). The control degree of the product care means the degree of consumer autonomy over product care behavior and the degree of product intervention on the user.

This project is aiming to explore what is the optimal balance between these two ways when they design for product care. This goal is reached by using the research-through-design approach.

In this study, three strategies of product care with different control degrees were formulated through analyzing and combining existing strategies from circular design and behavioral change design fields. Based on three strategies, six concepts were generated to test which strategies and control degree are most effective. And the result was that users preferred the concept of a balanced product care agency.

To verify and further define the optimal balance between user in control and product in control, the control degree mechanism of product care was formulated which includes 3 aspects, 7 themes and 15 design elements. The mechanism can be used to help the designers to determine the agency of the dominant product care in the concept by determining the control degree of the design elements contained in the concept, which has been validated by the second user test.

Besides, at the end of the project, the most effective and user's preferred scope of balance between user control and product agency in the mechanism are provided:

Awareness (The design intervention increases the awareness of product care and helps users to start care activities consciously.)： Balanced or more user-oriented

Support (The design intervention supports the user in the process of product care, making care activities cognitively or behaviorally clearer and simpler.): Balanced or more product-oriented

Feedback(The design intervention will give users feedback when they complete or fail to complete their product care activities.): Balanced

Acknowledgement

I would like to thank my wonderful supervisory team for their support, their insights and their discussion. So thank you Paul, for the critical questions and inspiring tips, during the meeting, you often liven up the atmosphere with your sense of humor and make me feel less nervous. Thank you Renske, for always wanting to help out, providing feedback and patience, you always encourage me to make my own choices and give me more confidence. Thank you all, not only have you supported me whenever I had my doubts or struggles, you gave me many helpful suggestions in the research process. This motivated me, and made me more confident about the topic as well.

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Peiyue

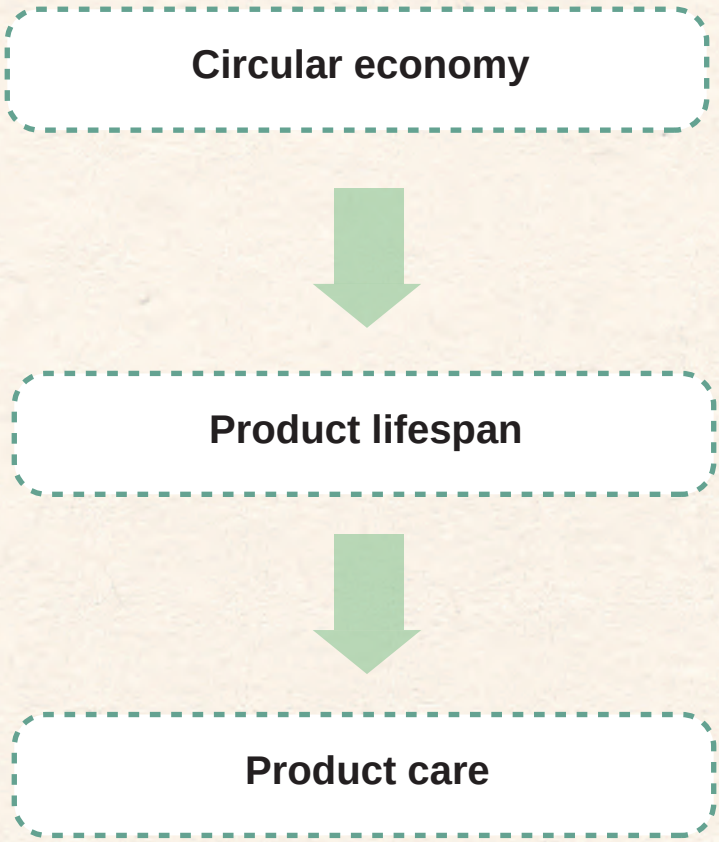
Table of contents

Table of contents

Table of contents

1 INTRODUCTION

This chapter illustrates the context of the project, background information, research questions and research domain to manifest the relevance of product care. It provides an overview of the project's structure.



Circular Economy

The environmental impact of our current consumption pattern on the earth is growing. The linear economy, where raw materials are made into products, are used by consumers and eventually thrown away to end up in landfills or incinerators, is accelerating the environment pollution and increasing the use of resources (Sariatli, 2017). According to Jackson(2011), because of population growth, material consumption will increase by three billion in 2030. This will have an impact on the availability of resources, the number of products disposed of, and the environmental problems resulting from unmanageable waste.

For our future, it is a good moment for designers to facilitate the shift from the current linear way of consumption. The circular economy is viewed as a promising approach to help reduce our global sustainability pressures. (Ackermann 2018), which focuses on slowing down the resource flow, and closing and narrowing down material loops (MacArthur, 2015).

The Ellen MacArthur Foundation supports this sustainable behaviour by providing businesses with frameworks in which the traditional linear economy (make, use and dispose), is replaced by a circular model which focuses on maintaining a continuous flow of technical and biological materials by looping them into the system (fig 1.1). The optimization of resources is essential to increase utility of products, components, and materials which are in the different cycles. And there are five practices which are presented as routes to get the highest utility: recycle, refurbish/remanufacture, reuse/redistribute, and repair /maintenance.

But completely changing the system of how our economy works and realizing this shift to a durable and sustainable economy, is a difficult

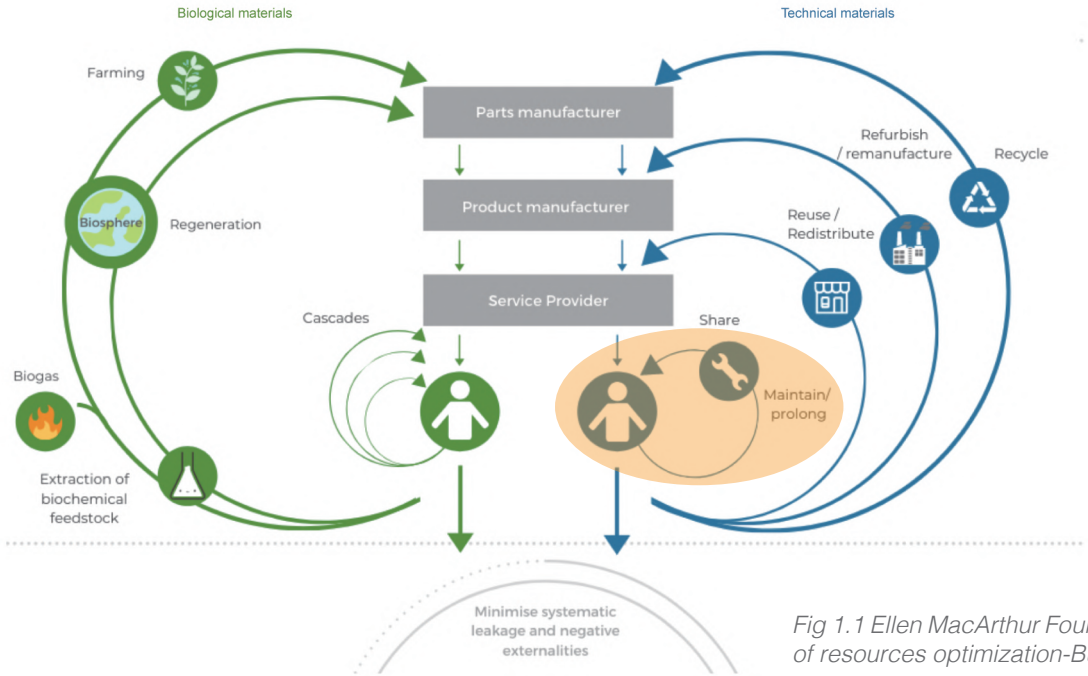


Fig 1.1 Ellen MacArthur Foundation. Routes of resources optimization-Butterfly diagram

and long process. Industries all over the world together, have to change the way they work, to make this possible. To achieve the circular economy, only focusing on sustainable production and products is not enough, we also desperately need sustainable behavior (Green, Ryder, Monaghan & Levett, 2006).

Product Lifespan

One of the basic goals of the Circular Economy is to prolong the product lifespan. A consequent step to extend the use of a product is to postpone its replacement (Ackermann 2017).

The current market dynamics are presenting models to the consumers in which old products are being rapidly discarded, and early replacement is seen as an upgrading process, disregarding its negative environmental impact. Therefore consumers' mindset has changed its focus from owning a product that satisfies their needs, to owning an upgraded product which follows market trends and has the latest features and functionalities. According to Chapman (2008), the growth in sales of household appliances and electronics in recent years, coupled with faster product obsolescence, has led to waste electrical and electronic equipment becoming the fastest growing waste stream globally.

When seeing the circular economy model, we can find that the inner circle is different from the other circles, it relates directly to the users without necessarily requiring a third party to perform the core action, which in this case refers to repair and maintenance. This circle is the most essential one since it can build awareness at early stages of the product lifetime and provides the products with an extended lifespan before considering moving on to the next cycle or disposing after a short span, because of this the inner circle should be consistently favoured, hence this project focuses on repair and maintenance.

Product Care

To realize the shift towards a Circular Economy, products should be used by consumers as long as possible. Not only products should be produced in a sustainable way but also the way consumers treat the product should be sustainable. According to the circular economy system diagram, product care behavior is the most efficient way of retaining products' desired level of performance.

The throwaway culture that we live in has made it often far easier to throw away products and buy new ones, instead of maintaining and repairing the things we have. But by evoking behavior of the consumer that persuades or stimulates them to maintain or repair their belongings, the lifetime of products can be extended and thus can be considered more sustainable. Therefore, if we want to be able to gradually move towards a circular system it is vital to include in this strategy the way products are being cared for.

Product care can be understood as any action that helps to prolong the lifetime of a product, such as maintenance or reparation (Ackermann, 2018; Ackermann, Mugge & Schoormans, 2018). Product care is the smallest loop of the butterfly diagram of the Ellen MacArthur Foundation and is the most effective way to keep resources in the loop.

Product care not only demands the product quality, material or function, but also the changes in the behaviour of consumers. Product care is an approach to use a product as a means to catalyze consumers' care behaviour change. It does so in a user in control way (you wash your coffee machine regularly without any reminder), but also in a product in control way (the coffee machine will stop working if you don't wash it on time), which can be found from current product design. However, it is still underexplored for designers what is the optimal balance between these two ways when they design for product care.

Research question

The main research question is: ***what is the optimal balance between user control and product agency in stimulating consumers to conduct product care behavior?***

This can be answered by answering the following sub-questions:

- ***1. What factors affect product care?***

To figure out consumers' obstacles and motivations of product care.

- ***2. What is the most effective design strategy for product care?***

To formulate and evaluate several promising product care strategies based on literature review.

- ***3. What is the consumer's most prefered balance of user and product agency?***

To define the optimal balance and provide recommendations and suggestions about product care to designers.

Research domain

As mentioned above, product care can ensure the product to be designed and produced in a sustainable way to enable the consumers to perform the product care behavior, which mainly focuses on physical durability. Besides, it can also contribute to changing the consumers behavior about product care, which mainly focuses on emotional durability. Therefore, this project will do the research from two different branches:

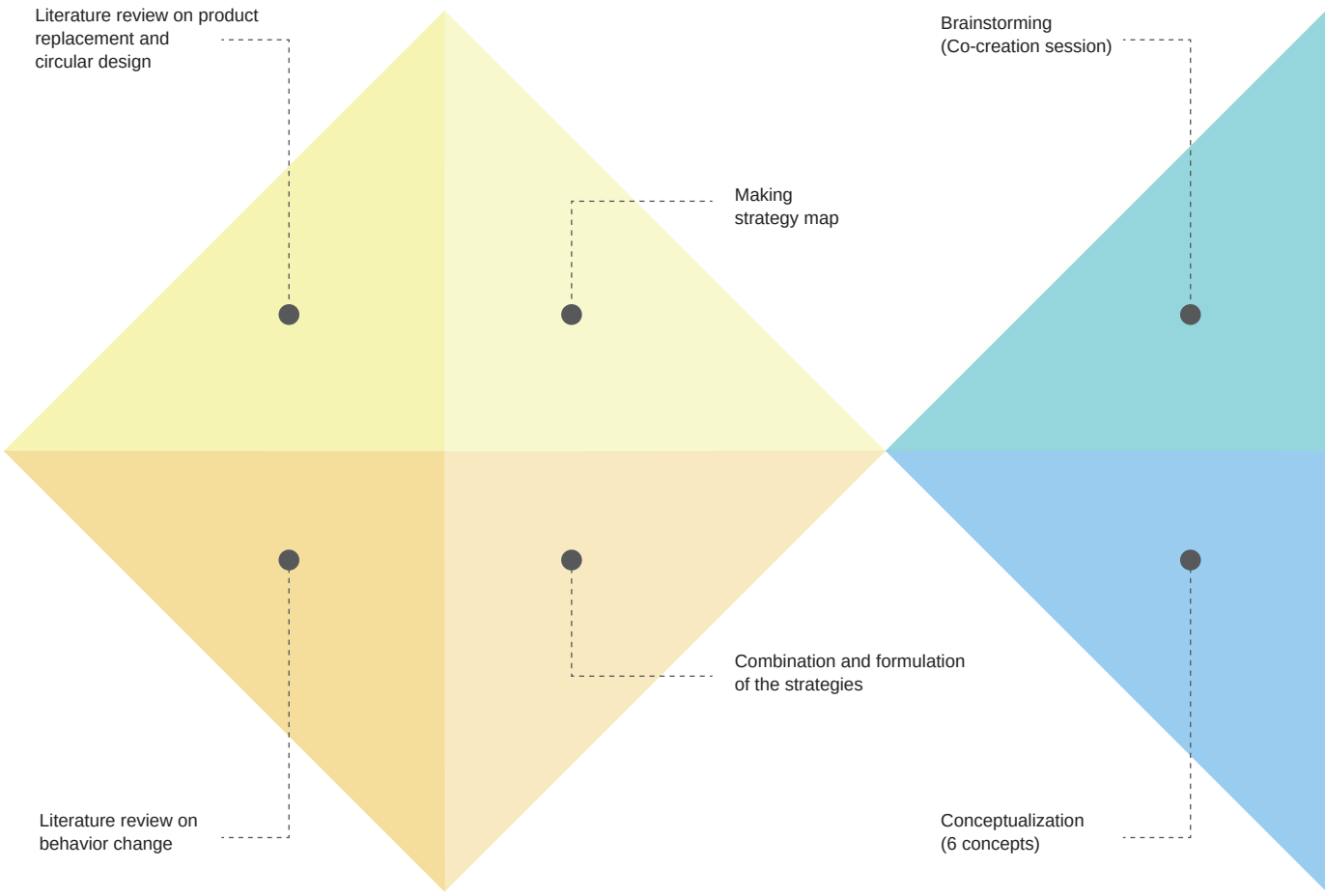
- ***Circular design***
- ***Behavior change design***
  - ***Behavior change model***
  - ***Behavior maintenance***
  - ***Design for sustainable behavior***
  - ***Dimension of behavior change***

CHAPTER 1 - PROJECT OVERVIEW

This project applied the research through design approach. The first phase is strategy formulation, in orde
the second phase is design exploration to initially identify the user's preferred product care balance. The la

STRATEGY FORMULATION

DESIG EXPLO



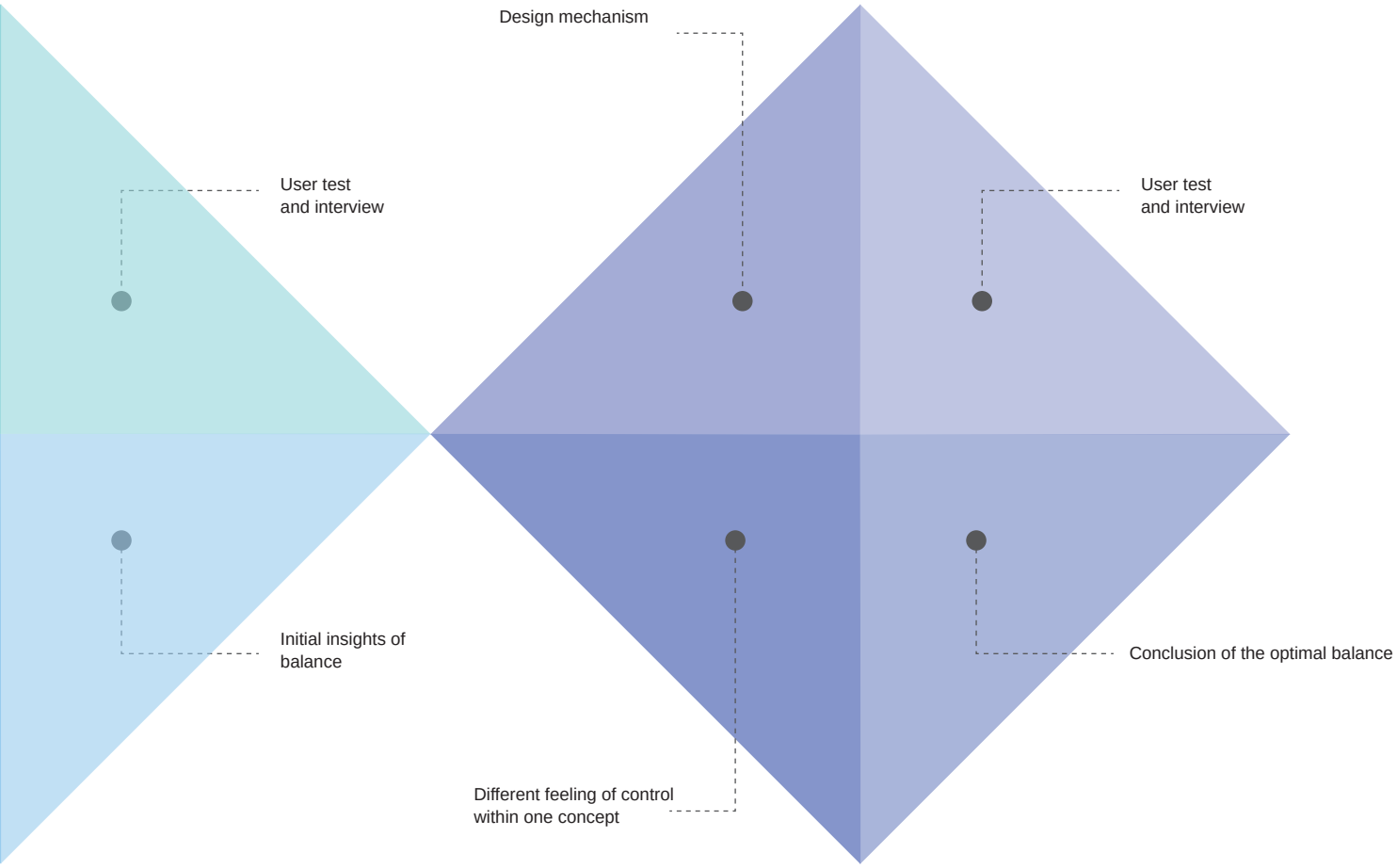
Comprehend the relevant fields and define the scale of control

Validate strategies

r to have a deep-understand of relevant fields and formulate strategies with different control degrees. Then, ast phase is defining the optimal balance through the new concepts and control degree mechanism.

N
ORATION

DEFINING THE OPTIMAL BALANCE



through explorations

Validate the optimal balance and provide the recommendations

2 LITERATURE REVIEW

This chapter will provide an overview of existing design strategies, theories and dimensions that are related to designing for Product Care. Strategies from circular Design, and behavioral change design will be discussed.
Finally the strategy map is made which contains most relevant and promising strategies from the literature. And it will be used in the strategy formulation stage.

Product replacement

Design for repair and maintenance

Design for product attachment

Circular design strategy

Product-related strategy

Service-related strategy

Behavior change

The theory of planned behavior

Fogg's behavior model

Maintenance of behavior change & Design for sustainable behavior

The dimensions of control

Strategy map

Product Replacement

Product care is an approach to postpone the product replacement. In order to have a deeper understanding of product care and find out where product care can work, learning about what are the people's reasons for replacing the product that still functions and strategies in prolonging the product lifespan field is necessary. In this way, the scope of this project can be defined more precisely.

According to Mugge (2015), there are six main reasons for product replacement.

Functionality problem

The product can still perform its basic functions, but some of its functionality cannot work as before or it has become worn out over time. And consumers would like to replace them if they perceive the costs for repairing the product to be higher than its benefits (Roster, 2001; Van Nes, 2003).

Increasing demand

The product still functions originally, but it cannot meet consumers' current needs anymore. Because the product can not be compatible with other new products or services on the market, it is technologically obsolete. For instance, the smart phone is still functioning correctly, but cannot download some new applications due to the outdated system. Besides, it's very common that consumers are induced by a fast-growing market. They will unconsciously compare their currently owned product with the new products introduced on the market, which makes the replacement needs develop easily.

New legislation

The product no longer conforms to new legislation, therefore consumers may develop a replacement need (e.g. seat belts).

Out of date

Fashion styles are changing quickly, when the currently owned product becomes out of date, the replacement needs will develop because of the desire for more fashionable and stylish designs. (Bayus, 1991; Bayus and Gupta, 1992; DeBell and Dardis, 1979; McCracken, 1986; Van Nes, 2003).

Consumers' circumstance

When the consumers' circumstances change, for example marriage, increase in family size, household move or the improved financial circumstances, they will be encouraged to replace the product they own as well. (Bayus and Gupta, 1992; Van Nes, 2003).

To stimulate product longevity, the motives that drive consumers' replacement of durables should be addressed. Therefore, following five practices in design which can extend the product lifetime and reduce product replacement have been proposed (Haug, 2017;Ackermann, 2018; Van Nes and Cramer 2005; Chapman 2005).

1. Design for reliability and robustness

Robustness and reliability are two important issues to be considered in product design. Robustness is related to counter manufacturing variation and improving the product quality, and reliability is focusing on maintaining the product feasibility.
Design for reliability and robustness can make the products more resistant to wear and tear and reduce the functional failure.

2. Design for upgradeability

Product upgrades allow the exchange of existing components for more advanced ones to improve the functionality of reused or remanufactured products, therefore to meet consumers' new requirements. This is an effective way to achieve reutilization. Design for upgradeability primarily focuses on improving a product's functionality and physical fitness for feasibility of upgrade.

3. Design for variability

Design for variability makes the product can be changed by itself over and over again, without the need for other components or tools. Such variation makes it possible to reduce the consumers' satiation of owned products, which allow the product to remain interesting for a longer period of time.

4. Design for repair and maintenance

Design for repair and maintenance can make the repair and maintenance activities more easy and require little or no knowledge from consumers to ensure that product will be cared for over time. (e.g. Cooper 1994; Vezzoli and Manzini 2008). For example, the product can be designed to avoid narrow slits for easier cleaning or allowing the use of standard tools.

5. Design for product attachment

Create or strengthen the emotional bond between person and product. When people feel a strong relationship with a product, they would be more willing to take care of it and postpone its replacement.

Takeaway

These five practices are able to prolong the product lifespan through product design in different ways. Design for reliability and robustness, Design for upgradeability and Design for variability mostly aims to extend the initial lifespan of the product, therefore, the product does not demand much on consumers' care behavior. For example, the product that applies Design for variability is more likely to be used for a longer time because it can attract consumers continuously rather than consumers taking care of it very well.

However, the last two practices, Design for repair and maintenance and Design for product attachment are more relevant to the product care domain, and they provide two ways for product care success. The one is to enable consumers to perform the product care or make the process of product care more acceptable for consumers. Another one is to stimulate

sustainable behavior from consumers' perspective.

Product care is not only about designing the product but also designing the consumer's behavior. Product lifespan is also very dependent on the user’s behavior, their intended and unintended use of the product. Besides, there are already many strategies targeting product design but are not taking the consumers emotions and behaviors into consideration. Product care needs the efforts from both products (designers) and consumers.
Hence, the following research will be conducted from both circular design and behavior change design aspects.

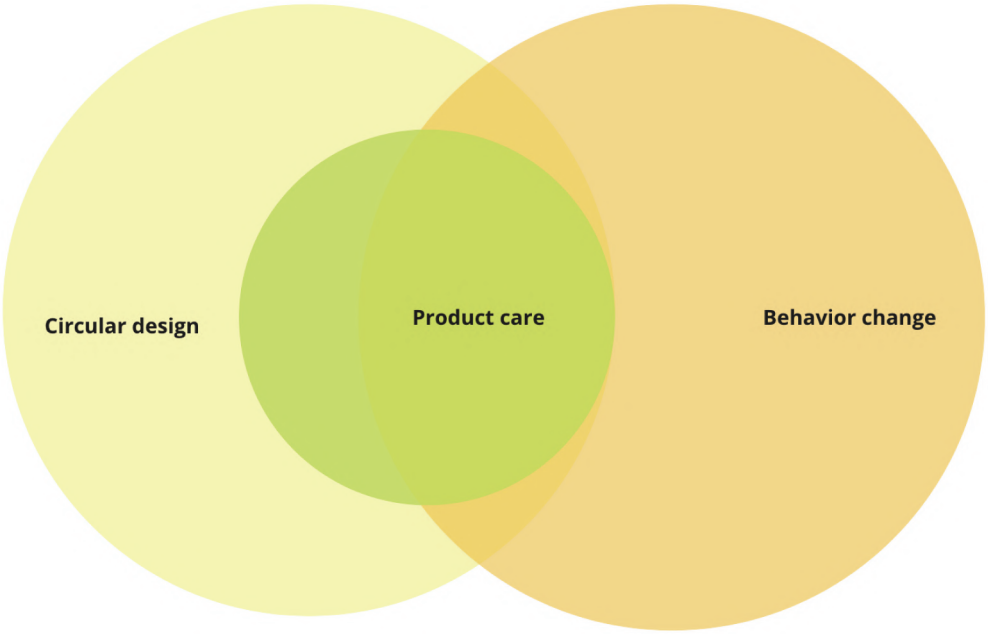


Fig 1.2 The theoretical background that forms the basis of the project

Circular design strategy (Enabling)

Circular product design proposes three effective approaches to reduce the use of resources (The Ellen MacArthur Foundation, 2015). Closing and narrowing down material loops are able to make waste products to be effectively recycled and reused, but this is out of the scope of product care. Another one is slowing resource loops, which is highly related to product care. This approach is concerned with the extension of the utilization period of the product through design. And the following existing strategies can contribute to achieve this goal through product (Bakker & den Hollander, 2014; Bocken, de Pauw, Bakker & van der Grinten, 2016).

Product-related strategy

- ***Design for Standardization and Compatibility***

This is about creating products with existing parts that fit other products as well, which makes the product more likely to be repaired. looking at what is already designed and making your product compatible. Instead of designing every little screw or using new resources, make use of existing parts and products. This also makes it easier for users to replace or fix parts when necessary. This is an important strategy to keep in keep in mind, especially for the design of more complex products where spare parts are needed for product care, these need to be easy to obtain.

Fig 2.1 Bike repair poles have all the basic tools that are needed to repair your bike

- ***Design for Upgradeability and Adaptability***

The product is designed to allow for future expansion and modification, therefore it can be used for a longer time through changing some parts of it. Modular or adaptable product structure is a good example, which enables consumers to integrate the advantages of new technology into the currently owned product or upgrade the appearance of the product.

Fig 2.2 Fairphone' interior

Design for Dis- and Reassembly

This strategy aims to make products and parts be separated and reassembled easily, so that the product care activity is easier to perform. As the name suggests it proposes designs that are easy to disassemble and reassemble. The important part from an eco-design perspective here is the result of the disassembly. For eco-design, it is important that after disassembly parts will always be able to be put together again, again and again and that they will always fit. This should not be confused with products that are easy to assemble and disassemble. Many IKEA pieces, when disassembled, feature ugly holes where once screws sat and it cannot be reassembled as firmly as it was before. IKEA beds and couches are probably the only exception to this issue. If it is necessary to disassemble it to perform a certain type of product care, Design for Dis- and Reassembly can be very important.

Fig 2.3 Ikea hackers promoting the greatest ideas for altering your products

Design for Ease of Repair and Maintenance

This strategy enables products to be maintained in tip-top condition by designing the product that is easy to be repaired and maintained. For example, the machine can clean itself by pressing a button. targets the same niche that this thesis targets with Design for Product Care. When properly applied, this strategy should enable the user to maintain the product in an excellent condition. It proposes that product design currently often limits repair and maintenance. Designers ought to design the product in a way that enables users to open up their products and clean and replace parts.

Fig 2.4 The Dopper is made in such a way that it is also easier to open it up and properly clean it

Service-related strategy

In addition to product-related strategies, there are some strategies mentioned in other papers on supporting users for care activity from service design.

Extended product warranties

This strategy can reduce the consumer's effort on product care, for example time, money, and knowledge, so that they will be more willing to do it. Implementing a 'long-life' guarantee encourages consumers to postpone the product replacement, because the cost of the repair or maintenance is covered by the producer. On the other hand, during daily use, consumers might won't treat the product carefully, because they do not need to pay an external fee for repair or maintenance.

Fig 2.5 Many products have a warranty on their products, making it possible for consumers to send their products back to fix them

Community repair

This service encourages consumers to support each other in an online or offline way. It supports consumer product care activities while also meeting consumers' social needs. Like the Repair Cafe, it is a place where people gather to work on repairing objects of everyday life such as electrical and mechanical devices, computers, bicycles, and other items. Repair Cafes are held at a fixed location such as church, library or campus where tools are available and where they can fix their broken goods with the help of volunteers.

Fig 2.6 Repaircafes lets people get help from other people from their city with repairing

Takeaway

It is important to consider the circular economy in the early phases of product design, as the structure and function of the product determines the difficulty of caring for it, which is one of the biggest reasons why consumers are hesitant to undertake product care activities.

When the product itself cannot contribute to product care, service is a way to compensate for this by lowering the threshold for product care and providing support to the consumers. However these strategies are mainly focused on offering better conditions for product-life extension and do not ensure that consumers perform product care behaviour exactly, therefore, if we want to motivate consumers to take action, the behaviour change research is essential.

Behavior change (Stimulating)

Another way to make consumers conduct product care more is implementing the behavior change strategies in design, including behavior change model, maintenance of behavior change, design for sustainable behavior and dimension of behavior change.

The theory of planned behavior

Ajzen (1991) indicated that there are three variables influencing the people's intention to perform a given behavior: attitude towards the behavior, subjective norms, and perceived behavior control (fig 2.7). When the given behavior is conducting product care activity, this model would be like:

Attitude towards the behavior:

how much consumers concern the environmental issues and their beliefs of individual effort.

Subjective norms:

how people around them think about product care and if the government and organizations emphasize the importance of product care.

Perceived behavioral control:

consumers' perception of the ease or difficulty of executing the product care and if the outcomes is desirable.

Takeaway

Attitude towards the behavior and Subjective norms are difficult to change because they are related to personal traits and beliefs and this kind of transition takes time. Therefore this project will focus on the Perceived behavioral control, perceived behavioral control, which is easier to be changed by design intervention and more importantly, it can influence people's behavior directly.

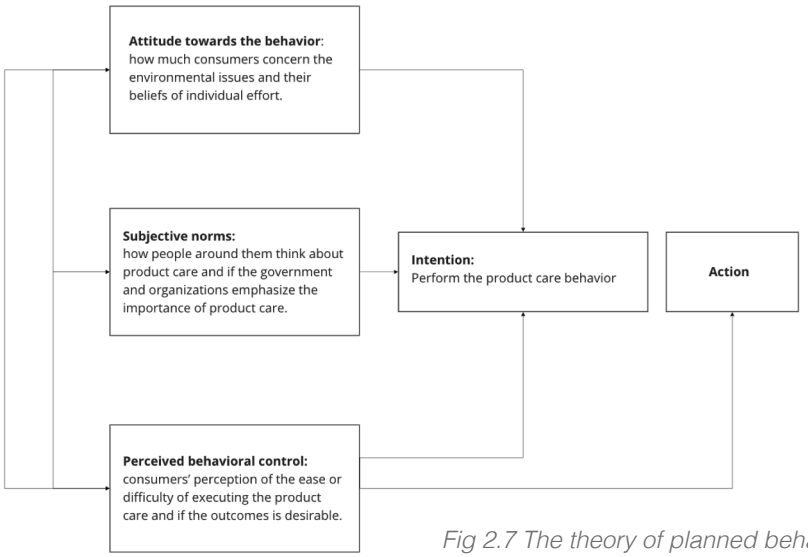


Fig 2.7 The theory of planned behavior

Fogg's behavior model

Fogg (2009) defined three factors that influence behavior change: motivation, ability and trigger. And Ackermann (2017) applied Fogg's behavior model into product care behavior and defined determinants which can be reframed into strategies for stimulating the product care behavior through design.

Motivation

Motivation is a relevant factor to consider when designing for behaviour change. It is typically determined by individual attitudes, values and beliefs (Verplanken & Holland, 2002).There are three kinds of motivations: product-related motivation, person-related motivation, and motivation related to person-product relationships. The product-related motivation is related to the product itself (functionality/appearance), which is mentioned before (in circular design strategy). The person-related motivation is about their attitude which is hard to design in the product care domain. Therefore, I focused more on the strategies about person-product relationships:

- ***The product can create or evoke positive memories***

Some literature concluded that the memories related to the product can enhance the relationship between the person and product, and have a positive impact on the product attachment (Csikszentmihalyi and Rochberg-Halton, 1981; Kleine et al, 1995; Schifferstein et al, 2004; Wallendorf and Arnould, 1988).
When the product carries the consumer's memory, it has a specific meaning for the consumer, which cannot be replaced easily by other products. As a result, the product with a specific symbol becomes irreplaceable, hence, it is more likely for the owner to take good care of it to postpone its replacement, because the replacement means the memories will be lost more or less.

Fig 2.8 Baby clothes hold dear memories about the past or hopes for the future

- ***The product can be personalized or customized by consumers***

This strategy makes it possible for consumers to be involved in the design process of their own products in order to personalize the product based on their own preference. The personalized product can present consumers' identity and become a personal product for them (Blom and Monk, 2003).
Mugge, Schifferstein and Schoormans (2004) found that consumers care more about their bike which is painted in eye-catching colours. When people invest their time, energy or money in creating the ultimate product, they serve as co-designers and they can show their creativity through products. Hence, it is more likely for them to take good care of this product.

Fig 2.9 These lamps can be customized by the user by popping their own desired patterns

Ability

There are three kinds of motivations: product-related motivation, person-related motivation, and motivation related to person-product relationships. The product-related motivation is related to the product itself (functionality/appearance), which is mentioned before (in circular design strategy). The person-related motivation is about their attitude which is hard to design in the product care domain. Therefore, I focused more on the strategies about person-product relationships:

- ***Provide sufficient knowledge to consumers.***

According to Mugge's research (2018), some participants mentioned that they were interested in product care, but due to lack of knowledge, sometimes, they are not able to repair or maintain their product. For some product category, like electronical product, consumers have to spend some time to learn how to care them, which is one of the reasons why they ignore product care activities.

Besides, participants indicated that required knowledge differs in the care activities, for example, cleaning is not problematic for the participants, however, repair is often regarded as a challenge, especially the products with electronic components or software. They are afraid of damaging the product or concern about the safety issue. Therefore, providing sufficient knowledge to consumers in an appropriate way is a promising strategy to help them conduct product care behaviour by themselves.

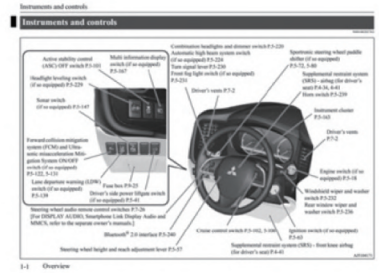


Fig 2.10 Many product come with clear instructions on how they should be used and what things means

- ***Support/improved consumers skills.***

Sometimes, even though consumers know how to complete product care activities, they do not have enough time or required tools to take care of the products. In this case, supporting consumers product care activities allows the product care process to be easier for consumers or provide the related tools to them.

Fig 2.11 Rotterdam now placed pumps for bikes near bikepaths, making it more accessible to pump your tires

Trigger:

Trigger is the stimuli that remind people to perform a certain behaviour, and trigger can influence motivation as well as ability. Previous care activities experience and challenge-based approach belongs to the trigger as well, but the relevant strategies are clearer in sustainable behavior design, so it will be explained in next section.

- ***Appearance trigger: The appearance of the product is designed in such a way that it changes over time.***

When the product's appearance does not look as nice as it used to be, consumers' motivation to care for the product will be increased. This appearance trigger can be the traces on the cover of the product because of a long period of use.

This strategy is to enlarge this kind of trace in a suitable way and keep the aesthetics of the product, otherwise it might lead to the intention to replace. In this way, the appearance trigger

can remind users that the product needs to be cared for.

Fig 2.12 White pants get dirty easily so if you don't wear/wash them carefully you will notice

- ***Time trigger: A signal that is integrated in the product and attracts attention after a certain time of usage.***

For some product categories, it is hard to notice that the product needs to be maintained if the product can be used as usual. Time trigger is a suitable reminder to help consumers carry out the regular product care in case consumers forget to do so.

Fig 2.13 Plantsome reminds the user when they need to take care of their plants

- ***Social trigger: The product emanates its care state in some way so that it is visible for other people.***

This strategy relates to the social environment and connects the product care activities with consumers identity. For example, if you perform product care frequently, you would be a person who treasures his possession in other people's eyes, which might increase the consumers' motivation to take care.

Fig 2.14 Peerby lets you borrow your neighbours stuff, they trust you to take care of it

Maintenance of behavior change & Design for sustainable behavior

The success of stimulating product care also depends on if consumers can maintain this behavior. It is a long term behavior change and the most ideal situation is that consumers regard the product care behavior as one of their habits. Therefore, it is important to know how individuals maintain initial behaviour changes over time and what are the relevant strategies.

Kwasnicka (2016) defined the five themes (Maintenance motives, Self-regulation, Habit, Resource, Social influence) to reflect specific theoretical explanations about behavior maintenance. But she did not provide the specific strategies about the five themes in the paper.

Bhamra (2011) formulated sustainable behavior strategies which are aiming to reduce the negative environmental impact. Although they are related to energy consumption, most of them can be applied to the product care field.

Therefore I decided to link strategies of sustainable behavior to five themes, to make the five themes more concrete for product care. And integrating the sustainable behavior strategy into the behavior maintenance theory can help me reframe the strategies and make them fit the product care domain.

Theme1. Maintenance motives:

People are more likely to sustain the behavior if the process is enjoyable and they can get the immediate and affective outcomes rather than long-term and rational outcomes.

Strategy:

Inform the consumers what is the effect of product care.

Provide the immediate and affective feedback after product care behavior.

Trigger other motivations through the product care activity, such as curiosity and achievement.

Make the product care process more enjoyable.

Theme2. Self-regulation

People need to deal with temptations, hedonistic and impulsive influences that are in conflict with product care behavior.

Strategy:

Provide punishment or reward when the product care behavior is missing

Theme3. Habit

The most sustainable mechanism for maintenance is to develop automaticity for the newly adopted behaviour.

Strategy:

Make people perform the product care behavior automatically through the product design.

Theme4. Resources

Sustained efforts and resources available to the individual are hypothesised to play an important role in behavior maintenance.

Strategy:

Provide knowledge or tools of product care

Theme5. Social influence:

Social influence affects the opportunity costs and incentive structure for behavioural options. It can affect the effort needed to perform product care.

Strategy:

Provided encouragement or help from others to increase individual capacity to maintain behaviour.

The dimensions of control

As Daae and Boks (2014) shows, the strategies can be classified by the degree of control between the user and product (fig 2.15). The user-control strategies focus on cognitive and affective influence and stimulate people to have intention to act product care behavior actively (more persuasive). The product-control strategies focus on practical influence and change the people's behavior directly (more coercive).

Bhamra (2011) indicated that coercive strategies may be more successful in behavior change, but they are less acceptable for consumers. Hence, it is hard to say the effectiveness of different strategies.

Takeaway

After the research, the two ways to stimulate product care through behavior change strategies were found, one is to strengthen relationships between people and product, and make consumers perform product care behavior actively by strengthening relationships between people and product and evoking their internal motivation. The other is to persuade or force behavior change by providing a trigger or changing the way people do product care.

And there is not a clear conclusion of what is the optimal balance between user control and product control, because their research is very broad and the result differs from one product to another. So for this project, It is important to develop balanced and effective strategies to encourage people to execute product care activities for electronical products.

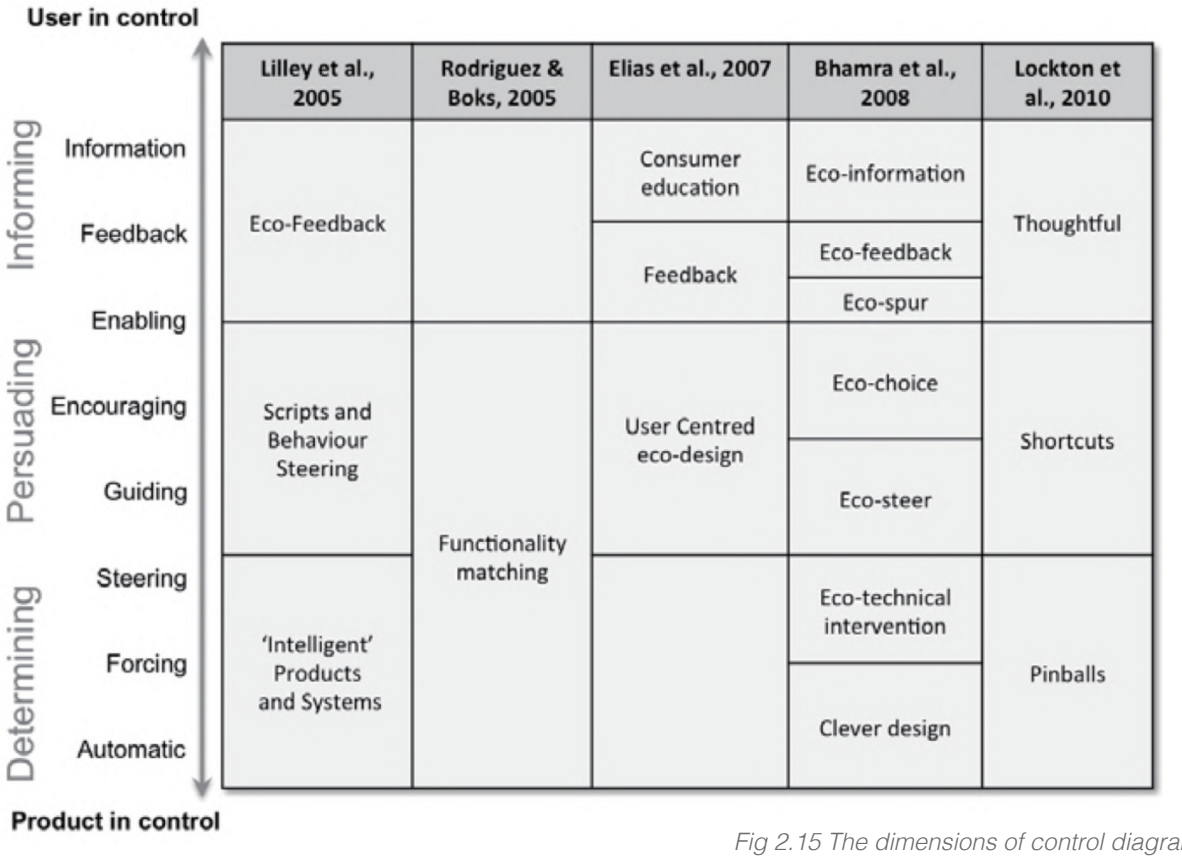


Fig 2.15 The dimensions of control diagram

Strategy map

During the literature review, I found lots of strategies from different fields. But some of them are not on the same level and some of them overlap each other. In order to make it clear, I reframed and organised strategies in one map, according to their degree of control (user/product in control) and which behavior change factor (Motivation/Ability/Trigger) they contribute to.

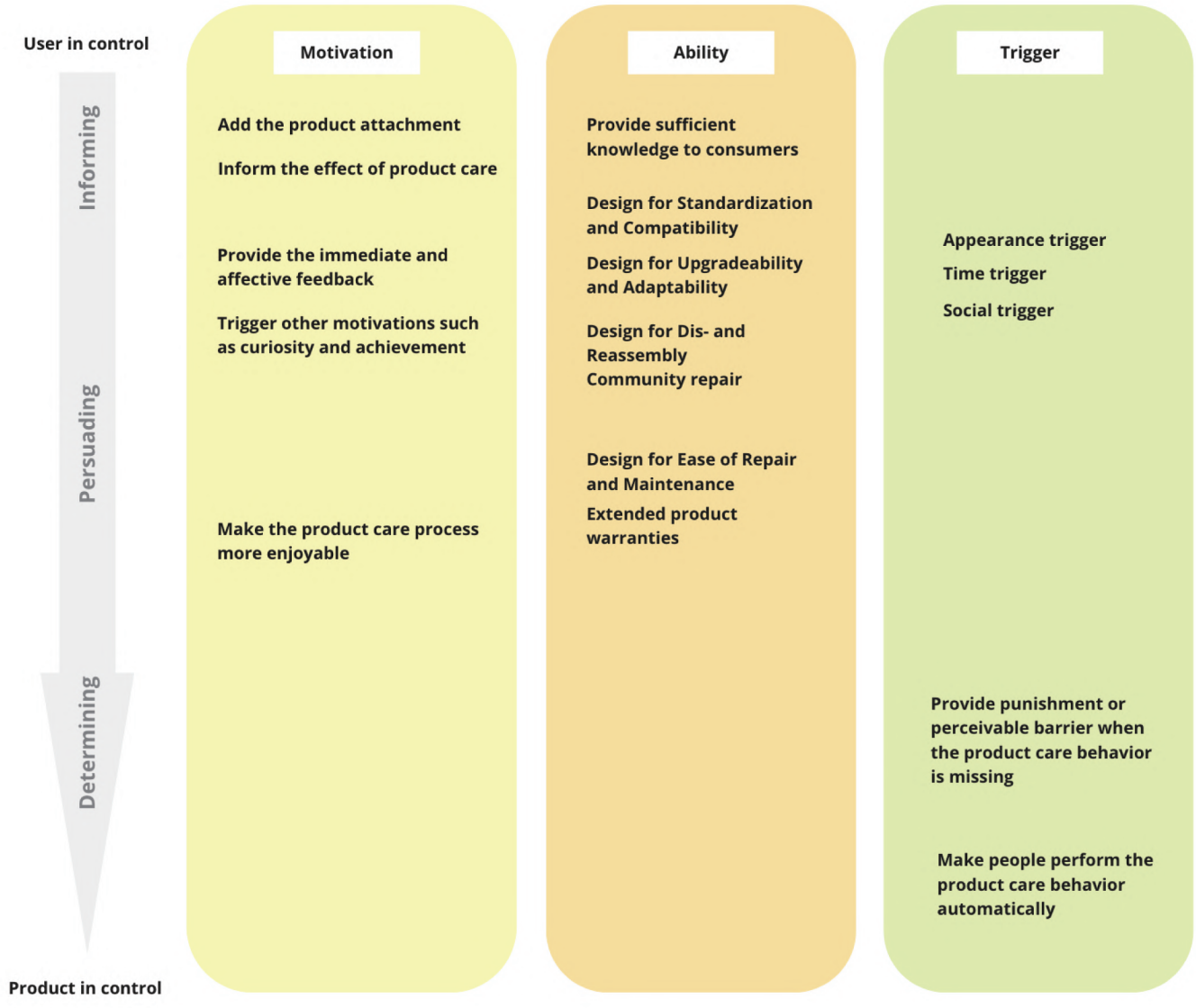


Fig 2.16 Strategy map

Conclusion

There are multiple motivations driving people to replace products together, and the right combination of different strategies can more effectively address the problem through design intervention.

As fogg's model said (fig 2.17), the triggers will succeed in certain conditions, which offers two ways to design the strategies: increase motivation, or reduce required ability. Besides, through the behavior change theory, it is obvious that triggers are vital for altering behavior in the long run. However, according to the strategy overview, most strategies just work as one factor. Therefore, I have an hypothesis that combination of trigger and motivation strategies or combination of trigger and ability strategies would create more effective design intervention for product care behavior.

Fig 2.17 Fogg's behavior model

Through the literature review, the effectiveness of strategies focused on user control and product control still remained little attention. Therefore, it needs practical tests to figure out the optimal balance for electronical products.

3 STRATEGY FORMULATION

This chapter elaborates how to combine the different strategies and lists them according to their product care agency. Then the final three strategies are selected from the strategy combination list.

Strategy combination

Strategy selection

Strategy combination

Based on the conclusion, the strategies from circular design more focus on the product itself, and consider little about the consumer side, while the strategies from the behavior change design more focus on the consumers behavior and their intrinsic motivation. The combination of these two fields would be more effective and strong.

Besides, strategies from different factors (motivation, ability, trigger) could have effects on product care from different perspectives, and combination of them could make the strategy more fruitful and rich.

All the strategies have their degrees of control (more user-oriented, or middle, or product-oriented), and I would like to figure out if there are optimally balanced strategies, so the combination should be different in the level of control as well (fig 3.1).

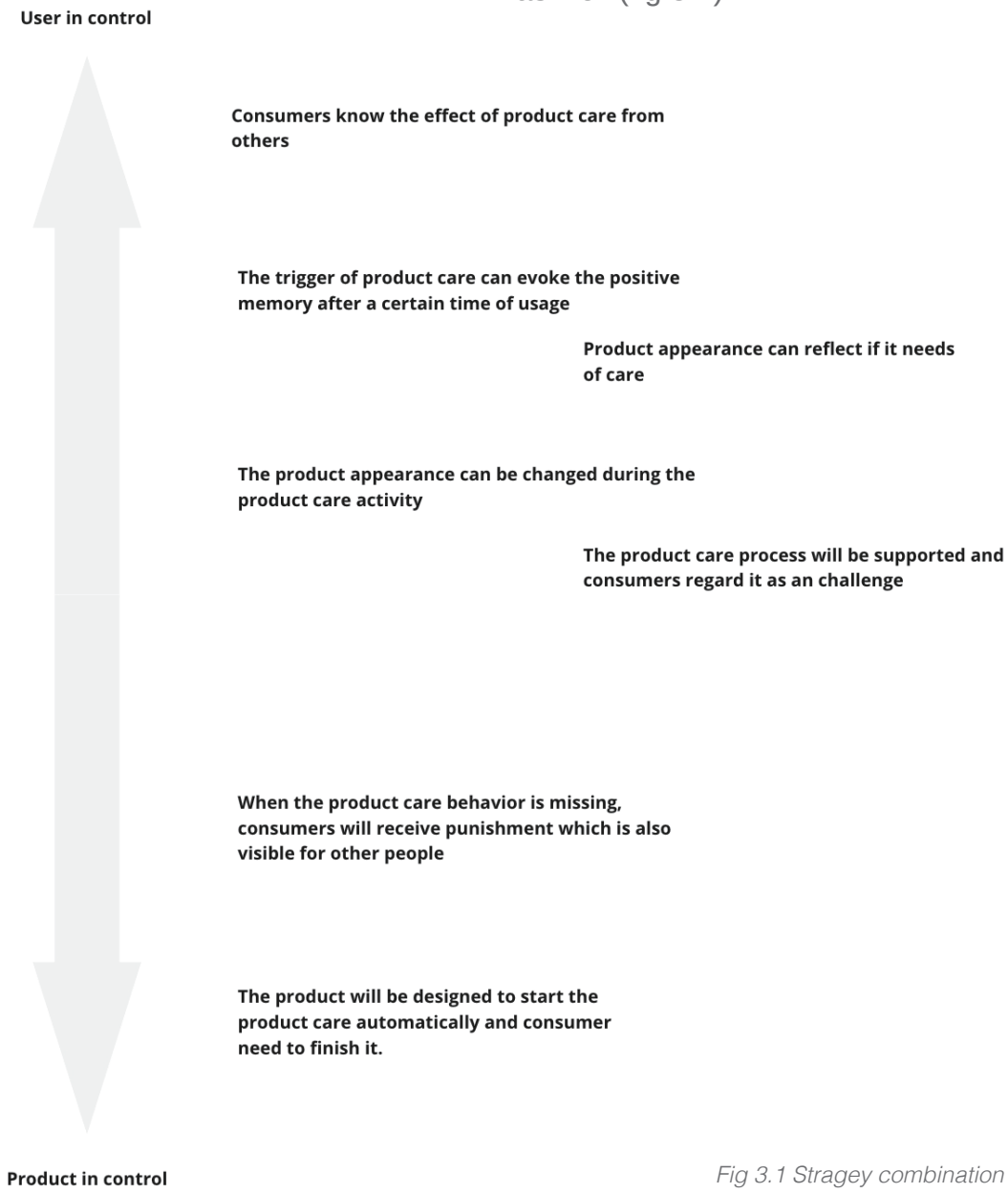


Fig 3.1 Stragey combination

1. Consumers know the effect of product care from others

- Inform the effect of product care (motivation) + Community repair (ability)
- This strategy aims to provide the information to consumers.
- Consumers will be informed about the result of others' product care experience.

2. The trigger of product care can evoke the positive memory after a certain time of usage

- Add the product attachment (motivation)+- Time trigger (tigger)
- This strategy aims to remind the consumers at the right time.
- The time trigger can be designed to let consumers recall the positive memory.

3. Product appearance can reflect its need of care

- Provide the immediate and affective feedback (Motivation) + Appearance trigger (trigger)
- This strategy aims to remind the consumers at the right time.
- The product's need of care can be designed obvious and visible for consumers.

4. The product appearance can be changed during the product care activity

- Design for Dis- and Reassembly (ability) + Make the product care process more enjoyable (motivation) + Appearance trigger (trigger)
- This strategy aims to persuade consumers to do product care.
- Consumers can make the appearance of a product become more personal through the product care activity.

5. The product care process will be supported and consumers regard it as a challenge

- Provide sufficient knowledge to consumers (ability)+Trigger other motivations such as curiosity and achievement(motivation)
- This strategy aims to guide and persuade consumers to do product care.
- Consumers can be supported or guided during the product care, and the process can trigger consumers' other feeling (a sense of achievement)

6. When the product care behavior is missing, consumers will receive punishment which is also visible for other people

- Community repair(ability) + Provide punishment or perceivable barrier when the product care behavior is missing(trigger)
- This strategy aims to make the experience of undesired behavior negative

7. The product will be designed to start the product care automatically and consumer need to finish it

- Design for Ease of Repair and Maintenance(ability) + Make people perform the product care behavior automatically(trigger)
- This strategy aims to force consumers to do the product care
- The product will perform the first step of product care to force consumers to complete it.

Strategy selection

In order to make the design exploration feasible, I should select the three most promising strategies.
At this phase, I tried to explore the nature of people caring something and set the criterias for selecting the strategy.

What makes people care?

Empathy:
People have the tendency to care about someone we can easily empathize with and feel attached to, and we are willing to help them out, with time and resources, when they need it. Social needs are the basic needs of humans, so that it is reasonable that people want to keep and maintain the connection with others.

Personal identity, value and worldview:
People have the tendency to engage and take action for something that affirms their identities and aligns with their deeply held values and worldview. Comparing the general objects, people are more likely to care about objects that reflect or represent their own characteristics or perceptions, which can satisfy part of their fundamental needs.

What makes people care some products more?

Caring is a resource, caring for objects takes up physical and mental energy - time, effort, planning, emotional investment, money... And like all resources, you need to choose who you invest it in.Therefore, objects are prioritized in people's minds, and they are more likely to take action for the items that are close to the center (fig 3.2).
These items that are important to people fall into two categories:
1. **The product itself** carries a special meaning that is irreplaceable to people, that may contain the connection of you and someone you value or you and your past, such as a gift from your best friend, a first prize of a competition, photos of your childhood...
2. **The interaction with objects** can meet some fundamental needs of people very well, like practicing piano to develop your skills, playing video games with friends to strengthen your friendship...

But these circles are not static, over time or for a variety of reasons, items in the centre may move away and items in the outer circle may move in. For example, as you put more physical and mental energy into an object, it becomes more important to you; or after you break up, the gift from your ex may become meaningless to you.

Fig 3.2 Care circles

There are two ways to make people more willing to care for products:

In psychological way:

Design for the product, strengthening the connection between the product and the person.

In the physical way:

Design for the product care experience, so that the care activity itself meets some of people's fundamental needs.

As people care for the product, they use more or less their resources (time, energy, money) and these efforts can make the product itself more important to people as well.

Then I set the criterias for selecting the strategies:

1. Selected strategies should achieve the goal in either of two ways (**psychological way/-physical way**).
2.Even though each strategy can create design interventions that have different degrees of control, the strategies themselves still can be defined as more user/product oriented. Therefore, the selected strategies are supposed to be **in different degrees of control** (fig 3.3).

The strategies that were not selected are more focusing on the external factors, for example, the strategy users are informed of the product care effect by others , which might be weaker and require people's awareness towards product care or sustainability otherwise it will not be effective for them or they might not use that product. Besides, the intrinsic motivation could contribute to long term behavior change better.

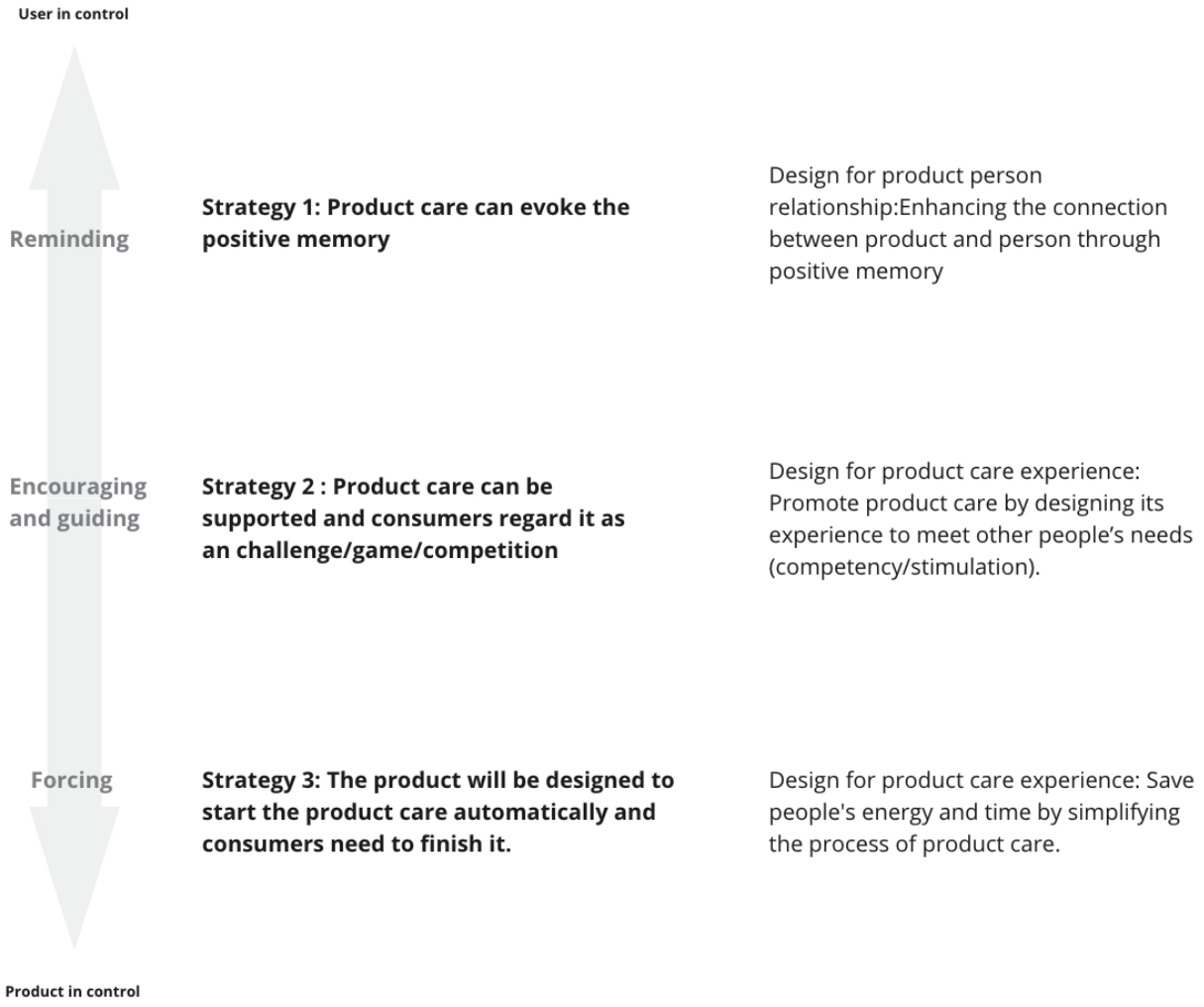


Fig 3.3 Final three strategies

4 EXPLORATION

After the three new strategies were formulated, relevant design interventions need to be generated by using the strategies in order to evaluate them in the next phase. Therefore, a co-creation session is a good approach to gain as many ideas as possible from different people.

Co-creation plan

Co-creation results

Co-creation conclusion

CHAPTER 4.1 - CO-CREATION PLAN

Goal

There are three goals of co-creation session:
1. Verifying whether the strategies are clear enough, and whether they are inspiring for people to generate ideas.
2. Collecting design intervention as much as possible.
3. Seeing if there are different control levels within one strategy.

Individual brainstorming

Before the start of the co-creation session, I first carried out individual brainstorming to check whether the strategy would be ambiguous for participants and to make sure that the participants could quickly and correctly understand what the strategy means.

Besides, my individual brainstorming could also provide some concrete examples for the co-creation session, so that the participants can better understand how to use these strategies and what the user and product in control mean. (See appendix FIXME)

Co-creation session procedure

This co-creation session was held with 4 IDE students from TUDelft who have the experience about applying the strategies and participating in creative activities. The session lasted 2 hours through Zoom (for introduction and discussion) and Miro (for writing and drawing).

Introduction

First I introduced my graduation project: Prolong the electronic product lifespan by stimulating consumers to perform product care.
Then I explained what is product care: Product care is all the activities that users can do to contribute to prolong the product lifespan. Two major activities are maintenance and repair.
After this, I showed the different fields I focus on in this project, so participants would think from different perspectives consciously.

Explain strategies

Then I explained what each strategy means and what their point.

Product care type

In order to inspire participants better during the co-creation session, the 7 product care types are provided which are based on Laura Ackermann's research (2020). The product care types can support participants, in being able to differentiate between the different product care acts. And they may support designers in targeting specific behavior when using the strategies, since product care in its whole, is too broad.

1. Repair

The product or a part of it is broken, preventing it from performing a function or performing poorly. The user performs product care activities that will make the product be able to function again. This can be the repair of existing parts of the product, or the replacement of parts.

Fig 4.1 Repair the mobile phone

2. Creating something new/different

The user creates a product themselves, let's something be made for them, or they rebuild/ remodel/reform an existing product so it feels like a new, different or unique product.

Fig 4.2 Personalized motorcycle

3. Product revival

The user tries reviving the product to a certain standard again. This could be to get it functioning better again or to regain a certain look.

Fig 4.3 Wax the floor

4. Preventive measures

These are measures taken to make sure a product won't break as quickly. These measures often contain external products that equip or protect the product against its environments.

Fig 4.4 Mobile phone case

5. Instructed & mindful handling

The user knows or feels which behaviors would be bad for the product. This could be by having read a manual, learning about it from others or just by experience. The user tries to prevent deterioration by abstaining from bad behavior/only performing the proper behaviors.

Fig 4.5 Using Silicone Spoons instead of metal spoons to avoid scratching delicate surfaces of nonstick pans

6. Small care

Nothing of the product is broken. Small activities are performed consciously to liven up the product again or to prevent it from deteriorating.

Fig 4.6 Clean the coffee machine

7. Routine acts

The user performs routine activities unconsciously. These are activities that they have learned to do and have never thought about doing differently or activities that were made into habits.

Fig 4.7 Wash the cup after drinking

Plan of the session

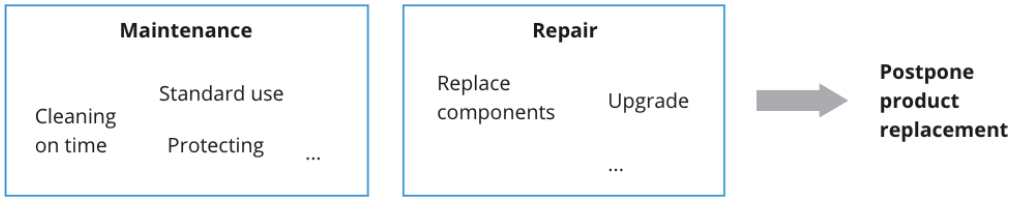
This session is divided into 3 parts (fig 4.8), in each part, participants need to use three strategies to design for one product (15min), after that there is a discussion to talk about every idea and arrange them based on their control level. Finally, everyone need to pick the ideas they like. And it is completely open if the product itself supports the user, or if it is an external product or service that helps people do this. See appendix FIXME for the complete co-creation session and appendix FIXME for the transcript of discussion.

Introduction

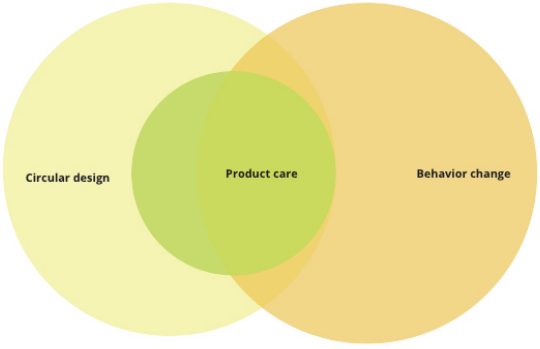
Design goal

Prolong product lifespan by stimulating consumers to perform product care behaviors

What is product care?



How to encourage product care behaviors?



Plan of the session

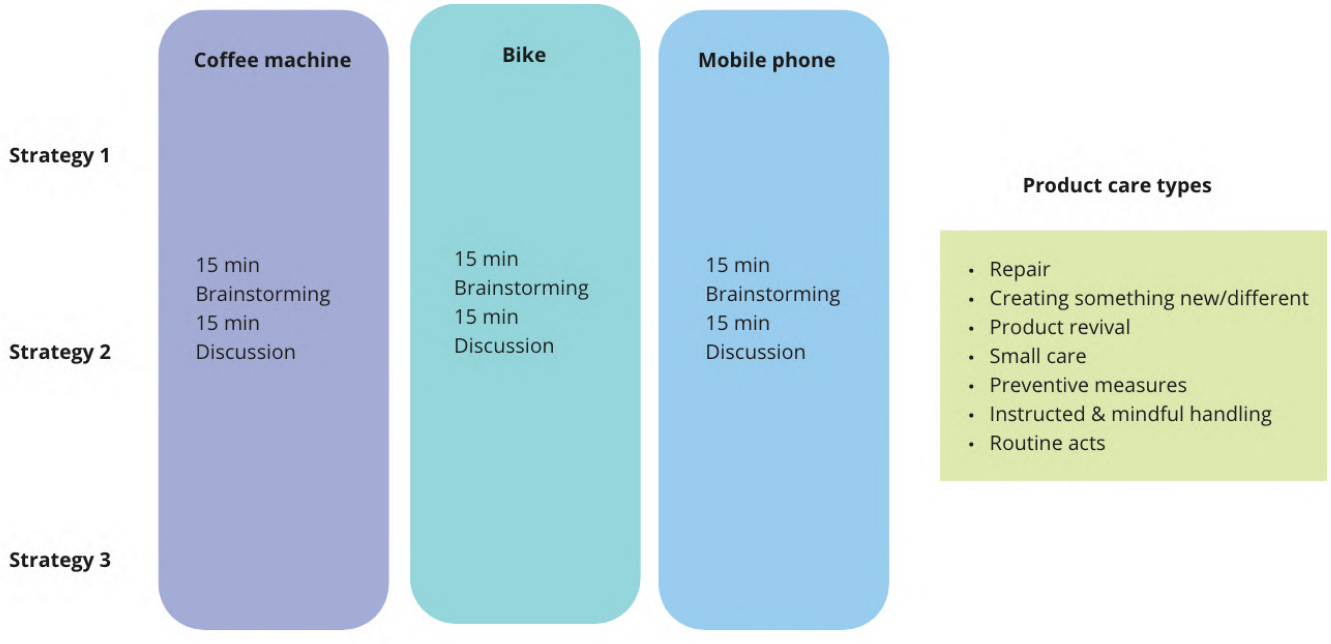


Fig 4.8 Plan of the co-creation session

Coffee machine

USER

PRODUCT

Strategy 1: Product care can evoke the positive memory

A coffee selfie a day： D

record users' emotion when drinking coffee every day (clock in)

Used coffee capsules can be collected or used as material for small crafts (giving a positive experience in cleaning coffee capsules)

This area is easy to get spilled with coffee, but is often overlooked when cleaning

Smiley faces on corners that are easy to overlook for clean-up (as a reward for a completed clean-up)

when I am cleaning the coffee machine, it will give off the aroma of coffee

The coffee machine will change color depending on how often you care it （frequent care can make your coffee machine more beautiful)

The coffee machine will play the sound of previous product care (washing\wiping\talk) when it needs cleaning

Strategy 2 : Product care can be supported and/or consumers regard it as an challenge/game/competition

Modular design
Users can change the shape of the coffee maker when cleaning it （like game skin)

A supreme coffee capsule which can only be brewed in just after maintenance of the coffee machine

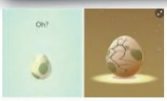
"Your product care behavior beats 80 percent of users"

You buy it means you are a person who care the coffee machine frequently

80%

If I insist on maintaining the coffee machine for 7 days, it can play me a interesting sound

The coffee machine can raise pokemon , product care is hatching the egg



After you perform the product care, you can get a latte art

Regular maintenance can be better rewarded （more beautiful latte art)

The modular design can give users some hints about how to assemble it again

Strategy 3: The product will be designed to start the product care automatically and consumers need to finish it.

When the detection of a long time no power off after the coffee machine will make a sound (like the sound of water boiling)

I often forget to unplug the power after use, resulting in the top cover of the coffee machine easily overheat

The coffee machine can be cleaned automatically after pouring in water

You can clean it with one click on the mobile app

The part of the coffee machine that needs to be cleaned automatically pops open after the machine is turned off

When it needs care (cleaning), it will make noise until you care it.

The coffee machine automatically pours calcium remover after certain usage

Mobile phone

USER ↔ PRODUCT

USER ↕ PRODUCT

Strategy 1: Product care can evoke the positive memory

Users can exchange components of the phone with others (connection\personalization)

Back cover of the phone can show the usage time (Wear and tear)

When the phone is charged with enough power (over20%), there will be a funny animation

After cleaning the photos, the phone will play the automatically generated photo video

Wallpaper can show the photos you took with this phone and reminds you to clean the phone

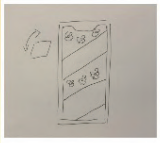
Strategy 2 : Product care can be supported and/or consumers regard it as an challenge/game/competition

Usage age and real age

If people do not care the phone, the phone's usage age would be older than real age

Back cover can be transparent and users can see the internal structure and disassemble/assemble components

While wiping the screen, users can play a small memory game



After upgrading the system, you will collect a card representing the last system

When wipe the screen, the wallpaper can be changed automatically

The phone with more care has a special LOGO

A small game pops up when the phone needs to clear memory

Strategy 3: The product will be designed to start the product care automatically and consumers need to finish it.

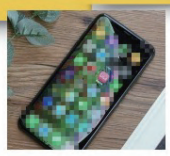
Remind people not to use the phone in scenarios that they are prone to drop it
"You are walking now, the probability of breaking it +80%"

it will disappear when you are at the safe place

When the power is less than 20%, the phone will be forced into power saving mode

Screen mosaic when power is too low

Black and white screen



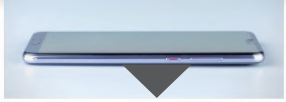
Turn on after 24 hours

The power will shut down soon when the power is below 20%

Automatic memory cleanup

Phone case: does not allow the user to place the phone on an unsafe plane such as too narrow/slip (to prevent dropping the phone)

Prevent users from using their phones when they shouldn't



Bike

USER ↔ PRODUCT

USER ↕ PRODUCT

Strategy 1: Product care can evoke the positive memory

have a special place to insert seasonal flowers

Design a pocket to put stamps or postcards

This pocket only can be seen when you take the bike apart for maintenance or repair (similar to coin bank)

clock in app

milometer

users can see the emotion of the bike (emotion change)

A camera on your bike captures laughter and regularly use the sound to reminds you to care it

Frequent care of the bike will be able to see the previous ride through AR

Strategy 2 : Product care can be supported and/or consumers regard it as an challenge/game/competition

Neighbors help each other

When the bike is broken, an app will let me guess where it's broken

After repair, help me record that I have a new repair skill :)

LEV.0 pump up

LEV.1 chain repair

After riding 1,000,000 meters, you can get a coupon to buy a bike?

Tires can change color according to tire pressure

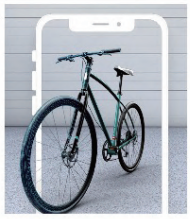
The appearance of the tire will change when pumping

Feel like doing hand massage when wiping the bike

cycling can charge the lights

Modular design makes disassembling and assembling the bike like solving a puzzle

App can help you repair the bike by using AR



Guide the user to wipe the bike in order of parts (1, 2, 3 indicators on different parts)

Strategy 3: The product will be designed to start the product care automatically and consumers need to finish it.

Bicycle has a special place to put repair tools

A part of the bicycle can also be the brush

Inform the user if it will rain recently

When the height difference is large, the bike will shriek to alert the user, and if the user continues, the bike will scream

When the tires are under-inflated, the bike will make strange sound

When the tires are under-inflated, it would be arduous for people to ride it.

Tire will automatically pop up when the tire is broken

Bike can lubricate its chain after certain time

About strategy

1.

All three strategies allow participants to generate rich design interventions for each product.

2.

Due to time constraints, the design interventions generated by brainstorming were not well thought out, therefore some ideas only partially applied these strategies. However, some elements in these interventions are similar and interesting, so it would be possible to summarize and extract them to make new designs in the conceptualization phase.

About control degree

3.

Without any reminding, the design intervention generated from the same strategy differed in the degree of control.

Strategy 1: Product care can evoke the positive memory

- User in control: Create or strengthen the connection between the product and the person, users will spontaneously conduct product care.
- Middle: The process of product care provides the user with a good memory or experience.
- Product in control: The product reminds the user to care through making users recall the memory or experience.

Strategy 2: Product care can be supported and consumers regard it as an challenge/game/competition

- User in control: The product has affordance and indicates the outcome or process of product care in a special way.
- Middle: The user is rewarded for completing the product care, which is more like a challenge or game.
- Product in control: The product itself can guide or support the product care process.

Strategy 3: The product will be designed to start the product care automatically and consumers need to finish it

- User in control: The product itself has some features to prevent misuse or make product care easier.
- Middle: The product will push the user to perform product care through constant reminders (appearance/sound).
- Product in control: The product will go into self-protection mode (some functions are affected) when it needs care to urge the user to take care the product.

4.

In general, within the same strategy, the user-oriented strategy has more user in control ideas, and the product-oriented strategy has more product-oriented ideas (fig 4.9).

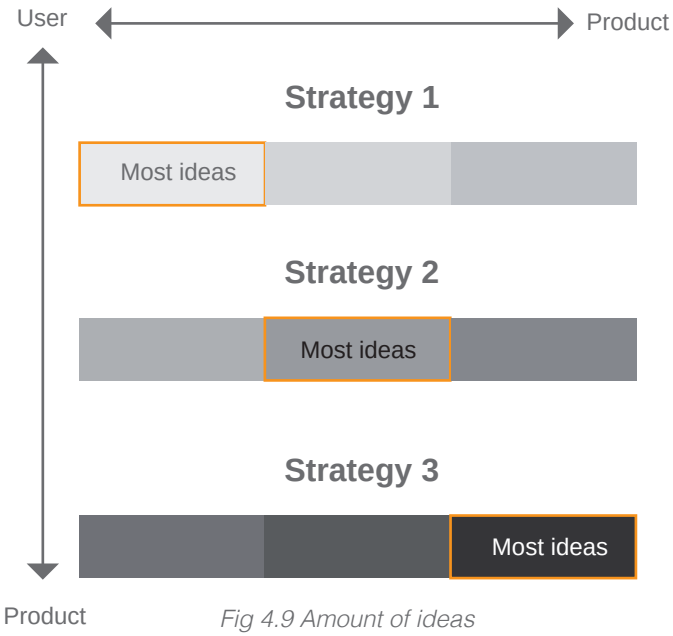


Fig 4.9 Amount of ideas

About product

5.

The richness and quality of designing with the same strategy varied across products.

Bicycles

During the co-creation session, strategies 1 and 2 were more able to inspire participants to ideation, that's probably because the human-bicycle interaction itself was more likely to create positive memory and participants are more familiar with bicycle maintenance and repair activities. However, participants mentioned that strategy 3 was more difficult to use because the structure of the bicycle itself was simpler than the other two products, making it more difficult to automate bicycle care activities.

Coffee machine

For the coffee machine, all three strategies were able to stimulate a lot of different interventions, but in brainstorming for strategy 2, participants focused more on rewarding after completing the product care instead of product care activity. Some participants said that due to their limited knowledge of coffee machines, the product care activity they are familiar with was relatively simple, mainly in terms of cleaning, so they focused more on the results of product care rather than on the consumers' experience of product care activity.

Mobile phone

Participants generally found it is more difficult for them to apply strategy1 to mobile phone, because the interaction between people and mobile phone is relatively simple and virtual (interaction with screen), and the technology nowadays allows people to transfer these "positive memories" to another mobile phone quickly and easily. However, with lots of powerful functions , mobile phones can easily use strategies 2 and 3 which are more product-dependent and can generate a lot of promising design interventions.

After the co-creation session, I found that the selection of products may also have an effect on the effectiveness of strategies. Also, during categorizing, different participants had different perceptions of control over the same design intervention. Therefore, I intend to choose two relatively suitable and interesting strategies for each product category to conduct conceptualization: Strategy1--Coffee machine and bike, Strategy2--bike and mobile phone, Strategy3--coffee machine and mobile phone.

5 CONCEPTULIZATION

After the co-creation session, much interesting inspiration and insights are collected. In order to develop the ideation to the concept, firstly the analysis of the ideas is made. Then, the presentation of the concept should be decided with the consideration of the current situation (online work mostly).

Ideation to concept

Presentation of the concepts

Selection of ideas

In the final stage of cocreation session, each participant was asked to select ideas they like, with no limit on the number of ideas. In the assessment of ideas, these picked ideas will be selected and analyzed in the following three criteria, and the final results will support the decisions in conceptualization (e.g. developing one idea or combining the different ideas).

Feasibility: How feasible the idea is

Due to the limited time and the high degree of openness of brainstorming, some ideas may not be realizable or may not be suitable for the current market. In order to make the later user test more reliable and real, feasibility needs to be taken into account in the conceptualization phase.

Match: How much does the idea match the corresponding strategy?

The three strategies given are all derived from the results of research, which means that the strategies are able to stimulate product care behavior to varying degrees. The better application of strategy could be a criteria of choosing the idea.

Pick: How many people pick this idea?

Since the participants are designers, they have some knowledge of product or service design. The participants' liking of the idea can also indicate the quality (e.g. novelty, usability, etc.) of the idea in a sense.

User in control
In the middle
Product in control

	Feasibility	Match	Pick

Strategy 1: Product care can evoke positive memory

Coffee machine

- when I am cleaning the coffee machine, it will give off the aroma of coffee
- The coffee machine will change color depending on how often you care it (frequent care can make your coffee machine more beautiful)
- The coffee machine will play the sound of previous product care (washing\wiping\talk) when it needs cleaning

Bike

- Design a pocket to put stamps or postcards
- Frequent care of the bike will be able to see the previous ride through AR
- A camera on your bike captures laughter and regularly use the sound to reminds you to care it

Strategy 2

Mobile phone

- Back cover can be transparent and users can see the internal structure and disassemble/assemble components
- A small game pops up when the phone needs to clear memory

- User in control
- In the middle
- Product in control

	Feasibility	Match	Pick
Prodeuct care can be supported, challenge/game/compitition			
Bike			
After repair, help me record that I have a new repair skill :)	●●●●○	●●●○○	●●●○○
App can help you repair the bike by using AR	●●●○○	●●●○○	●●○○○
Strategy 3: Product starts the product care automatically			
Coffee machine			
The part of the coffee machine that needs to be cleaned automatically pops open after the machine is turned off	●●●○○	●●●●○	●●○○○
The coffee machine automatically pours calcium remover after certain usage	●●○○○	●●●○○	○○○○○
When it needs care (cleaning), it will make noise until you care it.	●●●●○	●●○○○	●○○○○
Mobile phone			
Screen mosaic when power is too low	●●●●○	●●●●○	●●○○○
Prevent users from using their phones when they shouldn't	●●●○○	●●●●○	○○○○○
Phone case: does not allow the user to place the phone on an unsafe plane such as too narrow/slip (to prevent dropping the phone)	●●●●●	●●●●○	●●○○○

Conceptualization

Based on the result of the assessment, the six concepted are generated. The ideas with more black dots mean that they are more interesting and promising for stimulating product care behavior.

Some concepts are the combination of the ideas that are equally interesting or are more promising when they are together, and some concepts are improved from one idea. It will be explained more clearly in the presentation of concepts.

Concept iteration

At the regular coach meeting, some helpful suggestions about the technical problems and product care agency were given by the supervisors(The initial concepts can be found in the appendix 2). After the meeting, some adjustments on the concepts were made.

The final six concepts are (they will be expained in detail in next chapter):

Bike memory

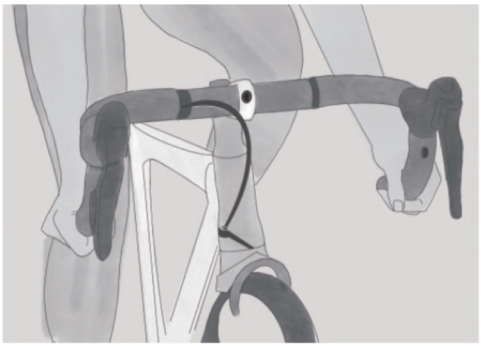


Fig 5.1 Bike memory

Wooden coffee machine

Fig 5.2 Wooden coffee machine

AR bike repair

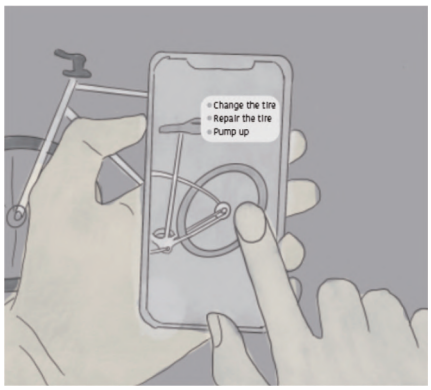


Fig 5.3 AR bike repair

Screen game

Fig 5.4 Screen game

Independent mobile phone

Fig 5.5 Independent mobile phone

Pop-up components

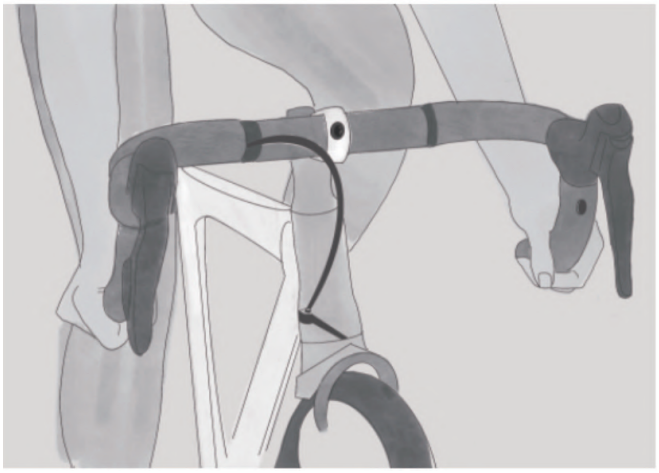
Fig 5.6 Pop-up components

CHAPTER 5.2 - CONCEPT PRESENTATION

Considering the current situation that most studying activities are online, how to present the concepts to the participants or viewers is very important. Because the following user test is aiming to let participants experience the concepts and feel about the agencies in product care area, instead of a usability test, the physical prototype or 3D modeling is time-consuming and it is difficult to make participants immerse themselves online.

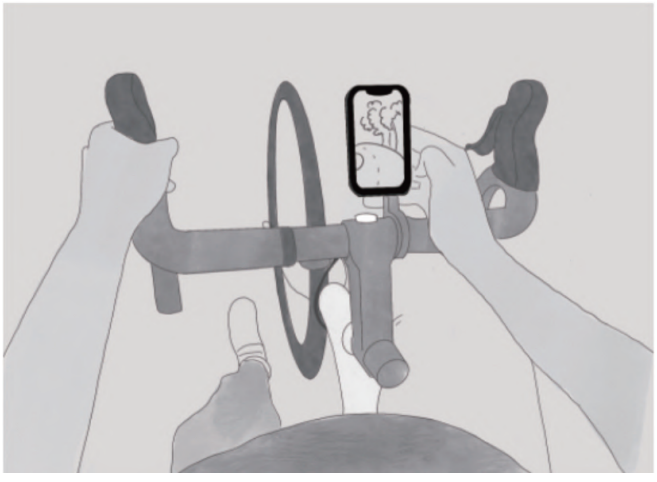
Therefore, the storytelling method would be a smart option. Stories serve as early input for innovatice idea and can filter out conservative response. The user test outcome is only valuable when the participants understands the new concept well. Storyboards with the narratives enable participants and viewers to understand the concepts and experience the designs better.

Concept 1: Bike memory



The bike is equipped with an embedded camera, and you can take the pictures while riding just by pressing the button on the handle.

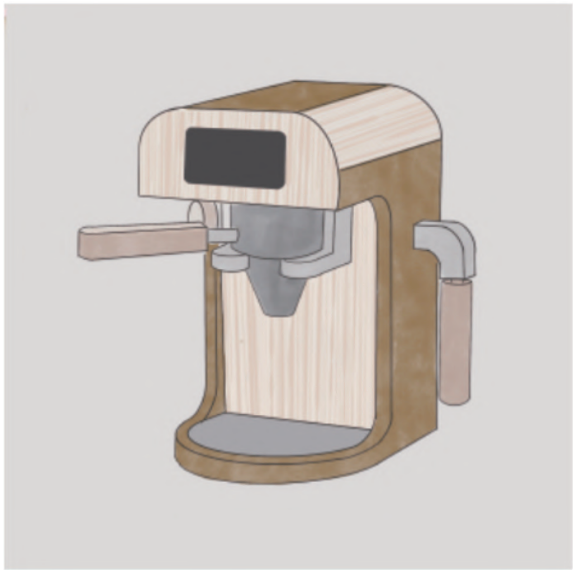
When you conduct some bicycle-related activities, such as exercise or picnic, you can always record the scene around you to keep the memory of this activity.



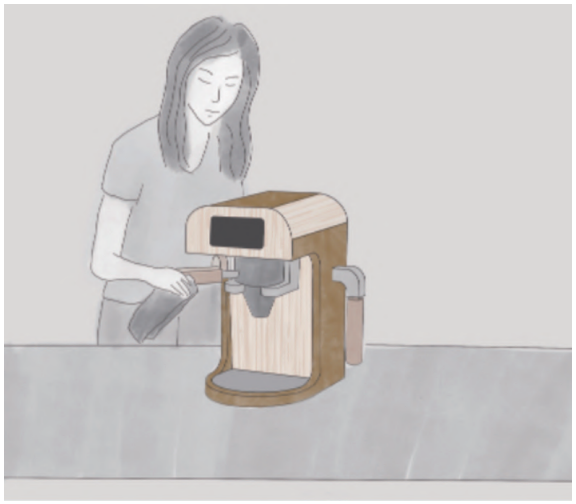
At the same time, if you want to see the pictures on the camera in real time while riding, you can connect it with your mobile phone.

Fig 5.7 Storyboard of bike memory

Concept 2: Wooden coffee machine



The appearance of this coffee machine is made of wood and leather, and the functionality is the same as a normal coffee machine.

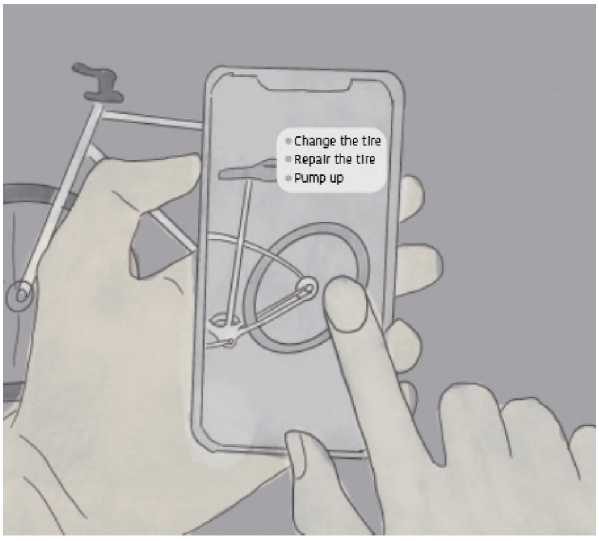


The special material of the appearance can easily show signs of wear and tear or some use history. Therefore, it would be obvious if you do not take care of it frequently.

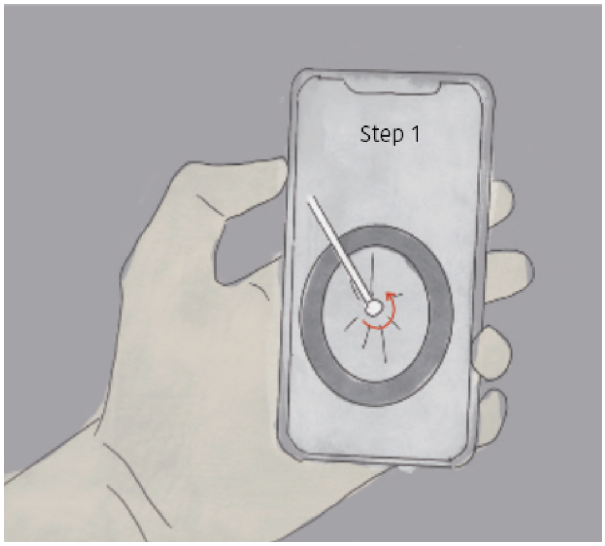
Besides, as time progresses, the appearance will change, for example, the color of wood will get darker and the new trace will appear on the leather.

Fig 5.8 Storyboard of wooden coffee machine

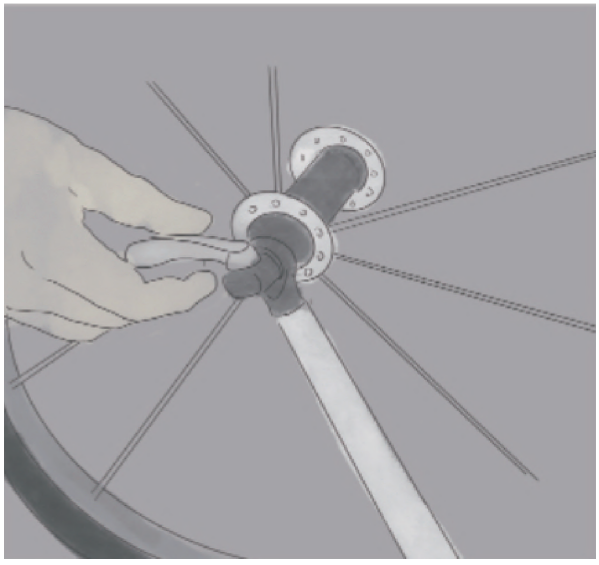
Concept 3: AR bike repair



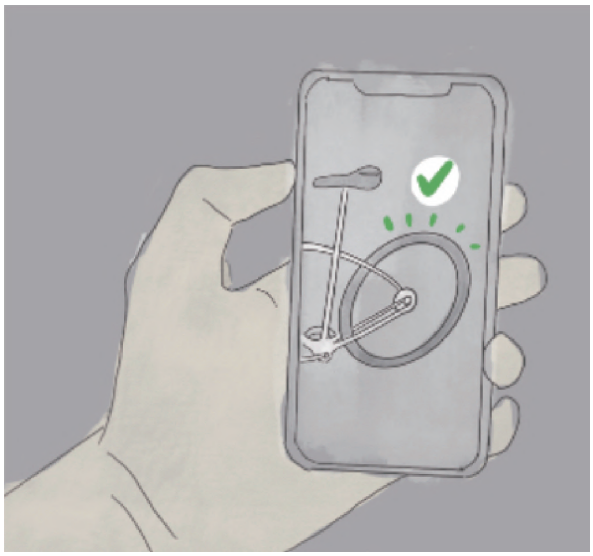
When your bike can not work as normal, you can open this AR bike repair app then scan the bike and click on the faulty part (e.g. tire). The app will provide some product care activities for that part (e.g. change the tire).



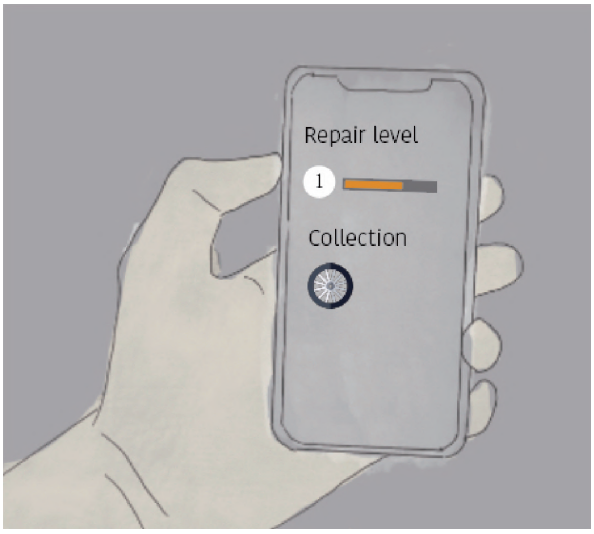
After you choose the repair activities, it will show you how to do it step by step.



You just need to prepare the tools and follow the provided tutorials.



After that, you can confirm a successful repair, which means you complete this repair by yourself.



Then, the app can record your level of repair and give you some rewards (badge or achievement).

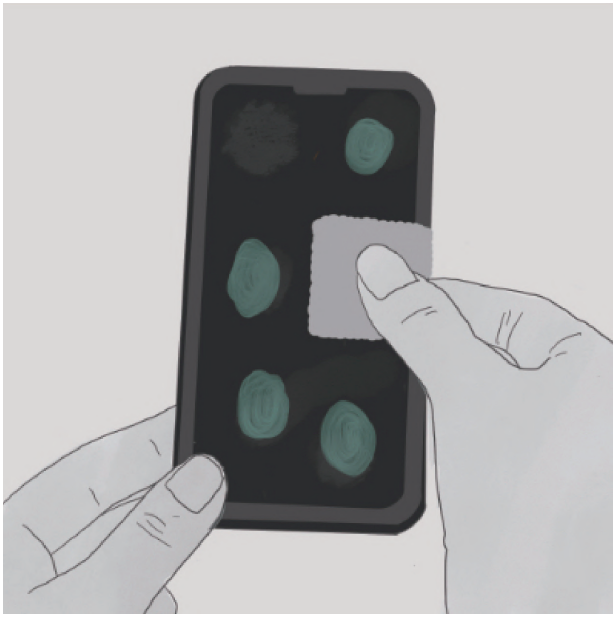
Fig 5.9 Storyboard of AR bike repair

Concept 4: Screen game

When you use your mobile phone for a certain period of time, the screen of your phone will become dirty, for instance the screen is full of fingerprints.

At this time, the phone will automatically pop up the synthetic ball game to remind you to clean the screen.

What you need to do is wrapping your fingers with clean tissue and dragging the same color balls together to complete this game.



When the same color balls touch, they will synthesize to another color ball. When there is only one ball on the screen, the game is finished.

It can also guide you to wipe every corner of the screen.

Fig 5.10 Storyboard of screen game

Concept 5: Independent mobile phone

When the power of your phone is less than 20%, it will enter self-protection mode.

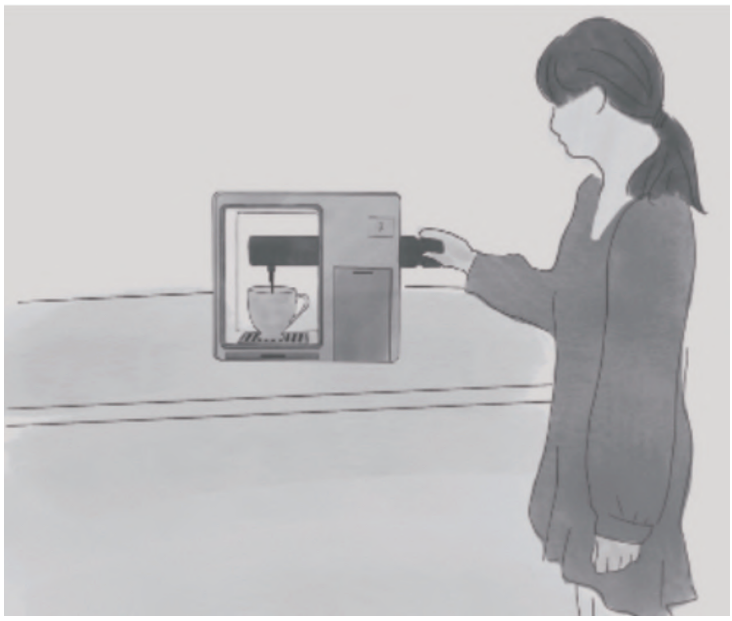
The screen of your mobile phone will turn into black and white, until you charge it.

When you play with the phone while walking, it will enter self-protection mode as well.

Fig 5.11 Storyboard of independent mobile phone

The screen will follow the pace of shaking, to reduce the probability of accidents with the phone until you put it down.

Concept 6: Pop-up components



After you have used this coffee maker for a while, the coffee machine will remind you that it needs to be taken care of.

First the sound of the coffee maker making coffee will become strange and sound like it is malfunctioning.

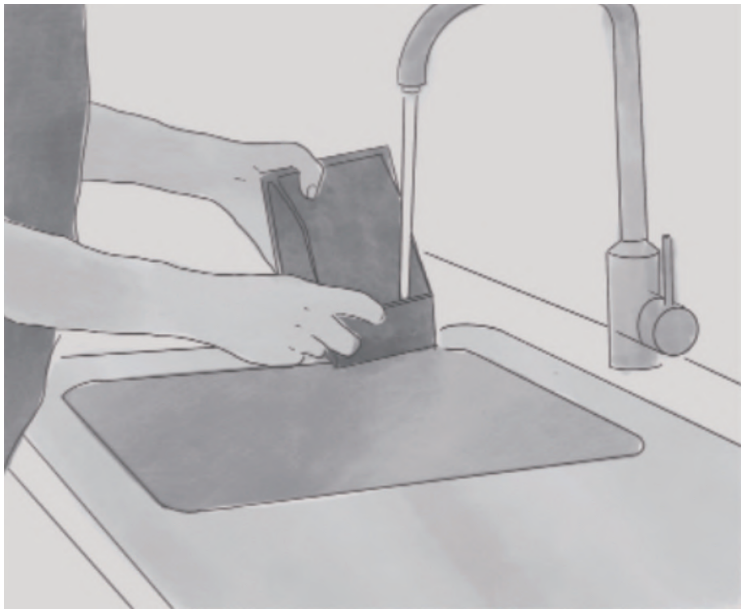


Fig 5.12 Storyboard of pop-up components

If you still do not take care of the coffee maker, the coffee maker will automatically pop up the parts that need to be cleaned to prompt you to clean it.

6 INITIAL USER TEST

This chapter illustrates the preparation of the user test, and analyzes the user test results. Finally, gain the initial insights about the balance of the product care agency.

User test plan

Evaluation form

Analysis method

Result of the user test

Initial insights of balance

CHAPTER 6.1 - USER TEST PLAN

Goal of the user test

In the last chapter, the six concepts are designed and presented. In order to learn about how the participants think about each concepts to gain the insights related to the optimal balance between the agency, the following research questions were answered:

- ***How do the three strategies work for each concept?***
- ***How do the participants feel the control degree for each concept?***
- ***To what extent does the concept stimulate the consumers' product care behavior?***

Method

Participants

These concepts are tested with five Master students from the Industrial Design Engineering Faculty of the University of Technology Delft and with one UI/UX designer.

The reason for choosing designers is that the designer is not only a consumer but also can better think about strategies and concepts from a designer's perspective, in addition to being able to analyze their own feelings and thoughts during the interview.

Process

Project introduction:

Before the test begins, there will be a brief introduction to the project in order to give participants some idea of certain vocabulary, such as what the product care agency is and what product care includes.

Showing the concepts:

After finishing the introduction, the participants will be shown the storyboard of each concept and the explanation of the concept will be given.

Filling in the evaluation form:

Then, participants will be asked to fill out an evaluation form (fig 6.1), which is divided into three sections, each corresponding to a research question, the details of which are explained in the next section.

Interview:

After participants answer each question they will be briefly interviewed to provide a deeper understanding of the reasoning behind the options. The answers will be used as important evidence to support the conclusions in the next chapter (initial insights of the balance).

CHAPTER 6.2 - EVALUATION FORM

First part: Strategy

To what extent do you think this strategy worked for the concept? Why?

The first part is to verify that the concept is designed by applying the relevant strategy well, and to clarify which design points the user perceives as corresponding to the strategy.

Second part: Degree of control

To what extent do you feel in control? Why?

Although the three strategies divide the degree of control into three levels, the previous co-creation session found that even within the same strategy, participants still felt different levels of control. In order to find out which concept (design elements) make them feel product in control and which make them feel user in control, this question is necessary, which will ask participants to compare two concepts that apply the same strategy. In the interview session, the participants will be asked to explain the reasons for their choice.

Third part: Product care tendency

The questions in the third part are adjusted based on the research that scale of product care tendency (Ackermann, 2021), to make this scale useful and reliable in this project.

The original scale can lead to recommendations on how design and communication can foster product care. And there are 3 important factors in this scale:

Factor 1: Easiness

Easiness describes the perceived ability of the participants to take care of their bicycle. It is based on former experiences. (“I am experienced in looking after my bicycle”) and the general self-esteem of being capable of taking care of the product (“I can look after my bicycle well”).

This factor consists of the current care behaviour and its importance, therefore the questions should be targeted at the general product category instead of the new concepts. But this factor is still important since it is helpful to know participants' current care behaviour (as a moderating variable) and the reason why they (dis-)like the new concepts.

I am experienced in looking after this product category.
I can look after this product category well.

Factor 2: Relevance

The second factor, relevance, describes the general care behaviour and its importance for the consumer. This factor includes three care activities (“I look after my bicycle”, “I try to prevent my bicycle from failure” and “I clean my bicycle”) as well as one item regarding the importance of care activities (“It is important for me to take care of my bicycle.“).

This factor can ask for the specific concepts to know if the new concepts make consumers perceive the importance of the product care.

It would be important for me to take care of the product in this concept.
I would look after this concept.
I would try to prevent this concept from failure.

Taking care of the product in this concept gives me a good feeling.
It makes me proud that I am able to take care of this concept.
This concept makes the repair activity easier.

Factor 3: Positive experience

The third factor, positive experience, refers to the emotional aspects of product care, such as the experience ("In general, looking after my bicycle is a positive experience") and the feeling of taking care ("Taking care of my bicycle gives me a good feeling").

This factor is also for the specific concepts. Besides, the product care easiness of the new concepts can influence consumers' feeling as well, hence, the last question related to the easiness is added.

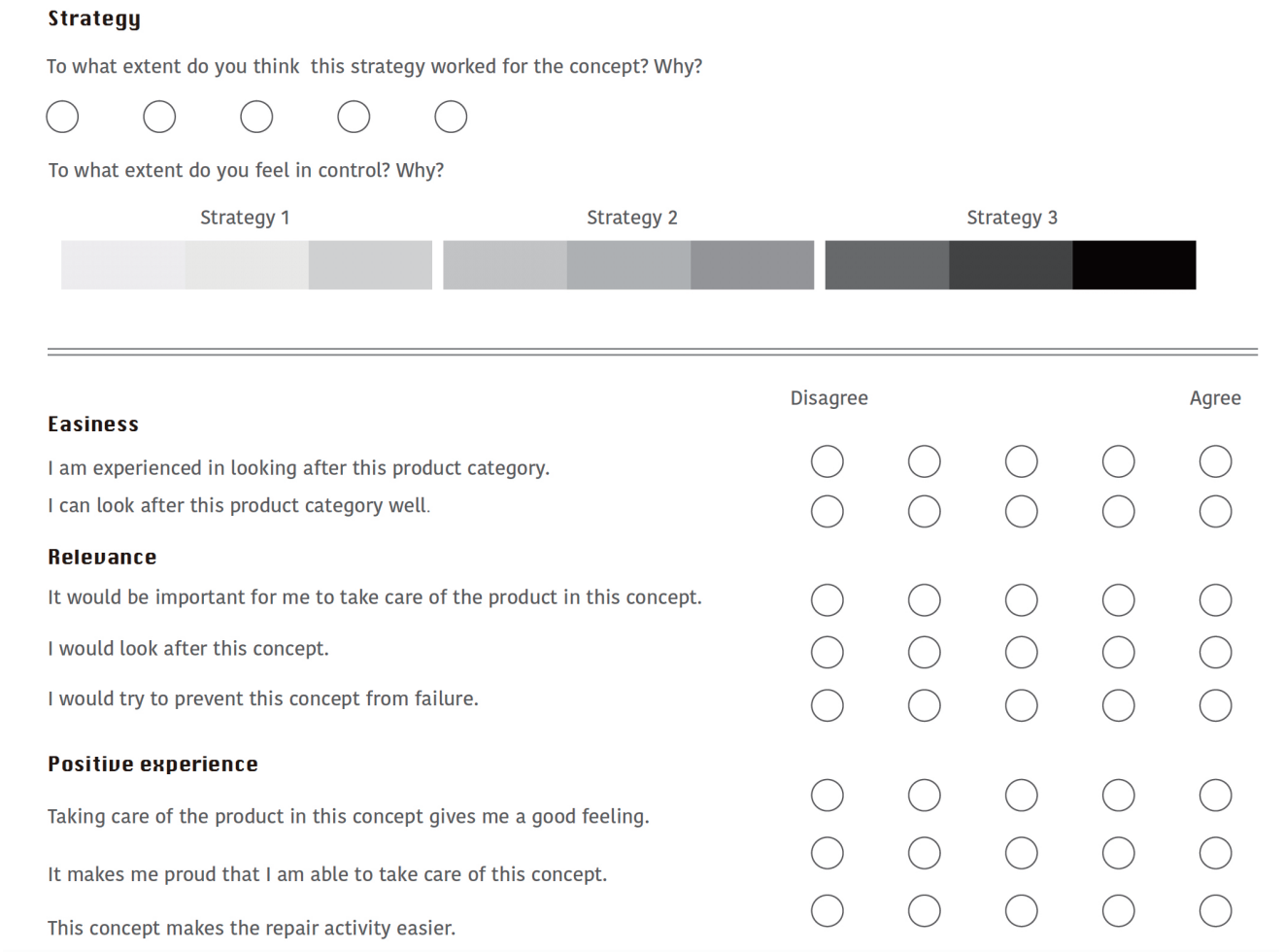


Fig 6.1 Questionnaire

Method

A total of six answered questionnaires and audio of the interviews were obtained after the user testing. The questionnaires‘ result will be used for the quantitative analysis and the audio will be used for the qualitative analysis.

Questionnaire

In order to more accurately and reliably select the most effective and promising concept (strategy), each concept was scored according to the participants' options.

However, since the second part of the questionnaire is related to the participants’ perceived control degree, it cannot be scored. And the easiness of the third part is focusing on the consumers’ current situation which does not influence the product care tendency of new concepts directly, therefore this question will not be scored as well.

Therefore only the relevance and positive experience in the third part of the questionnaire will be added together to get the final score of the user's product care tendency. Besides, all other questions will be averaged based on the participants' options, and the final score of the concept will be the sum of the average scores for each question. The higher the score, the stronger the product care tendency of the concept.

Interview

After participants selected the options for each question, they were asked to explain their reasons. And the whole interview was recorded to prevent the omission of interview notes. In order to make the analysis clearer, participants' answers were clustered and placed with the scores in the diagram (fig 6.2). Other concepts analysis can be found in appendix 4.

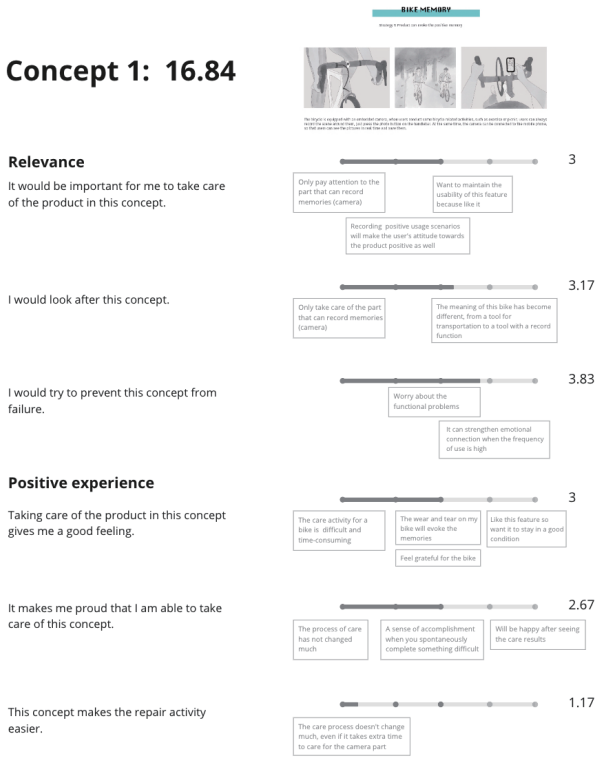


Fig 6.2 Analysis example

Applying strategy

In general, the figure 6.3 shows that the concepts using strategy 1 have lower score of the question (To what extent do you think this strategy worked for the concept?) than that using strategy 3. In other words, the user-oriented product care strategy is more difficult to be applied well than the product-oriented product care strategy.

For example some participants mentioned that for concept 1 (bike memory), they feel that the memories and products are separated, they would like to focus more on activities and photos instead of the whole bike. They agreed that strategy 1 sounds interesting, but it would be difficult to integrate the memory with the product if the product itself does not trigger meaningful activities.
As for strategy 2, it works better than strategy 1, because the support provided by the product is obvious for participants and the product care activities are changed positively.
Strategy 3 works best, and most participants could feel that they cannot decide their product care behavior because the product initiates it automatically.

Besides, comparing the user in control, participants are more sensitive to the product in control, probably because the product-oriented concepts offer the negative feedback which they dislike. (See appendix FIXME for the complete analysis for each concept)

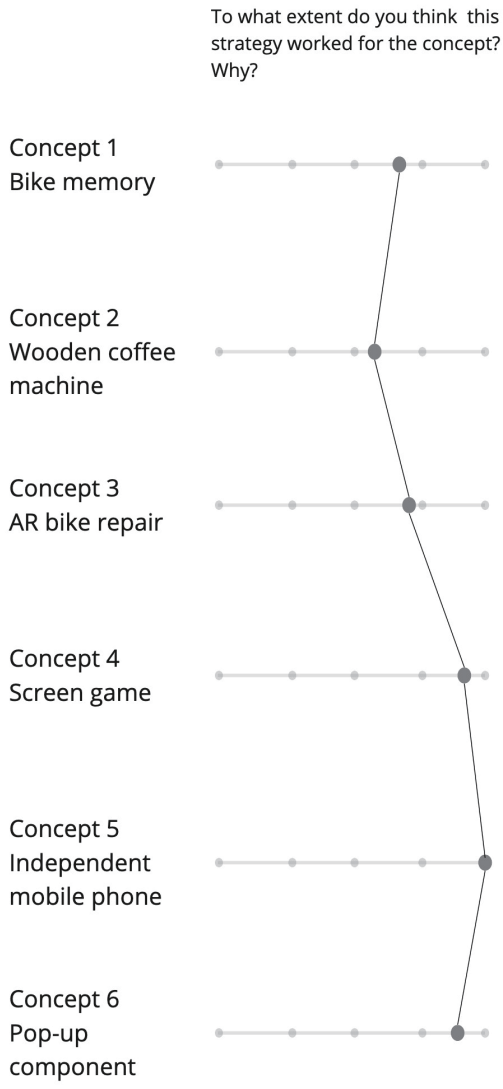


Fig 6.3 Result of applying strategy

Product care tendency

Easiness

In the easiness part, the similarities in the participants' responses of the current product care situation for all three products were that when the functionality of the product has not been affected, they are less likely to conduct product care behavior, and that their care activities are mostly maintenance and hardly involve repair activities.
In terms of ability, most participants indicated that they are willing to do simple care activities, but often forget or do not realize the importance of care activities to the product. And complex care activities require more ability and tools from consumers, so that many users are discouraged from doing so (see fig 6.4).

Relevance

As for the first two questions（“It would be important for me to take care of the product in this concept.” and“I would look after this concept.”）, scores of concepts using strategy 1 < strategy 2 < strategy3.
Participants mentioned that for concepts of strategy 1, they were willing to take care of the product because they like this product (functionality/appearance). But this emotional connection is difficult to last for a long time, and they hardly connect the positive memory with product care activities if they do not even realize the importance of the product care.

For concepts of strategy 2, the product care behavior is changed, and concepts would provide the support and rewards to the participants which encourage the product care behavior obviously.

Although concepts of strategy 3 have the highest score, participants felt that they have no choice but to take care of products, otherwise the product cannot work well.
In the third question (“I would try to prevent this concept from failure.”), the result shows that if the product care activity is simpler and more interesting, the score of this question is lower. In this case, consumers no longer see care activities as a task, but they find new meaning (fun/fulfillment) in them. They mentioned that they will not use the product carefully to prevent it from failure because they thought care activities were no longer a problem for them.

Positive experience

As the figure 6.5 shows, concepts using strategy 2 have the highest score of this part. Participants agreed that they could feel guided during the product care activities and the experience of the product care became more positive. In concepts of strategy 1, the product activities were not changed too much. For strategy 3, participants mentioned that they felt they were forced to do product care, and they thought the product was annoying. See appendix FIXME for the complete analysis of each concept.

Easiness

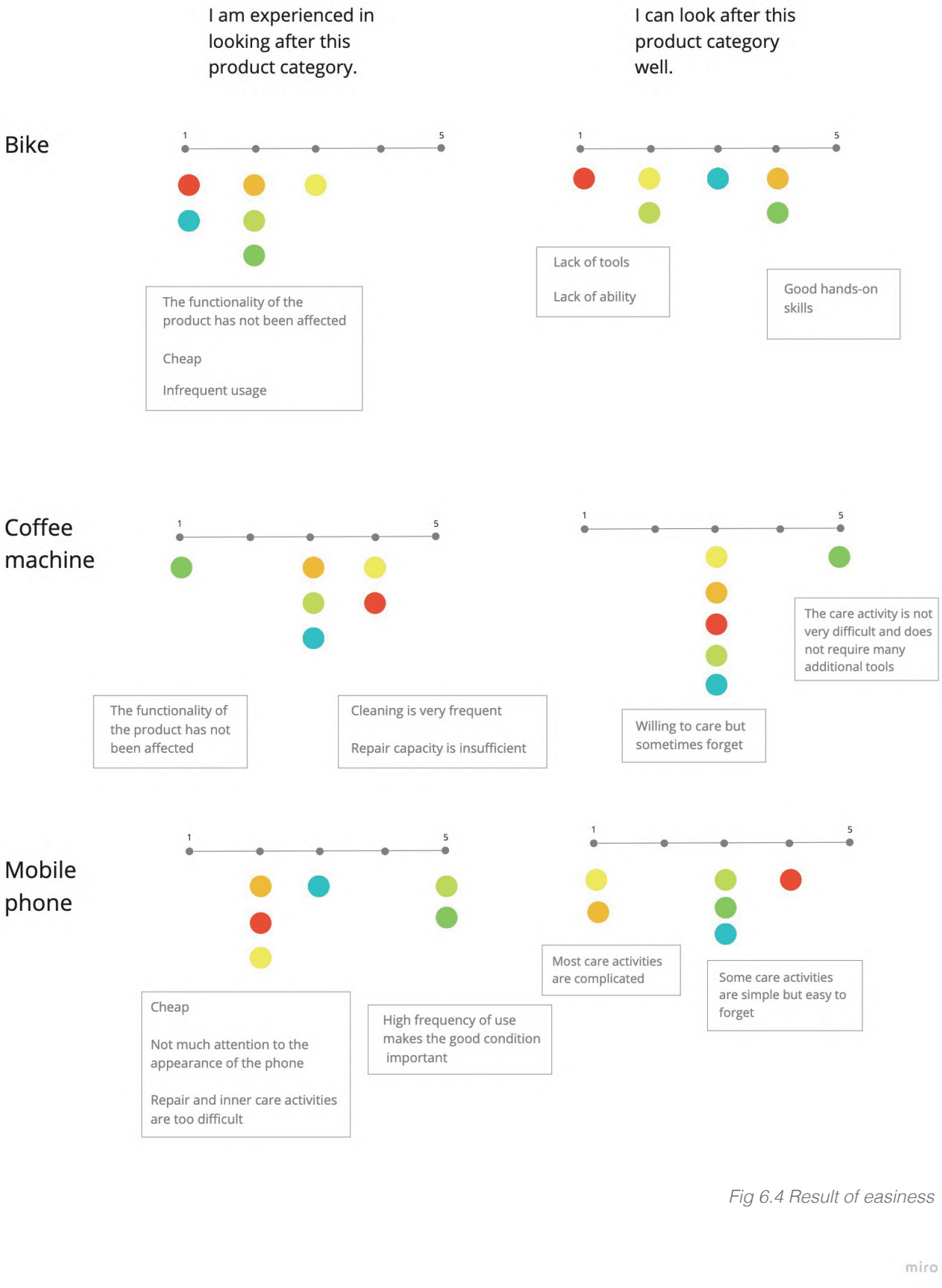


Fig 6.4 Result of easiness

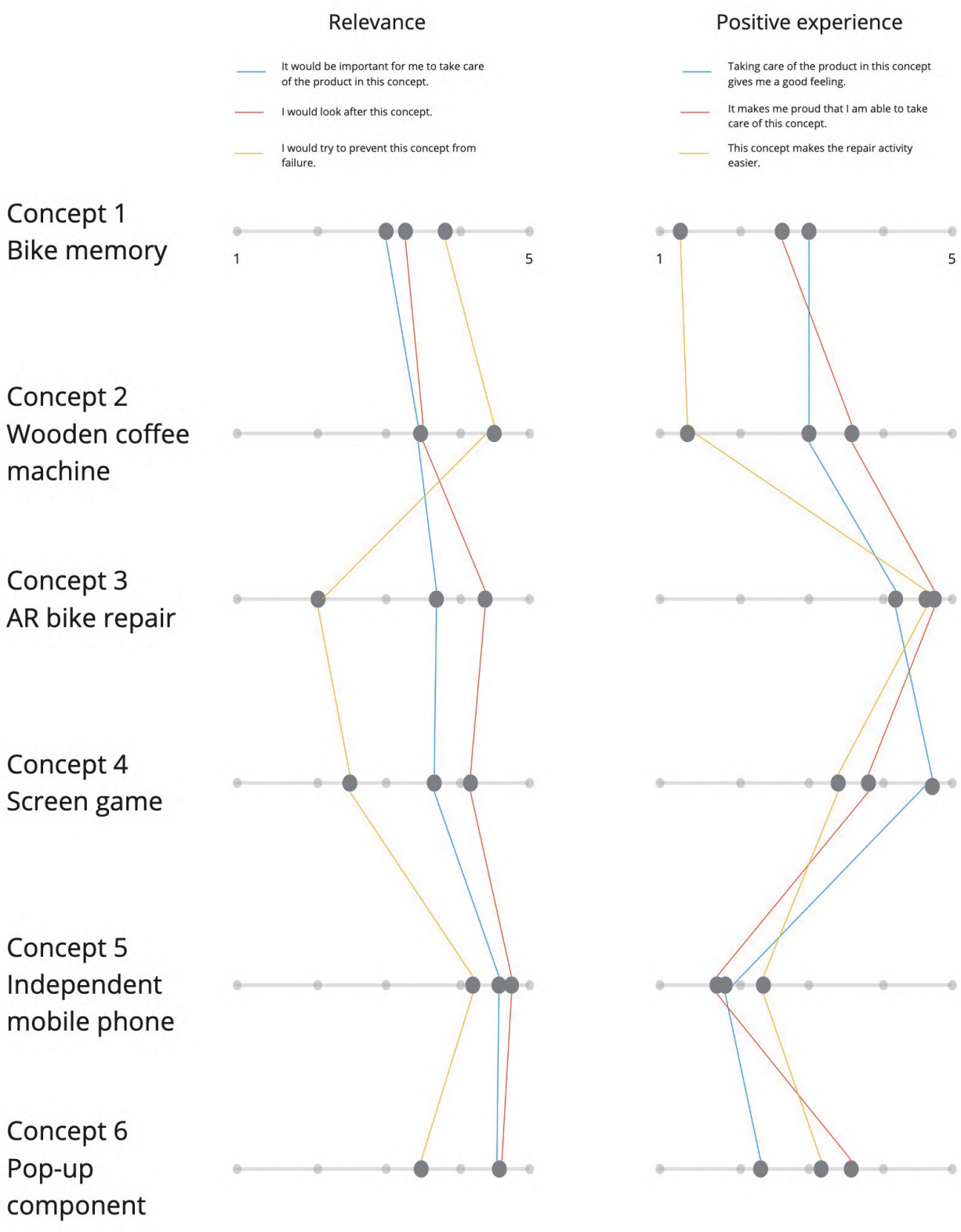
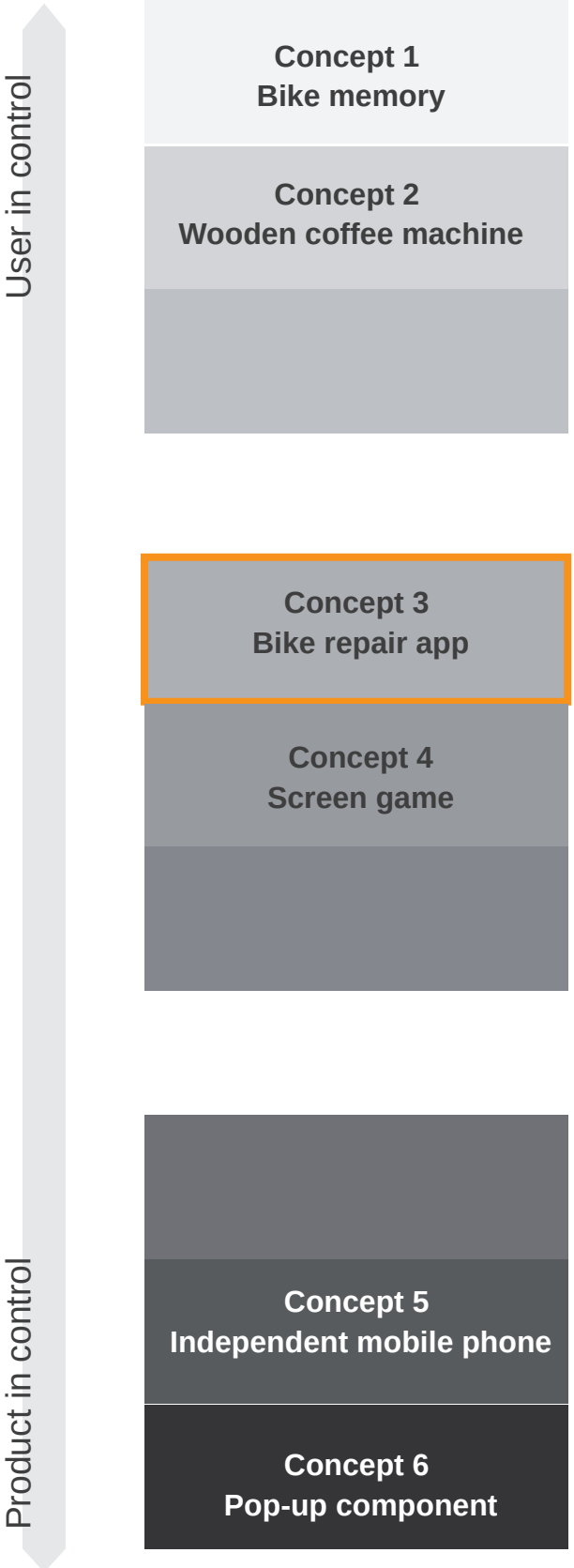


Fig 6.5 Result of relevance and positive experience

miro

Degree of control



Strategy 1: Product care can evoke the positive memory

In concept 1, the product does not interfere with the user's care behavior, which relies on the user's own initiative to take care of it.

In concept 2, the appearance of the product is like a reminder of the care behavior, so participants felt that concept 2 is more product-oriented.

Strategy 2: Product care can be supported and consumers regard it as an challenge/game/competition

In concept 3, the product mainly plays a guiding and recording role, and the care activity itself is initiated and performed by the user.

In concept 4, the product replaces the care activity with a game, weakening the purpose of product care, the user performs the care behavior more unconsciously.

Strategy 3: The product will be designed to start the product care automatically and consumers need to finish it

These two concepts are controversial.

Some participants think concept 5 forces them to do product care otherwise they cannot use the mobile phone normally, so they think the phone is in control.

But other participants think concept 6 pushes them to do the product care and they feel stressed, so concept 6 is more product-oriented.

CHAPTER 6.5 - INITIAL INSIGHT OF BALANCE

From the scores of each concept and the answers of the interview, it is obvious that strategy 2 can stimulate people to perform product care behavior better.

Strategy 1*: Product care can evoke the positive memory*

- Concept 1 bike memory: 16.84
- Concept 2 wooden coffee machine: 19.91

Strategy 2: ***Product care can be supported and consumers regard it as an challenge/game/competition***

- Concept 3 bike repair app: 23.99
- Concept 4 screen game: 21.50

Strategy 3: ***The product will be designed to start the product care automatically and consumers need to finish it***

- Concept 5 independent mobile phone: 19.42
- Concept 6 pop-up component: 19.30

Fig 6.6 Score of each concept

Strategy 1 can enhance the emotional connection between people and products to a certain extent, but this connection has less impact on users' tendency to take care of products. For the care activity of electronical products, users said that they are unaware of the importance of this or they don't have the ability to conduct product care (like repair). At the same time, electronical products are very functional, and the technology improvement is very fast. Therefore, if lack of care leads to the need for repair, users will consider the economic factors. Applying the strategy1 to electronical products will have some difficulties.

> *This bike does make me feel more emotional connection compared to a regular bike, which makes me want to use it more. But I'm probably less likely to care more for the bike, but would like to care the camera part on the bike.*

> *This coffee machine may make me care a little more about its appearance, but actually the appearance doesn't have much effect on the function of the coffee machine.*

From the interview of strategy 2, I found it's very important that the product has the ability to correctly and clearly express their needs of care, and it can provide assistance and guidance, as well as positive feedback (rewards instead of punishment). If the product has a personality, the user would prefer that the product be an assistant that can assist the user in the product care activities.

> *The app teaches me how to fix my bike and keep track of my progress, and it gives me very positive feedback that I can do things that I couldn't do before.*

> *This concepts are very good, it gives me a feeling of cleaning without realizing it. And I'll probably look forward to the phone popping up for this game.*

Concepts of strategy 3 have a dominant position in care activities that can cause users to feel stressed to use and care for the product. The product is like a young child who is crying for attention, the user may choose to take care of the product but such behavior is forced or

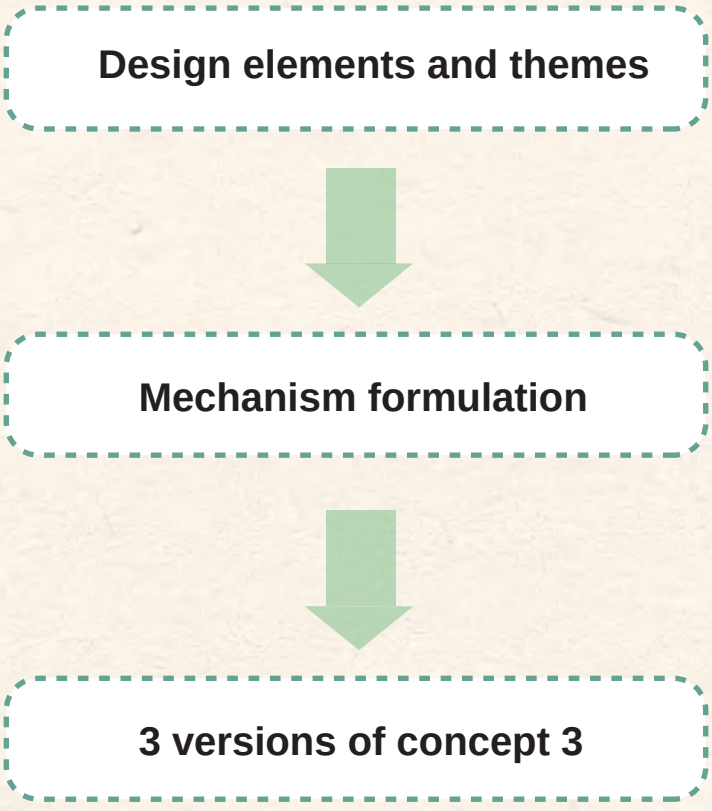
pushed and may lead to the replacement of the product.

> *There's no positive feeling about it, right? After the phone is charged up, I might feel relieved.*

> *It gives me the feeling like my mother put dirty dishes in front of me and asks me to wash them, it will make me very stressed.*

7 Design Mechanism

After the user test analysis, strategy 2 is the most effective and acceptable balance of control for users. In order to further verify the optimal balance of product care, this chapter will redesign concept3 by slightly adjusting the design elements of concept3 to change the user's perceived product care agency. According to the results of first user test, the control degree mechanism will be formulated.



CHAPTER 7.1 - DESIGN ELEMENTS AND THEMES

Goal

In order to verify and further define the optimal balance between user in control and product in control.

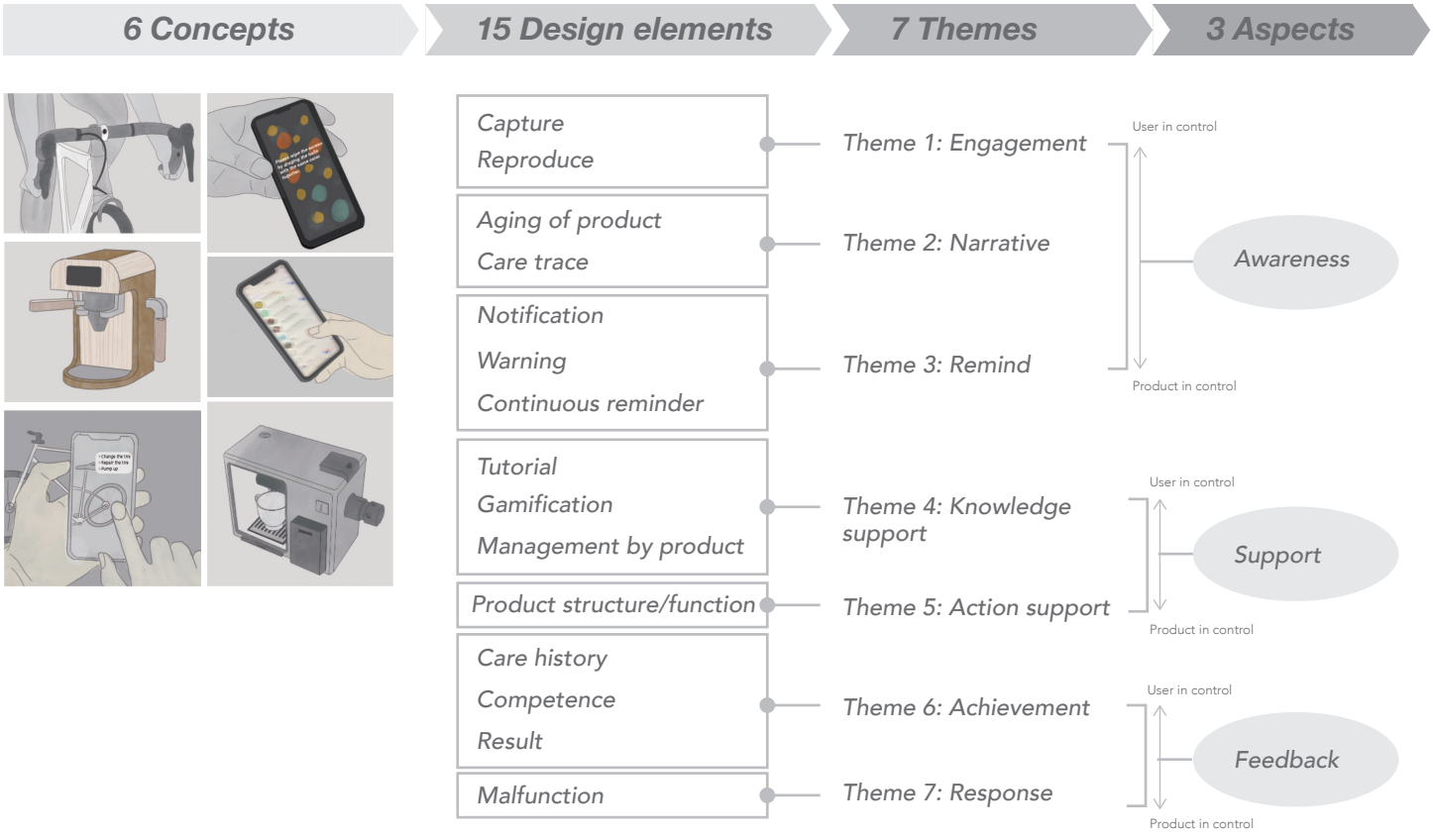
The first user test results are based on the participants' comments of the six concepts to define that most participants prefer the balanced control level (in the middle), but because the concepts are for different products and product care type, and the concepts are different in feasibility as well. Hence, the next user test should exclude the external factors then verify and refine the conclusion.

Method

1.Through the analysis of user interviews in the first user test, a total of 15 design elements related to product care were summarized from the six concepts. The 15 design elements can be classified into 7 themes according to the way they influence the user's product care behavior.

2. In order to compare the control degree of each theme, the 7 themes can be divided into 3 groups based on which aspect of the user's product care behavior they have an impact on. After that, the mechanism of product care balance was formulated.

3. 3 versions of concept 3 (bike repair app) were generated by applying the mechanism, aiming to define the user's prefered product care balance.



Design elements and themes

After listing all the design elements in 6 concepts, it is found that some elements influence the users' product care behavior in the same way. To move from the data to knowledge, the design elements are classified into 7 themes according to the way they influence the users' decision or experience of product care.

After the user interview, by comparing the users' responses with the result of the questionnaire (scores for each concept), it is obvious that the different design elements will influence the product care control degree perceived by the user in the concept. Therefore, in order to make the mechanism of the product care agency, the design elements in each theme should be sorted by its control degree.

Theme 1: Engagement

Enhance the product participation in the relevant activity

Capture

Capture the moments that users interact with products (or the activities involve the product).
Example: Users can take pictures of their surroundings while riding through the bike's embedded camera.

Fig 7.1 Bike memory

Reproduce

Reproduce the moments to evoke the users' memories with products
Example:Users can import photos from the camera into the phone for viewing.

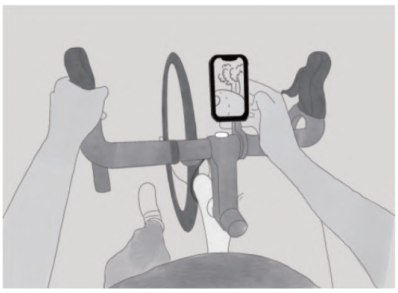


Fig 7.2 Bike memory

Within Theme 1

User — Product

Capture Reproduce

Engagement enables users to evoke memories through capturing and reproducing the interaction moment between product and users, therefore to make the relationship between product and users become more engaging (the bike is not longer just a means of transportation, it can also serve as a tool to document the good life). Due to the different value of the product in users' minds, users' care of this product is completely spontaneous and requires no external intervention or reminder. The user feels very much in control during care activities.

Capture is considered more user-oriented than Reproduce because users believe that Capture makes them actively think about caring for the product even when they are not doing product-related activities, and the product care behavior even becomes a habit because they like the product enough. In contrast, Reproduce relies more on the product to help users recall these moments which make users feel product agency more.

Theme 2: Narrative

Make the appearance of product more narrative.

Aging of product

Make the product appearance of the aging more obvious and nostalgic
Example: Over time, the wood and leather on the coffee machine are starting to age, the wood grain deepening and darkening, and the leather develops creases.

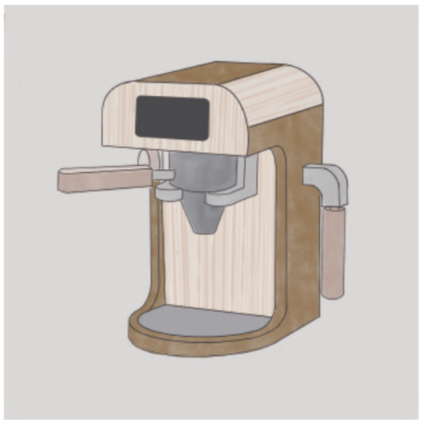


Fig 7.3 Wooden coffee machine

Care trace

The product is able to make the users' care behavior visible or more obvious in some way.
Example: The special material of the wooden coffee machine makes itself get dirty more easily than the regular coffee machine and visibly reflect users' improper/frequent care, for instance, coffee stains will become difficult to remove if not cleaned by users in time.

Fig 7.4 Wooden coffee machine

Within Theme 2

Aging of product
Care trace

Narrative allows the product to represent its relationship with the user in a more implicit way, and enables users to recall the previous usage scenario and the length of use, which makes the product more like their personal item. Hence, it can invoke users reflecting their product care behavior and motivate users to maintain and repair it actively instead of replacing.

Comparing these two design elements, users said that care trace makes them feel product in control more, because care trace is a subtle way for the product to express its care needs. Users indicated that they were willing to perform care behavior in order to keep the appearance of the coffee machine aesthetically pleasing. In this case users perceive the product as driving their product care decisions. The product care triggered by Aging of product is due to the nostalgia of the product's appearance that makes the product irreplaceable in the user's mind.

Theme 3: Remind

Remind consumers of conducting product care behavior when the product need it.

Notification

The product directly expresses its care needs.
Example: In the concept Screen game, a notification will pop up automatically when the phone's screen needs cleaning.

Fig 7.5 Screen game

Warning

The product alerts users by presenting the results of insufficient product care.

Example: In the pop-up component concept, when the coffee machine needs to be cleaned the internal parts, the coffee machine will make a strange sound when making coffee, as if the coffee machine is about to break down.

Fig 7.6 Pop-up components

Continuous reminder

The product increases its presence through constant reminders, thus forcing the user to perform product care activities.

Example: The shaky screen in the concept of the independent mobile phone will continuously remind the user that looking at the phone while walking is a dangerous use scenario.

Fig 7.7 Independent mobile phone

Within Theme 3

User — Product

Notification ***Continuous reminder***

Warning

Remind allows the product to proactively present their care needs in a way that users can visibly perceive，before users are aware that the product needs care. Users thought it is helpful because they won't forget to conduct product care behavior but it makes them feel that the product is controlling their care activities.

Of the three design elements, users mentioned that Notification made them feel more in control because this remind format gave them the option to do product care or not: when they have a positive attitude toward product care, they will follow the notification, or when they don't have the time and energy, they just ignore it .

Warning is more product in control, users indicated that it gave them an alert feeling to avoid scenarios they did not want, in which case users felt the product was pushing them to choose the options that it wanted--perform product care behavior.

Continuous reminder is the design element in which users perceive the product agency the most, and it makes users feel that they are dominated by the product and they are unable to manage their own care activities. They can do nothing but follow the product's instructions.

Theme 4: Knowledge support

Help users in the cognition of product care.

Tutorial

The product assists the user in the product care process by providing a detailed tutorial on the care activities directly.

Example: The concept of the bike repair app provides a step-by-step explanation of the care activities selected by the user.

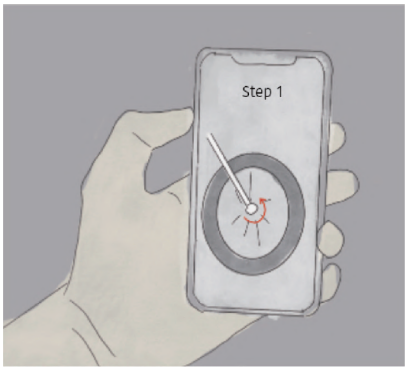


Fig 7.8 AR bike repair

Gamification

The product supports and facilitates care activities in a gamified way, making the user's product care experience more fun and enjoyable.

Example: Concept screen game is a game that turns the care activity of wiping the screen into a game, allowing the user to clean the screen while playing.

Fig 7.9 Screen game

Management by product

The product is responsible for managing all the related care activities, then the user only needs to follow the decision made by the product.

Example: The independent mobile phone will immediately go into self-protection mode when the user uses the phone in a way that might shorten the mobile phone's lifespan, and the user needs to take care of the phone according to the phone's alerts.

Fig 7.10 Independent mobile phone

Within Theme 4

Knowledge support can guide the user's product care behavior in some way and play a role in supporting and helping the user during the care activities. The main goal of this design element is to improve users' ability then lower the threshold of product care activities.

In these three design elements, users indicated that tutorials make them feel they are in control most during the process, because they know they are on track and are able to achieve a positive outcome. In contrast, gamification is more product in control, because users thought this design element weakens the purpose of product care, and that users engaged in product care behavior more because they wanted to play the game, so they felt that their care

behavior was more driven by product (game). What made users feel most product in control is Management by product, users mentioned that they had very little freedom in product care with this design element (they cannot arrange product care activity by themselves), and they can only conduct product care activities according to the product's needs.

Theme 5: Action support

Change product care activity through product design.

Product structure/function

By changing the structure or function of a product through product design, the goal is to make care activities easier and clearer.

Example: In the concept of Pop-up components, the coffee machine automatically pops up the components when the coffee machine needs to be cleaned to give consumers hints of where they need to take care of.

Fig 7.11 Pop-up components

Within Theme 5

User — Product

Action support

Action support helps the user by changing the product care activity itself. Since such help is more obvious to the user and directly affects the care activity, the user mentioned that it makes them feel that they are helping the product to accomplish the task, so they thought the product was taking a more active role in the care activity.

Theme 6: Achievement

Give the positive feedback of the product care result.

Care history

The product can show the user's previous care activities

Example: The bike repair app shows the user's care history by presenting the accumulation of product care experiences.

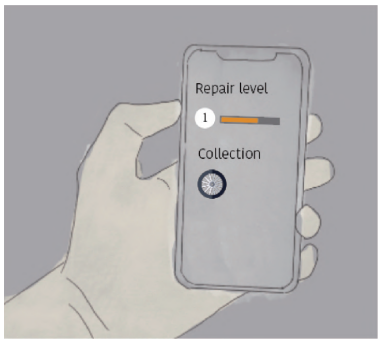


Fig 7.12 AR bike repair

Competence

Users can perceive the improvement in their product care skills through care activity

Example: When users complete product care activities with the bike repair app, the app awards the user with a badge indicating the skills gained during the activity.

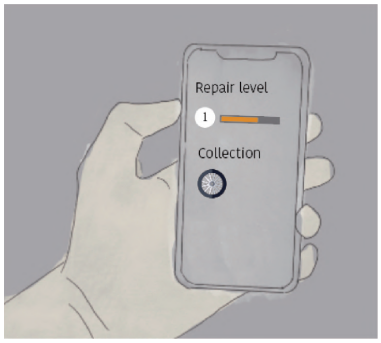


Fig 7.13 AR bike repair

Result

The product can amplify and demonstrate the benefits of the product care after the care activity is completed.

Example: In the concept of the independent mobile phone, when the user takes proper care of the phone, the phone will resume normal operation, giving the user a hint that it is their behavior that makes the phone last longer.

Fig 7.14 Independent mobile phone

Within Theme 6

Users mentioned that the achievement could make the outcome of the product care become more concrete, and this kind of immediate positive feedback could encourage them to conduct product care behavior.

Users believed that Care history is the most user in control in this theme, because the product only acts as a recorder and does not evaluate or intervene in the user's care behavior. Therefore, users thought that they could make their own care decisions freely.

As for the Competence, users felt like the product encourages them to take care of the product in a certain sense, transforming the product care behavior into improving their own hands-on skills or knowledge, and they could feel a greater sense of accomplishment after the care activities.

Result was considered more product oriented because this element makes the product evaluate the results of care activities, which users said makes them rely on and care about the evaluation of their care activities given by the product, thus making them feel that the product agency has a dominant role in the overall product care.

Theme 7: Response

The product's response when the user ignores the product's care needs.

The product will show failure when there is a lack of care.

Example: In the pop-up coffee machine, when the user does not clean the parts of the coffee machine on time, the coffee machine makes a malfunctioning sound when making coffee.

Fig 7.15 Pop-up components

Within Theme 6

Response magnifies and presents the consequences of lack of care for the user, and when it happens, if the user wants to use the product normally, they have no choice but to perform the care activity that the product requires. Users mentioned that they felt they were forced or pushed by the product to perform the care activity, as the product takes a completely dominant role in the care activity.

Mechanism formulation

After analyzing the first user test and defining the 7 themes, it is obvious that these themes have different control degrees, but since the design elements in these themes act on different aspects of product care, it is difficult to compare the 7 themes' control degree directly and arrange them in to a linear list.

Therefore, according to the role of these themes in product care, I divided the themes into three categories, so that the themes in each category can be arranged according to the control degree:

1. Awareness

Engagement Narrative Remind

The design intervention increases the awareness of product care and helps users to start care activities consciously.

2. Support

Knowledge support Action support

The design intervention supports the user in the process of product care, making care activities cognitively or behaviorally clearer and simpler.

3. Feedback

Achievement Response

The design intervention will give users feedback when they complete or fail to complete their product care activities.

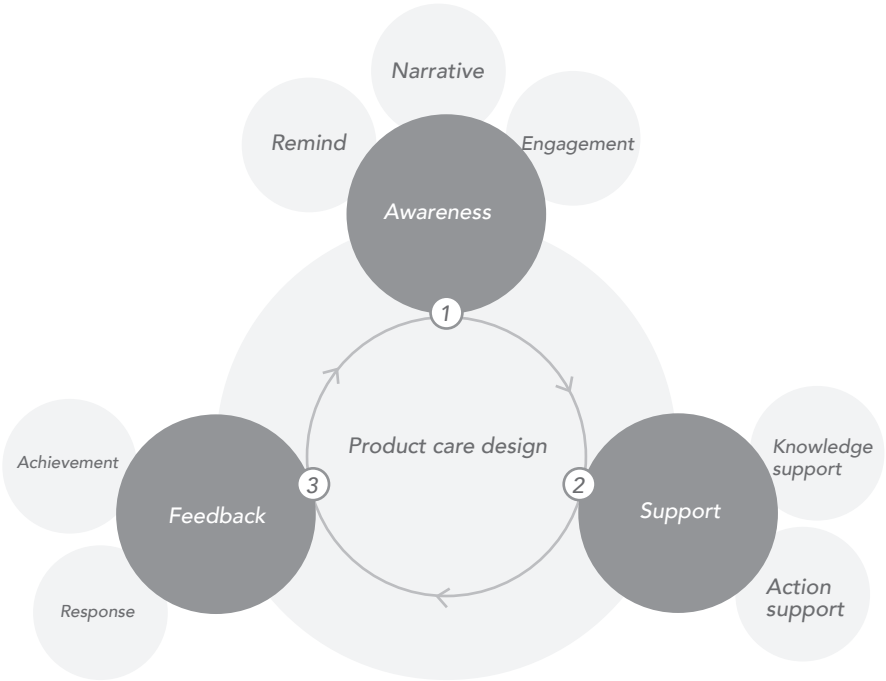


Fig 7.16 Product care aspect

Awareness is the first thing that happens in the whole product care behavior, and it is the key to start the care behavior. The design intervention on support comes into play during the product care behavior. At last, Feedback occurs at the end of the care activity and will also have an impact on the user's awareness. For example if feedback after product care satisfies the users, it would be more likely that they conduct product care behavior again.

Since product care design does not necessarily need to include all three aspects (e.g. The design can promote the user's product care behavior by simply improving the user's awareness, such as bike memory), when designing this mechanism, in addition to the seven themes mentioned previously, each aspect also added a "none" to indicate that the design does not have any influence in this aspect.

The themes in the same group act on the same aspect of product care， which makes it easier to compare their control degree through the explaination and anaysis of each theme in chapter 7.1.

The final result is this Control degree mechanism in product care (see fig 7.17).

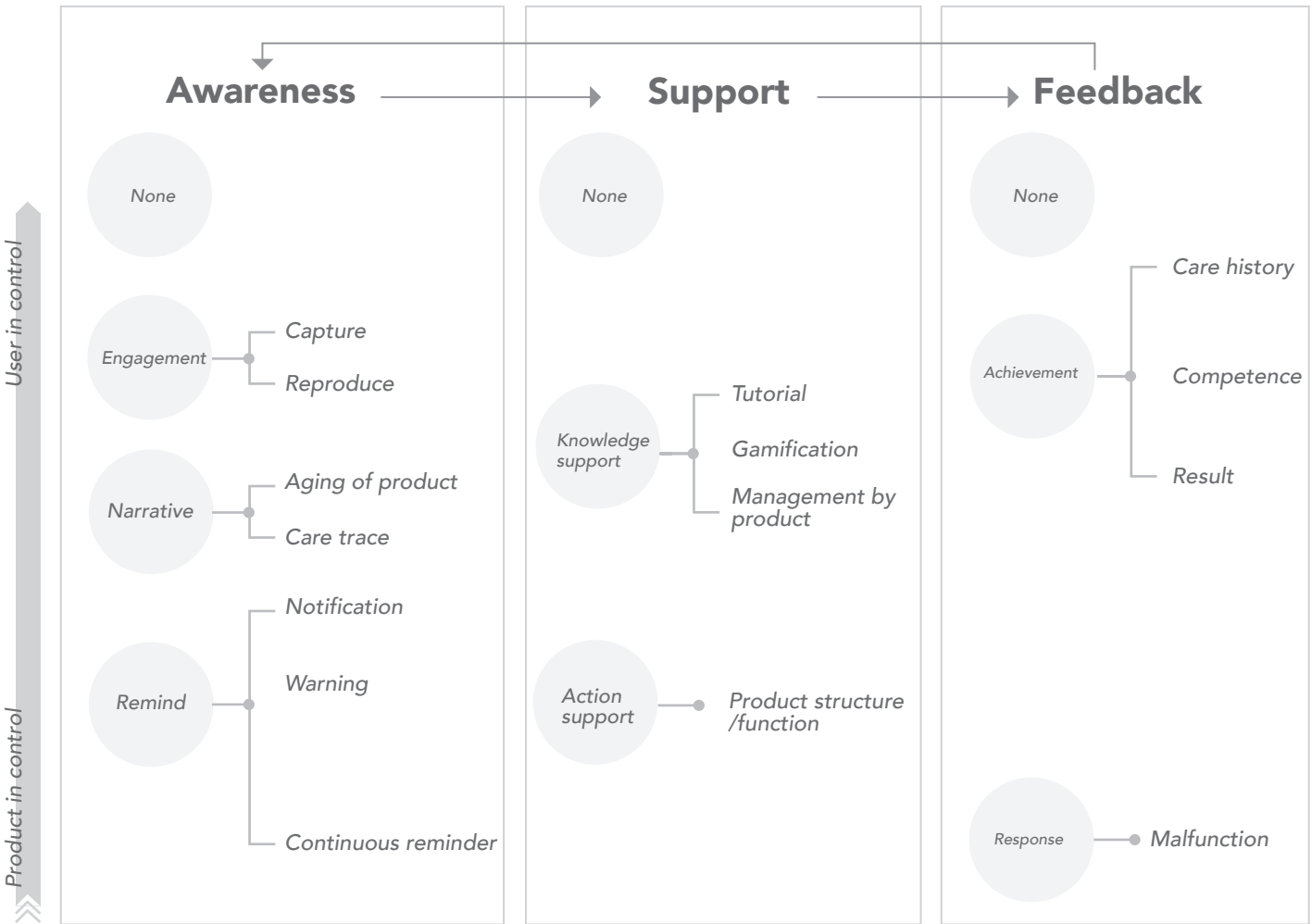


Fig 7.17 Control degree mechanism in product care

This mechanism can help the designers to determine the agency of the dominant product care in the concept by measuring the control degree of the design elements contained in the concept in these three aspects.

For example, concept1 (bike memory) contains only the design elements related to Engagement in Awareness, which has no influence on the Support and Feedback of product care. Therefore, concept1 is very biased towards the user in control concept.

Fig 7.19 Bike memory

For example, concept6 (pop-up components) contains Remind-Continuous reminder in Awareness, Action support - Product structure/-function in Support, and Response-Malfunction in Feedback.All of these design elements are very product-oriented, which finally leads to the concept that users feel product in control.

Fig 7.20 Pop-up components 3

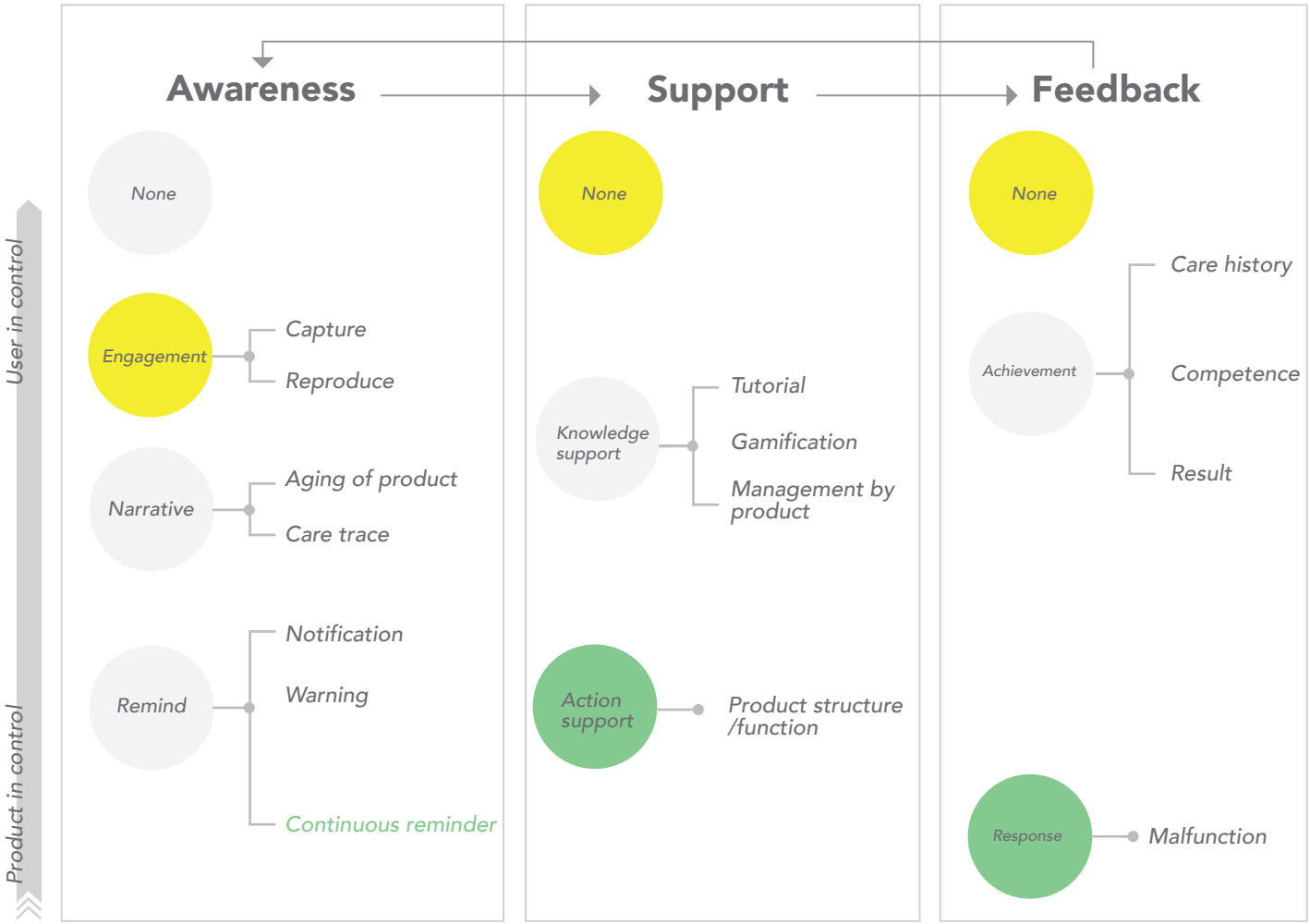


Fig 7.18 Control degree mechanism in product care

3 versions of concept 3

In order to further define and confirm the balance that users prefer, the next step is to use this mechanism to redesign concept3 (bike repair app) to generate 3 versions of concept 3 with different product care control degrees.

For the reliability and persuasiveness of the research, this test needed to ensure that the three new concepts were based on concept3 but with a different control feeling. Therefore, the best way to reach this goal is to use different design elements from the same theme to the concept bike repair app, because if different themes are applied, the concept itself may change significantly, for example, concept 3 is difficult to include action support, because the product itself is an app.
Therefore the selected themes are the themes in concept3:

- ***Remind***
- ***Knowledge support***
- ***Achievement***

To allow users to more clearly feel the different product care agency between the concepts, in the concept development, the user-oriented/-balanced/product-oriented design elements of different themes will be combined together. (The circles of the same color in the fig 7.21 represent being in one concept.)

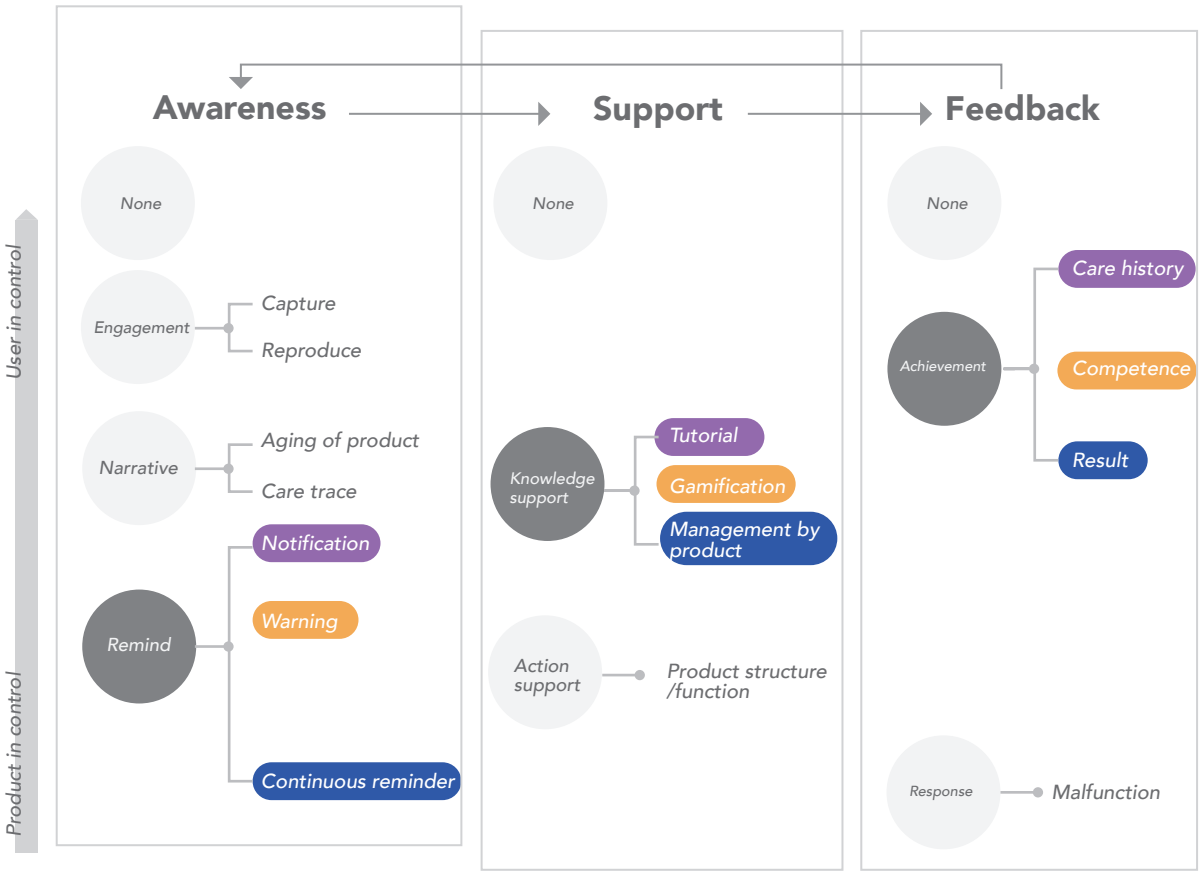


Fig 7.21 Control degree mechanism in product care

Concept 1

Fig 7.22 Interface of concept 1

1. Remind : Notification

When the user has not used the app for a long time, a reminder will appear on the app's home page near the current date: your bike tickled you.

3. Feedback : Care history

After users have completed the product care activity, they can record the activity. The app allows the user to clearly see the frequency of care activities (one wave means one week, the higher the wave means the higher frequency of product care in that week). It is also possible to further view their detailed care content, in which users can record their care feelings, moods and photos.

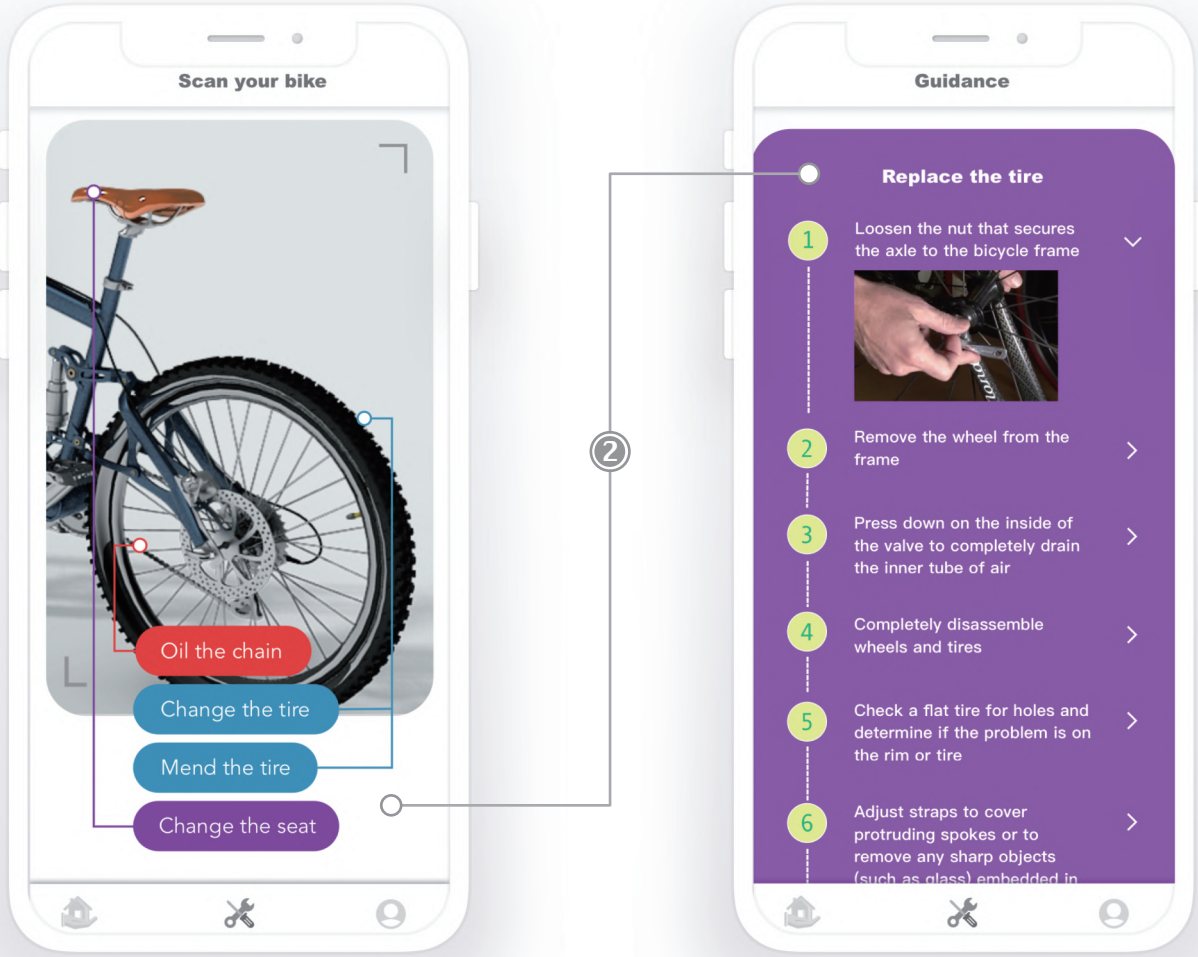
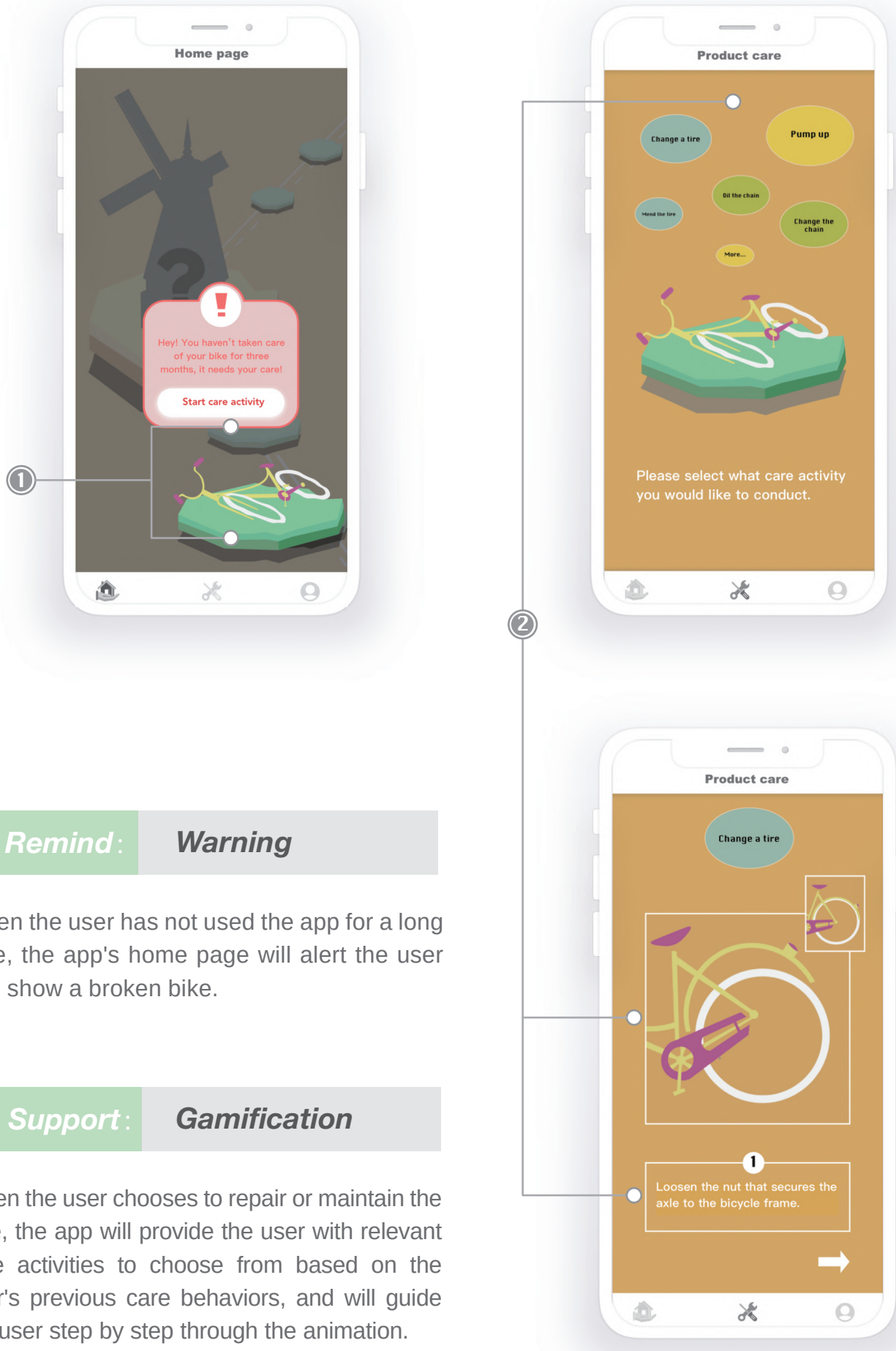


Fig 7.23 Interface of concept 1

2. Support: Tutorial

Users can scan the part of the bike that needs care by using the camera of the phone, and the app will recommend relevant care activities for the user by identifying the bicycle part and giving a detailed care tutorial.

Concept 2



1. Remind: Warning

When the user has not used the app for a long time, the app's home page will alert the user and show a broken bike.

2. Support: Gamification

When the user chooses to repair or maintain the bike, the app will provide the user with relevant care activities to choose from based on the user's previous care behaviors, and will guide the user step by step through the animation.

Fig 7.24 Interface of concept 2

Fig 7.25 Interface of concept 2

3. Feedback: *Competence*

After the user completes the care activity, the bike will return to its normal status and the user will receive a certain amount of coins, which can be used to “ride” the bike to unlock different city landmarks. The app will also record your care experience and the skills you have gained through the care activities.

Concept 3

Fig 7.26 Interface of concept 3

1. Remind: Continuous reminder

The app will always be present on the homepage of the phone in the form of a widget that communicates the bike's care needs to the user by showing the mood of the bike.

2. Support: Management by product

The app will schedule the user's care activities for each month, and the plan for that month will turn red if the user does not complete the tasks. The app also gives a detailed description of all the care activities, so users can check it when they encounter difficulties.

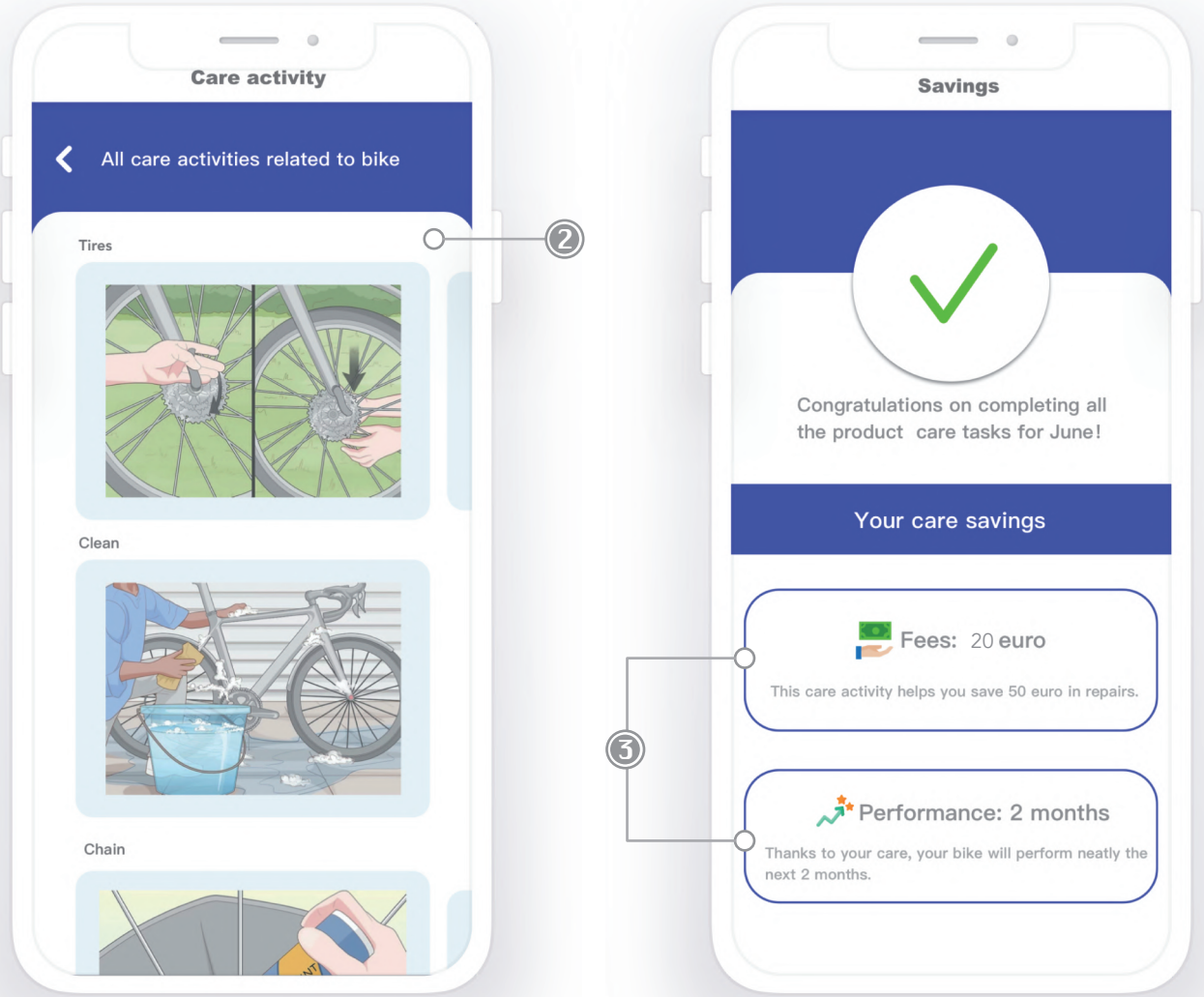


Fig 7.27 Interface of concept 3

3. Feedback: *Result*

After completing a care activity, the app will evaluate the user's care behavior, such as the amount of money saved and the life of the product extended by this care activities.

8 Second User test

In this chapter, the 3 versions of concept 3 (bike repair app) will be evaluated. And the goal of this user test is to validate the conclusions and draw more refined conclusions about the balance between product care agencies and provide suggestions and recommendations for the designers.

Result of user test

Conclusion of user test

CHAPTER 8 - USER TEST PLAN

Goal

1. Validate the conclusions from the first user test: the balanced control degree is most effective for users.

2. Evaluate the validity of the mechanism.

3. According to the mechanism and result of the user test, draw more refined conclusions about the balance between product care agencies and provide suggestions and recommendations for the designers who work on the product care design.

Method

Participants

These concepts are tested with four Master students from the Industrial Design Engineering Faculty of the University of Technology Delft and with two Bachelor students of industrial design.

Process

Test introduction:

The control degree is a bit abstract for participants who do not have enough knowledge about product care or behavior change. Therefore, before conducting the test, I gave two easy-to-understand examples of product in control and user in control to help participants understand the concept properly, in order to prevent any cognitive bias during the interview.

Showing the concepts:

After finishing the introduction, the participants will be shown the interface of each concept and the explanation of the concept will be given.

Filling in the evaluation form:

Then, participants will be asked to fill out an evaluation form (fig 8.1). Since the goal of this evaluation is different, the evaluation form only contains the third part (users' product care tendency) of the first evaluation form.

Interview:

After participants answer each question they will be briefly interviewed to provide a deeper understanding of the reasoning behind the options. The answers will be used as important evidence to support the conclusions.

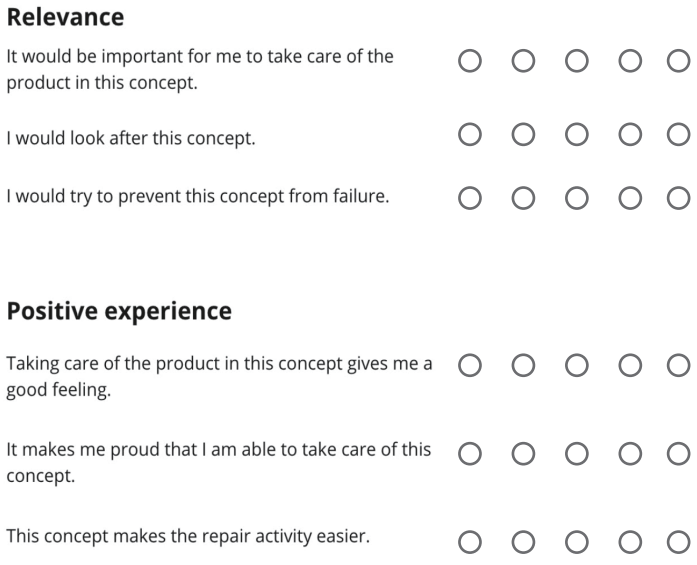


Fig 8.1 Evaluation form in second user test

CHAPTER 8.1 - RESULTS

Concept 1: product care history

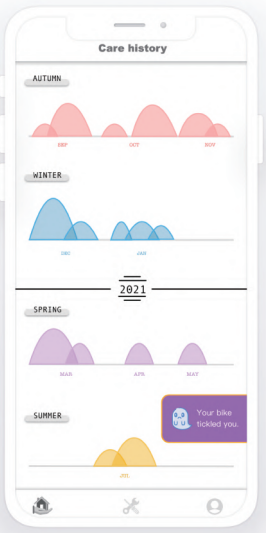


Fig 8.2 Concept 1

Concept 2: product care world

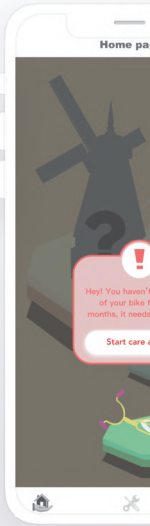


Fig 8.3 Co

More user in control

Data

5 out of 6 participants agreed that concept 1 is the most user-oriented concept in the test.
Score of roduct care tendency: 20.9

4 out of 6 participants agreed th
test.
Score of roduct care tendency:

Awareness

The product expresses the need for care in a way that gives the user a notification, without bringing feelings such as pushing or blaming. Users are free to take care of the bike or just ignore it.

The product expresses the pr
negative emotion to the user
product care behavior), which
more urgent need of care.

Support

Users also felt the freedom to actively choose the part of the bike they want to care for, and then choose the related care activity.

Users thought this concept is n
them options and a step-by-st
more immersed in the care act

Feedback

Users felt that this concept just presented a fact (a record of the user's care behavior) and did not reward or punish the user's behavior.

Users felt that the feedback w
their increased ability and exp
which was an encouragement

ncept 2

Concept 2: product care management

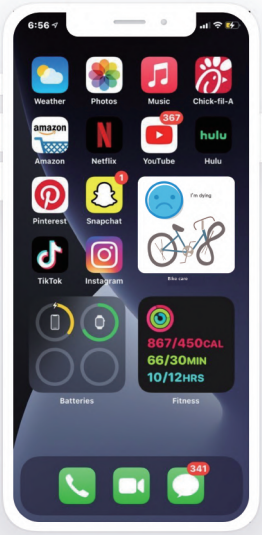


Fig 8.4 Concept 3

More product in control

hat concept 2 is the concept in the middle in the

: 22.9

oduct care need in a way that conveys some
(the bike may break if they do not conduct
makes it obvious to users that the bike is in

more like a game tutorial for new players, giving
ep guidance, which allows the user to become
ivity.

as more closely related to themself, reflecting
erience in repairing or maintaining their bikes,
for them to do so in the future.

5 out of 6 participants agreed that concept 1 is the most product-oriented concept in the test.

Score of roduct care tendency: 22.4

Product expresses care needs in a way that users feel an increased sense of bicycle presence, and if negative information is displayed users' pressure will be increased.

The app manages all the users' product care behavior, on the one hand, it reduces users cognitive barrier and helps to develop their care habit, on the other hand, this constrained way of support makes users feel that they have no choice but just follow the product's wishes to complete the task.

The feedback of this concept is more related to the bike itself, and users mentioned that such feedback made them feel that their behavior is well evaluated. Besides, the feedback is connected to real life and product, so they thought this concept is more product-oriented.

At the end of the test, participants were asked to choose the one they preferred. The results showed that four people chose the second concept (product care world) and two people chose the third concept (product care management).

As for concept 2 (product care world), users clearly felt that the app interfered with their care decisions by encouraging them to care for their bikes as often as possible, and the way the product interferes is positive for users, therefore the product care activity is no longer a task for them but something they actively want to do. Besides, users also had some freedom to choose care activities with the suggestions provided by the app.

Users preferred concept 3 (product care management) liked the management of product care activity made by the app. They mentioned that because they lacked knowledge about product care, they felt more relieved and relaxed having the product plan their care activities entirely for them. They also felt that a relatively product-oriented feedback would show them a more realistic impact of product care.

Conclusion

Most of the themes included in three concepts are in the middle range of mechanism and are the same as the themes in the first user test concept (bike repair app) which have the balance between product agency and user control. From the results of this user test, the three concepts generally scored higher than the concepts in the first user test, while the difference in scores between the concepts was smaller. Thus the conclusions drawn in the first test were validated: the balanced control degree is most effective for users. .

The design elements selected for each concept differed in terms of control degree, and the users in the interviews also indicated that they could feel the difference in control degree of each concept, and none of the concepts gave them an extreme feeling (very product/user in control). Therefore, it can be concluded: the mechanism formulated in the last chapter can be applied successfully in designing product care concepts with different control degrees.

In addition to this, the user test also contributes to the conclusion of the user's preferred and effective product care balance between user and product agency. (In next page)

Awareness:

Balanced or more user in control

Users prefer the product that clearly expresses their care needs, but they have the freedom to follow their needs or ignore them. More product-oriented awareness will make them feel stressed and annoyed, especially when the product does not provide enough support. And balanced or user-oriented awareness makes them feel the thoughtfulness of the product.

Support:

Balanced or more product in control

Users need the product to guide and help them during the product care behavior, but at the same time they are able to choose or organize the care activities. And users who are not familiar with product care activities but have an active attitude towards product care prefer more product-oriented themes (design elements) which can reduce the cognitive and behavioral burden of product care.

Feedback:

Balanced

Users prefer the obvious feedback of the product care which can show them the positive consequences after product care activity. Very product-oriented feedback can be more successful in ensuring users to perform the product care behavior, but this can lead to user resistance to care activities and even dislike the product. Besides, very user-oriented feedback can not motivate users to persist in performing product care behavior.

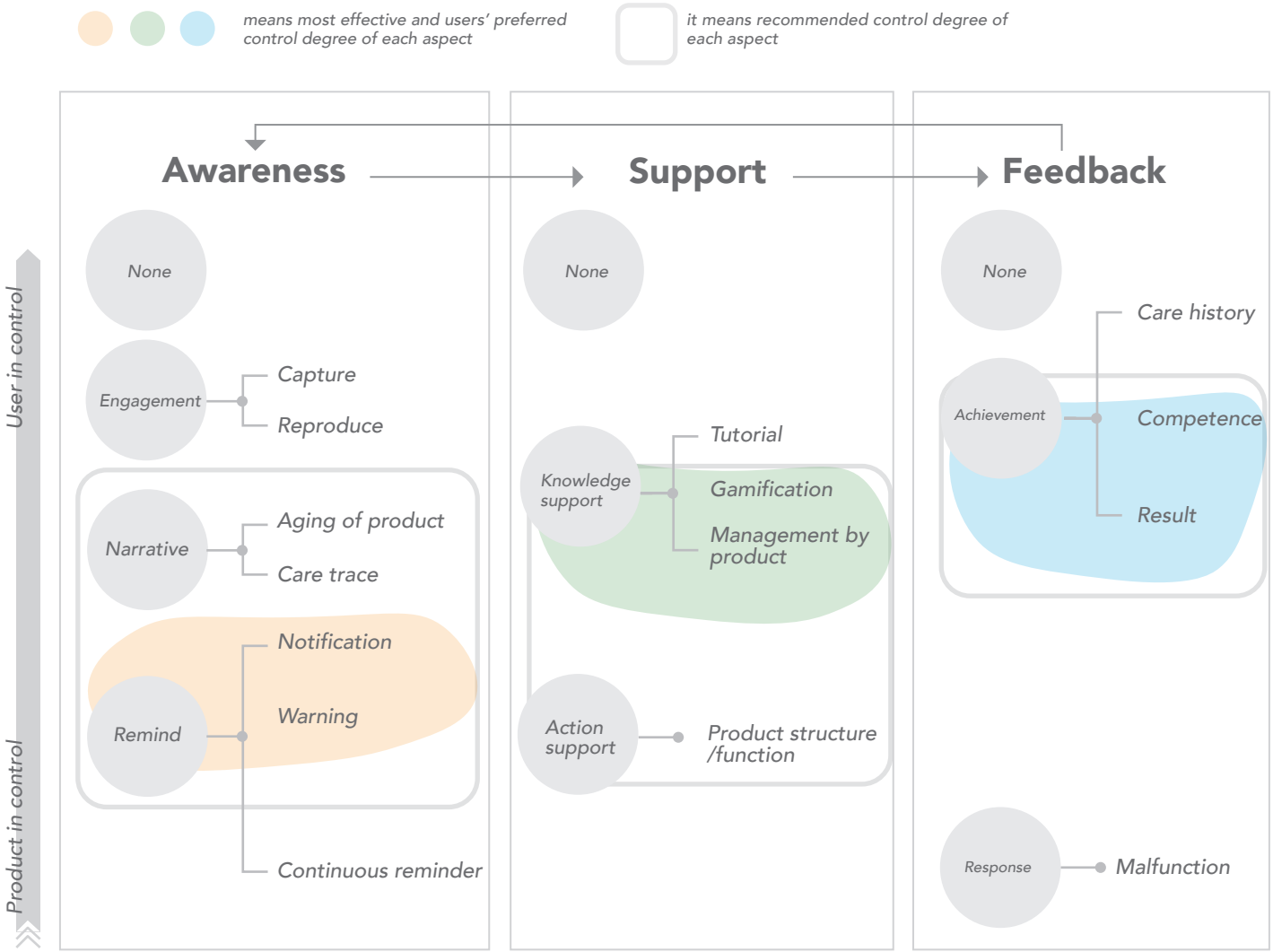


Fig 8.5 Control degree mechanism in product care

9 Reflection

This chapter offers a reflection overall process, the research questions and design goal of this Graduation Assignment. In this chapter recommendations for the tool will be given and after this I will reflect on my personal goals for this thesis and how I experienced my Graduation assignment.

Discussion

Limitations and recommendations

Personal reflection

Discussion

The intention of this project was to find out the optimal balance between user control and product agency in product care to motivate people to conduct more care activities, aiming at providing support and suggestions to the designers who will design for product care in the future.

To reach this goal, I developed a mechanism that includes 3 product care aspects with 15 design elements which are classified into 7 themes. With this mechanism, designers are able to measure the product's control degree in care activities. Besides, by using the mechanism, three concepts with different control degrees were generated and evaluated to suggest an optimal balance area in this mechanism for designers.

Literature

The current research on product care mainly focuses on circular design or behavior change, but there are fewer papers or products that combine these two to ensure that the product provides the conditions for product care and stimulates users to perform product care activity at the cognitive level. Therefore, the project started by combining different existing strategies to formulate new strategies to motivate people to take care of their products.

According to literature review, it was found that control is the dimension of behavior change (Daae & Boks, 2014), but no research has applied it to the field of product care and the effectiveness of different control degrees have not been validated. Hence, this project will provide an optimal product care balance that has been tested and validated as a user-preferred balance for future designers to better design, judge, and improve their product care concepts.

Design exploration

Both strategy and mechanism are difficult for users to evaluate directly, and to verify their effectiveness and feasibility, design interventions are needed, which are able to visualize the abstract design strategies and design mechanism. Therefore, there are two rounds of conceptualization in this project. The first one is to roughly determine the user's preference for the product care agency and to understand which design elements would make the user feel different degrees of control. The second one is to apply the mechanism to the concept and to verify the previous conclusion and mechanism. Besides, it also provides more detailed suggestions about the control degree in product care design.

Evaluation

Since the entire project was completed during the epidemic, the offline testing was more difficult, so all the evaluation activities were done in online format. In order to ensure that users could understand the content that concepts intend to communicate, the prototype was presented in the form of storytelling.

To get more insightful reflections on users' own behavior, I chose the IDE students in Delft to be the participants in my evaluation test. Since the design students have a certain design and evaluation foundation, they are more sensitive to the questions during the interview and know

how to analyze their feelings and choices from different aspects. At the same time, the designers are also the target users of this project, so that their opinions are also representative.

The evaluation form in this project was adjusted based on the research scale of product care tendency (Ackermann, 2019). Questions on strategy and control degree were added to the original questionnaire and the original questions were reframed to make the questionnaire more applicable to evaluate the product in the concept phase. In this way, while ensuring the validity and reliability of the questionnaire, it also helps users to evaluate the concept from all aspects. This questionnaire can also provide reference and support for designers who want to evaluate product care concepts instead of product category in the future.

All evaluations results in this project were done through a combination of qualitative and quantitative analysis. Users scored the concept through the questionnaire and were interviewed after answering each question. The advantage of it is that we can get a clear picture of how the users understand each question and the deep-going reasons behind the scores.

Define the optimal balance

At the beginning of the project I thought it would be a fixed answer to the optimal balance. But as the project went on, I found that the conclusion would be slightly differ from types of products and existing care bases of users, and it was difficult to conclude an accurate definition of the optimal balance. Finally, this project is to give an ideal control degree range instead of a certain answer. According to different situations, designers can adjust the balance by themselves, which also makes the designers be on a suitable balance in the design activities.

Limitations and recommendation

Product category

Due to the limited time of graduation project, only three product categories (mobile phone, coffee machine and bicycle) were selected for the conceptualization. When analyzing the results of the user test, I found that the difficulty and effectiveness of applying strategies differed for product categories. For example, compared to bicycles, there is less interaction between users and coffee machines and coffee machines are used in a relatively single scenario (such as in the kitchen), so it might be hard to apply user-oriented strategies (such as evoking the positive memory). The limitations of the product categories may have an impact on the generality of the final results.

In addition, the complexity of the product care will also change the user's preference for control degree. Therefore, the final three concepts used for the second user test are three versions of one previous concept (bike repair app) to exclude the interference caused by the product category. But this method is also flawed， the findings were only validated for one product category (bike). In order to increase the reliability and generalizability of the conclusions, the project needed to be tested repeatedly in different product categories to improve the final conclusions.

What's more, the creativity, aesthetics, feasibility, etc. of the concepts, aside from the strategy and design element, will have influence on the user's opinion and may affect the final conclusion. In order to reduce the impact, it is necessary to verify quantitatively by a larger sample size of concepts/products, and these concepts should preferably come from different designers.

Evaluation test

Due to time constraints, the two evaluation tests in this project were conducted online and carried out in a control environment, having limited functionality. Users cannot interact with the product in real life to experience the product care activities, but it is necessary to develop the product in order to properly assess the impact on consumers.

Besides, product care is a behavior that requires people to stick to it for a long time before it will be beneficial to the product, and due to insufficient conditions, this project lacks the research on the sustainability of the concepts. An extended testing needs to be conducted, by giving the users the possibility to interact with the product in a longer period of time, aiming at analyzing the impact in the long term.

The selection of the sample was relatively homogeneous, with participants being IDE students aged 20-30. And they have a high education level and good quality of life, as well as high acceptance of novel products, so they can only represent part of the target users, which may also affect the scope of application of the final results. Therefore, the project needs to be tested on different types of people to improve the conclusions.

Validating the mechanism

All the design elements in the mechanism are from the six concepts used for the first user test. Although I tried to make each design element be general and at the knowledge level, I do not rule out the possibility that other product care design elements exist. If others want to improve this mechanism, it would be better to collect, analyze and summarize more product care designs than just the six concepts.

Personal reflection

This graduation design is a challenge for me. As a DFI student, in my previous study, I was more familiar with the design process, such as defining the users' needs through context mapping or iterating on the product through user tests. But this project was mainly research-based, which tested my ability to process and integrate information, and the skills to conclude theoretical knowledge from design intervention. This was my first experience conducting a research project using the approach that research through design. Hence, while I felt the pressure, I was also excited to increase my in-depth knowledge of specific methods.

I have been interested in the human side of design since I was introduced to interaction design, and this graduation project is also closely related to human behavior and psychology. During the literature review phase, I also gained a deeper understanding of related fields, and I feel that my ability to understand and summarize literature has been improved. Although only about half of the literature I read was actually used, this phase helped me to build a body of knowledge, and implicitly influenced the design phase later on. In addition to practicing the research method, I also did a lot of design activities in which I was able to iterate on my own concept, and use and practice my visual skills.

Admittedly, I felt struggled, confused and self-doubt in this project, such as when I needed to capture the commonalities of the users from the extensive interview notes, but I also gained a sense of accomplishment when I found insights and drew conclusions. I feel proud of myself, because I think I create something that would be useful for designers and contribute to the knowledge pool about sustainable behavior change. I do hope this is just the first step of this research and that my mechanism and conclusion will in the future have a positive impact on the product care field. Looking back, this project has had a meaningful contribution to my own development. It has been a challenging but enjoyable experience for me. It made me know how to do a research project and I would like to continue the research even further.

If I have any regrets, it's that I didn't use the final conclusions and mechanism to generate a concrete design outcome in the limited time, and that I took some detours in the middle part of the project. But it's okay for me, graduation design doesn't mean an end, it means a beginning, and these regrets will make me a better designer afterwards.

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THANKS!

Table of appendix

Appendix2- initial concepts in first user test

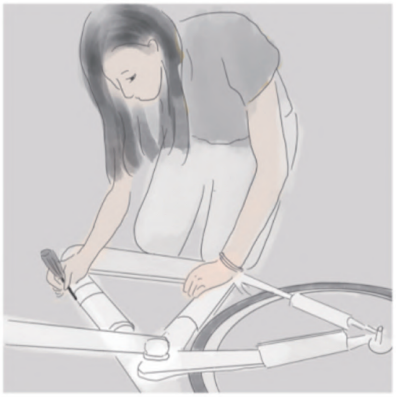
INDEPENDENT MOBILE PHONE



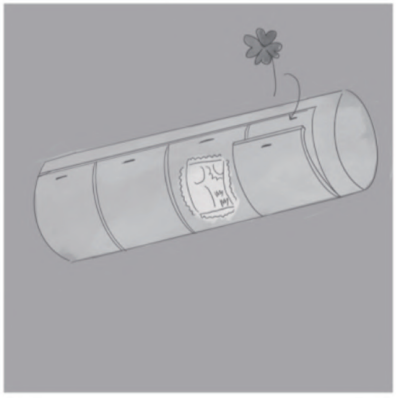


The phone will enter self-protection mode when the phone needs care, for example, when the power is less than 20%, the mobile phone will turn into a mosaic or black and white screen, forcing the user to charge. Or when the user plays with the phone while walking, the screen will also follow the pace of shaking, to reduce the probability of accidents with the phone.

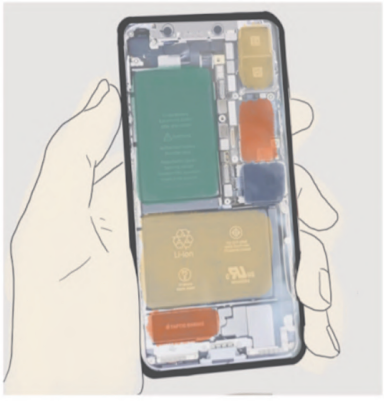
BIKE POCKET


It is a modular bike which allows the user to assemble it more easily, and in the process of assembling, the user will learn more about how the bike works. In addition, there is a transparent bike pocket on the crossbar to store memories of bike-related activities, such as stamps you bought from a museum or leaves you picked up while going for a picnic.

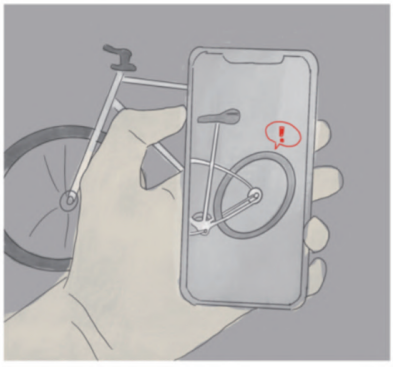



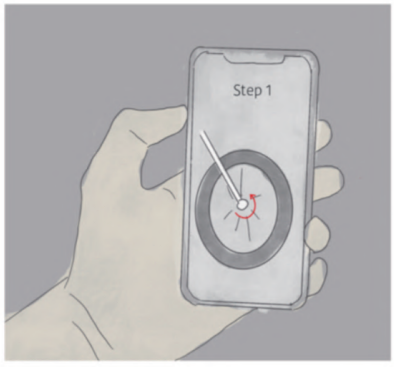
PERSONALIZED MODULAR MOBILE PHONE

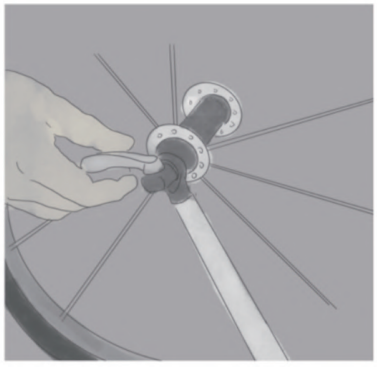


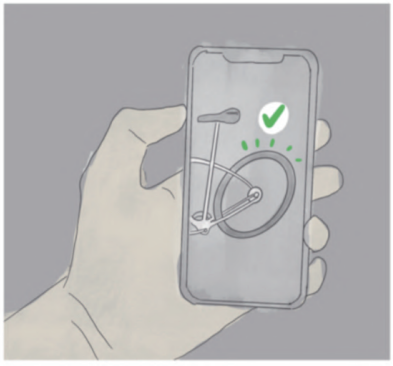
The back of the phone is transparent, which allows users to see the internal components of the phone, and the modular design allows users to easily change the parts themselves. There are different styles of components to choose, so when the phone is faulty or needs to be upgraded, users can pick any kinds of components they like to replace, and assemble their own mobile phone.

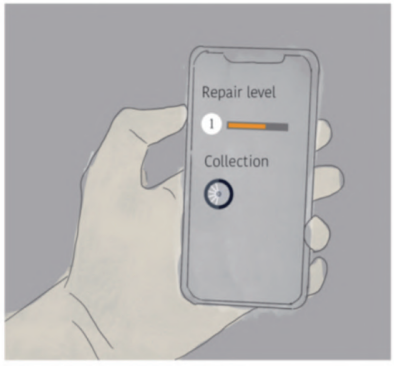
AR BIKE REPAIR











This is a mobile app that can guide users when they are repairing their bikes. When the user scans the bike with the app, the faulty part can be detected and then the app will teach the user how to fix it step by step. After confirming a successful repair, the user is shown the improvement of their repair level and given some rewards (badges/achievements).

Appendix3- interview transcript in first user test

Partcipants 1

Concept 1:

I don't think of the bike as being too important to me, I think of it mainly as a tool, so it works just fine. I shouldn't be able to maintain and repair the bike very well, all I can do is simple things like push it around the room and just keep it out of the wind and rain.

I think this concept would make care activities important to me, but I don't necessarily want to get up to care for it. I do feel a bit detached, I do have a good memory, but that memory doesn't necessarily remind me to care for the bike. I might think about the fact that I won't be able to record these memories without this bike, and I'll take good care of him, but probably not to the same degree.

I feel like I'll like it more because it brings back some good memories, and then I feel like I'll subconsciously take care of it, and then I'll probably feel grateful for the bike.

But really this solution doesn't change the process of caring for the product much, like cleaning it is the same, the cleaning process is no different.

Concept 2:

This concept is more product in control than the first one. This material can easily show me and some of its care behavior on the feeling that there is some guidance. Intuitively, I may sometimes give me feedback on product care directly because of the appearance of this product, so I feel that the product will give me a little guidance.

Because I think the leather and this should leave traces of use is not unsightly, so I think it is good. I still value the appearance of the product. I feel like there are traces of my actions, and it has the feeling of a historical record. Because the appearance can also feel that some traces of my care can be seen, it feels like the process of my care is still accumulated.

Concept 3:

It will promote me to take care of my bike, but maybe I have to do it once before I feel it is important. If I had gotten the app alone, I wouldn't have felt that the care activity was important, but after I had used it a few times, I might have been able to appreciate the benefits of the increased care behavior. The main thing is that after you have repaired your car through this app, you can feel the benefit of the repair.

I think I will use this app because now I don't know the name of each part of the bike, and when it breaks down, I feel like I know a general part of the bike, so I feel that the process of searching for how to repair it makes me feel especially troublesome, and sometimes I don't get much out of it. At the same time, this app has some feedback and a sense of certainty after I'm done.

Because I think it may be an indirect effect, because I repaired it myself, I certainly can not easily give it a mess. I had a feeling of being guided, and then I felt more in control, and a sense of satisfaction, I felt like I was the best at fixing bikes, and then I could help others fix their bikes.

Concept 4:

This one is a little more productive than the last one. I think it's a kind of advice and guidance that then directly affects my phone screen. It will make the care activity feel important because it will remind me of the importance and the process is fun.

I'm a little more careful about using my phone afterwards because I want it to last longer, after

all, I've cleaned it and I don't want to waste my efforts. This game makes the care activity more fun and it feels easy.

Concept 5:

This concept gives me the feeling that I have to take care of it. If you know the harm of this thing, you may want to avoid it.
There is not a lot of good feeling, but there is a feeling of saving it. There is a sigh of relief, a little relaxed. I feel that this program is to help prevent the harm in advance, there is a feeling of saving for a rainy day, I think it may be a little easier.

Concept 6:

This concept gives me a kind of my mother next to me crazy yell, you hurry over to wash the dishes, and then put all the dishes in front of me. It will make a sound, and then pop up these things, it gives me a feeling of having to clean it, there is a feeling of passivity.
If you do not care for the phone, you may not be able to see the screen, and then you can not use the phone, the coffee machine it is not only can not be used, it is still hands out of the kind of feeling, there is a kind of inserted in your neck of that feeling.

Partcipants 2

Concept 1:

When you recall the scenery you saw at that time, you will probably remember some of the feelings you had when you rode, but it didn't evoke much emotion for me and the bike. The bike is just a tool for me to get around, and I don't have much affection for it. I can still do simple care activities, like pumping or something, but I can't fix the chain for sure.
Because first of all, this product must make me feel more attached to the bike, because it has changed from a transportation tool to a technical function, which means it is more important to me, so maybe I will want to clean it more, and this aspect may make me take care of it.

Concept 2:

I think the first one is more user, I think I have an emotional connection with the bike, but this one will give me some negative feelings. When I see something that is old, I think more like I would like to get a new one. I think the maintenance of the coffee machine is probably more important to maintain the inside of it, but the changes in its appearance are not very connected to the inside, so I may not realize that I need to take care of the inside of the coffee machine.
If it looks better and I care about the product and want to use it for a longer period of time, then I would probably use it more carefully.

Concept 3:

This app is a tool for me, not strong enough to make me actively want to take care of my bike. I think it should be able to give me some hints and guidance on problems I couldn't solve before, and then I can do more things I couldn't do before.

Concept 4:

I think this is quite interesting, and I think it's a good reminder that I need to take care of it. It definitely gives some satisfaction at the end of the cleanup, but not as much of a sense of accomplishment. But actually this app doesn't make the act easy, because the act of wiping your screen, you actually just wipe it.

Concept 5:

I think this concept is a little too aggressive, it forces me to do this thing, it will certainly make me feel important, because I have no other choice. If I had this phone, I would have been anxious when I saw the 21% battery.

Concept 6:

This concept also makes me feel like I have no other choice. Most of the time I don't take care of it because I don't remember to do it, and by the time I realize to do it, the product has changed a lot. For example, the coffee machine I often think about cleaning it when its scale is already very obvious, the concept has a designed time period, to time to remind you to take care of it, I think this is still quite good. It will remind you that you will be a little more at ease. When you complete the care activities, you will feel that you turn it from a not so good state to a good state, that feeling will be more positive.

Partcipants 3

Concept 1:

The concept doesn't tell me directly that the bike needs care, so I feel a bit separated from the memory and care activities. I don't really care about my bike, I'm too busy, and if I do repair it, it's far away, and I don't use it very much. This concept is quite useful to me, because if I want to go out and have the need to take photos or video recordings, I will use it a lot.
It's more attractive to me than my current bike, so I'd like to protect it more carefully.

Concept 2:

I think it's normal for products to age, which happens with any product. If it ages beautifully, I would be more willing to take care of it.
Because I will use it to use more, because I will certainly he used a lot, so he will be more important to the opponent, and it is easier to have some signs of age of this material, I will be more careful to care for her this feeling.
Because I do not have much experience in caring for leather or something, and then this coffee machine may be more special to me, so it is very fresh. I think if it looks good, I will have a sense of accomplishment after caring for it. This concept actually makes the nursing activity more tedious.

Concept 3:

I think the main reason I would use it is because it's kind of fun to have a level up and to get a badge. The app gives me positive feedback, as if it's encouraging you. The app can guide me, but it's also fun!

Concept 4:

The concept reminds me to wipe the screen on time. I think this game is good. Wiping the screen is not a particularly difficult task, and I usually do it myself, but this concept motivates me because it is more fun. But I might be too lazy to do it sometimes, but it reminds me that I might do it.

Concept 5:

This concept gives me a feeling of compulsion. It may cause me to worry and pay attention to my phone constantly, which may give me some pressure.

Concept 6:

The sound would be a bit annoying because I would worry that there is something really wrong with it. In time some part of the coffee machine would pop out and then the sound would come back and at that point I would feel like I had to go through the act of care.
It would make it easier for me because it pops out the parts that need to be cleaned on its own, it saves me a step feeling, and I don't have to check exactly where I should clean and where I don't have to clean.

Partcipants 4

Concept 1:

This concept I think I will be more willing to care for it for the first few months because it is new or it is more special, but after it has been with me for a long time, I may get used to it and stop caring for it so often. mainly because I like it, then I bought it back, then I polished it and I feel happy looking at it.
I think this concept can increase the degree to which I like it, and then the degree to which I like it depends on whether I will care for him. I still want it to last longer and stay in good condition for a longer period of time.

Concept 2:

The main thing about this concept is that it shows the old feeling and brings you back to your past memories. If it gets better and better, the feeling it gives me is more positive. I think my tendency to care for this product depends on what happened when I was with it, but I don't seem to care about the specific traces. I would definitely take care of this coffee machine if I had it, and sometimes I don't want to use it if I can't protect it.

Concept 3:

For me, the back part of the concept is not particularly useful, but the front part of the support is what I value. This will make the process of product care easier and smoother, so I don't have to look it up on the internet. Because I feel that this concept makes other people help you to fix it into my own repair to prove my competency.

Concept 4:

I think I can ignore this concept if I want to, and the difficulty of wiping the screen is different from the act of fixing the bike. And it doesn't affect you if you don't wipe it, it just reminds me that I need to wipe the screen.
I usually actually wipe the screen, in order to make it easier for me to use, mainly to ensure that the functionality is normal. I feel like if I'm more idle, it reminds me I might go back and do this. But if I'm a little busy I may choose to ignore it.
This game can still bring me good feeling. And I feel happy when it becomes cleaner after care.

Concept 5:

I will take care of this phone, it's really hard to use. I think the good thing about it is that it's not particularly forced, it doesn't just shut down so I can't use it. The reason I'm taking care of it is because I want to use it normally, so I might not do it if I'm playing with it on the road or if I'm playing with it unnecessarily, for example.
I feel like I have a sense of compulsion, like someone forcing you to study, something that is good for you in itself but takes a lot of energy and just doesn't want to do it. But since I am aware that my phone has such a feature, I will probably try to avoid this kind of thing.

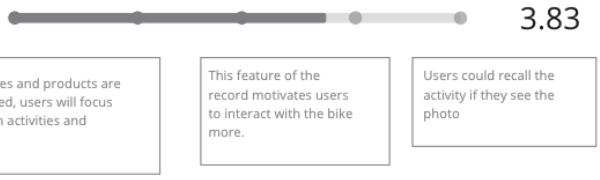
Concept 6:

This solution would make me feel that caring for the coffee machine is more important, because the parts that need to be cleaned have been popped out, so he would create a feeling that if I leave him alone it might have a negative impact on its function. Because I always feel that this general situation is it to the limit, it will appear this reaction, if you then ignore it will cause harm to its function.
It serves as a reminder, so I feel more relaxed and I don't have to think about it on my own.

Appendix4- result of each concept in first user test

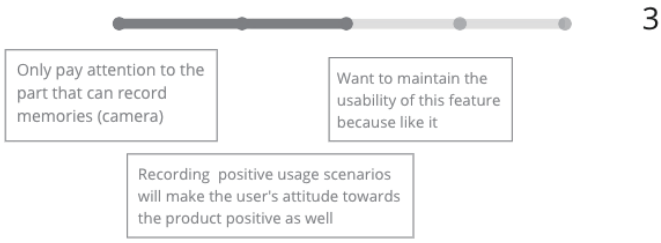
STRATEGY 1

Concept 1 bike memory: 16.84

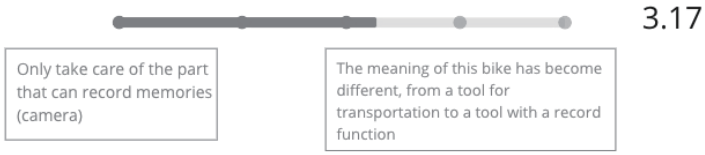


Relevance

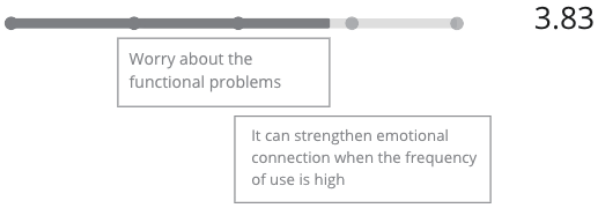
It would be important for me to take care of the product in this concept.



I would look after this concept.

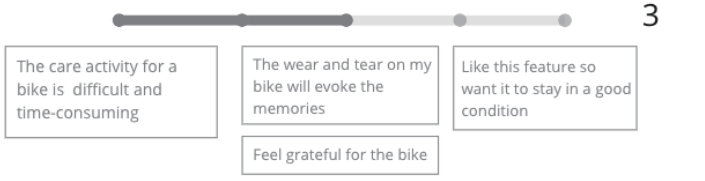


I would try to prevent this concept from failure.

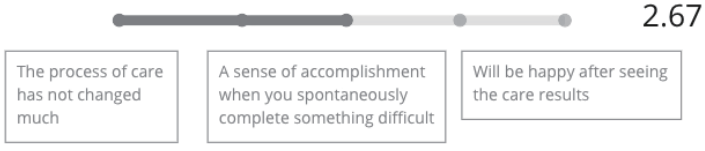


Positive experience

Taking care of the product in this concept gives me a good feeling.



It makes me proud that I am able to take care of this concept.



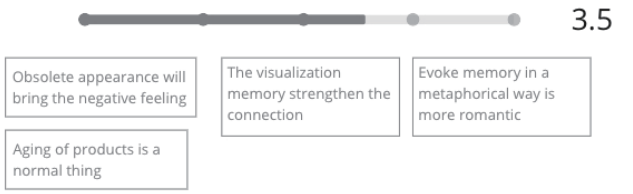
This concept makes the repair activity easier.

STRATEGY 1

Concept 2 wooden coffee machine: 19.91

Relevance

It would be important for me to take care of the product in this concept.

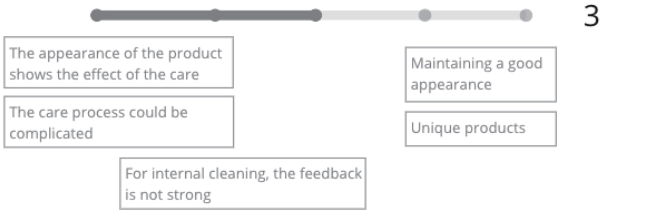


I would look after this concept.

I would try to prevent this concept from failure.

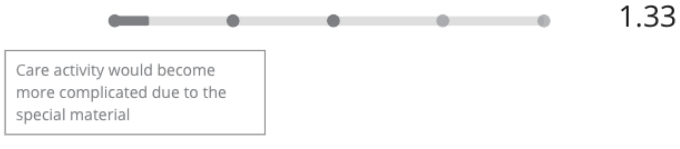
Positive experience

Taking care of the product in this concept gives me a good feeling.



It makes me proud that I am able to take care of this concept.

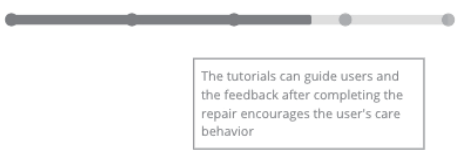
This concept makes the repair activity easier.



STRATEGY 2

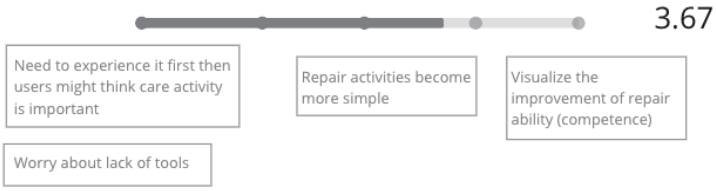
Concept 3 AR bike repair: 23.99

To what extent do you think this strategy worked for the concept? Why?

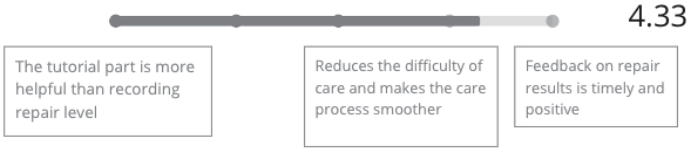


Relevance

It would be important for me to take care of the product in this concept.



I would look after this concept.



I would try to prevent this concept from failure.

Positive experience

Taking care of the product in this concept gives me a good feeling.

It makes me proud that I am able to take care of this concept.

This concept makes the repair activity easier.

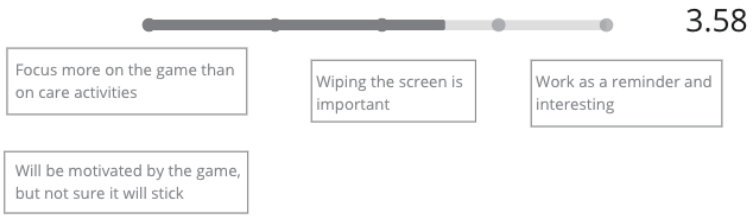
STRATEGY 2

Concept 4 screen game: 21.5

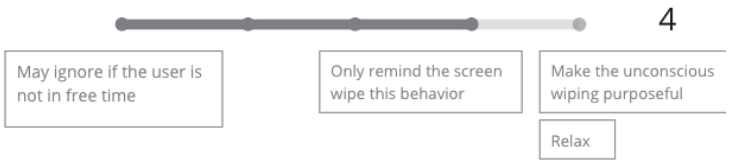
To what extent do you think this strategy worked for the concept? Why?

Relevance

It would be important for me to take care of the product in this concept.



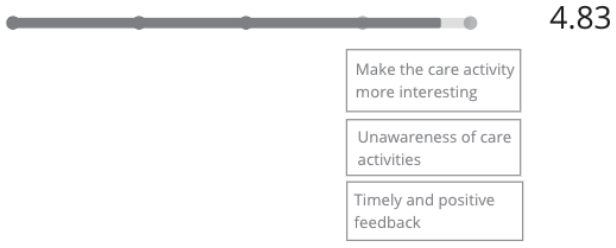
I would look after this concept.



I would try to prevent this concept from failure.

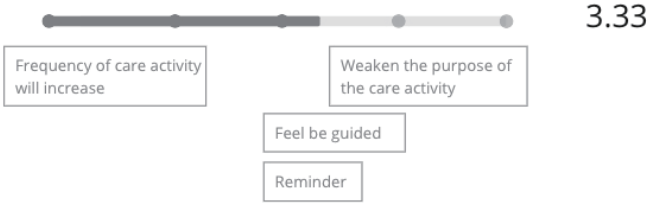
Positive experience

Taking care of the product in this concept gives me a good feeling.



It makes me proud that I am able to take care of this concept.

This concept makes the repair activity easier.



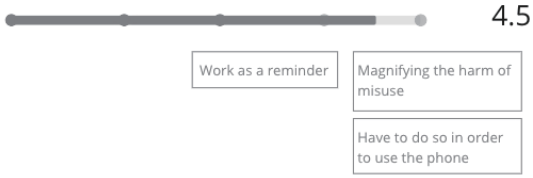
STRATEGY 3

Concept 5 independent mobile phone: 19.42

To what extent do you think this strategy worked for the concept? Why?

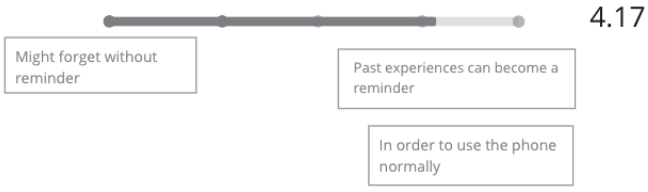
Relevance

It would be important for me to take care of the product in this concept.



I would look after this concept.

I would try to prevent this concept from failure.



Positive experience

Taking care of the product in this concept gives me a good feeling.

It makes me proud that I am able to take care of this concept.

This concept makes the repair activity easier.

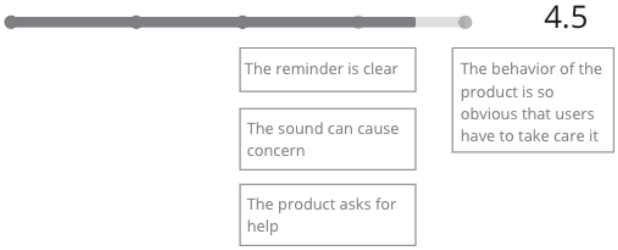
STRATEGY 3

Concept 6 pop-up component: 19.42

To what extent do you think this strategy worked for the concept? Why?

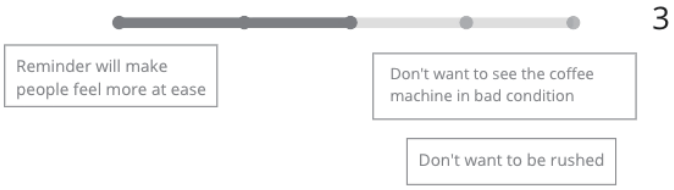
Relevance

It would be important for me to take care of the product in this concept.



I would look after this concept.

I would try to prevent this concept from failure.



Positive experience

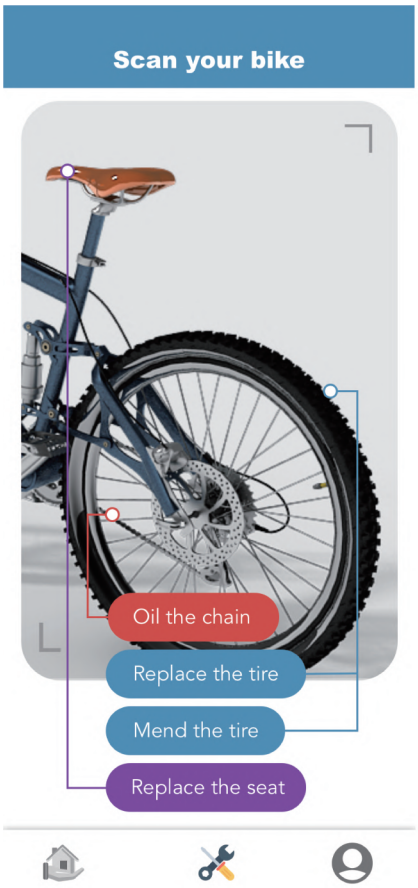
Taking care of the product in this concept gives me a good feeling.

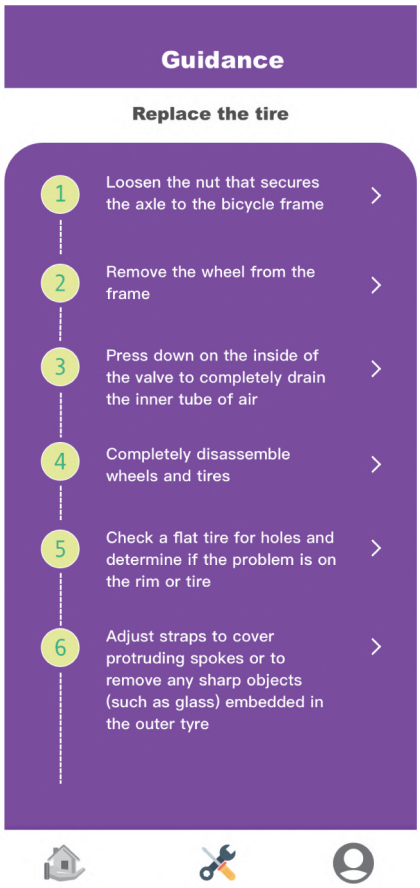
It makes me proud that I am able to take care of this concept.

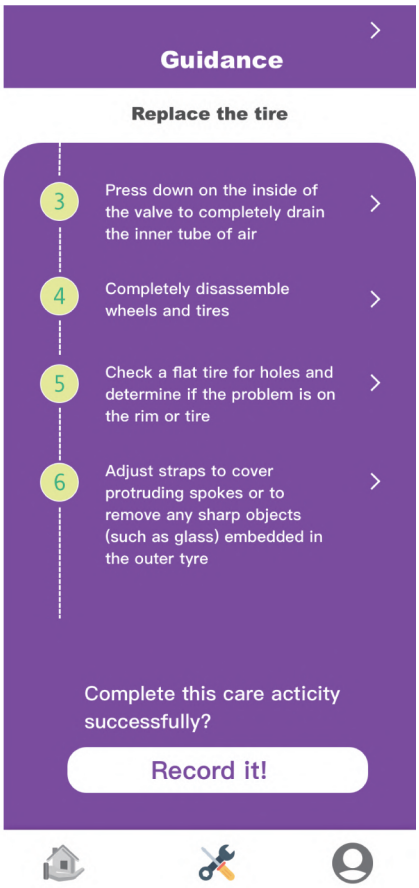
This concept makes the repair activity easier.

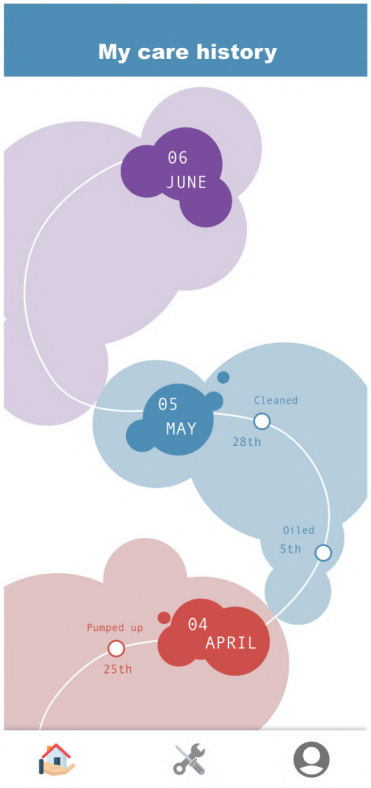
Appendix5- initial concepts in second user test

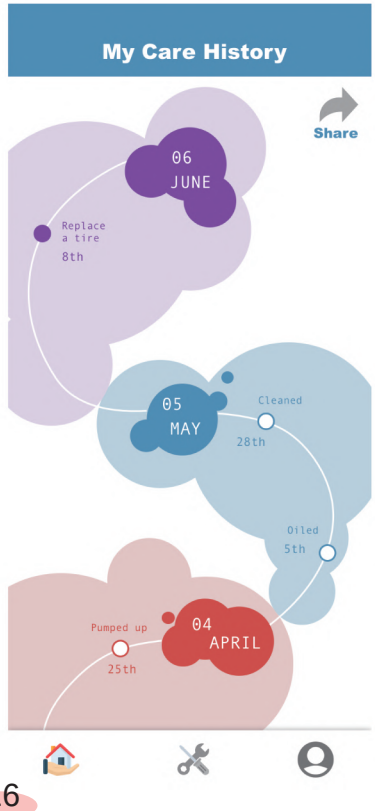
Concept 1





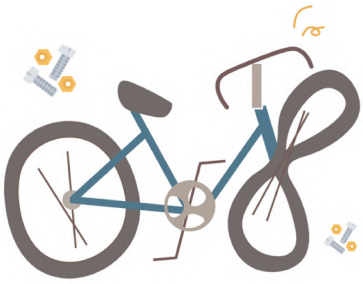






Concept 2

My care history



Hey! You haven't taken care of your bike for three months.

Start product care

Scan your bike

Oil the chain

Replace the tire

Mend the tire

Replace the seat

Guidance

1 Loosen the nut that secures the axle to the bicycle frame

If the nuts are too tight, you can spray some lubricant at them. Silicone lubricant or even vegetable oil can do the job. (Many modern bicycles don't have nuts. They have quick-release bars so you can easily loosen and remove the wheel).

Guidance

Repair

Lv.13

Congratulations on your successful completion of this care acticity!

Comfirm

My account

Repair professor

Maintenance

Lv.8

Lv.13

Collection

Skill

Achievement

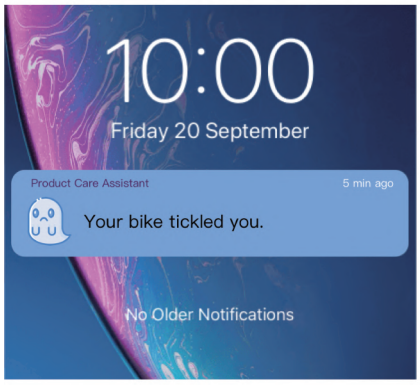
Maintenance Lv. 5

Repair Lv. 5

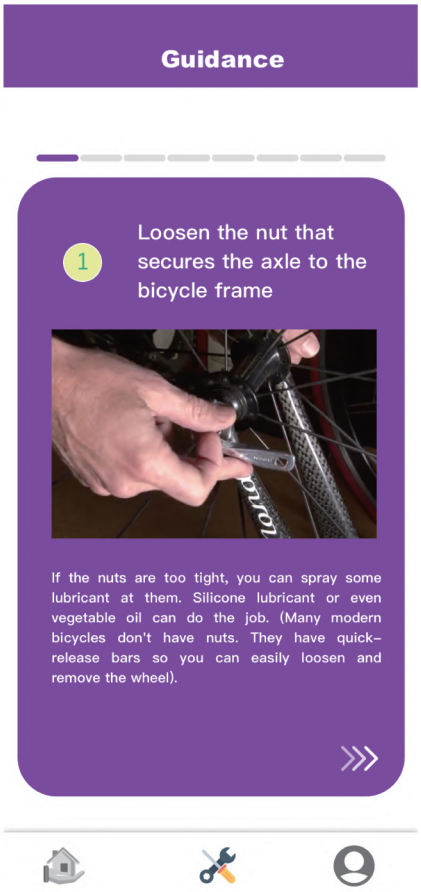
Repair Lv. 10

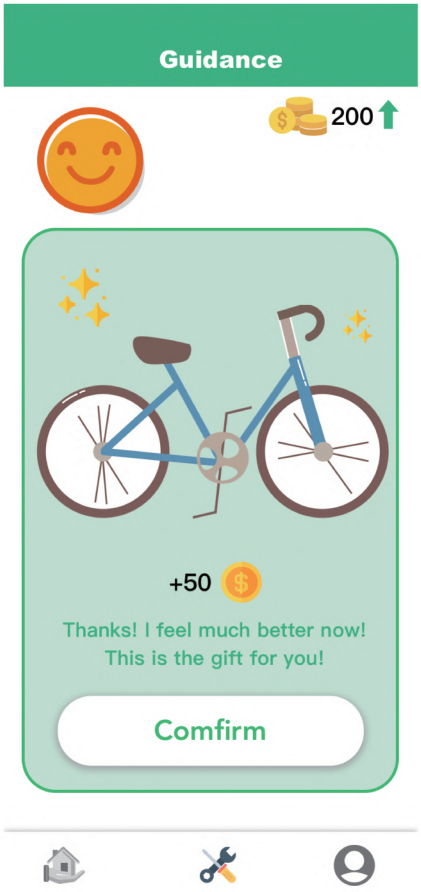
Repair Lv. 15

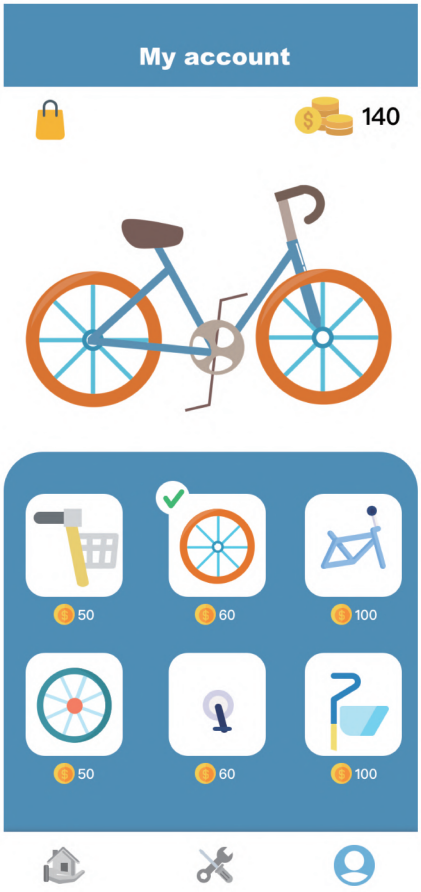
Concept 3


10:00
Friday 20 September
Product Care Assistant
5 min ago
Your bike tickled you.
No Older Notifications


My bike
150
Hey! I haven't been taken care of for three months...
Start product care


Guidance
1
Loosen the nut that secures the axle to the bicycle frame
If the nuts are too tight, you can spray some lubricant at them. Silicone lubricant or even vegetable oil can do the job. (Many modern bicycles don't have nuts. They have quick-release bars so you can easily loosen and remove the wheel).


Guidance
200
+50
Thanks! I feel much better now!
This is the gift for you!
Comfirm


My account
140
50
60
100
50
60
100

Appendix- Interview transcript in second user test

Partcipants 1

Concept 1:

It might increase the frequency of care, hinting where to care makes me want to click (there is a hint), it would be better if I could eliminate after clicking.
reminder I might not care too much about
history will give me hints about what I've done, so I might explore more care activities.
I don't feel anything, I can even add a few more slopes if I'm not careful.
It will be easier, I don't need to find out how to take care of it or how to fix it myself, it becomes easier, so there is good feeling.
Maybe, one more slope will give me some sense of accomplishment.
I do not feel that the product forced me to feel, are giving me a kind of: you do this thing it you see how convenient ah. I want to do this more by myself.
This is an objective record of a fact.

Concept 2:

The last one is a bit like a discrete point, this one is more like a continuous process, the accumulation of this feeling of purpose makes me less likely to give up.
This program is more connected to my own, so the motivation will be stronger.
This is also a stronger sense of story, and I said the bike is dead blablabla.
In general I am more careful with things.
If I don't take care of it, I may not be happy to see the bike, so I will have a good feeling if I take care of it.
The connection with your own ability is stronger, and it feels like the bicycle has come back from the dead.
Almost as simple as the last one.
It also gives me the feeling of user control, this one may be more product in control, this one will give me a little negative feeling, this one has a little nudge feeling, but it's not very product, because I can ignore it.
Program 1 is to show me some facts, but the second one changed my emotion.

Concept 3:

If I had been prompted a few times and I didn't do it, I would have seen so many red ones that I might have been less motivated. He kind of forced me to do this, but I don't think people are necessarily forced to be more useful.
I feel that I am completing a hard requirement, this is done to achieve this purpose, but the previous is done to exceed this purpose.
I feel like the pride comes from the COMPETENCE, but the RESULT is more like a judgment on my behavior, like I'm losing money if I don't do it. It's more like a penalty for me for not doing it.
It's not necessarily easier to execute, but it's less of a psychological burden when it's set up for me.
These are all pretty PRODUCTIVE, this is from a product perspective, and the second is from a personal perspective.
I hope my bicycle and I are friends, the first a little indifference, the third a little push feeling. I hope we can help each other.
I don't want to be planned very dead, completely follow the product's wishes. My wishes may not be reached, so I hope our wishes can be balanced.

Partcipants 2

Concept 1:

If I see that I have cared many times this month, I may reduce the number of times, and if I see that I have hardly cared, I will be motivated to care.
The feedback is not enough, there is no response after the care, the motivation is not very useful.
The good feeling comes from adding a peak to the history after the care is done.
If I am a person who does not love care, this app may not move me.

Concept 2:

Collection is the main motivating point for me.
The interface of the game is more important.
The tutorial interface can somewhat prevent users from maliciously clicking to get badges.
It will make me click in when I have nothing to do with my phone and then motivate me to do the care activities.
Seeing the abilities I got after the care and the care experience I gained made me feel proud and stimulated me to do different care activities.
The animation is more visual than the last one, but maybe not as detailed as the last one.

Concept 3:

Don't like to list all the nursing activities, wish it was only for this month. The tasks that were not completed before made me feel blamed.
The reminders feel a bit anthropomorphic to me, but the second step is a bit cold.
It's a little bit weaker than the first in terms of presence, because I feel like I'm the one actively noticing it. I want to do this not because I haven't nursed in a long time but because I want to make it happy.
Questioning the authenticity of the feedback, but this feedback with real life connections would make me feel more connected to me and the product.

Partcipants 3

Concept 1:

I don't feel any consequences if I don't maintain or repair, and I don't have a lot of motivational effect, I think it will be troublesome
The motivating effect is there, but it is not strong. I would probably do it because I want to try the feature and the app would help me find out what's wrong with the bike.
The reason I would have a good feeling is that I feel professional and detailed, mainly on top of recording, which makes me feel like I'm a very organised person.
I'm not so proud of myself because I don't feel like I did it independently.

Concept 2:

I feel worried when I fall on the grass, so I feel that nursing activities are more important.
The achievement system will motivate me to do this, I want to exercise my skills, and I want to be a more professional rider
I will use with confidence, I will feel that even if the car is broken I have the ability to take care of her
I like to click on new maps, collect skills also have a sense of accomplishment, and I will bring into the role of the bike, I repair the bike to stand up also makes me happy
This one may not help me as much as the last one, because it starts from the cause, and the last one starts from the phenomenon

Concept 3:

The strong implication would make me feel like he was making a big deal out of it
The arranged interface will make me feel that I have a lot to do and the psychological burden will be increased
Saving money will make me feel happy, but checking this thing will make me feel that this thing may break at any time, so I may need to spend money to fix it at any time, if I don't check it

Partcipants 4

Concept 1:

I think it will still become important, poking me as a reminder will make me feel that this is something important, recording and guidance will increase my importance, feeling that my behavior is recorded and guided will increase awareness.

Lower the threshold for me to do this

Following step by step makes me feel more at ease and more accomplished, but I will still feel a little bit of trouble at first, but will feel a sense of accomplishment when it is finished

Sometimes it's the same thing that's broken, but I can't remember it, and sometimes it's the same thing that's broken many times that can cause irreversible consequences.

Concept 2:

The death of the bicycle makes me feel that it is important to take care of it and that there is an emotional connection

I mainly find the gamification more interesting.

This tutorial makes me feel in control, which I think is more important to me, and this collection will also make me feel that my skills have increased and I am curious about the next unlocked city.

Concept 3:

I can see this thing every day, so it's better.

There are no consequences for not doing this proxy, so I think it's fine

I like this arrangement, and it will probably make me a habit.

This feedback has a feeling that you have earned it, because it is more closely connected to real life, this satisfaction is more real

Reduce the risk of bad, do not have to repair for me is the best

Partcipants 5

Concept 1:

I felt a little anthropomorphic and alive when I shot it, and I thought I should take care of it. The second thing is that making records makes me want to do this thing and stick to it well

Taking good care of this thing will give me a sense of accomplishment

Adding Poopo will give me a feeling of happiness, the feeling of filling.

The pride comes mainly from this thing itself, right?

Concept 2:

This interesting way makes me more interested, and I feel like recording and getting positive feedback.

Concept 3:

It's hard not to notice this reminder, so it makes me feel that it's more important

This one gives me more negative feelings, I'm not very comfortable with the feeling of being given a task, I may not take care of it once or twice, it reminds me everyday and I want to unload it

Keep appearing on my phone screen, I may notice it often

feedback more practical, more closely linked to real life, I will feel more beneficial to me itself.