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Psychological Ownership Affordances as Routes to Influence Product Lifetime: Integrating top-down & bottom-up insights

Ploos van Amstel, Dirk ^(a,b), Kuijer, Lenneke^(b), van der Lugt, Remko^(a)

a) Utrecht University of Applied Sciences, Padualaan 97, 3584 CH Utrecht, the Netherlands

b) Eindhoven University of Technology, Groeneloper 3, 5612 AZ Eindhoven, the Netherlands

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Abstract: Extending the lifespan of products can be approached in several ways. One promising way is to give users a greater sense of ownership of the products that are used. In the context of Product Service Systems (PSS), products are often used temporarily, shared with others, and offered through a technology-mediated environment. Not much is known about psychological ownership in this context. To evaluate psychological ownership affordances as an intermediate knowledge tool in the context of PSS, we started a case study focused on a bicycle sharing service of The Student Hotel (TSH). The central question was how a design approach, based on psychological ownership, can help to redesign the bicycle-service of TSH to contribute to extended lifespans of the bicycles. This resulted in ten exemplary designs as project outcomes and two implemented design interventions in a TSH branch. All project members and stakeholders (app supplier X-bike and Roetz-bikes mechanics) and students of Eindhoven University of Technology (TU/e) and Utrecht University of Applied Sciences (HU) (n=42) were interviewed on process efficiency, process quality and design quality at the end of the collaboration. We performed a qualitative analysis to identify when and how the team members applied the design tool, how these obstructed or supported the design process, and if the team members show shared understanding of the behavioral and/or social consequences of their decisions. The results show both top-down and bottom-up insights, leading to four suggestions for adapting the existing model as an intermediate knowledge tool: (1) being more goal-oriented, (2) consider a hierarchy of affordances, (3) consider to add a new affordance and (4) recognize a more active role of the service provider.

Introduction

Products are increasingly available for use without ownership, a phenomenon also known as Product Service Systems (PSSs) (Demyttenaere, Dewit, & Jacoby, 2016; Tukker & Tischner, 2006). The Student Hotel (TSH) bicycle service is a recent example of such a PSS. It is a designed mix of tangible products (a bicycle, a loan app.) and intangible services (use, storage, repair and maintenance), aimed at achieving the consumer's goals (getting you from A to B). Products within a PSS are used without ownership. This can have an effect on the lifespan of products, as a lack of a sense of ownership can potentially lead to a less caring handling (Bardhi & Eckhardt, 2012). One way of lengthening the product lifespan is therefore to give users a *sense of ownership*. This is referred to as Psychological Ownership (Pierce, Kostova, & Dirks, 2003). Research has shown

that when psychological ownership is increased, products are handled with more care (Pierce et al., 2003). However, not much is known about designing for psychological ownership in the context of PSS (Baxter & Aurisicchio, 2018).

A broad field of both service design agencies and providers of PSS need both more theoretical guidance as well as methodologies based on practical experience that help to deal with this change (Appleton, 2019; de Zeeuw, 2019; Rietbergen, 2019; Uffen, 2019; van Beek, 2019; Wray, 2019). When a design researcher wants to come up with substantiated solutions, he does indeed navigate back and forth between theory and practice (Austin, Van Dijk, & Drossaert, 2020). On the one hand, more abstract knowledge can help design researchers to arrive to "Top-Down"

theoretically substantiated design solutions. On the other hand, concrete knowledge regarding the implementation of design practices can help to relevant "bottom-up" solutions, matching the perception of all partners (Austin et al., 2020; Dalsgaard & Dindler, 2014). The design process can thus be seen as a connecting process between theory and practice, in which iteratively builds up so-called intermediate forms of knowledge (Aken & Andriessen, 2011; Hevner, 2007). However, as Austin, Van Dijk, & Drossaert (2020) conclude, we still know little about navigating back and forth between abstract and concrete knowledge flows.

This paper contributes to the described knowledge gaps by presenting a case study in which a theoretical model of Psychological Ownership is applied "Top-Down" and in which the resulting design solutions are evaluated "Bottom-Up" in the practice of TSH bicycle service. In this way, a first step is taken to arrive at new intermediate forms of knowledge about designing for ownership in the context of PSS.

To arrive at answers to the main question, how does a design tool based on psychological ownership contribute to redesigning the bicycle-service of TSH for extended lifespans of the bicycles, three aspects of design performance, as established by Hekkert and Tromp (2019), were applied. First, Process Efficiency (PE) is about the question to what extent a theoretical model helps designers to arrive at design solutions efficiently. Second, Process Quality (PQ) is about the question to what extent designers consciously apply a theoretical model. Both PE and PQ are indicative of the degree of "Top-Down" usefulness of a theoretical framework, in this case that of Psychological Ownership. Third, Design Quality (DQ) is about the extent to which the design solutions are effective for the intended result and is indicative of connecting design solutions in the context of the relevant practice, in this case the bicycle service of TSH. A "Bottom-Up"- analysis of these insights can enrich and deepen the existing theoretical framework.

Case Study: TSH Bike Service

To gain more experience with psychological ownership during the use of PSS, we started a

case study with TSH, her partners (app supplier X-bike and Roetz-bikes mechanics) and students Constructive Design at Eindhoven University of Technology (TU/e) and Communication & Multimedia Design at Utrecht University of Applied Sciences (HU)¹ between September 2019 and October 2020.

First, we conducted a systematic literature review, which revealed an existing Psychological Ownership Affordance model (Baxter, Aurisicchio, & Childs, 2015). Affordances, a concept introduced in interaction design by Norman (2016), can be seen as intermediate form of knowledge, which makes it possible to incorporate theoretical knowledge about Psychological Ownership into the design of an artifact.

Second, we further elaborated the theoretical framework in a model and a card set (together as an online tool²) and presented and distributed these to the groups, both as part of a design curriculum between February 2020 and November 2020. A total of ten groups worked with the tool on the TSH case. This resulted in ten exemplary design proposals as project outcomes.

Third, the ten project outcomes were used as input for a generative session with TSH and its two partners, resulting in two substantiated interventions. These two interventions, which will be explained below, were subsequently implemented simultaneously at the TSH Amsterdam West location.

Fourth, we conducted twelve interviews with students and partners based on PE, PQ and DQ, which will be explained below.

Tools used in the Case Study

Psychological Ownership Model

Based on PO affordances, the sense of ownership can be increased by giving users more control over products and services (Control route), having them invest in the product or service (Self-investment route) or gaining intimate, personal knowledge about a product (Intimate-knowledge route). These routes are bi-directional or, as Baxter et al. (2016) argue: "Users are constantly changing

¹ From here on, reference will be made to "groups" and "partners".

² From here, both the model and map set will be referred to as "the tools."

through the possession process as they receive feedback from the interaction (e.g. how well objects fulfill the routes).” The model is redesigned as shown in Figure 3.

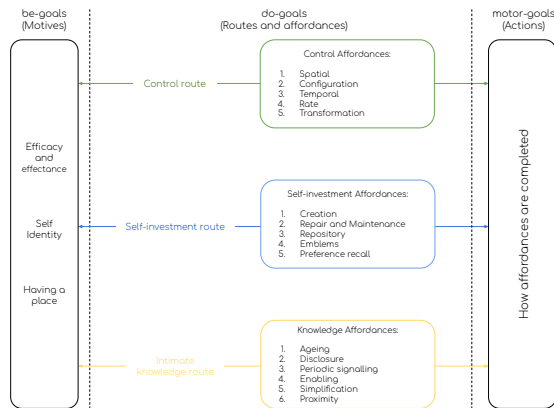


Figure 3. Psychological Ownership Model

Psychological Ownership Card Set

The model has a total of three routes and sixteen affordances, which we have developed for this case study in a physical and digital card set, in which affordances are clustered and colored per route. The tools as shown in Figure 4 (a,b,c) were available both physically and online³.

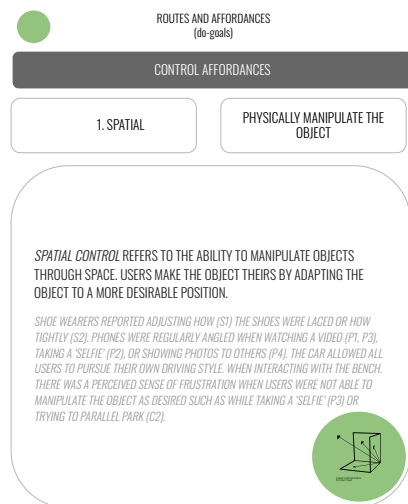


Figure 4a. Exemplary Control Affordance Card

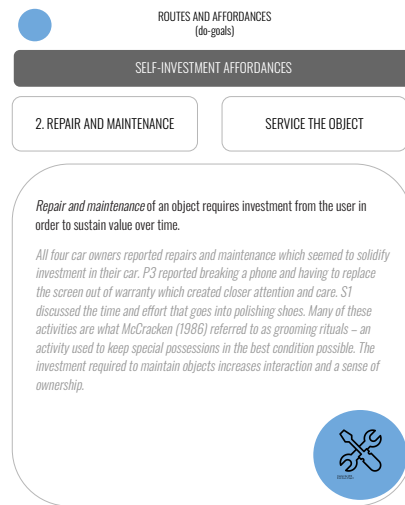


Figure 4b. Exemplary Self-Investment Affordance Card

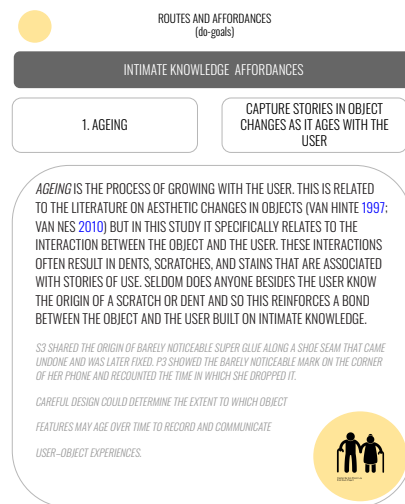


Figure 4c. Exemplary Intimate Knowledge Affordance Card

Interventions as output of the Case Study

By incorporating Psychological Ownership affordances into the interaction design of the bicycle, the loan app and the physical space of the bicycle parking facility, we can attempt to increase the sense of ownership among users of TSH and achieve more responsible use, resulting in two substantiated interventions.

³ An expanded version of the tool can be found online at <https://www.hu.nl/onderzoek/projecten/ontwerpen-voor->

duurzaam-gebruik-van-producten-binnen-product-dienst-systemen

Intervention 1: Intimate Knowledge

When consumers use the same objects more often, the likelihood of 'intimate knowledge' increases, which can contribute to a greater sense of ownership. Therefore, it was decided to offer bicycles per cluster of users (as displayed in Figure 1). At the Amsterdam West branch, approximately 500 users share 180 bicycles. In the new set-up, the 500 users are divided into clusters of 50 users, who have access to 18 bicycles per cluster. This arrangement offers possibilities to increase the psychological ownership of bicycles via the intimate knowledge route: after all, users will more often use a specific model and the reservation of a tailor-made bicycle (such as the height of the saddle) is more likely.



Figure 1. Clustering of bikes at TSH

Intervention 2: Control & Self-Investment

It was decided to give the user and TSH joint responsibility for the bicycle service. The user was given *control* by having the bicycle *checked for defects* after use. When defects are observed, the user is asked via the X-Bike hire app to place them in the 'Bike Hospital' (a separated part of the bicycle storage facility, as displayed in Figure 2). Because this process takes time and effort, we also allow the user to *self-invest* in the bicycle service. The mechanics at Roetz-Bikes repair the defective bicycles and return them to the fleet.



Figure 2. Bike Hospital at TSH

Materials and Methods

To determine how we could translate theoretical insights "Top-Down" into practice, we conducted a total of twelve interviews with students and partners. These interviews all took place after the collaboration, at the end of the project. Ten interviews were with all student project groups and two interviews involved project partners Roetz-bikes and X-Bike. The interview questions were based on Process Efficiency and Process Quality and served as a semi-structured in-depth interview (as shown in the appendix).

During the same interview, all project groups and partners were asked about the Design Quality and helps us to determine which insights we "Bottom-Up" can translate back into the existing theoretical framework.

All interviews were transcribed, entered in Atlas.ti and coded. We performed a qualitative analysis to identify when and how the team members applied the design tools, how these obstructed or supported the design process, and if the students and partners showed shared understanding of the behavioral and/or social consequences of their actions.

Results

Process Efficiency

Eight out of ten groups indicated that they actually applied the tools during the project. The two groups who indicated that they had not used the tools said that this was because they were too complex and extensive. In their view, this, together with the short time frame of the project, created too high a barrier to use the tools.

The tools were applied by the students in all phases of the project. At the beginning the tools were used to gain a better shared understanding of the situation, for example by incorporating the affordances in a mind map. According to the interviewees, the tools during this phase mainly contributed to an effective design process, by creating a common vocabulary about the most complex concept of psychological ownership. Although attention to the tools was lost in some groups in the middle of the project, they were applied to other groups at this stage during the generation of concept solutions. The tools contributed to an efficient design process because there was focus during concept development. By keeping the maps next to conceived concepts and validating the concepts in the meantime, a direction was chosen quickly. The tools were also applied at the end of the project, by analyzing the test insights of their prototype gained afterwards. The tools facilitated agreement on how choices made regarding design solutions can be justified.

The two partners within the project both indicated that the tools helped to (efficiently) arrive at desired (effective) solutions in a short period of time. One of the partners mentioned the confidence that the tool gave to properly substantiate the design solutions. Both partners indicated that the tool was mainly used during the generative process: on the one hand to arrive at solutions and on the other hand to substantiate them.

Process Quality

Six out of ten groups knew how to name specific affordances behind the maps applied during the project and how to relate them to choices made. This indicates that these groups have consciously applied the tools. Two groups did not know how to name specific affordances, but they did manage to identify the routes chosen. One group conducted an expert interview with an external behavioral scientist during the process. From this interview, a rival explanation emerged on how the subsequently chosen design solutions work, namely the Broken Window Theory (James Wilson & Kelling, 1982). This theory was mentioned by this group during the interview, was used in the report and during the final presentation of the work.

One of the partners indicated the same Broken Window Theory as an explanation for the first intervention (the colored clustering of bicycles). Neither stakeholder was able to explicitly name the affordances afterwards.

Design Quality

All groups were asked to name the social consequences or consequences for behavioral change as an effect of design solutions. None of the groups spontaneously mentioned the initially intended effects (careful handling of bicycles by users in order to achieve a longer lifespan and therefore less environmental impact). This indicates that the intended end result of the project has generally been lost sight of.

After further questioning, in most cases the degree of ownership of the bicycles among users was first mentioned. Four groups looked for their answer in the degree of user satisfaction. During the process, they found that before there can be a greater degree of psychological ownership and caring for users of bicycles, the service must first meet basic needs. From their tests, they found that many bicycle users are dissatisfied, especially with the slowness of the app and a long wait before using the bicycle as a result. Two groups referred to this as the affordances of Simplification and Enabling (after all, the unlocking process with the app isn't easy and it doesn't enable the user). One group went even further and took customer dissatisfaction as the starting point for a new concept of protest, which is actually a hyperbola for a complaint. The group tested the extent to which dissatisfied bike users were willing to protest and found that no one was willing to do so. They referred to this as a lack of self-investment and attribute this to a lack of Psychological Ownership within TSH bicycle service.

When asked, both partners spontaneously mentioned the intended effects of the design interventions: careful handling of bicycles through a greater sense of ownership. We can therefore conclude that the partners have not lost sight of the intended end result of the project. Both partners noted that monitoring the expectations generated by the interventions is very important for the degree of perceived ownership and careful handling of the service. Involved users only exist with

good service. This is in line with previous findings of groups.

Discussion and Conclusion

The aim of this study was to arrive at answers to the main question: how can a design tool based on psychological ownership help to design the bicycle-service of TSH to contribute to responsible choices regarding the use. In order to give answers, we analysed the design performance during a case study with design students and project partners.

Concerning the Process Efficiency, the results of the Top-Down approach showed that the tool was perceived efficient in all stages in the design process. Using the tool for shared vocabularies and for project scoping, proved most beneficial.

Concerning the Process Quality, most student teams kept sight of specific affordances identified at the start of the process, but had lost sight of the effects on object handling, responsible use and / or product lifetime. This indicates that the tools may be too focused on the mechanisms (the affordances) and too little on their effect as the end result.

Concerning the Design Quality, an important insight is that one of the performed interventions can be explained by a rival theory. It therefore seems advisable to further investigate the internal validity, for example by means of an expert review.

From our analysis from both the Top-Down and the Bottom-up approach, new intermediate knowledge about the Psychological Ownership model has been gained.

Firstly, several student projects show that end users were dissatisfied with the user-friendliness of TSH bicycle service. This dissatisfaction might be linked to (lack of) the affordances "Enabling" and "Simplification". Both affordances can contribute to a greater sense of ownership through the route of intimate knowledge, the degree of private knowledge and experience with an object. Both the students and the partners stated that this affordance must actually be sufficient before other affordances can have effect. Although more evidence is needed, this might

indicate a possible hierarchy in the affordances (as shown in bold in Figure 5).

Secondly, the study showed that making a complaint or providing feedback can be seen as a self-investment of users. As a result of the lack of user-friendliness (previously linked to the affordances 'Enabling' and 'Simplification'), we can consider the ability to complain or provide feedback as an additional affordance within the self-investment route (as shown in bold in Figure 5).

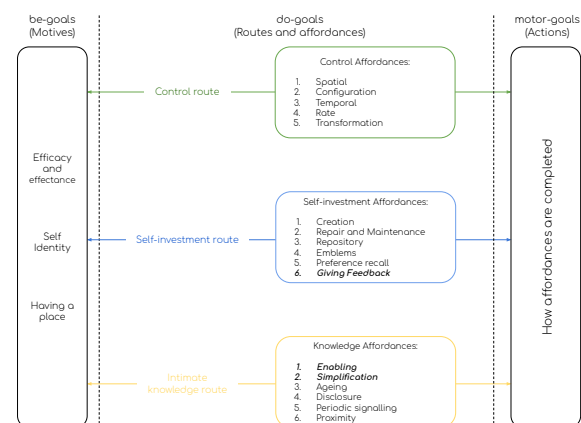


Figure 5. Revised Psychological Ownership Model

The role of and follow-up from the service provider plays a major role in both Bottom-Up findings. After all, it is this service provider who can show through the affordances of Enabling and Simplification that user effort (such as providing feedback on a slow-functioning loan app) is followed up. The tool in its current form pays little or no attention to the role of the provider. It therefore seems advisable to include this role in the tool.

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