

Investigating Users' Interaction with Physical Products Applying Qualitative and Quantitative Methods

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Abstract. When using products, people are sometimes involved in activities other than the products' primary use. Some of these activities are peripheral, while others may reinforce people's experiences with the products. The latter is related to the focus of this research – user engagement. User engagement is defined as a situation in which a product provides one or more additional features related to its primary function, so the user engages more senses through the product experience. This research investigates how six product samples engage subjects. The result shows that the six product samples can engage users and therefore result in an interesting user-product relationship. Based on the subjects' reactions, user engagement can be categorized into at least three types: sensory, physical, and emotional engagement. In addition, products can enable user engagement because they possess particular properties that represent mimicking, inspiring, or staging a function.

Keywords: user engagement, engaging products, user-product interaction.

1 Introduction

When using products, people are sometimes involved in activities other than the products' primary use. Some of these activities are peripheral, while others may reinforce people's experiences with the products. The latter is related to the focus of this research—*user engagement*. User engagement is defined as a situation in which a product provides one or more additional features related to its primary function, so the user engages more senses through the product experience. For example, if a toaster is transparent, the user can see the bread darkening; the transparent sides stage the toasting process as a visually engaging performance. The user has additional interaction or meaning with the toaster. Another example is a tape dispenser with a simple odometer. In addition to acquiring tape, the person who uses such a dispenser can observe how much tape has been dispensed in terms of distance. This kind of product satisfies people who expect participation, contribution, or involvement when using products. Interestingly, people use “engaging products” in a way that is frequent, intense, active, vivid, or complete, etc.

2 User Engagement - A Special Case of User-Product Interaction

Several studies summarized in Table 1 discuss specific user behavior related to user engagement. Engagement could be a synonym for participation, involvement, and immersion. It refers to a person taking part in an activity in order to affect the activity or to be affected by the activity. In fact, studying on user engagement is valuable in understanding how people participate in activities. It is common that memorable experience can be occasioned by a process, prop, souvenir, activity, and/or interactivity. Designers can apply these elements to enhance user engagement. This research follows this concept and user engagement is defined thusly for this research:

When a person uses a product, he or she also participates in another activity enabled by the product other than the primary use. The person:

- . *is entertained by the activity through his or her senses and participation, or*
- . *creates something as a part of the activity and enjoys the result, or*
- . *escapes temporarily from his or her normal daily reality, or*
- . *is attracted by an interesting aspect of the activity.*

That is, the person has more senses, actions and/or feelings engaged by the product. As a result, his or her product experience is reinforced.

Table 1. Studies related to user engagement

| Domain | Researchers | Characteristics |
|--------------------|---|--|
| Design | Wright et al.[1] | Four aspects to describe experience: (1) the compositional aspect, (2) the sensual aspect, (3) the emotional aspect, and (4) the spatio-temporal aspect. |
| Marketing | Pine and Gilmore[2] | Three elements to engage consumers: (1) shopping process as a performance, (2) services as a stage, and (3) goods as props. |
| | Pine and Gilmore[2] Gupta and Vajic[3] | Three levels of consumer engagement: (1) theme, (2) central activity, and (3) supporting activity. |
| Social interaction | Kearsley and Shneiderman[4] Chung[5] | Three components of engagement in learning: (1) relate, (2) create, and (3) donate. Four phases of social engagement: (1) initiation, (2) participation, (3) cooperation, and (4) solidarity. |
| | Falk[6] | Four elements for live role-playing games: (1) character, (2) costume, (3) props, and (4) stage. |
| Interaction design | Blackwell et al.[7] Hoven et al.[8] Nack[9] | TUIs makes user-product interaction more engaging. Four aspects of experiences: (1) attributes, (2) presence, (3) temporality, and (4) interactivity. |
| | Hoven[10] Overbeeke et al.[11] | Interactive devices function as souvenirs How to make products engaging: (1) beauty in interaction, (2) rich actions, and (3) irresistible. |

3 Selecting Product Samples

Based on the definition of user engagement, six primary criteria for assessing product candidates are determined. On the contrary, five secondary criteria are considered in order to narrow the scope and control the quality and categories of product candidates. Next, to verify the six primary criteria, six professionals in product design are involved, including three males and three females. They are practicing product designers or product managers who have more than 10 years of professional experience. Analytic methods applied in this verification include a well-structured interview and a digital questionnaire, both of which take for around one hour. Besides, a web-based video editing tool for processing interview data was used for protocol analysis. This step helps to rate, refine the primary criteria and add new ones for assessing product candidates. However, the five secondary criteria are not examined.

Then, the refined criteria are clear enough for determining if one product is engaging or not. Any product that meets any of the criteria is a potential product candidate. To collect product candidates, hundreds of products were examined online. For variety, only one candidate was selected among products that provided the same functions and that met the same set of criteria. Subsequently, 16 product candidates are gathered, each of which meets two to five criteria, respectively.

Last, to select product samples, an online survey is applied to examine the 16 product candidates. This survey consists of 16 product pairs, including the 16 product candidates and 16 typical products that provide similar functions. Thus, it is easy for online respondents to rate each product candidate against to the six primary criteria in a five-point rating scale. For statistical significance, there are at least 30 respondents who rates 4 of the 16 product pairs. For randomization, the questionnaire was presented in four different sequences; therefore, the resulting data was less susceptible to respondent fatigue. In this way, whether each of the product candidates is a qualified product sample can be determined based on respondents' examination. Regarding methods, Independent-Samples T Test is applied to examine qualified product samples. Factor analysis and mean rating are used to examine the effectiveness of the six survey questions (criteria). Finally, the six product samples are selected as shown in Fig. 1.

4 Qualitative User Investigation

This research argues that the six product samples possess particular properties that foster specific types of user engagement. The product properties and user engagement can be identified through product trials and subject interview, that is, the qualitative investigation of user engagement.

4.1 Investigation Design

The purpose of this investigation is to uncover ordinary users' experience with the six product samples, focusing on the type(s) of user engagement that each product sample enables and the distinctive product properties that foster user engagement. Thus, this research requests each subject to use one product sample for one week at home or at



Fig. 1. Six Product Samples

work. The reasons are three-fold: (1) The subjects needed time to become familiar with the product sample. The one-week trial allowed them to use the product sample in daily life. (2) The one-week trial minimized the sample's novelty and the subject's curiosity. (3) Unlike in a laboratory, the subjects felt comfortable using the product at home or at work. Next, an observational interview was conducted to investigate each subject's actual experience with the product sample. Each interview was videotaped.

This investigation recruits 24 subjects, four for each product sample. There are three requirements for selection: (1) Each subject must have no expert knowledge of design-related domains in order to represent ordinary users. (2) Each subject must be willing to use the product sample for one week at home or at work. (3) The four subjects who try out the same product sample must comprise two males and two females of different backgrounds. In addition, one subject, a graduate student in design, was recruited for a pilot test in order to improve the investigation.

The investigation contains seven steps:

1. Introduction – Each subject was given a product sample, a one-time-use camera, and instruction guidelines. The disposable camera was used to capture the subject's experiences with the product sample. The instruction guidelines presented tasks for the subjects to perform.
2. Product trial – Each subject used a product sample for one week at home or at work. During this period, he or she took pictures to document significant experience with the product sample. All pictures were developed before the follow-up interview.
3. Meeting with each subject – At the beginning of the observational interview, three questions were asked:
 - . Where did you use the product, and why did you use it there?
 - . How many days have you used the product for?
 - . How many times total was the product used?

4. Observation – The researcher observed how each subject typically used the product sample at home or at work. Thus, the subject's situational experiences with the product sample were recorded.
5. Interview Pictures – Each subject explained the pictures that he or she took. The purpose was to enable the subject to actively discuss user engagement and product properties without biased prompting.
6. Interview Question 1 – Please tell me about your experience with this product sample in comparison to an everyday product. Each subject was encouraged to talk about his or her experience with the product sample and with a corresponding typical product.
7. Interview Question 2 – What specific functions, features, or aspects of this product enable the experience that you just described?

Throughout the observational interview, the researcher asked follow-up questions depending on the subject's responses in order to specify experiences, especially user engagement, with the product sample.

To analyze the 24 subjects' verbal reports, a web-based video editing tool was applied for protocol analysis. Each subject's verbal report related to user engagement is paraphrased for better comprehension. Therefore, user engagement enabled by each product sample is determined.

4.2 How the Six Product Samples Engage Subjects- One Example

The Pop Art Toaster™ engaged subjects in four ways (Table 2). Fig. 2 shows three subjects' experiences with the branded toast. First, the toaster elicited sensory engagement. When the toast popped up, four subjects liked to check the images made

Table 2. How the Pop Art Toaster™ engages subjects

| Types of Engagement | Description |
|---------------------------|--|
| . Sensory engagement | . When the toast pops up, four subjects like to check the images made on the toast. |
| . Emotional engagement | . The toast amuses three subjects and provokes an emotional response. |
| . Physical engagement (1) | . One subject likes to play or make a joke with the toast in front of his family or friends. |
| . Physical engagement (2) | . When using the toaster, one subject is inclined to toast an extra slice of bread. |



Fig. 2. Subjects' reactions with the branded toast

on the toast. This engagement fulfilled their curiosity, amused them, and reminded them of what to do next time in order to create better images on the toast.

The branded toast also provoked an emotional response. For example, the smiley face image plate gave the three subjects a funny feeling, because they imagined that the toast was smiling at them. Three subjects reported that branding images on toast enabled a wonderful breakfast experience in the morning. Regarding physical engagement, one subject liked to make a joke with the toast in front of family or friends, for example, by placing the smiley face toast next to her own smiling face. With a slice of “BITE ME” bread in hand, one female user pretended to bite a chunk of bread and laugh wildly. Another female user held up the “i’m hot!” bread to indicate that the toast was complimenting her. This type of user engagement enabled social interaction and allowed subjects to share amusing experiences with others.

One subject was inclined to toast an extra slice of bread in order to create different images or better images. This engagement allowed for a test through which the subject found out how to correctly brand images on bread. In addition, the toaster engaged one subject by relating to a larger activity. This female subject hosted a toasting party and invited her female friends to make pop art toast, taking turns or using the toaster together. This type of engagement turned breakfast into a social occasion.

Regarding product properties, the subjects reported that the Pop Art Toaster™ differs from a typical toaster in appearance and use. The six removable image plates were key components that inspired the subjects to brand images on the toast. However, because the image plates are not fastened components, they make the toaster’s appearance less attractive. These accessories also affect toaster use. Two image plates must be selected and correctly installed in order to brand pleasing images on the toast. This is not necessary with a typical toaster. Thus, the Pop Art Toaster™ engages subjects, but its appearance and ease of use are compromised.

4.3 Types of User Engagement and Product Properties

The qualitative user investigation shows that the six product samples can engage users and therefore result in an interesting user–product relationship. Based on the resulting reactions, user engagement can be categorized into at least three types, sensory, physical, and emotional engagement, each of which represents an additional interaction and product meaning. To articulate, *sensory* engagement takes place when products engage the user’s senses. Sensory engagement is similar to what tourists do from the top of a skyscraper; they comprehend the distant scenery by seeing and listening. For example, the Sunbeam®/Oster® toaster can visually engage users. *Physical* engagement takes place when products cause users to act. Physical engagement is similar to how a person acts if given a stick to hold. He may become a baseball player, an orchestra conductor, or even a Jedi knight. With imagination and enjoyment, physical engagement can be triggered by many objects, including products. For example, the Still Life Fruit Bowl can engage users in playful activities. *Emotional* engagement takes place when products evoke specific ideas and/or feelings that affect users. Emotional engagement is similar to the way in which people are inspired by reading an old diary or when given a precious souvenir. For example, the Viceversa® Weight Scale can cause users to imagine they are lighter (or heavier).

In addition, the qualitative user investigation reveals that the six product samples can enable user engagement because they possess particular properties that represent mimicking, inspiring, or staging a function. *Mimicking* means that the appearance of a product is designed to simulate a character, object, or circumstance. For example, the Dinersaurs™, a fork and spoon set for kids, simulates dinosaurs. *Inspiring* means that a product is designed to be associated with another interesting object, activity, or circumstance. For example, the Still Life Fruit Bowl associates a pile of fruit with a still life painting. *Staging a function* means that a product is designed to present a compelling view of an invisible mechanism or to display its attractiveness. For example, the Sunbeam®/Oster® toaster with viewing window allows users to see the internal wires. These three attributes potentially foster user engagement.

5 Quantitative User Investigation (Online Survey)

In the previous section, how the six product samples engaged subjects is investigated. The finding is confirmed through a quantitative user investigation- online survey.

5.1 Investigation Design

The purpose of the online survey is to confirm (1) the types of user engagement that each product sample enables and (2) the product properties that foster these types of user engagement. The online survey includes six product samples. Each product sample was compared to a corresponding typical product (similar to the product pairs in section 3). The questions were developed according to the user engagement and product properties investigated in the previous section. For randomization, the questions were presented in four different sequences. Therefore, the resulting data were less susceptible to participant fatigue. In this way, how the six product samples engage users can be confirmed. For statistical significance, this online survey required at least 30 respondents for each product sample. Respondents must have no expert knowledge in design-related domains.

The procedure for taking the digital questionnaire is summarized as follows.

1. Obtaining respondent information – Each respondent provides their name, gender, specialty, nationality, and age.
2. Presenting the product – Pictures and description of each product appear. After the respondent has reviewed the product, he or she proceeds to the next page.
3. Rating the product – The respondent rates the product by answering questions.
4. Rating the corresponding typical product – The respondent rates the corresponding typical product by answering the same set of questions.
5. Rating other product pairs – The respondent rates other product pairs by answering related questions.

The online respondents' answers indicated whether they agree with the user engagement and product properties investigated in the previous section. The author assumes that if a product sample is rated significantly higher than its corresponding typical product, then the question that specifies the user engagement or product property is confirmed. In order to calculate statistical significance, Independent-Samples T Test was applied.

5.2 Result of Online Survey- One Example

For the Pop Art ToasterTM, 32 online respondents are involved in this quantitative user investigation. Table 3 shows that all types of user engagement are supported by the online respondents. The author assumes two reasons for this result. First, branding images on bread makes sense to online respondents, and they are excited about it. This feature would significantly affect the experience of using the toaster. Second, online respondents are familiar with a typical toaster in appearance, use, and function. Compared to a typical toaster, it is easier for them to assess what the Pop Art ToasterTM could prompt them to do, as the survey questions describe.

Before the online survey, the author doubted that Question 4 would be confirmed. The reason is that people usually toast slices of bread for breakfast or snack; extra slices are only toasted when the user prepares breakfast for others or during the first few uses of the Pop Art ToasterTM. Thus, the online respondents likely agree with Question 4, because they have never used the Pop Art ToasterTM. They answered the question based on what they would do at the first time if they use it.

The questions verifying product properties are also supported. That is, the online respondents confirm that the Pop Art ToasterTM would inspire them to make special pieces of toast. The image plates and the different ways of use are two factors that enable user engagement.

The quantitative user investigation presents the validation of this research. The identified product properties and user engagement were confirmed by an online survey. The results show that (1) the six product samples provide additional interaction and meaning to engage users; (2) there are at least three types of product attributes that can foster user engagement (mimicking, inspiring, and staging a function); and (3) user engagement can be sensory, physical, and/or emotional. The causal relationship between product properties and user engagement would reveal

Table 3. Results for the Pop Art ToasterTM

| Type of Engagement | Description supported by online respondents |
|---------------------------|--|
| . Sensory engagement | Q1: When the toast pops up, I would like to check the pattern made on it. (Four subjects) |
| . Emotional engagement | Q2: The toast from this toaster would amuse me and provoke an emotional response. (Three subjects) |
| . Physical engagement (1) | Q3: I would like to play or make a joke with the toast in front of my family or friends. (One subject) |
| . Physical engagement (2) | Q4: When using this toaster, I would be inclined to toast an extra slice of bread. (One subject) |
| Product Property | Description |
| . Appearance | Q5: This toaster's accessories enable an interesting experience. (Four subjects) |
| . Use | Q6: Using this toaster would result in an interesting experience. (Four subjects) |
| . Attribute: inspiring | Q7: This toaster would inspire me to make a special piece of toast. (Four subjects) |

patterns among the product samples. By relating product properties to the elements of engagement, guidelines for enabling user engagement can be discussed. These guidelines must lead to a preliminary framework for generating product ideas that enable user engagement.

6 Conclusion

To conclude, this research claims that an engaging activity is comprised of an original activity and at least one reinforcing activity, both of which attract people to participate. As a result, each person involved in the engaging activity has a better experience. In terms of user-product relationship, the original activity is use of the primary function of a product. The reinforcing activity is a user-product interaction in which the person senses more, acts more, and/or feels more during the product experience.

This research shows that the six product samples can engage users and therefore result in an interesting user-product relationship. The results show that products that enable user engagement are currently on the market. Thus, user engagement is an existing product value that certain users desire. Based on the subjects' reactions, user engagement can be categorized into at least three types, sensory, physical, and emotional engagement, each of which represents an additional interaction and product meaning. This research shows that products can enable user engagement, because they possess particular properties that represent mimicking, inspiring, or staging a function. Thus, it is clear that typical products can become engaging through the addition of mimicking, inspiring, or staging a function.

Not surprisingly, people use engaging products in a way that is frequent, intense, active, vivid, or complete, etc. User engagement makes the user-product relationship more interesting. It is different from, but as significant as, domains such as functionality, usability, aesthetics, interaction, pleasure, and emotion, all of which are important to satisfy user needs. It satisfies users who expect participation, contribution, or involvement when using products. The author expects that this research will lead to a better understanding of how products can be designed to enable user engagement, providing additional interaction and meaning with products and bringing another dimension of value to product design.

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