Identifying Emotions Provoked by Unboxing in Virtual Reality

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Abstract. Unboxing a product, i.e. removing a newly acquired product from its packaging, often is a momentary strong emotional experience. Therefore, it is increasingly regarded as a critical aspect of packaging design. This study examines the user interaction when unboxing a product in Virtual Reality (VR) by comparing three plain textured boxes, each with a unique packaging design, and by inquiring the participants' emotions provoked by each design. The boxes were created based on the following interaction design guidelines: freedom of interaction, interaction pattern, and richness of motor actions. The findings indicate that there is a difference between the strength of certain positive emotions when unboxing the three boxes in VR. This study discusses the relationships of certain interactions in VR, and how they can shape people's expectations. These findings can serve as guidelines for how designers can improve the virtual experience through different interaction methods, and they provide insights into the differences between the unboxing experience in the real and the virtual world.

Keywords: Unboxing · Affective interaction · Virtual Reality · Emotions

1 Introduction

The utilitarian packaging for consumer products has changed, and what has taken its place is a strong drive towards viewing the packaging as an integral part of the overall experience. What this entails is a shift in a product's packaging design so that it takes into account the first step after retrieving a product, namely, the unboxing.

The appeal and expectations for a newly acquired product strongly rely on its packaging, and by altering its characteristics, the appeal and expectations will change as well. Beneath the visuals is the often overlooked aspect of interaction with the packaging itself. In the real world, the interaction with the package during unboxing may provide emotions of satisfaction, fascination and admiration [11], which strongly depend on the interaction to unbox the package.

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Virtual Reality is another dimension that is ready to be explored, and the unboxing process poses the unanswered question of how this interaction provokes emotions. Unboxing is a core example of a situation that elicits strong emotions and relies on little exterior stimulation. Ideally, it can provide a basis for exploration of intense emotional interactions in VR.

This paper presents a virtual environment and interactions for unboxing a product to heighten presence. Based on this environment, an unboxing experiment is constructed and tested with the aim to contribute to the scientific understanding of interaction in VR.

2 Related Work

Unwrapping a newly acquired product often is a process of joy. As you unravel the casing to reveal what is underneath, you might experience a momentary intense emotion [11]. A survey from 2016 on packaging design [12] shows that good packaging can increase repeat products purchases from the same merchant by 52%. Furthermore, good packaging makes the brand seem more upscale and excites consumers about the product.

Unboxing has seen several descriptions, most focusing on the strong emotional value. Lazarrera [13] claimed that unboxing adds value through provision of memorable and shareable experiences. Furthermore, it has been described as a narrative experience as it is a process in which a product can speak for itself, and which gives the product a body and soul [15]. Similar views include ritual-like nature with intense emotional arousal [10] and a trigger for personal emotional response [8]. Several of these descriptions share the sentiment that unboxing is an impactful experience. As with most of such experiences, they are often exciting to watch on digital medias as well, which arguably has contributed to it gaining a large following on online video sharing platforms.

Most studies concern themselves with the visual appeal of the package, yet Kim et al. [11] and Wang et al. [16] claimed that multi-sensory aspects dominate the emotional influence during unboxing. The multi-sensory aspect is defined as a phase that offers the user short-term, hands-on, non-instrumental, realized and explorative interaction [16]. This study adopts a similar line of thought to further explore and understand the emotional response during unboxing, based on affective interaction in VR.

For this study, "affective interaction" describes an interaction that results in the experience of a feeling or emotion. Kim et al. [11] defined a multi-sensory appraisal experience as an aesthetic interaction, reasoning aesthetic to be a a provocation of higher-level pleasures of the mind, stimulating sensory modalities. Hashim [7] argued that aesthetic is more often used in a philosophical setting. Therefore, affective interaction is used to describe the multi-sensory appraisal experience. Höök et al. [9] proposed that well designed affective interaction should not infringe on privacy or autonomy, but instead empower users. Guribye et al. [6] drew inspiration from this definition, and used it for constructing a tangible affective interaction device. One of their findings is that such a device should invite squeezing and it should feel good to squeeze. These findings argued that visuals are not only for aesthetics, but for raising desire for interaction.

Combining the thoughts from the presented sources, we define unboxing as a strong positive affective, one-time experience, relying on visuals to raise desire and interaction to empower the user. If this is achieved, the experience should be memorable and spark a personal emotional response. Kim et al. [11] suggested three different box designs to achieve affective (aesthetic) interaction based on a series of principles on interaction by Djajadiningrat [4]. Djajadiningrat proposed three factors for affective interaction: *freedom of interaction*, *interaction pattern* and *richness of motor actions* [4].

To evaluate affective interaction, the Product Emotion Measurement Tool (PrEmo) by Desmont [3] has seen use in similar experiments [11], and is argued to capture enough emotions to cover a large array of feelings [2]. Therefore, PrEmo is the chosen method for evaluating affective interaction in this study. PrEmo is a non-verbal self-report instrument to measure emotional responses, consisting of 14 animations representing positive (i.e. desire, pleasant surprise, inspiration, amusement, admiration, satisfaction, fascination) and negative (indignation, contempt, disgust, unpleasant surprise, dissatisfaction, disappointment, and boredom) emotions. Each animation is coupled with a Likert scale from 0 (do not feel) to 4 (feel strongly).

In order to achieve an actual unboxing experience in VR, this study focuses on having participants feel strong *presence* [5] in the virtual world. To evaluate presence, this study uses the cross-media presence questionnaire ITC-SOPI [14], which consists of 61 questions that deal with four factors: *sense of physical space*, *engagement*, *ecological validity*, and *negative effects*. The questionnaire is not tuned for interaction, but still holds validity as one of the most researched presence measurement methods and provides a control group to compare the data to, in order to analyze presence. A study by Baños et al. [1] is used as control group, in which participants used a VR headset in an emotion-provoking experience with no interaction. The emotion that the study was aiming to provoke was sadness. Given the differences between the two experiments, the findings from this comparison may have limited validity.

3 Experiment Implementation

3.1 Overview of Artifact

The artifact for the experiment, i.e. the software, was developed with the game engine Unity using the assets SteamVR and VRTK to build the interactive VR experience. The hardware used is an HTC Vive head-mounted display with its standard wand-like controllers coupled with headphones for audio. The virtual environment aims to simulate a real environment, with a virtual agent representing a realistic male model with animated idle movement guiding the participant

Fig. 1. Panorama picture of the environment created for the experiment, with the virtual agent.

along (see Fig. 1). To explain the concepts and to simulate a talking character, floating speech/thought bubbles are used. Similarly, to fill out the PrEmo questionnaire, a floating interactable UI was used.

When the software starts up, it presents users with the virtual world and allows them to explore it while providing a short introduction. During this process, users are asked to use the triggers on each controller and are shown how to interact with objects and UI elements. After the tutorial, they are presented with one of a total of three boxes and are asked to unbox it. Once unboxed, they are given a new box, until all three have been opened. After each unboxing, they fill out the PrEmo questionnaire (in VR), first showing the six positive emotions followed by the six negative emotions.

3.2 Box Designs

Each box was created with a different design guideline in mind: *Freedom of interaction*, *Interaction pattern* and *Richness of motor actions*. All boxes share the same dimensions and a plain paper texture. Furthermore, all outer boxes are fixed to the table, so as to not have the participants accidentally shove them onto the floor. Each box contains a computer mouse, which the participants are asked to unbox and place on an adjacent platform. If they were to lose or throw the mouse away, it would reappear in its original position in the box. The boxes can be seen in Fig. 2.

The boxes incorporate the design guidelines in the following way: Type A (freedom of interaction) is filled with balls similar to styrofoam. The material is widely used in packaging to absorb shock and protect the product. This design is meant to encourage participants to extract the product in any way they wish without a fixed order or sequence. Each HTC Vive controller was equipped with a transparent rectangular box, which would push away styrofoam if they moved the controller close to it. It was necessary to limit the amount of grains, and they were noticeably larger than typical packaging materials, as otherwise the simulation would have suffered from performance issues.

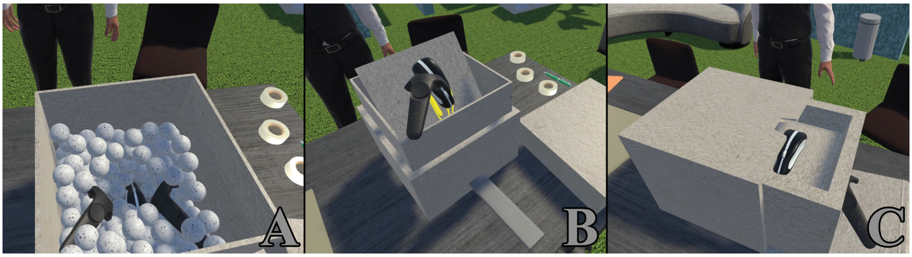

Fig. 2. (A) Freedom of interaction. (B) Interaction pattern. (C) Richness of motor actions.

Type B (interaction pattern) consists of a white box with a black pull-cord. Type B was designed so that if the cord was pulled, an animated sequence would rotate the inner box, revealing an open surface with the product, and if the user let go, the box would rewind back into its original position. This interaction was designed to represent an interaction pattern, as the users first needed to lift the cover, pull the string and then pick up the mouse. The timing, flow, and rhythm of the procedure were all linked to the action of unboxing.

Type C (richness of motor actions) was composed of a series of sequential procedures accompanied by corresponding tasks required to retrieve the packaged product. The transformative axis of each element differed to encourage the use of motor skills, providing participants an unboxing experience enriched by motor action. The implementation in VR poses some difficulties to this design, as it requires many physical surfaces and use of hinge joints, which are complicated to replicate properly in VR. To ease understanding of the unboxing process, instructions were added onto some of the walls of the box.

3.3 PrEmo

The PrEmo layout was created following a design proposed by Caicedo [2] with slight differences. Originally the questionnaire is to be answered on a computer or paper. In this study, it was recreate in VR to remove the hassle and confusion potentially caused by taking off the head-mounted display after each unboxing. The original layout of the questionnaire included all 14 emotions on the same screen. The design was changed to have the positive and negative emotion separated in different UIs to lessen the amount of information given at once.

3.4 Controller Interaction

Interaction with the virtual objects using the controller poses some challenges to the design of the setup. Participants should be able to open all boxes using only one button on each controller. The interaction should provide the feeling that the user is in control of the process. Furthermore, their behavior should avoid glitches that could affect the realism of the world. For the most part, the trigger button served as ‘grab’, meaning that if the controller is inside an object, and the button is pressed, the object will follow the translation and rotation of the controller.

Some boxes were of more complicated design and, thus, required a specific approach to interaction. These decisions were made based on the observations made in the internal pilot testing. Boxes B and C (Fig. 2) featured animations for pulling the chord (box B) and dragging the inner box out of the outer one (box C) using the controller. In addition, box C had an outer cover which the participants needed to lift and rotate over in order to access the inner box. This cover was set to not follow the rotation of the controller, making it easier to lift over the box.

4 Experiment Procedure

31 participants were recruited for this study. One of them did not complete the ITC-SOPI questionnaire, and was thus left out of the analysis. The final analyzed sample consisted of 30 participants, 8 female and 22 male, with age ranging from 21 to 45 years ($M = 25$). 10 different nationalities were part of the experiment, majority being Finnish ($n = 11$). All participants were either students or lecturers casually recruited from the School of Art and Design at Aalto University. None reported severe motor, hearing or visual impairments. All participants with visual impairments wore corrective glasses/lenses during the experiment.

Each participant was briefly told that the system was made to test certain means of interaction in VR. An initial tutorial, given by a virtual agent, explained how to interact in this experiment, along with the tasks that the participants had to complete. After this, they were presented with one of the three boxes, in random order, repeating until all three boxes had been completed. After having completed the virtual experiment, they were immediately asked to fill out the ITC-SOPI questionnaire on a tablet. During the tutorial stage, a few participants asked questions regarding how to ‘grab’ an object. No questions were raised concerning the UI. Only two participants asked questions during the unboxing stage: one regarding how to open box C, and another about where to place the mouse once it was unboxed.

The place of the simulation itself was inside a larger study room. The VR set was in a corner, free from any obstruction. There were other students present at all times scattered around the room, but it was generally quiet with no perceived distraction. The facilitation of the experiment itself was given by the virtual agent.

5 Results

5.1 PrEmO

Following the hypothesis that the boxes provoke different strength of certain emotions, the aim was to disprove the null hypothesis that they provoke an equal

Table 1. The ITC-SOPI results vs. the control data set.

	Treatment		Control	
	M	SD	M	SD
Spatial presence	3.35	0.70	2.85	0.30
Engagement	3.48	0.65	3.01	0.43
Ecological validity	3.19	0.44	3.21	0.56
Negative effects	1.93	0.32	2.41	0.81

strength of emotions. The boxes, A, B and C are the independent variables with the 14 emotions being the dependent variables. The groups are independent, thus a one-way ANOVA was used as it can find if any of the emotions measured by PrEmo were statistically significantly different from each other for each group. With an α of 0.05, satisfaction is the only emotion that shows significance ($n = 30$; $p = 0.029$). Using Tukey's multiple comparison test between the means of groups shows that the difference is significant between group A and B ($n = 30$; $p = 0.034$). Using one-way ANOVA to compare the average positive and negative scores for each group shows no significant difference between them.

5.2 ITC-SOPI

Based on the ITC-SOPI data, mean scores and the standard deviation for each group were calculated for the spatial presence, engagement, ecological validity and negative effects. See Table 1 for the mean and standard deviation for this data set and Baños et al.'s [1]. Comparing the results found in this test (treatment group) to their results (control group) using a two-tailed t-test showed that the results for spatial presence ($p = 0.007$) and engagement ($p = 0.012$) are statistically different. Ecological validity ($p = 0.9$) and negative effects ($p = 0.08$) results are are not statistically different.

5.3 Observations

There were a few interesting observations during the VR experience. When placing the mouse on the platform to continue the experiment, a highlight of the borders of the mouse model would appear. Many participants would take the time to put the mouse down and turn it in the right direction before placing the mouse on the platform. Furthermore, boxes A and B included a cover for the participants to take off. Several participants would try and use both controllers to take off the top. Unintentionally, box B served as a way to teach the participants to use both controllers, as using only one would make the top spin back to its original position, before they had time to grab the mouse. As such, they needed to hold the black cord with one controller, and use the other to grab the mouse. Only one managed to throw the mouse off the table by accident, and quickly discovered it had returned into the package.

6 Discussion

6.1 Results

The PrEmo responses showed little difference between the emotions provoked for each experiment, with satisfaction being the strongest. Box A showed the highest satisfaction, and it was common that the participants would take their time to play with styrofoam balls. Comparing A, B and C in terms of difficulty, box A was generally quick to unbox, whereas box B would require a short time to figure out that the chord could be pulled – users' expectations regarding what is possible in the first place played a role here. Box C would typically take longer to open, as it required more steps, and the rotational interaction was not as intuitive as hoped, frequently causing confusion. It appeared that at times box B and C almost became puzzles, which possibly skewed the final results.

The presence results a show statistically difference between the groups for spatial presence and engagement, suggesting high presence. Interestingly, ecological validity and negative effects showed no significant statistical relevance. Ecological validity follows from how believable the environment is, and the perception of characters and objects as being real. The lack of a significant difference indicates that the virtual environments of both experiences were similarly believable. The same appears to be true for negative effect. As both tend towards low values with no significant difference, they should not strongly affect the experience. For engagement, a statistically significant difference was to be expected as both experiences were affective experiences since Baños et al.'s experience [1] was a negative (sad) experience, whereas this was a positive one. Assuming that the worlds were of similar audiovisual quality, interaction is likely to be a key difference. However, it could also be due to the nature of the engagement that a positive emotion strengthens presence, whereas a negative one lowers it.

6.2 Future Work

While the findings are mostly insubstantial for emotions, showing only satisfaction as a significant difference, they suggest that differences do exist and provide insight concerning what causes strong emotions. Furthermore, the work discusses possible factors for improving VR experiences through more intuitive interaction methods. Ideally, a study such as this could improve the focus towards affective interaction in VR, as it is a field with notable potential for a wide array of uses.

7 Conclusion

This study evaluated affective interaction, that is, interactions that provoke strong emotions, in an interactive virtual environment in Virtual Reality (VR). The study identified factors related to the unique experience of unboxing, based on a synthesis of existing studies and real-world comparison, aimed to both recreate an unboxing experience as well as to evaluate it. The packages were visually bland, as to not interfere with the emotions elicited from the interaction, and differed instead based on the interaction required to unbox them. We found out that satisfaction is strongly affected by different designs, and gave hints on how to evoke positive emotions in a virtual environment. The null hypothesis ("Different interaction methods provoke no difference of emotions in VR") could, therefore, be rejected. The study further evaluated presence based on other similar experiments, finding that differences in spatial presence are significant, although it remains unclear if the cause is the introduction of interaction, or the kind of emotional engagement the experiment provoked. The findings contribute to the current knowledge on affective interaction in VR.

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