Encountering the Unexpected: Influencing User Experience through Surprise

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Abstract. When purchasing an interactive product, users nowadays seek more than a flawless functionality and a comfortable ease of use. Products need to be enjoyable and exciting to have a unique selling point. User Experience (UX) is constituted by the instrumental qualities as well as the hedonic qualities of a product and impacts on the user's overall appraisal. One way to improve product appraisal is the use of surprise as a design element. Surprising product design has been shown to be beneficial for the user and the rating of a product. By using the classical computer game Tetris, the impact of surprise on UX ratings of a digital, interactive computer game was investigated. The results of our study stress two points. First, unexpected events with *undesirable* consequences lead to negative surprises which in turn impede users' information processing and have a bad impact on user experience. Second, whether unexpected events with *desirable* consequences lead to positive surprises, mainly depends on the interaction context and on the kind of system under consideration.

Keywords: User Experience, Surprise, Usability, User Centred Design.

1 Introduction

For many years, usability issues, such as effectiveness and efficiency [1], have dominated research and development in the domain of interactive systems. But due to technical advancements and the growing importance of user centered design, good usability is no longer something to be excited about. Instead, it has turned into a quality feature that is almost taken for granted. Today's customers are on the lookout for products that are not only easy to use, but that are exciting and pleasurable [2]. As Norman states "...the emotional side of design may be more critical to a product's success than its practical elements."[3, p.5]

Exciting products motivate customers to prefer one product over another [4]. Classical product design strives to create excitement and interest by adding surprise features to a product [5]. Because such products do not match the expectations of their users, they are more interesting, easier to remember, and elicited increased word-of-mouth than similar, conventional products [5]. These insights raise the question whether similar effects can be attained by furnishing interactive products with surprising aspects because surprise may arouse interest and intensify user experience (UX).

2 Expectation, Surprise and User Experience

UX can be defined as “a person's perceptions and responses that result from the use and/or anticipated use of a product, system or service” [6]. Expanding this definition, the CUE model (Components of User Experience) by Mahlke and Thüring [7] describes the emergence of UX in more detail: When users interact with a product, they perceive its various instrumental and hedonic features, get impressions of its strengths and weaknesses and gradually form an opinion about it. These cognitive activities are accompanied by emotions which may be positive or negative depending on the quality of the interaction. Together, cognition and emotion constitute the users’ overall experience that evolves from their actions and the responses of the system.

Some authors highlight the relevance of expectations which arise in the course of interaction. For instance, Pohlmeyer, Hecht and Blessing [8] emphasize the importance of anticipated experience for UX, and Karapanos states that even a person who has never interacted with a particular product may have expectations about its behavior when in use [9].

According to Reisenzein, there is a direct connection between expectations and emotions. In his belief-desire theory of emotion (BDTE), he claims that “emotions are the product of cognitions (beliefs) and motives (desires)” [10]. The result of an unfulfilled belief (or expectation) is surprise. If expectations are disconfirmed and this disconfirmation co-occurs with desire fulfillment, the result is a pleasant surprise. An unpleasant surprise results from a disconfirmation of expectations which co-occurs with desire frustration. In both cases, a prolongation in reaction times (RTs) can be observed, which may be used in an experiment to check whether an attempted surprise manipulation was successful or not[10].

Product designers have made use of the benefits of pleasant surprise for instance when designing tangible products [11]. They were able to demonstrate the beneficial effect of surprise by creating products that had similar visual appearances but differed in their tactual characteristics [5]. By creating these visual-tactual incongruities, they were able to provoke surprise reactions.

While pleasant surprise has been studied extensively in classical product design, not many researchers have actively explored it as a design factor for digital, interactive products. Although some studies refer to surprise related concepts, like WOW, delight or appraisal [4, 12, 13], most research was constrained to non-interactive products. In contrast, we investigate surprise in the context of interactive products. To clarify how surprising behavior of digital products might influence UX, we address two issues: 1) Does UX differ between two products which are basically identical but elicit either pleasant or unpleasant surprises? 2) Is a surprise event still surprising when it occurs more than once? To answer these questions, we carried out an experiment in which three groups of participants played three differently surprising Tetris games.

3 Method

3.1 Participants and Experimental Design

A total of 60 persons took part in the study, (14 female and 46 male). Their average age was 24.6 years (SD = 4.2). All of them were familiar with the game.

Two independent variables were manipulated in the experiment. The first one was a between-subjects variable called *'group'*. It had three levels. The *'bonus group'* unexpectedly received 50 additional points during the game, while the *'minus group'* suffered an unexpected loss of 50 points. The third group served as *'control'* and played the game without any surprising incidence. The participants were randomly distributed over the groups with 20 persons per group ensuring a similar male/female ratio per group. The within-subjects factor *'event'* served as second independent variable. It consisted of three treatments, i.e., the first, second and third time an unexpected event occurred (e1 to e3). Four different measures were employed as dependent variables. Reaction times (RTs) were measured for processing a Tetris stone that was accompanied by a surprising event. UX was assessed using three questionnaires: (a) the self-assessment manikin (SAM), a 2-item 9-point non-verbal instrument for the evaluation of emotions measuring the dimensions *valence* and *arousal* (SAM) [14], (b) the AttrakDiff questionnaire, a 28-item semantic differential with the subscales *pragmatic quality*, *hedonic quality identification*, *hedonic quality stimulation*, and *attractiveness* [15], and (c) a self-developed single-item questionnaire for judging the overall UX on a 6-point non-verbal scale showing a thumb down at one end and a thumb up on the other (see [16]).

3.2 Hypotheses

Three effects of the independent variables *group* and *event* are expected:
H1: For the factor *group*, a main effect on reaction times is predicted. Mean RTs for the *bonus group* and for the *minus group* are longer than for the *control group* because surprises increase processing time.
H2: For the *bonus group* and the *minus group*, mean RTs will decrease from event 1 over event 2 to event 3 because the extent of surprise diminishes when an unexpected event is encountered more than once. Therefore, an interaction effect of *group* and *event* is predicted for the reaction times.
H3: Since a positive surprise will lead to an improvement of UX, ratings of the *bonus group* will be better than those of the *control group*. Also, ratings for the *minus group* will be worse than for the *control group* because negative surprises impair UX.

3.3 Procedure

Participants played a game of Tetris and were instructed to reach a certain amount of points within 5 minutes, gaining 10 points for every stone they placed on the square board. All participants played the same sequence of 66 stones. They were not informed about the possible occurrence of any surprises beforehand. To motivate them to play as ambitiously as possible, they were rewarded 7 Euros for participating in the experiment and received an additional 3 Euros for reaching the required goal.

To induce surprises, a message flashed on the computer screen at three different times during the game (i.e., simultaneously with the appearance of stone 38, 47 and 51). While the *minus group* saw “!!!Abzug: -50 !!!” (Abzug=Reduction), the *bonus group* saw “!!!Bonus: +50 !!!”, see figure 1. The c*ontrol group* played the game without encountering any surprising message. RTs were measured via key log from the first simultaneous appearance of a stone and a message until first key stroke.

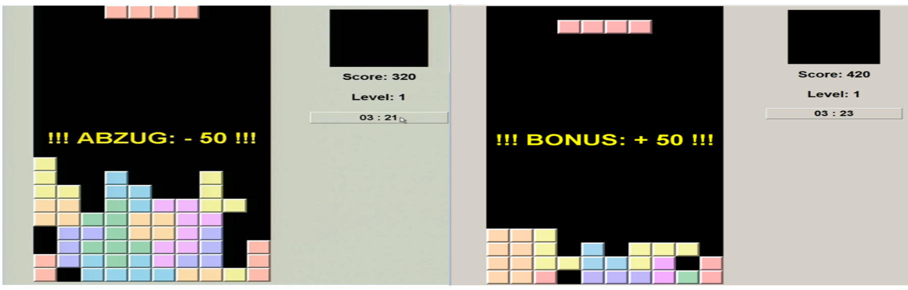

Fig. 1. Surprise events for *minus* group (left) and b*onus group* (right)

4 Results

Of all 60 participants, six were not able to finish the game, resulting in a game over. To avoid this negative experience having any impact on UX ratings, these participants were excluded from further analysis. A 3x3 analysis of variance (ANOVA) of the RTs was carried out with event as a within-subject factor and group as a between-subject factor. There was a main effect for the factor group ($F(2,47)=6.46$, $p=.003$, partial $\eta 2 = .216$). Figure 2 illustrates that the control group was faster than the bonus group which in turn required less time than the minus group to react under the surprising conditions. Contrasts revealed that participants in the minus group were significantly slower than participants in the bonus group ($p=.047$) as well as in the control group ($p=.001$). The difference between the bonus group and the control group, however, was not significant.

There was also a main effect for the factor event ($F(2,94)=3,338$, $p=.040$ partial $\eta 2 =.066$), indicating that RTs decreased from e1 over e2 to e3. Contrasts showed that e1 differed significantly from e3 ($p=.016$). There was no significant interaction between group and event ($F(4,94)=1,413$, $p=.236$, partial $\eta 2=0.057$).

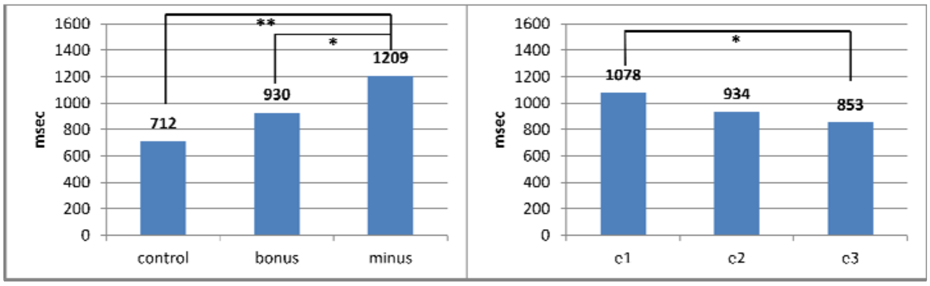

Fig. 2. Mean RTs per group (left), and mean RTs per event in milliseconds

Mean ratings for the dimensions of the UX-questionnaires are shown in table 1. To investigate surprise effects on UX ratings, a one-factorial MANOVA was carried out with '*group'* as between-subjects factor (all values z-transformed). The MANOVA revealed a significant main effect (F (30, 66) = 1,851, p=.019; Wilk's Λ = 0.295, partial η2 =.46). Significant effects were found for the SAM subscale Valence (F(2,47)=4,662, p=.014, partial η2 =.166) and the AttrakDiff subscale Hedonic Quality Identification (HQI), (F(2,47)=4,647, p=.014, partial η2 = .0165). Contrasts showed that participants in the *minus group* gave significantly worse ratings than participants in the *bonus* and c*ontrol group* on both of these scales. Furthermore, contrasts revealed that participants in the *minus group* rated the game significantly worse than participants in the *bonus group*.

Table 1. Untransformed questionnaire ratings (Overall: 1=thumbs down, 7= thumbs up; SAM Valence: 1=happy, 9=sad SAM Arousal: 1=aroused, 9=calm) per group (AD: AttrakDiff).

Group	**Overall**	**SAM Valence**	**SAM Arousal**	**AD-PQ**	**AD-HQS**	**AD-HQI**	**AD-Attraction**
Control	5,86	2,31	4,75	5,14	4,09	4,24	5,29
Bonus	5,75	3,47	4,65	5,19	4,21	4,48	5,47
Minus	6,24	2,06	4,76	5,03	3,51	3,71	4,96

5 Discussion

Research on surprise as a design strategy has shown beneficial effects on the appraisal of a variety of non-digital artifacts [5]. The goal of our study was to test the influence of surprise on UX with digital, interactive products.

To induce different surprises in the course of a Tetris game, a *bonus group* received unexpected additional points, whereas a *minus group* suffered an unexpected loss of points. We predicted an increase of RTs in these two groups for trials, in which a surprise occurred, compared to a control group (H1). In support of this hypothesis, a significant effect of the factor *'group'* was found. However, single comparisons revealed that there was no significant difference between the *bonus group* and the *control group*. Only the differences between the *minus group* and the other two groups proved to be statistically relevant. Since the prolongation of reaction times is a good indicator for surprise, we cannot be sure that the unexpected bonus worked as intended. An explanation for this result might be that a bonus in a game is not that unusual and hence not very surprising. On the other hand, a sudden and arbitrary reduction of points is rather uncommon and might therefore come as a real surprise.

Our second prediction concerned the change of reaction times over time (H2). It was assumed that an unexpected event loses its surprising character when it is encountered for a second or even a third time. In accordance with this hypothesis, reaction times decreased from the first to the third occurrence of the unexpected event (see right side of figure 2).

To measure the impact of surprise on UX, a number of rating scales was used. Our results do not fully support H3. However, it revealed that emotional valence as well as HQI were affected by the factor *group*. This effect resulted from the impact of negative surprises in the *minus group*. Mean ratings differ between this group and the other two groups in the expected direction. But similar to the results of the reaction times, no difference between the *bonus group* and the *control could* be substantiated.

In summary, it seems that our manipulation of surprise was only partially successful. Apparently the unexpected bonus was not as surprising as we had intended. This interpretation is supported by both, RTs as well as UX ratings. The unexpected loss of points though had the predicted effect. Trials with unpleasant surprises took longer to process and the ratings of the respective group indicate a less positive UX.

With respect to UX, our results stress two points. First, unexpected events in the course of human computer interaction which entail *undesirable* consequences should be prevented under all circumstances. They lead to negative surprises which in turn impede users' information processing and have a bad impact on UX. Second, whether unexpected events with *desirable* consequences lead to positive surprises, mainly depends on the interaction context and on the kind of system under consideration. As our experiment shows, an unexpected bonus in a game may not be as surprising as one might suppose. For other systems and in different contexts, such as software in a working environment, an unexpected and beneficial system response may prove as more surprising. Therefore, more research is required to investigate the causes and effects of positive surprise.

From a marketing perspective, our study raises the question whether all positive features of a system should be immediately apparent or whether some of them should be covered. Is it more beneficial to tell customers all positive aspects to prompt them to purchase the system? Or is it better to let them discover some surprising extras later which might pay off in the long run by increasing brand loyalty? Obviously, our results are not far-ranging enough to provide a sound answer, but future investigations may shed more light on this issue.

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