From Goal to Means

Shifting the Use of Emotions in User-Product Interaction

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Abstract: In most Design for Emotion projects, evoking positive emotions is the goal and endpoint of the design intent. However, psychology literature suggests a potential other role for emotions; as a means to change people's thought-action tendencies, which comprises among other things people's perception, attention, attitude, and behavior. As each distinct emotion has a different thought-action tendency, each emotion can be evoked as a distinct design strategy. The two current roles of emotions in design are reviewed, as well as the newly proposed role. The implications of using emotion in design as a means are discussed. An explorative study is reported that was designed to find differentiated effects of five different emotions on a user-product interaction. The five emotions, anger, sadness, fear, amusement, and interest, were evoked by validated movie clips. The task comprised the building of a bridge between two columns with rectangular building blocks. The effects of the five emotions were evaluated. Although the results are yet inconclusive, they show clear differentiated effects for different emotions and yield important insights for future studies.

Key words: Paper Template, Guides, instructions, author's kit, conference publications

1. Introduction

One of the main goals of research in interaction design and experience design in the last two decades has been to stimulate enjoyable use experiences, or to *evoke positive emotions* (e.g., see [1-3]). Several design researchers have considered the nature of these emotions and studied in what ways products and services can evoke them. Furthermore, an increasing number of design practitioners intently target positive emotions with their designed products. It is not surprising that designers and researchers regard the elicitation of positive emotions through design as a desirable goal, as such emotions are per definition pleasant and engaging, and lead to happy users, returning customers and successful brands. This is derived from the idea that emotions are intuitive evaluations of the momentary situation. A positive emotion signals to the user that something good has just happened, which is worthwhile to repeat, whereas a negative emotion signals that something bad has occurred, which is better to avoid in the future [4].

However, this insight represents only part of the contemporary understanding of emotions. Apart from being intuitive evaluations, emotions are also adaptation programs that produce coordinated changes in people's thoughts, actions, and physiological responses [5]. An often-used term for these programs is 'action tendency': an urge to act in a particular way in reaction to the situation that evoked the emotion [6]. Fredrickson argued that these tendencies are not necessarily for physical action only, but can also be for cognitive activity. To express the combined behavioural and cognitive effects of emotions, she introduced the term "thought-action tendencies". These thought-action tendencies comprise a wide range of effects on individuals, including people's perception, attention, preferences, decisions, interests, reflectivity, creativity and behavior. For example, someone who is angry is likely

to take higher risks in decisions, will have a preference for active over passive activities, and will be more assertive in opposing other people's ideas. These (and we can imagine others) are different manifestations of a similar thought-action tendency for anger. The concept of thought-action tendencies suggests another way to use emotions in user-product interactions: products can be designed to evoke emotions with the intention of having a specific transforming effect on the user's perception, attitude or behavior (see also [7]). Not the emotion as such, but its effect is somehow beneficial or pleasant for the user. This shifts the role of evoking emotions as a goal in itself, to evoking as a means to achieve some type of intended effect on the user.

This paper first discusses two ways emotions have been involved in user-product interactions that consider evoking emotions as a goal, and introduce a new way that is only just emerging in design research and practice, which treats emotions as a *means* to an intended effect. Next, we discuss the known effects for a few selected emotions from psychology literature, and hypothesize the meaning of these effects in the context of product interaction and product experience. Subsequently, a study is presented that constitutes a first effort to show the effects of these emotions in a user-product interaction – an emotion was elicited in different participants, after which they carried out a product task. Lastly, the results of this study are discussed, as well as the implications of using emotion as a means in product design.

2. Three roles for emotions in user-product interaction

In our view, emotions have mainly been involved in user-product interaction in two ways: 1) The product is a means for evoking user emotions, and 2) the product is a means for measuring user emotions. Reflecting on both, we propose a third way: 3) the product is a means for user transformation, in which emotions are a means for this transformation. The three directions are illustrated in figures 1, 2, and 3 respectively.

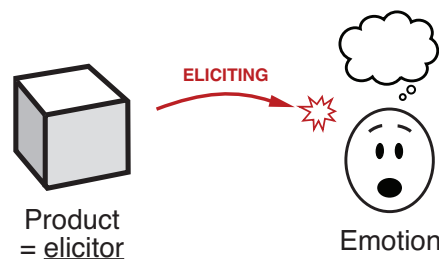### 2.1 Product as a means for evoking user emotion

Figure 1 – Product as a means for evoking user emotion

In the first category the focus is primarily on the product side of the human-product interaction. The main question in this area is how different product (interaction) characteristics systematically evoke certain emotions. Hence, in this research the product mainly plays a role as an emotion elicitor (figure 1). Most projects in the Design-for-Emotion domain fall in this category. For example, Patrick Jordan asked users for over a dozen products how much pleasure they generated as well as how and why [8]. Geke Ludden researched how certain product attributes systematically evoked surprise, and how designers are able to manipulate these attributes to optimize the surprise reaction [9]. Several research efforts have supported this practice in different ways. Some psychologists and design researchers have proposed (modified) emotion psychology models that can be used both to analyze how existing products evoke emotions and to generate new emotional designs (e.g., Desmet, Norman, Jordan).

Secondly, product-emotion evaluation methods have given designers better tools to understand whether their designed products really evoke the intended emotions. Thirdly, researchers have contributed insights by discussing both good-practice and bad-practice cases of products evoking emotions (e.g., [3]). And lastly, the increased tendency of designers to involve real users in different ways into the design process has generated products and services that more reliably evoke positive emotions and pleasant experiences (e.g. cultural probe, context mapping, and co-creation).

By focusing on the stimulus side, these research directions have generated a lot of knowledge on how products can evoke user emotions, and how these emotions can be 'designed for'.

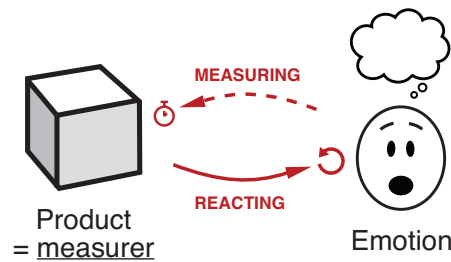## 2.2 Product as means to assess user emotions

Figure 2 – product as means to assess user emotions

The second line of research originates from the field of affective computing (e.g., see [10]), which later inspired a direction in Design-for-Emotion research. In this field, the main question is how products or systems can be designed to measure user emotions during or before usage, so the system can dynamically react or adapt to these emotions. Most research in this direction focuses on the challenge of reliably measuring human emotions – regardless of how these emotions came about, so not necessarily elicited by a product. Hence, in this research the product mainly plays a role as an emotion measurer (figure X). For example, Bill Gaver and colleagues equipped a house with a number of sensors that measured the moment-to-moment emotions of its residents, and used this data to provide them with a cryptic horoscope at the end of every day (figure X) [11]. Stephan Wensveen researched the possibility of measuring the emotional mood of users when they set an alarm clock in the evening, and designed the clock to respond with an emotionally congruous alarm the next morning (figure X) [12]. Bruns Alonso designed a pen that measures people's stress through their direct interaction with it, and which attempts to decrease the stress through haptic feedback [13]. These directions of research deal with two issues - one of which is often discussed and another that is discussed to a much lesser extent. The much discussed issue is that it (still) proves very difficult to reliably measure someone's emotions, especially if this has to be done in an unobtrusive way – without the user noticing that the measurement takes place. Methods of automatic facial recognition, physiological or neurological measurement are all still unable to reliably measure a person's discrete emotions – they can at best detect changes in emotional dimension like valence and arousal. On the other hand, measurement methods that are more reliable are usually very obtrusive (e.g. attaching several physiological sensors to the user's body or putting users in a full-scale MRI scanner). Most (technical) research in this area is directed at solving this problem. However, there is also a second, less addressed issue. Even if a system could potentially measure a user's emotion with full certainty, what should the system do with this information? Should it just make the user aware of their emotion (as Gaver and colleagues did with the horoscopes); should it react congruent to the current emotion (which

Wensveen's alarm clock did); or should it neutralize people's current emotion (which Bruns Alonso's stress pen aimed to do)?

2.3 The product is a means for user transformation, in which emotions serve to stimulate this transformation
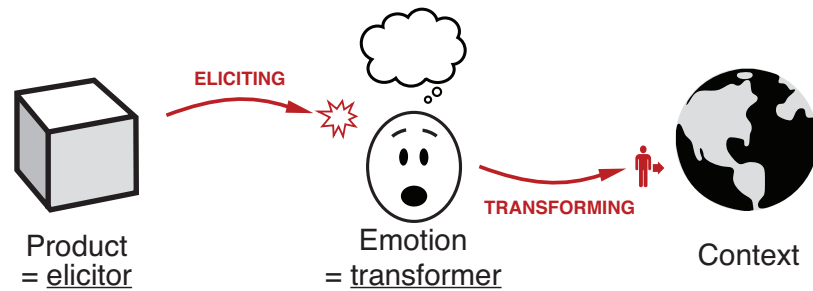

Figure 3 – The product is a means for user transformation, in which emotions serve to stimulate this transformation for a specific context

The third direction of research, which is proposed in this project, intends to answer the questions that the other two directions leave mostly unaddressed. Specifically, it considers the transforming effects of emotions evoked in human-product interactions, in order to determine which emotion is the most appropriate and enjoyable in a given user-product context (figure X). A good starting point of this consideration is emotion psychology literature and studies that aim to find the different effects and thought-action tendencies of different emotions. To start with, there are differences between the thought-action tendencies that positive and negative emotions produce. For instance, most positive emotions serve to broaden an individual's momentary thought-action repertoire (e.g., to be open-minded), whereas negative emotions serve to narrow them (e.g., to concentrate) [5]. However, there are also differences in thought-action tendencies between different emotions of the same valence. For instance, fear stimulates an individual to retreat and protect, whereas anger stimulates someone to approach and oppose [6]. Or, for positive emotions; interest invites a person to explore, whereas contentment urges someone to keep things as they currently are [14]. Designers and design researchers who wish to use this knowledge have to focus on the nuances of different emotional effects, in addition to nuances on the product-side of the interaction. An interesting sub-domain is the effect emotions have on the interaction with the product itself (figure X). If the interaction with the product is an ongoing activity, in which at some point an emotion is evoked, than the effects of that emotion will also change the subsequent product interaction. For instance, if a teakettle evokes surprise in the user, how will the following interaction between the user and the kettle change?
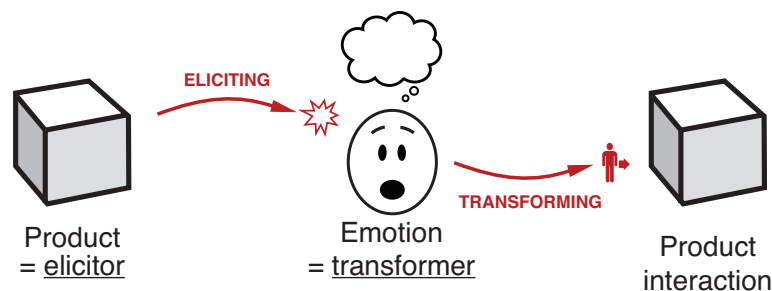

Figure 4 – product as elicitor and emotion as transformer of user-product interaction

3. Implications of using emotion as a means in design

Apart from being able to solve some of the issues that are not addressed by the first two directions, we see several other implications of using emotions as a means to transform people's thought-action tendencies. First of all, it expands the scope of design from providing utilitarian functionality to also providing mental or motivational 'functionality'. Most products that people use in their daily lives have a practical purpose: they help to user to get from A to B; they ease household tasks; they provide physical comfort, and so on. In contrast, products that use emotions as a means can fulfill a new range of functionality: for instance, they can evoke emotions to motivate users (e.g., to exercise), to stimulate users' creativity (e.g. to come up with solutions for a work problem) to help users attend to important information (e.g., while driving a car), and to empower users to be more assertive (e.g., for a job interview), among many other possibilities. Especially powerful will be products that combine both utilitarian and emotional functionality, for instance, an appliance that helps the user to clean the floor *and* that helps the user to get motivated to clean the floor.

A second implication is the increased responsibility that this widened scope brings. The designer needs to be thoroughly informed about both the psychological effects of the emotion and the usage context of the product, through emotion theory and user testing. Without this knowledge, the design can either fail to work or even have adverse effects. For example, in 2010 Mercedes-Benz introduced technology that warned the driver when the system sensed that he or she was too drowsy to drive safely. A coffee cup icon would popup on the dashboard. In some cases, however, this resulted in drivers that would get stressed instead of taking the advice to get some rest, causing even more unsafe driving [15]. The technology works, but the resulting thought-action tendency may not be the intended one. (figure 5). Furthermore, the designer is also responsible for considering *who* is benefitted by the emotional effect. Hopefully, this is most often the user himself, such as in the example of the floor cleaner. But the benefit could also be to society as a whole, as shown by the following example: 'Poor little fish' is a basin for washing hands that draws its water from a tank in which a fish swims and lives (figure 6). If the user wastes too much water, the water level lowers so that the fish does not survive. The (anticipated) pity and shame that this interaction evokes is meant to make people more aware of water wastage, which results in a behavior change that benefits society. The emotional effect is thus not directly beneficial to the user, even though he or she might support its intention. However, it might become more questionable if the implemented emotional effect primarily benefits the company selling the product. For instance, a food product that emotionally motivates its user to consume and thus buy more than desirable, might be ethically problematic.

Figure 5 – Drowsy driver alert system

Figure 6 – Poor little fish

Thirdly, when the effects of emotions are considered, it is no longer sufficient to only think in terms of positive and negative experiences. As each emotion has distinct effect that may even be opposite of the effects of seemingly related emotions (such as interest and contentment), it becomes paramount that designers increase the granularity of their understanding of emotions. To this end, Desmet recently proposed an overview of 25 different positive emotions that can be used in design [16], and the authors of this paper are currently working on a similar overview of a few dozen negative emotions. A future aim is to expand these overviews with all the different emotional effects that are relevant for user-product interactions.

Lastly, if the good or bad feeling that accompanies an emotion is no longer the only purpose of emotional design, this means that the spectrum of emotions that can be used in design widens to also include negative emotions. If a certain negative emotion has the proper intended effect on the user, it will be more appropriate to evoke than any other (positive) emotion. For instance, Fokkinga & Desmet discussed a concept for a wristband that gives its user the sensation of being chased; using the effects of fear as a motivation to keep running [17]. The only additional requirement for the designer is that he or she makes sure this emotion can be experienced by the user as rich, rather than purely negative (see [7]).

4. The transforming effects of different emotions

If a designer wants to make use of the knowledge about different emotion effects, he or she will find a rich source of information in emotion psychology papers that have been published in the last two decade (for a discussion, see [18]). Many of these papers discuss experimental studies that compare the effects of two or more emotions on a specific task or preference. However, because there are many emotions to consider, and because emotions have such a wide-ranging effect on people, a comprehensive overview of all the effects for each emotion does not yet exist. Furthermore, to keep the experiments straightforward, psychologists usually study the effects of emotions through simple tasks or situations that were designed to uncover a single effect for one or two emotions; e.g., the effect of an emotion on an person's ability and speed to solve a simple puzzle (e.g Fredrickson & Branigan (2005) used four images of different patterns made with black squares and triangles in a task that involved respondents making comparisons between patterns, or the effect of two emotions on a person's choice between two holiday destinations [19]). The simplicity of these tasks helps to clearly observe the targeted effect separately from other variables. However, it diminishes the generalizability of the results to real-world situations, and thus the applicability to design for user contexts, in which tasks are rarely simple and the effects of emotions seldom isolated. Thus, studies that influence user emotions before or during a real-world product interaction can show more relevant effects that are insightful for designers.

5. Study: identifying emotional effects on user-product interaction

A study was designed to make a first effort in exploring and understanding the effects of different emotions that are relevant to user-product interactions. This was done for five target emotions: anger, sadness, fear (negative), and amusement and interest (positive). An experimental setup was used in which respondents were individually tested for about an hour. First, the emotional state of the respondent was manipulated using a short movie clip. Five different clips were shown to different participants between-subject; each respondent saw one of the five movie clips. After that, the respondent performed a predefined interaction task. A questionnaire was filled out after the interaction

task. Apart from the post-task questionnaire, data was collected through an unobtrusive video recording of the interaction task from two angles (see figure 7), and photos that were taken of the end-result of the interaction task (see figure 8).

Figure 7 – Image of the respondent in the interaction task from the two camera angles
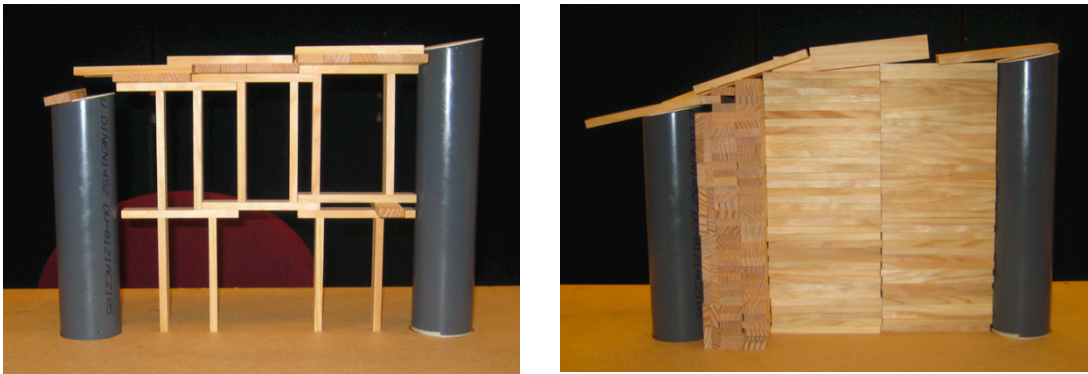

Figure 8 – photos of the end results of the interaction task

5.1 Emotion manipulation

Emotions were manipulated with five movie-clips (maximum of 10 minutes) taken from Hollywood movies: Anger – *Crash (2004)*; Sadness – *The Champ (1979)*; Fear – *The Ring (2002)*; Amusement – *Monster's Inc. (2001)*; Interest – *Planet Earth (2006)*. Movie clips were used because they are a reliable and ethical way to evoke strong and distinct emotions in a short time and a controlled environment, making it easier to collect relevant data [20]. Evidently, in the design approach that was discussed in the section 2.3 'The product is a means for user transformation, in which emotions serve to stimulate this transformation', the emotion is intended to be evoked by the product itself (as represented in figure 3). However, in the study it was decided to elicit the emotion with validated movie clips (see figure 9), so the focus was entirely on the right side of the equation, i.e. the effects of the emotions.
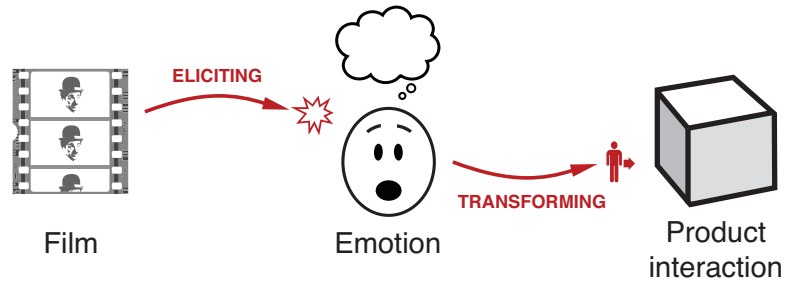
Figure 9 – Movie clip as elicitor and emotion as transformer of user-product interaction

5.2 Interaction task

The user-product interaction was a task in which respondents used rectangular wooden building blocks (Kapla, see[21]) to build a construction that fulfilled a specific goal: transporting a marble from the higher to the lower column (see Figure 10). The respondents could use any number of blocks, and as much time as they need. The task was finished when the marble was placed on the higher column, and it rolled into the bowl of the lower column without additional help.
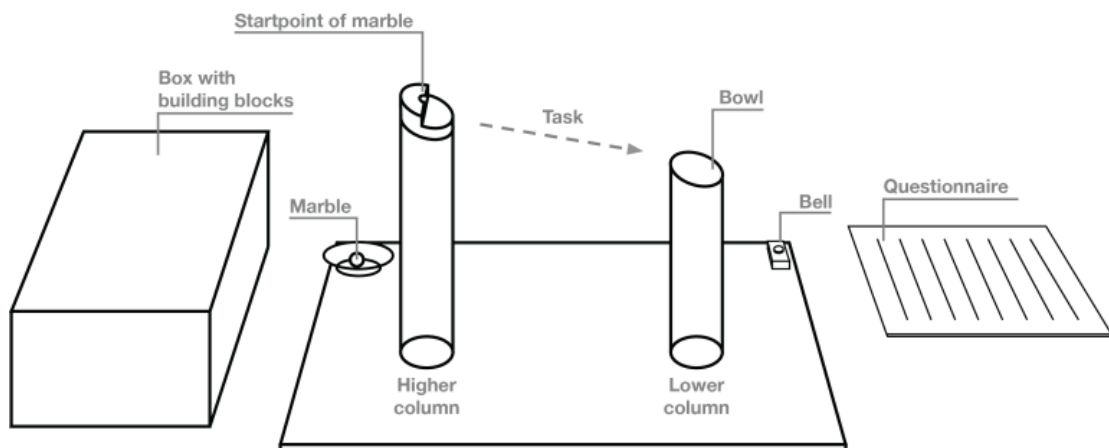

Figure 10 – layout of the interaction task

This interaction task was created on the basis of several criteria. Because of the applicability to product design and the interest in the effects on physical interaction, the task was required to involve the handling of physical objects. In order to observe effects of emotions, the task had to allow (but not require) the manifestation of a wide range of emotional effects, including creativity, playfulness, conformity to instruction and reflectivity. The task was also meant to give a lot of freedom in how the interaction was shaped, meaning no fixed strategy or interaction path was required. At the same time, the activity was meant to be goal-driven, so that the user could create a strategy on how to achieve the goal, and have a clear idea when the goal was achieved. The interaction task was intentionally introduced as an unimportant in-between activity that was only included to fill some time between the movie and the questionnaire. Did was done to lower the awareness of the fact that the emotion evoked in the movie had some effect on how the task was done – since this awareness itself might have a large effect.

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5.3 Post-task questionnaire

The post-task questionnaire consisted of three parts. The first part assessed the emotions experienced during the video clip. Following the procedure of Hewig and colleagues [22], 21 emotions were measured with 10-point scales ranging between "not at all" (1) and "a great deal" (10): Amusement, anger, anxiety, calm, confusion, contempt, contentment, disgust, embarrassment, excitement, fear, guilt, happiness, interest, joy, love, pride, sadness, shame, surprise, and relaxed. In additional questions respondents were asked to describe in their own words the strongest emotion they felt during the video, the intensity of that emotion, and how strongly they still experienced that emotion (while filling in the questionnaire). There were also asked which moment in the clip stood out for them and whether they had seen the movie before. The second part included questions about the interaction task: to what extend respondents had enjoyed the task and how confident and satisfied they were with their (creative) performance and result. Next, one of five sentences had to be selected that best reflected their approach to the task; whether they immediately started building instinctively or first imagined the whole construction in their mind before starting. Next, respondents were asked to estimate how much time they had used for the intermediate task, and if they estimated to have finished the task slower or faster than other respondents. In the third part, respondents were invited to note comments about the intermediate task and about the study. They were also asked if they had an idea what the aim of this study was. Finally, some questions about demographics were asked.

5.4 Procedure

One moderator ran the experiment session. This moderator welcomed the participant, provided the necessary instructions and was available for questions. Apart from the introduction and the finishing part, the respondent was alone in the experiment room with the moderator in the control room behind the camera controls. When respondents had questions or when they were finished, they could alert the moderator by pushing a button. After the session, respondents were asked not to discuss the content of the experiment with other (potential) participants, to ensure that future respondents were not aware of what was going to happen.

5.5 Respondents

In total 90 respondents (43 women) participated. The sample's mean age was 23.5 years (min. 18 yrs, max. 38 yrs; SD = 3.2 yrs). The participants were students of the faculty of Industrial Design Engineering at Delft University of Technology. They received a gift coupon for their participation. Each respondent was shown one of the five movies. The data of 16 participants was ruled out for several reasons. Eight respondents did not complete the procedure; another eight respondents did not experience the target emotion (Crash: 2; Ring: 3; Pixar: 2; Earth: 1). The number of respondents of which the data was included in the analysis per movie was as follows: Anger (Crash) N = 11; Fear (The Ring) N = 11; Sadness (Champ) N = 12; Interest (Planet Earth) N = 19; Amusement (Monsters, Inc.) N = 21.

5.6 Measurement

Data was collected in several ways. The questionnaire measured the self-reported emotions and experiences of the respondents during the movie and the building task. The results of the building tasks were photographed (for qualitative analysis) and weighed (for quantitative analysis). During the

building task, the respondents were filmed by the moderator, who also kept a digital count of the blocks as they were put down, which was automatically time-stamped by a computer program.

5.7 The five target emotions and their effects

The five emotions in the study, anger, sadness, fear, amusement, and interest, were selected because they were expected to have distinct effects on user-product interaction, extrapolating from the effects that have been uncovered by psychologists. Table 1 shows for each emotion the effects that have been found in literature and the corresponding hypothesized effects for the current study.

Emotion	Psychological effect	Hypothesized manifestation in interaction task	Emotion	Psychological effect	Hypothesized manifestation in interaction task
Negative emotion	Tendency to focus attention [23]	More goal-oriented building style	Fear	Tendency to avoid risks [18]	More conservative structures / building style
			Anger	Tendency to take risks [18] Preference for activity [19]	More idiosyncratic structures / building style
			Sadness	Tendency to reflect [24] Preference for passivity [19]	More planned structures / building style
Positive emotion	Tendency to broaden attention [23]	More experimental / decorative building style	Interest	Tendency to explore [[23]]	More experimental structures / building style
			Amusement	Tendency to play	More playful structures / building style

Table 1 – the effects of the five emotions and their hypothesized manifestation in the interaction task

6. Results

6.1 Manipulation check

Table 2 shows the emotions that were reported to be experienced most strongly for each movie clip. Only emotions that are rated significantly higher than the scale midpoint (= 5.5; $p < .05$; one-sample t-test) are mentioned.

Movie clip	Target emotion	Experienced emotions (10-point scale)
Crash	Anger	Disgust (7.9), Anger (7.2)
The Ring	Fear	Fear (8.1), Anxiety (7.6)
Champ	Sadness	Sadness (8.4)
Planet Earth	Interest	Interest (8.4), Relaxed (7.8), Calm (7.7), Happiness (7.4), Amusement (7.3), Joy (6.7)
Monsters	Amusement	Amusement (8.2), Joy (8.2), Happiness (7.9), Interest (7.7), Relaxed (6.9)

Table 2; manipulation check.

The mean ratings indicate that the movie clips that intend to evoke negative emotions are differentiated and evoke the target emotions. "The Ring" evokes the target emotion Fear (and also Anxiety); "Champ" evokes the target emotion Sadness. "Crash" evokes the target emotion Anger (and Disgust). The emotions evoked by the positive movie clips are a bit more diffuse, but also these evoke the target emotions: Amusement for "Monsters, Inc." and Interest for "Planet Earth".

6.2 Quantitative data

Although an ANOVA did not find significant differences between the numbers of blocks used in the different conditions, it did find a low but significant positive correlation between the emotion anger and the number of blocks used (.20; $p < .05$). Significant correlations were also found between self-reflective questions and experienced emotions. For example, respondents who experienced higher levels of amusement believed they took more time than those who experienced lower levels of amusement (correlation is -.27, $p < .05$). Likewise respondents who experienced higher levels of sadness believed they took less time than those who experienced higher levels of sadness (correlation is .20, $p < .05$). For the question 'are you satisfied with your solution' a significant correlation was found with fear: the more fear respondents had experienced, the more satisfied they were with their result (correlation is .22, $p < .05$).

7. Discussion

In this study we found some correlations between the emotional state of the participants and their interaction behaviour and their perception of this interaction. Note that the found correlations were low. Nonetheless, they do show differentiation between emotions: different emotions have different effects on the participants' interaction behaviour and perception. This supports our claim that rather than an endpoint, emotion can also be a means for transforming users through thought-action patters. Although inconclusive, this indicates that it is worthwhile to further investigate the relationship between distinct emotions and user-product interactions. These further investigations can shed light on what particular effects are associated with what particular emotions and support or refute the hypothesized effects in table 1. This first study did not provide us yet with much insight on these effects because we can only speculate on what caused the found effects. Angry people appear to have used more blocks than people who were in other emotional states. Are angry people perhaps more rough in their interactions than those who are not, which requires a more sturdy construction and thus more blocks? Why did respondents who experienced enjoyment have the feeling that they took more time? It would be more logical that they would have had the feeling that they took less time because 'time flies' when you are enjoying yourself. These questions, which cannot be answered with the current data, are aimed to be explored in a new study. For the design of such studies, some limitations of the current study need to be addressed. An important issue to be solved is the emotion manipulation procedure. In the current study, the emotion was manipulated with movie clips. Although this is an efficient and reliable approach, the actual interaction task may also have an emotional impact itself, which then interferes with the intended emotion. For example, the task may evoke fascination or boredom, or perhaps relief or enjoyment. Emotions can change quickly, so we cannot be sure that even though someone was angry directly after the emotion manipulation, this person was still angry while doing the interaction task. One way to solve that challenge is to merge the emotional manipulation with the interaction task so that the task itself elicits the intended emotion. That way, not only will the interaction task seize to produce any 'noise emotions', the emotion elicitation will also be much closer in time to the measured user actions in the task.

Another challenge is dealing with interpersonal differences: people differ in how they approach the task, and these interpersonal differences dilute the emotion-effects. Possible ways to address this is to give less freedom in the interaction task (so fewer variables are tested) and to have a larger sample, so that interpersonal variables will cancel each other out.

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