Towards the Evaluation of Emotional Interfaces

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Abstract. The emotional design approach has become increasingly preponderant for the design teams. However, we observed that most of the efforts of the designers to elicit positive emotions are based on empirical and subjective approaches. This paper shares the state of our current research towards the proposal of heuristics for emotional and empathic interfaces. We focus on the actual design practices, and discuss methodologies to assess the emotions elicited by these design strategies.

Keywords: User experience design · Emotional design · Empathic design · Ergonomics

1 Introduction

1.1 From Usability to Emotional Design

During numerous years, ergonomic recommendations or « golden rules » [1, 2] have been put forwards, tending to focus on users' cognitive and perceptual-motor abilities. Ergonomists and designers have seeked for an ever-reduced cognitive load required by tasks and interactions. Thus, human-computer interaction is traditionally conceived and assessed through the restrictive scope of usability rather than based on what users feel when interacting with a system [3, 4].

Although this approach has led to an overall improvement of the interfaces ease-of-use, it is now being overstepped by design teams, as well as researchers. The « feeling » level has become a popular research topic in cognitive science and the science of design. New systems must also inject a little fun and pleasure into people's lives [1]. Thus, in addition to their functional characteristics, interactive systems must be regarded as conveying feelings through interfaces' design features. Pleasurable products would likely suggest security, confidence, pride, excitement and satisfaction, whereas displeasurable products would carry annoyance, anxiety, contempt and frustration [5].

Thus, the question of the feelings of users – preferentially associated to positive emotions - has become crucial for the interface project stakeholders.

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1.2 The Emotional Design, and the Designers

According to various design publications, many designers now seem to be aware of the emotional design issue. Friedman [6] manages a collection of web design books targeting an audience of designers. He underlines to his readers the crucial importance of an emotional approach towards design: "A strong, reliable emotional relationship between your clients and their audience could be the best thing that ever happens to your career." [6], this statement being supported by the various assets of an end-user positive emotion. Thus, in Friedman's books collections, and in several others, one may find a selection of websites, good examples of a 'surprising' or a 'delightful' experience. These publications are very representative of our question: Designers are today aware of the importance of emotional design; however, shared empiric solutions and case studies appear to be the only available resources to guide their works beyond the trial and error approach. It seems that the interface design stakeholders miss strong methodological tools and references to base their works on.

Ergonomic psychology could probably assist the designers in their tasks, helping them to define the emotions to elicit, and to target more accurately the design strategies leading to positive emotions. Designers would not be the only beneficiaries; also ergonomists in charge of interface assessments towards effective end-users needs, would identify more easily emotional design assets and improvements.

1.3 How to Design an Interface Emotionally? A State of Our Current Research

In this paper, we share the state of our current research towards the proposal of heuristics for empathic interfaces, targeting both designers and ergonomists communities.

As a first step of our research, we reviewed and pointed out several actual empirical practices and strategies used by interface designers to elicit a positive emotion.

As a second step, we present a methodological approach grounded into cognitive psychology, to assess those emotional design strategies. In addition, an emotional design process representation is proposed, in order to extract the design factors from the others that compose the global emotional experience of the user.

We conclude by introducing a potential third step, an alternative setup to assess emotional design interfaces in a more ecological environment.

2 Emotional Design and Interfaces: A Review of the Field Practice

2.1 Focus Group with Designers: From Emotions to Empathy

In order to establish a set of heuristics proposals, a first step in our research consists of identifying emotional design strategies by studying the nature of the actual empirical approaches used by designers. As a preliminary stage, a focus group was set up with three designers of complementary profiles, whose experience varied from four to

eleven years: a user experience manager, a mobile product designer, and a user interface designer. The discussion was set up on an opened basis, framed by this initial question: "We are interested by the ways to elicit an emotion to the end-user through an interface. You may know or already use some specific strategies in order to elicit positive emotion. What would be those strategies?" Many aspects were evoked by the designers, presented here as a thematic synthesis.[1]

Primordial usability. Ergonomic requirements, such as Bastien's and Scapin's [3] lead to consistency, intuitiveness, and ease of learn. Those qualities participate to the feel of trust towards the application, and by extension, towards the brand or the under-lying product or service. Usability is also connected to the notion of 'robustness', understood as the actual effectiveness and efficiency, completed by the notion of 'perceived robustness', which addresses more graphic design strategies.

These usability requirements are crucial for the designers. Usability is not a strategy in itself; it is considered as a fundamental solid foundation without which emotional design cannot be built.

Error handling, and dialog. Beyond the notion of 'robustness' already evoked, the error message was considered as a good opportunity to engage a dialog with the user. Thus, it is an occasion to elicit an emotion. As one of the designers said: "We try to explain what happened in human terms. We suggest a way to solve the problem. If it is really not possible, then we apologize." This point underlines an important pattern: the designers try to get as close as possible to a natural human-to-human (friendly) relationship, rather than a usual disembodied human-to-computer interaction.

Identity. "The keyword is 'personalization' […]. We create a relationship because people do not totally trust machines yet." In order to build a relationship similar to human behaviors, the user should be considered by the interface as a real identified person, rather than an impersonal iterated entity. Several ways are evoked by the designers: customized messages with the user's name, taking into account user's behaviors or geographic localization… Used in a proper way, these strategies may improve trust towards the application.

Identity does not only refer to the user, it also refers to the application. A strong and clear identity should also belong to the interface. The underlying design intention is to make the interface more human and less abstract: "They [the interface designers] talk to you [the interface user] as a human being. They talk to you nicely, normally, with their guts."

Targeted side content. Following the idea of a humanized interface, some content may be relevant, although they look surprising at first. The example of Balsamiq was evoked by the designers: Balsamiq is an application whose purpose is to design websites wireframes. In the help menu, you can find a link towards a cooking idea and its video recipe "What should I make for dinner?" [8]. This feature looks incongruous

[1] Detailed results are available in [4].

in a professional software. Beyond the first surprise, the intention of the software is to understand, sympathize with the user. The video recipe is accompanied with this little explanation: "We know how it is. It's 5 pm, and you've just had a glorious day of work, creating awesome wireframes for your next project. You are giddy with excitement, and cannot wait to see your designs in the hands of your sure-to-fall-in-love-with-it-immediately users. And then it hits you: crap, what should I make for dinner tonight? […]."

Another more discreet example evoked by the designers is the little mention in the footer of each page of Vimeo [9]: "Made with ♥ in NYC." With this simple little sentence, Vimeo's designers become tangible humans, who feel love and passion towards their work, and who therefore hold high esteem to the end-users. As a consequence, the end-users return trust and sympathy towards the application.

Targeted audience. These last statements evoked by the interviewed designers share a common background: In order to apply a strong identity and tone to an application, the audience should be carefully defined and targeted. The designers explain that the most emotional the interface is, the most characterized the audience must be: "the most important stage is to understand who we are talking to, and to identify the right leverages, specific to that audience."

Gamification. Designers also mentioned game patterns as a way to engage the users more. Gamification is widely documented, so we chose not to develop it in this paper.

Conclusion: hedonomics and empathy. This focus group emphasized several emotional design patterns. Beyond the fundamental usability requirement, the notion of 'interface as a human' seems to emerge in order to elicit positive emotions. The more the user perceives the empathy of the [author/designer/interface], the more his/her use experience would be delightful. According to this hypothesis, several successive thresholds could be defined as we progress towards a positive emotion of the end-user:

1. The application is useful and effective.
2. The application's efficiency is optimal.
3. The communication strategy and the content are coherent and relevant towards the individual.
4. The end-user is aware of the existence of an author/designer: "These people made this for me."
5. The end-user is aware of the empathy of an author/designer: "These people understand me very well, they think about me, and want to please me."

We formulated these thresholds as a derivation from the works of Hancock, Pepe and Murphy [5] who proposed a 'hedonomic' pyramid, derived itself from Maslow's pyramid. We note that the highest the level of conception is, the more the underlying design strategies need to be targeted towards a specific audience. Most of the users may consider an application useful, but only some of them may perceive and respond to the author's empathy. Thus, emotional design strategies would only be applicable since the third level of this pyramid.

2.2 Designers' Returns of Experience: The Emotional Design Books

With the rising importance of the emotional approach in interface design, many technical publications, written by designers for designers, have appeared during these last years [7, 10–12]. These publications are mainly structured onto case reviews, with several commented examples. Therefore, this documentation constitutes a large resource in order to draw an overview of the actual design practices for emotional design. These publications gather many different approaches, which do not always refer strictly to positive emotion elicitation. Thus, persuasive design approaches were dismissed. Gamification would likely drive positive emotions as well, but was dismissed too, as it belongs to a different set of strategies.

Application personality. The notion of personality was evoked by several authors [10–12]. These authors note that users may behave and interact with an application or a product as if it was a real human being, even if those users are conscious that it is indeed an inanimate object [6, 13].

The design persona is a design technique whose goal is to define a consistent identity and personality to the application. If the application was a character, who would it be? How would it speak? What would be its values, and its way of mind? This technic provides a guideline to build an application identity, for a more humanized human-computer relationship [12]. Thus, building up an application personality compatible with the users' expectations would constitute a strong leverage on the user experience improvement; the user-interface relationship would be brought closer to a friendly relationship [14].

Çakmakli [14] thus proposes to get inspired by the traits characterizing a friend in order to design an emotional interface. She identifies a set of seven traits from a parallel with social psychology research on mate selection, which may be translated into design features:

- Attractiveness (sexy, cute, beautiful, graceful);
- Social status (lifestyle, social class, value system);
- Intelligence (smart, adaptive, intuitive, functions well);
- Trustworthiness (loyal, safe, trusting);
- Empathy (understanding, adaptive, communicative);
- Ambitious (innovative, forward thinking, aspiring, motivated);
- Exciting (good sense of humor, positively surprising, creative).

Çakmakli's categories [14] establish an interesting synthesis, as most of the strategies elicited by the designers in their publications may fit one of these traits. It also seems possible to bring some of these traits closer to the three emotional levels of Norman [15]: visceral, behavioral, or reflective.

2.3 Emotional Design Approach Mapping Diagram

The various sources that we compiled, based on a focus group and a design literature revue, led us to a mapping of the designers' strategies to the intended product design

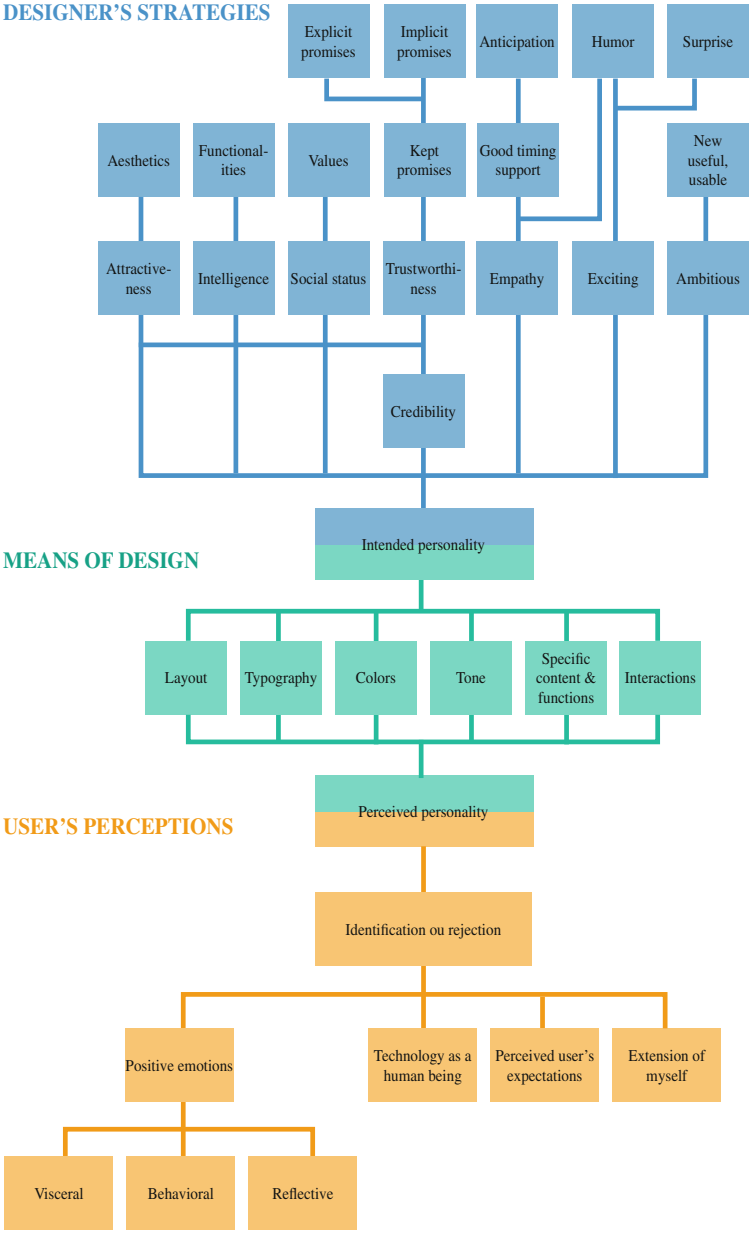

Fig. 1. Emotional Design Approach Mapping

personality. We therefore propose a diagram of our current understanding of the designers approach (see Fig. 1). The diagram is divided into three categories, which should be read from the top.

Designers' strategies. This group represents the emotional intention that the designers expect to build up. Çakmakli's product design personality traits are located at the core of this section. The items placed before stand for the technics handled by the designers in order to give rise to these product personality traits.

Means of design. This second section represents the actual materialization of the design. In a way, this is the "tip of the iceberg", the interface design features which could be analyzed through an ergonomic expert approach.

User perception. This third section corresponds to the impact of the design strategy onto the end-user. As we noticed earlier, emotional strategies are not universal, and the positive emotions may only be elicited if the end-user is receptive to the design personality of the interface.

This mapping diagram therefore allows us to identify how a designer could attribute a personality trait to his/her interface design. For instance, the empathy, whose importance was underlined earlier, could be generated by working both on humor and an assistance with good timing. This latter strategy requires to anticipate users' difficulties.

Having a better view of designers' strategies, although this work is still in progress, we wanted to evaluate the actual impact, the actual 'emotional efficiency' of those strategies.

3 How to Assess Emotional Interface Design Strategies? An Experimental Approach

In order to assess the actual impact of an emotional design strategy, a first requirement is to determine how to measure emotion.

3.1 What Are Emotions?

From a psychological perspective, many different models co-exist, and no consensus was reached. However, some trends can be drawn.

Defining emotions. Several terms appear in the literature, such as emotion, affect, mood, but the meaning of those words may vary among researchers. In this paper, we will subscribe to Scherer's definition: an affective state whose cause is identifiable, and which does not last very long [16].

The role of emotions. Emotion plays an import role in human's adaptation to his/her environment. Emotion can be understood as a cognitive process, involving a key-step of *appraisal*. Emotions is engaged in the evaluation of a stimulus, environmental or internal, in order to potentially prepare the body to an appropriate behavior.

In the context of design, according to a model proposed by Desmet [17], emotion is a result of an appraisal process based on individual factors and product features. Desmet also specifies that the product may drive thoughts, which become the effective source(s) of emotions. This can be related to Norman [15] who distinguishes three

emotional levels of product interaction: a first "visceral" level standing for immediate and instinctive emotion, and two other levels connected to the perception of the interaction ("behavioral"), or to a more socio/intellectual assessment (the "reflective" level).

Characterizing emotions. Two main streams have emerged in order to characterize the different emotions: a dimensional perspective and a discrete perspective.

This latter discrete perspective considers emotions as a sum of categories, which can possibly be intersected or intensity-faded to get finer sub-categories. For instance, Plutchick [18] considers eight primary emotions (joy/sadness, trust/disgust, fear/anger, surprise/anticipation). These discrete models are quite popular, especially in the design field, because they are easily linkable to the 'folk psychology': most common vocabulary terms standing for different emotions are localized into discrete model schemes, making them easy to handle.

However, certain drawbacks were pinned on these discrete models. Emotions may be difficult to categorize [17]. A term-based categorization would imply to share a same cultural and language background. It would also imply to skip any inter-individual variation in the interpretation of the meanings of the terms. By definition, a discrete model limits the potential number of emotions, inducing biases. Therefore, other models co-exist, based on a dimensional perspective. Two dimensions emerge from most of the dimensional models: valence and arousal [19, 20]. Valence is a pleasure/displeasure scale, whereas activation corresponds to sleepiness/excitation. These scales define a circumplex space where it is possible to locate any 'folk-psychology' emotional term.

3.2 How to Measure Design-Driven Emotions During an Interface Use Experience?

The experience of interface use is quite specific: a long lasting experience during which emotions may change, and whose intensities may remain quite low. Therefore, a set of recording technics should be chosen accordingly. Moreover, having recorded the users' emotions would provide indicators of the overall emotional state of the users, whereas the impact of the emotional design may only partially contributes to this overall experience. Thus, two questions have to be addressed:

- Which set of recording technics should be chosen?
- How to extract the design-component from the other components constituting the emotional use experience?

Selecting assessment methods. Measuring emotions requires to associate emotional states with cognitive or physical changes. These changes may be readable through three components: physiological, behavioral and cognitive [21]. We therefore set up an experiment in order to assess a choice of specific emotional assessment methods [22].

Among the numerous available physiological methods, we turned towards electrodermal activity (EDA). This approach is based on the influence of activation on skin sweating. Electrodes are placed on two fingers of the participant to monitor these changes. EDA provides a constant monitoring during the use experience, and may therefore allow a mapping of the emotional state to the interface stimuli throughout the

experience. The user cannot orientate the recording results, and some unconscious emotions may be detected. Our results confirmed that EDA is limited to the "activation" dimension of emotion. Therefore, it should only be used when the user actually interacts with the interface, whereas 'passive' reading and picture-viewing tasks would not lead to any readable data.

For the behavioral component, we turned towards the observation of changes on the user's face. This method is based on the facial action coding system (FACS) [23]. Noldus' Facereader [24] was developed in order to automate such analyses. Our results showed that a web interface does not provide enough emotional intensity to change users' face patterns. Therefore, finer technics, such as micro-electromyography (μEMG) would rather constitute better options.

The third cognitive component was set up through questionnaires. The principle is to record the user's subjective perception. Questionnaires being one-off, they do not allow a continuous monitoring, as we discarded any experience interruption. Two questionnaires were tested. The first one is the Geneva emotion wheel (GEW), which was developed following Scherer's emotional model [16]. A set of twenty emotion labels are arranged in a circle. Each label can be rated according to its intensity using a five points scale, from the center of the circle to its periphery. A free response area is also provided and the user may also indicate that no emotion was felt. A drawback of label-based questionnaires lies in the interpretation of the label meaning. Therefore, the second questionnaire we used is the self-assessment manikin (SAM) [25]. This questionnaire is composed of three scales, matching the three dimensions of the "valence arousal dominance" system. These scales make use of a pictures-based representation of emotional values, thus bypassing the terms-understanding issue. Our results showed that both scales were relevant for the assessment of short episodes. The SAM was notably easier to handle by the participants, although the third "dominance" scale was more difficult to understand.

Extracting the design-component from the emotional use experience. As evoked earlier, users' emotions are dependent on individual factors such as past experiences, culture, interests towards the task… User Interface design, from which designers are in charge, only constitutes one of the many variables influencing the overall emotional experience. We propose a diagram in order to represent the interactions between the components constituting the overall user emotion (Fig. 2).

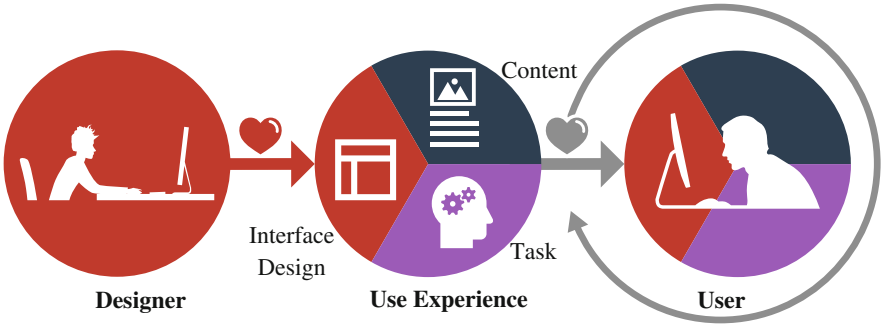

Fig. 2. Emotional design process

Two main components lead to the recorded overall emotion: the use experience (external stimulus), and the individual characteristics (internal stimulus, such as interests, expectations, past experiences). This scheme therefore matches Desmet's model [17]. However, Desmet's product component had to be enriched for the specific context of an interface use. We therefore identified three sub-components:

- The content stands for the textual and pictorial items communicated to the user. Those items are typically produced by redactors, who are distinct from the designers.
- The interface design stands for the layout and the presentation strategy of information and interaction. It directly refers to the means of design in the emotional design approach diagram (Fig. 1). Information design and interaction design may be distinguished as two sub-categories of the interface design.
- The task stands for the purpose actions supported by the interface (read, write, compare, organize, conceive…) Performing these tasks may affect the user's emotions.

One other component should also be taken into consideration:

- The specificities of the user at the moment of the interaction (internal stimulus), which include a variety of combined factors leading to the user's individuality (cultural profile, previous experiences, expertise, personality traits, mood, interests…). Some of these features being continuously affected by the use experience, the global processes should therefore be considered as continuous iterations.

Designers' emotional strategies only affect the interface design sub-component. To evaluate the emotional impact of a design strategy, its emotional value should be extracted from the overall emotional experience. An experiment was conducted to address this issue [26]. Two interfaces were provided to a set of users. These interfaces were designed for this experimental purpose and differed by a variety of design assets (layout proportions, colors, animations of the interactions and transitions…). The efficiency of both interfaces was similar, as well as the nature of the tasks: an article about a movie, spread upon four pages, with one title, one text, and one image per page.

The goal of the experiment was to measure the relative emotional impact difference between the two design strategies underlying these interfaces. Each participant used the two interfaces with a counter-balancing order to dismiss the individual specificities component. The two tasks being similar, it was also possible to dismiss the task component. The content component was assessed by isolating each content item, and by presenting them to the users during a previous phase. It was therefore possible to evaluate the emotional value of each content item, and to evaluate the global emotional values of the contents alone.[2] By substracting the contents value from the overall experience, we were therefore able to identify the relative emotional impact of the two different design options (see Fig. 3).

[2] Another experiment was conducted in order to appreciate more accurately the global emotional value of a web page contents according to the emotional value of each isolated piece of content. Results showed that low-valence content had more impact than neutral or high-valence content. The global emotional evaluation of a page content should therefore be balanced accordingly [4].

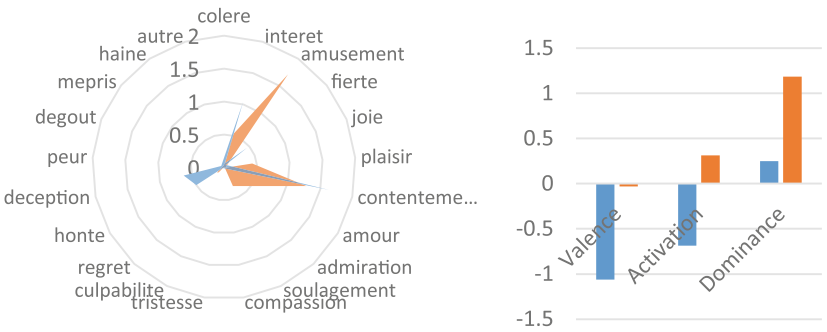

Fig. 3. Extract of the relative emotional impact of the interface design component for the two questionnaires GEW (left) and SAM (right), for design A (blue) and B (orange).

4 Conclusion from Experimental to Ecological Setup

The experimental setup presented in the previous section makes the evaluation of interface emotional design strategies possible. However, some of the designers' strategies are targeting longer terms behaviors. For instance, emotional design strategies intended to accompany a discovery phase may be different from the strategies maintaining the attractiveness on the longer run. Another experiment is therefore currently being performed to assess the efficiency of those longer term emotional strategies: a full scale website is deployed, with different variations matching the design strategies to be tested. Participants can use the application freely during two weeks. A set of indicators are logged by the program in order to track any evolutions in the used functions, which could be interpreted as a motivation shift, an expertise gain, or any behavioral pattern.

This establishes the current position of our research, and we hope this work will contribute to a better assessment of emotional interface design strategies, a required step towards the constitution of emotional design heuristics.

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