

Principles for User Experience Design

Adapting the TIPS Approach for the Synthesis of Experiences

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Abstract: The idea of User Experience (UX) is to achieve a positive emotional reaction of users on a product interaction and thereby to create a unique selling proposition. Unfortunately, people's needs, perception and resulting emotions are subjective and thereby very diverse. Furthermore, UX is highly dependent on the physical and social context. We developed the User Experience Interaction Model (UXIM) which consists of UX-relevant elements from the disciplines industrial design, human factors and psychology to handle this complexity. Based on UXIM, we propose concrete principles derived from examples of successful experiences to support UX design. These were taken from real product reviews found in magazines and internet (e.g. Amazon). Thereby, we bridge the gap between abstract UX theory and concrete principles with practical examples.

Key words: *User Experience, Emotional Design, Human Machine Interaction*

1. Introduction

1.1 User Experience

Beyond usability, which has been a point of interest in science and industry for several years, the quite young approach of User Experience (UX) extends the view on user product interaction by emotional aspects. The motivation of UX is to develop positive experiences instead of avoiding bad ones by usability considerations. Therefore, products have to meet psychological needs and motives of the user. By triggering the user's emotions and thereby create a brand loyalty, UX can help differing products in saturated markets.



Figure 1. Bottle closures designed for Usability (left), User Experience (right) and as a compromise (center)

UX is understood in many different ways by several disciplines. The definitions and approaches range from a psychological to a business perspective [1]. The challenge is to bring these views and strengths together and to enable multidisciplinary development teams to effectively work together on UX. Mostly, psychological experts and competencies are missing in product development teams. This deficit needs to be considered when creating an approach to support designers developing or designing for UX.

1.2 Problem situation

The scientific state of the art offers a lot of theoretical descriptions of UX as well as methods for measuring it. This analytical view is widely covered, even though on a rather abstract level. However, there is a deficit of concrete tools and methods supporting the synthesis of UX. Approaches like the «psychological needs-driven experience design approach» [2] or Kansei Engineering [3] aim at creating an emotional impact on users. Both approaches require dealing with user needs and influence the early stage of product development.

In order to create a more pragmatic tool which is applicable throughout the whole development process, we surveyed real experiences of users in written or video-based reviews. We observed that the variety of described emotional reactions is very high – we found many different mechanisms for creating an experience. Some of these mechanisms could be described by the mentioned needs-driven approaches – others were «just» the result of pleasant product details without fulfilling user needs.

1.3 Goal

We want to achieve two goals: supporting the analysis as well as the synthesis of experiences. In the first step, we provide a descriptive model to developers helping them to **analyze** and understand occurring experiences. Based on a UX model which already combines several approaches (chapter 2.1) we integrate more aspects from relevant disciplines – our result is the User Experience Interaction Model (chapter 2.2). It serves as a basis for the following approach to support UX design.

In the next step, we adapt the TIPS (Theory of Inventive Problem Solving) approach by Altshuller [4] (chapter 3.1) to support developers with the **synthesis** of UX: We analyze experiences from real reviews (chapter 3.2) and derive UX principles (chapter 3.3). These principles and the examples are allocated to corresponding elements in UXIM to inspire situation-related solutions (chapter 3.4).

Students applied the gathered principles in their theses with the goal to create a positive experience in different scenarios in order to evaluate the approach. We show one example clarifying the application in chapter 4. The first results show that concrete examples from product reviews ease the generation of innovative ideas with better UX, even without the theoretical background.

2. Analysis of Experiences

2.1 State of the Art

We take the Customer Experience Interaction Model (CEIM) [5] as a basis for our model, shown in figure 2. It provides a holistic view on the interaction of users with products. Therefore, CEIM incorporates different relevant models and views from the disciplines of engineering, ergonomics, industrial design and psychology. It supports the communication of developers by creating a shared understanding and a common terminology [5].

CEIM is based on the block diagram of **human machine system** by Schmidtke [6]. It focuses the human machine interaction with relevant ports in between (sensory organs, muscular system and user interface). This interaction takes place in a disturbing environment stressing the user. This model represents a classic ergonomics perspective with the goal to improve the working task fulfillment by adapting the machine, its interface and the environment impact to the user's capacity. As the UX view requires a stronger consideration of the human perception and processing, CEIM details the user element by adding triggered **emotions** and user **motives**.

Furthermore, CEIM enlarges the functional understanding of products by **indication**, **aesthetic** and **symbolic** aspects according to Steffen [7]. UX is more than just fulfilling tasks in a most efficient manner. The emotional value and experience by using an expensive sports car can be the result not only of great driving properties (practical function) but also of the pleasant exterior and interior design considering shape and materials (aesthetic function) as well as the prestige through product and brand (symbolic function). Another UX-relevant consideration is involved in the element **behavior** according to Rasmussen [8]: UX highly depends on the user's level of training. The experience of driving a car for the first time is very intensive and completely different from the driving experience of an expert driver. Both users need to be considered in the UX design perspective.

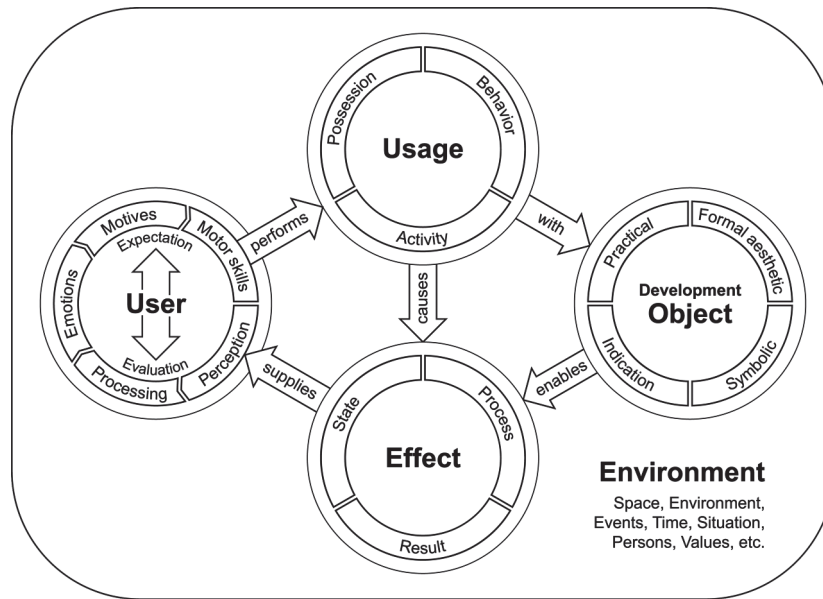


Figure 2. Customer Experience Interaction Model [5]

We evaluated CEIM in several running industrial and student projects with the task of supporting UX design. Some UX aspects are missing. We could derive several opportunities for improvement of CEIM:

- A descriptive model needs to cover the **temporal** aspect of UX beyond the actual interaction: People would have had some experience before their first encounter through expectations formed from existing experience of related technologies, brand, advertisements, or others' opinions. Similarly, indirect experience extends after usage through reflection on previous usage, or through changes in people's appraisals of use [1].
- The inner representation of the used product, called **mental model**, has a strong impact on UX. Users derive a mental model from their observation of the product [9]. Unfortunately, this inner model need not necessarily be appropriate to what leads to confusion and frustration – a bad experience. The mental model is created before the interaction (expectation) and needs to be adapted during or after usage in case it is not adequate.
- UX focuses at triggering positive user's emotions [2]. We noticed that these **emotions** need to be considered stronger than in CEIM. A differentiation between rational and emotional perception before, during and after the interaction would offer a new perspective on the human perception and judgment of products.
- CEIM illustrates many relevant aspects of UX, but we could hardly argue, where exactly «User Experience» arises. The model gathers many different perspectives but is difficult to explain to people without any previous knowledge. Furthermore, the illustration is text-based apart from the arrows and elements. In particular, as in cooperation with designers, a model should be more figurative and thereby intuitively understandable.

2.2 User Experience Interaction Model

We enriched CEIM with these insights to the User Experience Interaction Model (UXIM), shown in Figure 3. It consists of three UX-relevant parts: the **interaction** of user and product (considering rational and emotional processing), the **temporal** perspective on the experience (expectation before usage and remembrance after usage) and the surrounding **environment** (including social influences and service systems). Additionally, we include the **mental model**, as the user's inner representation of a product strongly influences UX.

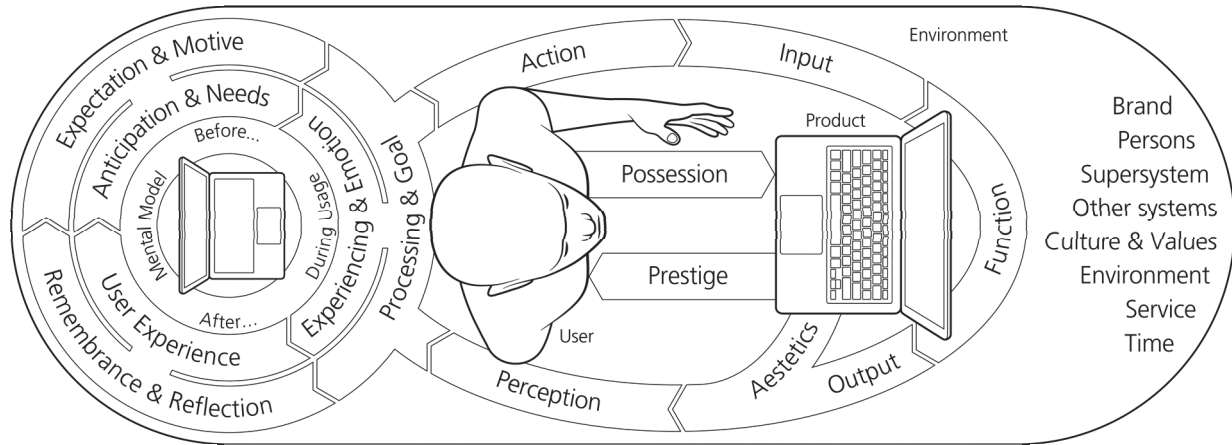


Figure 3. User Experience Interaction Model

The illustrated user interacting with the product (represented by a laptop) takes the center stage. User and product are linked via a classic ergonomics cycle according to Schmidtke's ports [6]: the user performs an action with the product using its input devices. The product carries out a function and returns the result via the output device. This is perceived and processed (interpreted) by the user leading to new actions. We included the enlarged function perspective of Steffen [7] by adding the arrows «Aesthetics» and «Prestige» between user and product.

As UX is a subjective emotional reaction within the user, we get more into detail regarding the processing element: On the one hand, we distinguish between three time spans, represented by the cycle on the left side – before, during and after usage, according to Roto et al. [1]. On the other hand, we divide the processing element into a rational-driven cycle (the external ring) and an emotional-driven (the internal one):

Before the usage a user expects a certain result based on motives (cp. Activity Theory [10]). Emotionally, he anticipates an experience based on needs. **During** usage the user processes his perception and plans further actions based on goals. With an emotional view he experiences (cp. [1]) the interaction causing emotions. **After** usage the user remembers and reflects the interaction leading to a new expectation of further usages. The emotional retrospective view on the usage is the UX itself. This retrospective validation changes over time (cp. [11]).

We included a representation of a **Mental Model** in the center of the processing cycle. The user creates his initial inner model by expecting its system behavior and by anticipating its outcome. During usage it serves as a manual to the user and influences his goals and planning (cp. [12]). An adequate Mental Model can strengthen the experience, a wrong one can lead to confusion and frustration. After usage the Mental Model is adjusted by the user unconsciously based on the reflection and remembered experience.

The whole interaction over the different time spans is highly influenced by the surrounding **environment**. It does not only impact in a disturbing way but can also be an important factor for a positive experience. For example, uninvolved people observing a sports car driver would allow the prestige experience of feeling popular.

3. Synthesis of Experiences

3.1 Adaption of TIPS Approach to UX Design

Based on the descriptive view, we present our approach on how to support the synthesis of experiences. UX design faces similar challenges as creating innovations. It requires creativity to overcome existing weaknesses and to solve problems or create user needs in a new way. This process can hardly be «automated» by applying methods and tools, but approaches like biomimetic and creativity methods can trigger innovative ideas of designers.

One successful approach for innovation support is TIPS, the «Theory of Inventive Problem Solving» by Genrich Altshuller [4], developed in the middle of the last century. The idea of TIPS is that successful patented inventions are based on a low number of principles and patterns to overcome contradictions leading to innovation. Altshuller surveyed a large number of patents (approx. 30000) and derived 40 innovation principles [4]. In order to propose the right problem-specific principles Altshuller provides a table of contradicting physical quantities. Furthermore, examples of successful application are meant to support the creativity process.

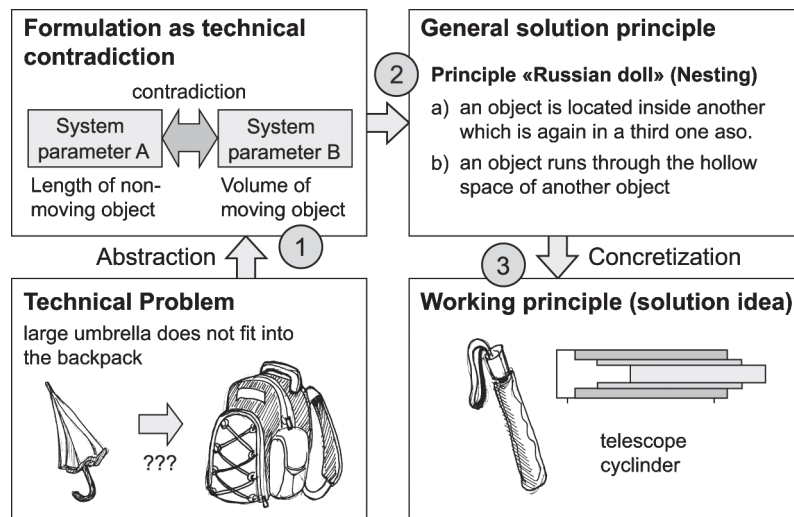


Figure 4. Example for application of TIPS [13]

Figure 4 shows an example of applying TIPS [13]. Starting point is a technical problem, e.g. the too large umbrella for a backpack. This problem is formulated as a technical contradiction of two parameters according to Altshuller's matrix [4]. In the example it is the «length of the non-moving object» (umbrella) versus the «volume of the moving object» (backpack). Based on these parameters the matrix proposes up to four solution principles, in this case the principle of «Russian doll» (Nesting). In the last step, it is up to the designer to adapt this principle to his problem. For example, he could design the umbrella's cylinder as a telescope to save space.

What needs to be adapted to apply this approach in the context of UX design? First, the principles need to be derived from successful experiences instead of patents. Therefore, we surveyed **product reviews** from different sources and extracted examples with good, respectively bad UX. We took parts of the reviews, in which authors described an emotional judgment of the product use, e.g. when they were excited or bored.

Furthermore, the **classification** of examples and principles needs to be adapted. The TIPS approach uses the matrix with contradicting technical parameters. For UX design principles, we propose the UXIM and its elements to structure and thereby support designers in applying the right principles. In the final methodology a designer can choose problem-related UXIM elements and gets appropriate principles with convenient examples for his situation.

3.2 Analysis of Reviews

In his student project, Reinhardt [14] surveyed different sources for good and bad UX examples. He looked at Amazon **product reviews** of a camera, an electric shaver, shoes and a lemon squeezer. Furthermore, he analyzed web-based **experience reviews** of services like bungee jumps, cruises, a rollercoaster and one **magazine article** about a computer game. Finally, Reinhardt ran **interviews** with users of an all-purpose remote control and an electric guitar. He recorded these interviews with video (Figure 5) and analyzed the UX-relevant comments in parallel by highlighting corresponding elements in the Customer Experience Interaction Model (CEIM) [5]. UXIM has not yet been developed enough at this time.

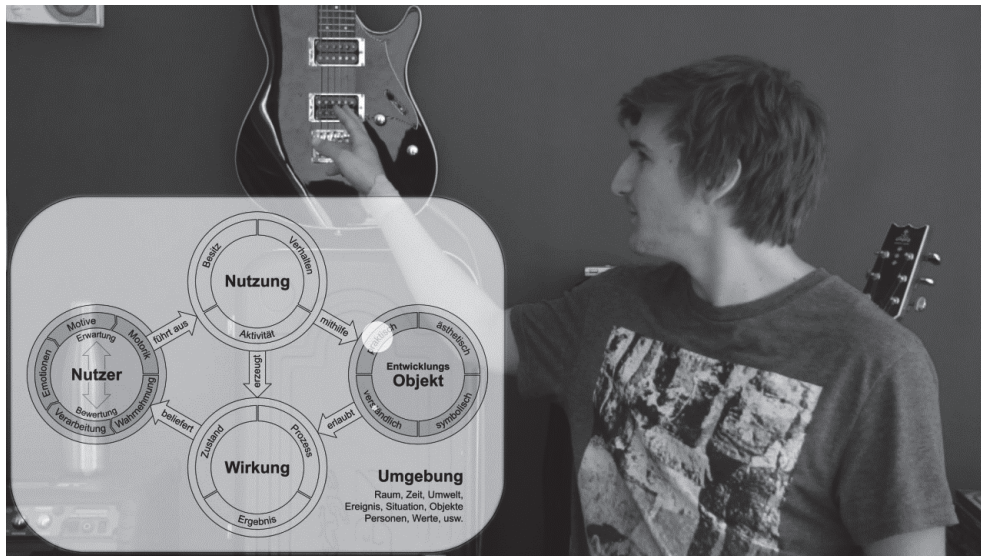


Figure 5. Interview of guitar user with UX analysis in parallel based on CEIM [5]

Similarly, Reinhardt [14] analyzed the written reviews. He highlighted every emotional description of an experience and added the corresponding CEIM element. In the following, we show an e-book review, taken from a news magazine [15], which we analyzed with the UXIM. Corresponding elements are highlighted in bold:

*Why the farewell from paper books is so difficult for us – and why the reading machines are the future. An experience report of an e-book admirer: (...) My brother presented me with the Steve Jobs biography two days before the launch of sales. **[Persons/Possession]** I was pleased **[Emotion]** – but then I bought the electronic version online **[Service]**. I love buying digital books and have it with myself on the smartphone. **[Other systems]** (...) some weeks later I downloaded the first update – and felt ungrateful somehow. **[Reflection/Emotion]***

*(...) Traditionalists like praising the beauty of paper books and the haptic pleasure, **[Aesthetics]** but I prefer my lightweight reading advice with its 247 grams. (...) One click and an unknown word gets translated **[Function]**. After some months I caught myself seeing paper books as museum-like faulty products with heavy weight and missing translation button **[Remembrance/Function]** (...) I can share quotes and comments in a kind of Facebook for book-lovers and can see what other users currently read – a strange feeling **[Function/Service/Persons/Emotion]**. You never know who is looking over your shoulder. **[Experiencing/Emotion/Persons]***

*(...) Another characteristic of the new times is that you never really possess an e-book. **[Possession]** Some years ago, some books were simply deleted because of a license controversial. **[Service/Values]** (...) This is a nuisance: I must pay, but I am not the owner; rather a tolerated spectator in my own library. (...)*

3.3 User Experience Principles

After having analyzed the written reviews – both products and services – Reinhardt concluded that there are several recurrent patterns of UX descriptions and sources [14]. In the video-recorded interviews he emphasized the advantage of being able to observe emotional indications of gesture, voice and facial expression. Reinhardt derived 21 Principles for UX design, allocated them to CEIM elements and linked them to the original reviews. In the following we present an excerpt of six principles, classified with corresponding UXIM elements:

- **Trigger perception via several senses.** Computer games offer the opportunity to immerse into the gaming situation. Some players completely forget their physical environment during the activity. The main condition therefore is the feedback via several senses. The gaming review author emphasizes the experience by getting feedback through visual, acoustic and haptic (force feedback) output.

Corresponding UXIM elements: Output, Perception, Processing.

- **Create pleasant anticipation.** The review author of the electric shaver mentions his positive anticipation on the product due to the appealing package. The aesthetic package with high quality materials influences his perception and the judgment of the shaver itself in a positive way and lets him excuse weaknesses.

Corresponding UXIM elements: Expectation, Perception, Aesthetics.

- **Meet psychological needs.** According to Kim et al. [2] the fulfillment of psychological needs leads to a positive UX. There are some basic heuristics on the human behavior: Human beings want to face challenges – the basic concept of computer games with continuously increasing difficulty. People want to be related to others and to experience physical stimulation – in combination the basic idea of tandem bungee jumping.

Corresponding UXIM elements: Needs, User Experience, Environment, Emotion.

- **Allow learning process.** Users have a different previous knowledge and abilities in using the product [8]. Considering the learning process and supporting new users adequately during usage is as important as giving experienced users the possibility to tap the full potential. The reviewed camera provides a beginner's mode taking pictures easily. It supports new users with a learning mode and allows professionals to adjust many details.

Corresponding UXIM elements: Mental Model, Processing, Action.

- **Ensure Usability.** Some reviews are negatively influenced by a poor product's usability. The electric shaver reviewer is frustrated due to an inconsistent interface and a bad handling. The negative usability highly influences his overall judgment of the product. Although he likes the packaging, the product's design and materials of high quality, he does not recommend the product, as the usage is rather annoying.

Corresponding UXIM elements: Mental Model, Input, Output, Processing.

- **Generate technical advance.** Technological innovations can lead to a unique experience, although the degree of novelty does not necessarily need to be too high. The reviewed rollercoaster offers one new section, the «dark ride». This new application is the motivation of the experienced reviewer to try and review it. The reviewer of the camera describes extensively a new technology (at least he thinks so) allowing close Macro shots.

Corresponding UXIM elements: Function, Anticipation, Prestige.

Although the derived principles are based on only ten reviews, some of the UX-relevant aspects could be found in multiple applications. We need to analyze many more reviews, products and deduce more principles, but this first conduct of the approach shows that the generation of UX in different products can be explained by similar mechanisms if regarded on a more abstract level.

3.4 Classification of Principles in UXIM

In order to support designers in specific situations, the principles are classified with the UXIM elements, as shown in Figure 6. It helps in triggering ideas and defining the targeted UX of a product in the planning stage of product development. Furthermore, it can be applied in the embodiment design stage to optimize the detail design to UX. As an example, a designer planning the input device of his product should consider the principles allocated to the elements «action» and «input». He could improve UX by trying to create a flow experience through the interface (10), should consider the product's haptic (11) or allow a learning process (13). Looking at the principle description, as shown in chapter 3.3, he can be inspired by a variety of successful examples.

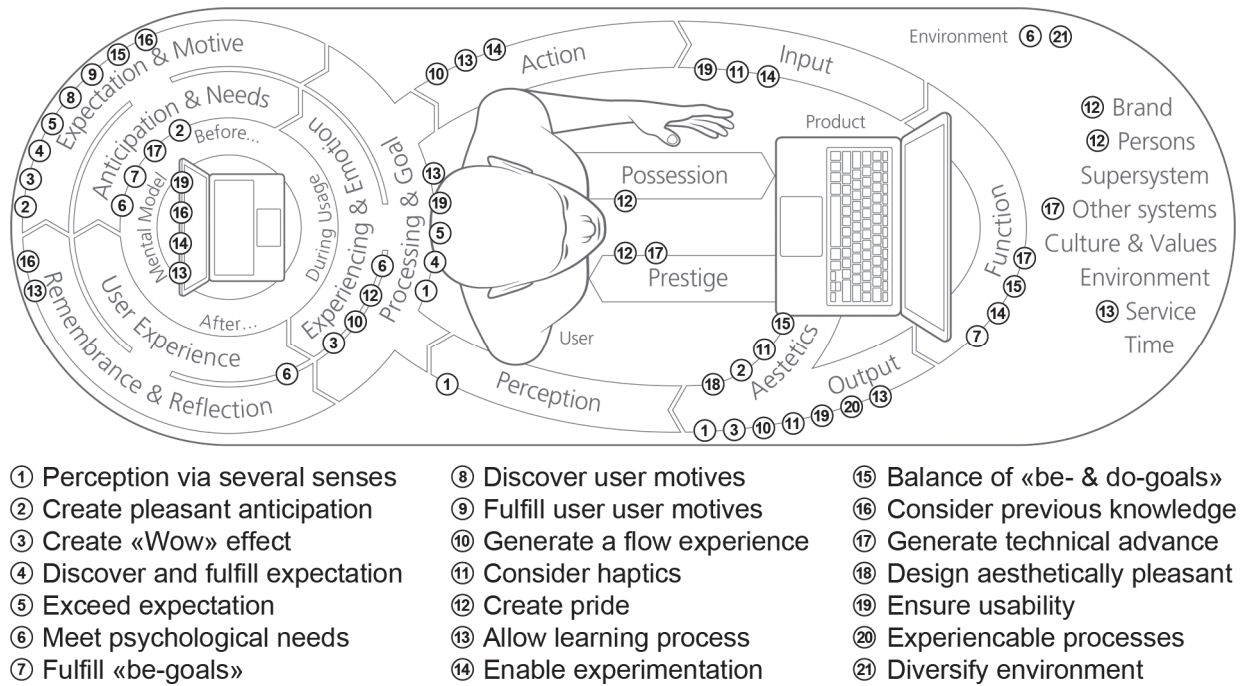


Figure 6. Classification of the 21 principles by Reinhardt [14] in UXIM

The allocation of principles to elements shows some interesting characteristics: The time span before usage is covered widely by the derived principles. By contrast, only few principles deal with the remembrance of experiences. There seem to be more possibilities to raise an expectation towards UX than influencing the reflection of interaction. Furthermore, there are many opportunities to create UX via the product's output in the reviews, while the product's actual function is mentioned rarely when an experience is described.

4. Evaluation of Principles

For the evaluation of derived principles, Reinhardt [14] put himself in a cellphone designer's place with the task to design the output device involving the surrounding environment. The UXIM classification proposes nine principles for «output» and «environment». Reinhardt took these principles and corresponding examples for successful UX. The following four principles inspired him to UX-related ideas:

- **Meet psychological needs (6).** The human need for relatedness («I feel close to people I care about» [2]) triggered the idea to create a permanent link to friends via the cellphone interface. Authorized friends could have the possibility to change the user's background image, pictures, music or applications. Thereby, they could avail of a more intimate way of being in contact with each other without necessarily writing or calling.

- **Allow learning process (13).** This principle made Reinhardt think of inexperienced users of cellphones including elderly people. He came up with the idea of providing a physical service button which connects the user directly with a call center or a preset contact, for instance the grandchild. Via remote display this contact or service could give an adequate assistance. Furthermore, the cellphone could learn from repeated mistakes made by the user: If he repeatedly misses the appropriate letter area on the display, the cellphone could adjust the divergence automatically. Finally, based on the frequency of use, the cellphone could also vary the icon size of applications or functions and could fade out unused ones.
- **Experiencable processes (20).** In case of loading applications or contents for a longer time, the cellphone could show personal pictures instead of just a progress bar. This would put the user in a much better mood, remind him of prior experiences and distract him from the annoying loading time.
- **Diversify environment (21).** As cellphones oftentimes lay on tables, in particular when they are switched to silent, lights in the cellphone frame could use the table surface as an output medium without activating the display. The light color could indicate the cellphone status (volume, connection to network, battery charge level) with a flashing light for incoming calls or messages.

The evaluation example shows that the principles help in considering different UX-related issues [14]. Although the current principles are only based on few reviews, they already cover a variety of user-specific perspectives and problems. We see a high potential to find many more principles that help designers empathizing with «normal» users. Finally, it must be clear that this approach can only be a tool and no automatism. The principles can just be a trigger for designers to be more innovative in creating their own ideas

5. Conclusion

5.1 Summary

We presented the User Experience Interaction Model (UXIM) which combines different perspectives and aspects of UX. The approach thereby, helps in analyzing occurring experiences. Furthermore, we presented our synthesis approach to support developers in UX design. Based on the TIPS approach by Altschuller, we gathered and analyzed product reviews and experience descriptions, mostly taken from internet sources like Amazon. These reviews were classified by the UXIM elements and we derived UX principles from them. Finally, we ran a first evaluation in the context of a Bachelor Thesis. The student could apply the principles in a use case triggering new UX-related ideas.

The evaluation showed that even without previous knowledge concerning UX, the approach helps in asking the right questions and getting hints for appropriate solutions. Other approaches like the need-driven by Kim et al. [2] can be included in terms of an own principle.

5.2 Outlook

The presented principles, mostly based on student's works, were derived only from a few examples. Many more reviews from different sources need to be included to get more principles to inspire concrete ideas. Furthermore, it would be helpful to gather reviews concerning bad UX and derive corresponding principles. We see a high potential in supporting designers to avoid bad experiences by showing poor UX use cases. We could find a

lot of those reviews. Obviously, people like writing reviews when they are frustrated. We should take advantage from this circumstance and help in preventing them.

What we did not consider so far, is the way of illustrating the principles, examples their links. With a high number of examples, the presented paper-based framework would be too extensive and would therefore be no longer usable. A web-based solution could aid in easily finding the appropriate principles and examples to support understanding by use of icons and images. A storytelling approach could also help in clarifying the principles and application examples.

Finally, the approach should be enriched by more existing UX approaches and corresponding literature links; like the one of Kim et al. [2] which was included by the principle «meet psychological needs». Developers should be able to deepen their knowledge about a specific principle – our framework serves no more than an overview.

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