

Exploring Relationships Between Interaction Attributes and Experience

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ABSTRACT

Not long ago, interaction was predominantly determined by technology itself or adhered to simple principles of efficiency (e.g., only three clicks away). Today interaction has to "feel good" and has to be "beautiful". This poses the question of how to conceptualize this emerging "aesthetics of interaction". In the present paper, we discuss existing approaches and present an own perspective. In our approach, the conscious differentiation between interaction attributes (e.g., *slow*, *mediated*, *delayed*) and the emerging experience (e.g., experiencing a *positive and meaningful moment*) is a crucial, conceptual step. Creating a particular experience (the *Why*) requires awareness and the purposeful combination of attributes on the interaction level (the *How*). To support this, we developed an *Interaction Vocabulary*, i.e., a systematically derived set of interaction attributes to describe interaction in a modality- and technology-free way. We then present a study, which explored the relationship between interaction attributes and emerging experience (i.e., feelings, thoughts, meaning). The found relationships serve as first heuristics for the more conscious design of interaction in line with desired experiences.

Author Keywords

Aesthetics of Interaction; Interaction Design; Experience Design; interaction attributes.

General Terms

Human Factors; Design; Measurement.

INTRODUCTION

As technology matures, products are defined by more than their mere functionality, technology or material form. Consider, for example, the wide selection of different mp3-players available. All in all, they provide the same basic functionality. What can make a difference beyond form is the interaction. For example, going through a song list can involve pressing a button, turning a scroll wheel, tapping or sliding on a touch screen, or many other ways to interact.

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But the interaction required is not only a means to invoke a function. It is an essential part of the product itself and shapes emerging experiences.

The sheer number of potential ways to design interactions creates new problems. Obviously, using a particular modality or technology (e.g., touch, a touchscreen) alone is not sufficient to ensure a more "natural" or "better" interaction [27]. Designers need to develop a notion of what a "good" interactions constitutes beyond mere effectiveness and efficiency (e.g., [6, 14, 15, 24]). In analogy to visual aesthetics, designers need to make decisions about the *aesthetics of interaction* (in the sense of the theory of the beautiful).

Research in Human-Computer Interaction and related design disciplines recently acknowledged this and suggested a number of approaches to the aesthetics of interaction. ([2, 15, 29] for an overview). While being different in detail, all these approaches understand the aesthetic quality of interaction and emerging experiences as crucial for designing interactive products. However, many approaches focus only on specific aspects of the experience (e.g., "magic" [17], "performative" [4]). Even more importantly, many approaches subsumed under the heading of an aesthetics of interaction, often address quite different conceptual levels, with the majority of approaches actually dealing with experiential attributes (e.g., surprise) rather than actual descriptions of interaction attributes (e.g., pace). In addition, only few approaches explicitly discuss links between both levels (e.g., [10, 20]).

The present paper aims at advancing the notion of an "aesthetic of interaction" by clearly distinguishing between low-level attributes of particular interactions and higher-level meaningful experiences. We start with a review of existing approaches to motivate the plea for a clear distinction between different conceptual levels. We then introduce the *Interaction Vocabulary*, an empirically developed tool to describe attributes of interactions and outline its development and application. Finally, we empirically explore how interaction attributes may shape emerging experiences.

APPROACHES TO THE AESTHETICS OF INTERACTION

A small group of approaches to the "aesthetics of interaction" suggests particular principles or characteristics of an especially "good" or "aesthetic" interaction, such as *rich interaction* [10] or *resonant interaction* [16]. Their basic notion is that an interaction with a certain attribute, such as "rich" or "resonant", is superior to other forms of interactions. These approaches are normative.

Other approaches take a more descriptive stance. They discuss relevant elements or attributes, but without strong recommendations about what attributes are desirable. In addition, these approaches often address different conceptual levels. Hassenzahl (e.g., [12], but see also [13]) suggested to distinguish between a *Why*-, a *What*- and a *How*-level, when talking about design. The *What*-level addresses the functionality a product offers, i.e., the things people can accomplish through a product, such as "making a phone call". The *How*-level addresses the concrete way interactions with the material are arranged to put functionality into action. This is the level of the sensomotoric (e.g., turning a knob, pressing a lever, using a voice command). In contrast, the *Why* focuses on what makes use meaningful to people, such as "feeling close to a loved one" or "being stimulated during a long wait". The *Why*-level addresses psychological needs and emotions emerging through an activity.

Existing approaches to the aesthetics of interaction can broadly be distinguished into some approaches addressing the *How* of interaction (e.g., [19, 21, 22, 30, 31]) and a greater number of approaches focusing on the *Why*, that is, emerging experiences (e.g., [1, 3, 4, 5, 10, 17, 20, 23, 24, 25]).

The Why: Experiences

Approaches to the aesthetics of interaction on an experiential level (*Why*) focus on users' emotions and subjective impression emerging through interaction, sometimes also referred to as the perceived *interaction character* [10]. According attributes that focus on the emerging experience are, for example, *exciting*, *unnatural*, *unordinary* [17], *surprising*, *inspiring*, *memorable*, or *tellable* [3]. Löwgren and Stolterman [23], for example, subsume such attributes in categories such as *qualities dealing with the user's creation of meaning*, *qualities dealing with motivation* or *qualities dealing with our immediate experience*.

Another facet discussed is the temporal structure of a resulting experience. Löwgren ([24], p. 130), for example, calls this the *dramaturgical structure*, i.e., "the beauty (or lack thereof) with which the interaction between user and product unfolds over time". Dalsgaard [5] puts a specific focus on how to design for *inquisitive use*, and the temporal composition of design sensitivities, such as *challenge*, *risk* and *resolution*.

Finally, a number of approaches discuss the aesthetics of interaction from a *social* perspective, introducing terms such as *aesthetics of emergence* [1], *socio-cultural factors* [28], *social action space*, *identity*, or *personal connectedness* [23]. Dalsgaard and Hansen [4] stress the *performative perspective*, i.e., when interaction becomes socially situated, the user not only engages in interacting with a system, but becomes a performer observed by others. Marti [25] discusses the emerging social dialogue between user and the system itself and provides examples of *shared perceptions*.

The How: Interaction

Naturally, approaches addressing the *How*-level stick to simple, often descriptive interaction attributes (e.g., *slow-fast*, *static-dynamic*, *discrete-continuous* [22]; *Duration*, *Position*, *Motion*, *Pressure*, *Size*, *Orientation* [31]). Others [30] pick up notational systems from non-technical areas like Laban movement analysis and its concepts, such as *interaction effort*, *kinespheric reach*, or *shape qualities* [19], originally intended for describing aspects of bodily movement in the area of dance.

Relationships between the How and The Why

The majority of the available approaches suggest models to describe experience emerging through interaction rather than models to describe interaction itself. In other words, they describe experiential aspects to design for, such as challenge, but do rarely discuss how interactions may actually form these. The less common low-level approaches, on the other hand, are good for describing interaction, but rarely attempt to tie low-level attributes to high-level experiences. Some authors begin to address relationships between the experiential level and lower level attributes. Landin [20], for example, discussed the relationship between certain attributes of interaction (e.g., *fragile*, *changeable*) and so called "expressions of interaction" (e.g., *anxiety*, *thrill*, *trust*). Djajadiningrat and colleagues [10] discussed, how certain combinations of action and reaction may lead to "expressions", such as *shy* or *stubborn*. Others, however, do not even distinguish levels. Lim and colleagues [21], for example, present physical attributes (e.g., *movement range*) side by side with much more complex experiential aspects (e.g., *expectedness*) without discussing the conceptual differences.

We believe both levels to be important. But research and design needs to acknowledge their conceptual difference, needs to address each specifically, and needs to explore their relationship. Following the general approach of *Experience Design*, we tend to focus on the *Why*-level first, i.e., "to set the story straight before we start thinking about how we can create this story through a technology." ([12], p.163). However, high-level experiences are always mediated and created through the arrangement of concrete interactions on a lower level, i.e., the *How* of interaction. Creating meaningful experiences on the *Why*-level, thus,

requires (1) an awareness of potential attributes of interaction on the *How*-level, and (2) reflection about which attributes may lead to which particular experience. To assist both activities, we first engaged in a systematic exploration of basic interaction attributes on the *How*-level and subsumed them into an *Interaction Vocabulary* (see also [9]). We then used this vocabulary as a starting point for reflections on related experiences, resulting in an overview of relations between both, interaction attributes and experience. Our approach, thus, explicitly differentiates the *How* (concrete interaction on a sensomotoric level) from the *Why* (experiences and meaning emerging from or supported through the interaction). In the following, we present both research activities and provide first examples of practical applications of our approach to design.

DESCRIBING INTERACTION ON THE HOW-LEVEL: THE INTERACTION VOCABULARY

With the *Interaction Vocabulary*, we aimed for a list of attributes to describe how an interaction "feels". Instead of focusing on a specific technology, such as graphical user interfaces [22] or gestural interfaces [31], we were aiming for a widely applicable, technology- and modality-free description of interaction. We also avoided evaluative attributes, since we believe that the question of whether a certain attribute, such as *fast*, is good is a matter of the experience to be created. In addition, most other approaches did not derive dimensions or attributes systematically or at least did not report it. While certainly addressing important aspects, it remains unclear on what basis these particular aspects were identified as relevant. In sum, the *Interaction Vocabulary* is meant as a comprehensive, systematically derived set of attributes, able to describe felt differences between forms of interaction.

Development

We developed the vocabulary and further refined it by applying it in the field. Both was done in the context of interdisciplinary research projects with partners from different disciplines (e.g., computer science, psychology, interaction design) and industries (e.g., business software, home automation, medical software). Besides the project partners, research colleagues from other universities were involved. In the following, we provide a brief overview of the development:

Initial development. We started with compiling a heterogeneous pool of alternative interactions for the same function. "Switching on and off lamps" served as a trigger for collecting more than a hundred alternative interaction forms, contributed by eight experts (five of our project partners plus three external research colleagues). Examples ranged from a simple, wall-mounted switch, to moving or touching the lamps, or controlling the lamps via sound, light or temperature (see Figure 1 for examples). The resulting interaction forms covered a wide range of possibilities, independent from technical restrictions.

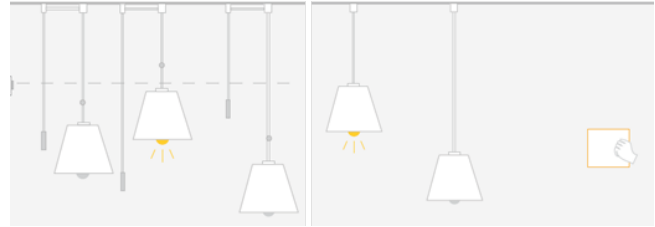


Figure 1. Examples of interaction concepts. Left: Switching a lamp on by pulling a cord. Over time, it moves downwards and gets darker. When passing a certain height the light turns off. Right: Controlling a lamp via "knocking".

This pool of interaction concepts was then used to extract attributes that describe perceived differences between those forms of interaction. Five experts (a subgroup of those, who took part in designing and collecting the interaction forms) engaged in a card sorting procedure. Similar interactions were grouped and ideas for describing similarities within a group and differences to other groups were collected. This resulted in a large number of dimensions consisting of opposite attributes, such as *slow-fast*, *direct-mediated* (see Figure 2 for examples). In a subsequent discussion the team excluded redundant dimensions, resulting in a tentative minimal set of dimensions.



Figure 2. Examples of extracted interaction attributes. Left: Dimmer switch (fluent) vs. flip switch (stepwise). Right: Switch on the lamp (direct) vs. wall switch (mediated).

The tentative set of attributes was then again shared among the eight participants of the initial workshop. Based on their individual understanding of the attributes, participants tried to come up with new interactions exemplifying the 22 attributes of all eleven dimensions. The subsequent discussion of the examples revealed ambiguous wording and differences in understanding. This iterative matching of understanding resulted in an initial version of the *Interaction Vocabulary*, accompanied by a list of short definitions and typical examples of interaction forms for each dimension (see also [8]).

Refinement of the Interaction Vocabulary in the field. We further refined the vocabulary through applying it in our own design projects, by handing it to colleagues in various domains (e.g., automobile, smartphone apps) and collecting their feedback from application, and through more formal research (e.g., [7, 26]). All in all, the *Interaction Vocabulary* was used in 29 studies or workshops with a total of more than 1500 participants. The feedback suggested slight changes of the original dimensions, e.g., the exclusion of redundant dimensions or changes of

wording to improve the discrimination between similar-sounding dimensions.

In its current form, our interaction vocabulary consists of eleven dimensions, namely, *slow-fast*, *stepwise-fluent*, *instant-delayed*, *uniform-diverging*, *constant-inconstant*, *mediated-direct*, *spatial separation-spatial proximity*, *approximate-precise*, *gentle-powerful*, *incidental-targeted*, *apparent-covered*.

Application

The *Interaction Vocabulary* allows for a broad range of applications (see [9] for a detailed discussion). Foremost, we understand it as a tool for designers to reflect on possible interaction attributes. Actions on the *How-level* (e.g., sensomotoric) become quickly automatized and, thus, remain unconscious [18]. This makes it quite difficult to talk about how an interaction "feels" or "should feel". The vocabulary provides attributes to talk about interaction, such as Laban's analysis provides a way to talk about movement in the context of dance.

At a later point in the design process, one may use the vocabulary to specify a profile of intended interaction attributes along the vocabulary's eleven dimensions. Finally, the vocabulary can be presented as a semantic differential questionnaire. Through this it becomes an evaluation tool in user studies. Participants' perceptions of an interaction can be compared to the profile specified by the designer (through profile correlations) or related to other experiential or product-oriented measures (e.g., affect, usability).

To provide a better insight into the application of the vocabulary consider the following examples. Figure 3 compares the interaction profiles chosen by the respective designer for three design, i.e., the *candle lamp*, the *picture frame*, and the box for an *engagement ring* (see Figures 5-7 for more information on the three concepts). Obviously, there are considerable differences in the chosen interaction attributes. These differences emerge because the designers had particular experiences in mind they wanted to create through interaction. In other words, the interaction was chosen to support a particular story to be told through the object and interaction.

The *candle lamp* by Kai Eckoldt (Figure 4), for example, intended to emphasize the precious moment of coming together for a romantic dinner. To stress the moment and signify its meaning the *candle lamp* should offer a *slow* and *stepwise* interaction. As a distinct sign of consciously starting an evening with a loved person, "switching" on the lamp should be *apparent* and *targeted*. Furthermore, he decided to make the interaction *gentle* to show mindfulness and *precise* to leave room to concentrate one's attention on everyone present. His resulting design is a lamp including a heat sensor and a sound sensor to literally light the lamp and blow it out. This kind of "switch" would not be adequate for every situation – but for emphasizing a special

moment with the loved one it feels more adequate than any efficiency-orientated flip-switch.

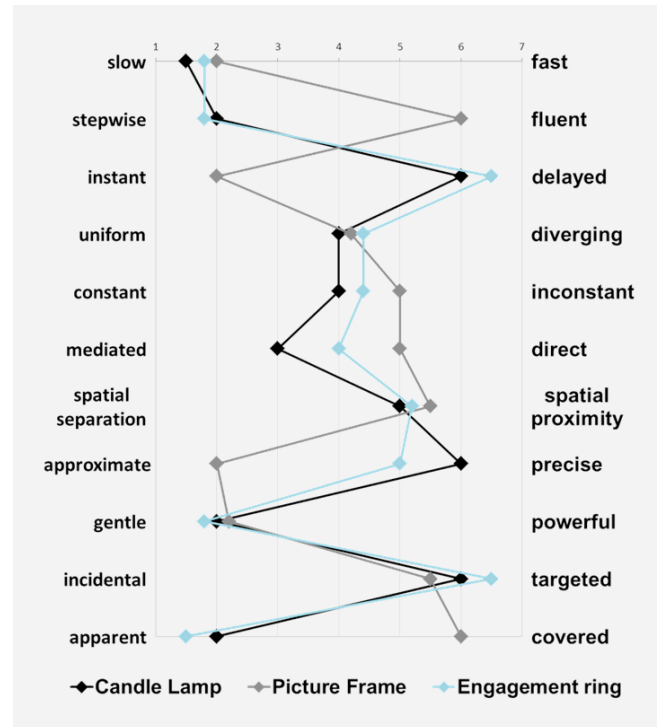


Figure 3. Comparison of interaction profiles: candle lamp, picture frame and box for an engagement ring.

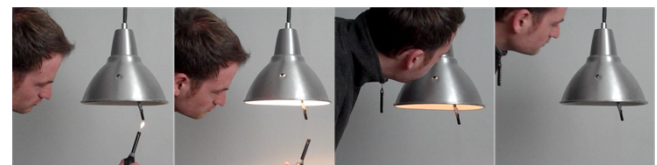


Figure 4. Interaction concept for the candle lamp (Eckoldt): slow, stepwise, apparent, targeted

The *picture frame* (designed by Eckoldt, Hassenzahl, and Kim, see Figure 5 and also [12], p. 72) is another concept that supports a special moment of feeling related. However, in a quite different situation, which also changes the selection of appropriate interaction attributes. While the lamp was meant to create a special moment for lovers, the picture frame creates a moment of relatedness, when being separated, by offering a short glimpse on the loved one's picture. Compared to the lamp the picture frame does not intend to attract attention. It is not about sharing the moment with other people. Instead, the picture frame aims at creating a cocoon to feel separated from the physical surrounding. Therefore the interaction is defined as *covered* and *fluent*. There is no visible hint to something hidden, such as a "secret button" or a lock. To turn the public picture into the private one, a user has to pick up the frame, grab it with both hands and tilt it gently in an intimate gesture. In line with the experience of revealing a secret, the designed interaction is *slow* and *gentle*. It is an unobtrusive gesture so no one will become suspicious and take notice of

the secret. To quickly cover the private picture when necessary, the interaction is *direct* and *instant*.

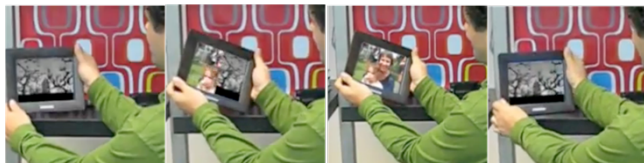


Figure 5. Interaction concept for the picture frame (Eckoldt, Hassenzahl & Kim, [12]): slow, gentle, direct, instant

Another interaction concept celebrating a special moment of relatedness is the *jewelry box* for presenting an engagement ring (designed by Julia Lackas, see Figure 6). Given the special significance and far reaching consequences of this moment, opening the box should demand attention and provide a certain structure. Besides celebrating the moment, the interaction needs to leave time for asking the “big” question (and to prepare for the right answer). Thus, the interaction was specified to be *slow, stepwise, delayed, precise, gentle* and *targeted*. The lid has to be unscrewed carefully while the couple’s song starts to play. After the song faded the lid lifts a little bit and finally exposes the ring.



Figure 6. Interaction concept for the engagement ring (Lackas): slow, stepwise, delayed, precise, gentle, targeted

Even though the box and the lamp have completely different functionalities, they both intend to emphasize a shared moment of relatedness and importance. This common intention on the experience level also becomes visible in the interaction profiles, featuring similar interaction attributes. For example, *delayed* and *stepwise* seem to be appropriate interaction attributes for creating feelings of anticipation, for celebrating a special occasion, and for allowing the “spectator” to participate. The picture frame, in contrast, intends to create a moment of privacy, *not* being shared with or detected by others. This also becomes visible in the interaction profile, which suggests *instant, fluent* interaction.

In sum, while the vocabulary is helpful to specify, how an interaction should feel, designers themselves need to come up with this specification: They might do so by matching interaction attributes to desired experiences and meaning. In the three examples, the designers, however, were left to their own expertise, their own tacit knowledge about how interaction attributes and experiences may be related to each other. In the remainder of the paper, we will explore those potential relationships a little more systematically.

THE HOW AND THE WHY: RELATIONSHIPS BETWEEN INTERACTION ATTRIBUTES AND EXPERIENCE

The *Interaction Vocabulary* provides a value-, modality-, and technology-free way to describe, how an interaction

should “feel”. Desired profiles can be specified by the designers and compared to users’ perceptions. However, the very question what profile to specify remains the choice of the designer. The vocabulary itself provides no recommendations of how to specify an interaction. Appropriateness or “beauty” emerges on the higher, experiential level, and is not a property of the attributes. Whether an interaction should feel “slow” or “fast” depends on the experience to be created. To put it the other way round: certain attributes may inevitably create particular experiences. A “fast” interaction may create the impression that the actual action is unimportant, only attaining the goal counts. In contrast, a “slow” interaction may create the impression that the action is important, and has to be done with care. To shape an experience, thus, designers may need to orchestrate an interaction based on the experiences it suggests (see also [20]).

To gain an understanding of potential relationships between interaction attributes and experience, we ran three workshops with a total of 38 participants ($n = 8$, $n = 13$, $n = 17$). Workshop participants were partners from an interdisciplinary research project with backgrounds in computer science, psychology, design, as well as students of industrial design from the Folkwang University of Arts.

In each workshop, participants presented a self-selected interactive product from their daily life, which has a “good”, “beautiful” or “special” interaction. They first were asked to specify their product’s interaction profile with the vocabulary (cf. Figure 3). Then they reflected freely on how this interaction relates to their experience. For each specified interaction attribute, feelings and cognitions – in short: meaning – were reported. For example, a number of participants picked their coffee maker and described how the interaction felt and the experiential aspects and meanings it created (see Figure 7). While the interaction with a rather manual *Bialetti espresso machine* was felt to be “powerful” and giving pleasure from “creating something with one’s own hands” and “doing something”, the interaction with the automatic *Philips Saeco Exprelia One-Touch Espresso* was perceived as “gentle” and “fluent”, creating an impression of convenience. The “precise” *Gastroback espresso machine Advanced ProG* features an automatic coffee mill with ready set programs of specific amounts of coffee and water, guaranteeing that coffee will taste the same every morning. This added to the experience of a secure morning routine. A *slow drip coffee filter* feels more “approximate”. There is no predefined amount of coffee and water; this has to be estimated each morning. This creates the experience of competence and popularity. As the participant explained: “*I feel empowered and fully responsible for anything that happens. I have the power to change what I drink! Every morning I will look forward to it. I will ask myself, will I make a better coffee than yesterday?*”



Figure 7. Attributes of interaction and experience related to different types of coffee preparation

Due to space limitations, we refrain from the detailed description of all 38 examples. The following collection summarizes experience and meanings related to particular attributes shared among participants (see Appendix, table 1 for a detailed overview).

Slow vs. fast: Slow interaction was associated with appreciation of the moment, the interaction itself, and the object of interaction. As one participant reflected on scale modeling: *"The interaction requires an investment, an investment of time. That strengthens the connection to the object."* Fast interaction was experienced as animating, stimulating, indicating a focus on efficiency and attaining the instrumental goal of the interaction.

Stepwise vs. fluent: Stepwise interaction was experienced as guidance through complex situations or processes and a way to ritualize interactions. One participant explained about a *Bialetti espresso machine*: *"Every step has got meaning. It's like a ritual."* Fluent interactions gave users a feeling of autonomy and the power to change the interaction the way they want it to be. *"I don't need to stick to predefined grades."* (on *Grundig Mini Chopper Multicut*).

Instant vs. delayed: An instant interaction felt like joining forces with the device, as one user explained: *"the phone understands you"*. It made one's own action experiential and creates a feeling of one-ness. In contrast, delayed interaction celebrates the moment and gives importance to it. It creates awareness of what is going on. *"On one hand the delay is a bit irritating. On the other hand, it creates awareness for the underlying technology."* (on *wireless iPod docking station*).

Uniform vs. diverging: The relationship between action and reaction depends on what is expected. Uniform action/reaction is what users expect. It is intuitive and provides a feeling of being in control, *"the more I push the more it beats"*. Diverging action/reaction was experienced as unnatural and grasping for attention.

Constant vs. inconstant: Constant interaction, i.e., the same action always results in the same effect, created a feeling of security. Inconstant interaction, in turn, created room for surprise and challenge, also adding "life" (autonomy) to the object. *"Its ever changing reactions make it appear more lively."*

Mediated vs. direct: Mediated interaction created an emotional distance between own actions and its instrumental effect, like one participant explained, *"It wasn't me who put the energy into it"* (reporting on electric kitchen utensils). Direct interaction emphasized the significance of action and created a close relationship between the human and the thing being manipulated. As one participant reflected on playing the electric guitar *"You are constantly linked, you are in full swing, in a flow, you feel good, that's imbuing."*

Spatial separation vs. spatial proximity: Spatially separated action created a feeling of distance and alienation. Spatially proximate interaction created identification with ongoing processes and an awareness of details. It also created a feeling of security, because one is directly involved.

Approximate vs. precise: Approximate interaction was associated with the need of a deeper analysis of one's doing. It created room for variation and therefore room for competence. Like one participant explained *"It's up to me to decide. It leaves scope for action. I will be responsible for the result."* Precise interaction, on the other hand, conveyed a feeling of security because you get an exact idea of the result. It is always the same. This created room to concentrate on something else.

Gentle vs. powerful: Gentle interaction expressed caring and appreciation, which deepens the relation with the object (*"entering a relation and being gentle with it"*) and added value to it. One participant explained how the gentle interaction with the *slow drip coffee maker* let the coffee appear more precious: *"it 'high ends' the coffee – even if the coffee is from a cheap supermarket"*. Powerful interaction,

in contrast, supports feelings of strength, power and effectiveness. It evokes positive feelings about oneself (the actor), but not towards the object or goal of interaction.

Incidental vs. targeted: Incidental interaction was described as a side issue that just happens. By contrast targeted interaction was seen as worthy of attention. One participant reported on the *Avocado* app to send a hug from afar: *"The special gesture I need to make emphasizes that this is targeted towards a specific person. An intentional gift."*

Apparent vs. covered: Apparent interaction made one feel competent to figure out the functionality of a system, like one participant commented, *"anybody can do that"*. Everybody around can see what is happening. Covered interaction was associated with excitement and exploration. One participant explained on an augmented reality system using an *iPad* as a magnifier on a map to get 3D information *"It was like magic, a private view, I was getting information that others couldn't view."*

In sum, participants provided insights into how certain attributes of interaction may result in specific experiences and ultimately meaning. Note, that this is meant as a first "map" of potential relationships between concrete interaction attributes and resulting experiences.

EXAMPLARY APPLICATIONS IN DESIGN

While the *Interaction Vocabulary* alone provides designers with a means to "talk about" and to specify the aesthetics of an interaction, in combination with potential resulting, higher-level experiences, designers may start to more deliberately orchestrate interaction in line with desired experiences.

One tool-like representation of the gathered knowledge is a specific card set (see Figure 8). Each card represents one of the *Interaction Vocabulary's* dimensions, with the opposite poles on each sides of the card. In the design process, turning a card on one or the other side may represent a preference for the according interaction attribute. To support the designer to align her or his choice with the intended experience, the card also informs about potentially related experiences. Turning the card on one side or the other, thus, may also be motivated by the desired experiences. Through this a designer can "toy" with different forms of interaction, reflecting on differences in resulting experiences or can start with a particular experience and try to match basic attributes of the interaction to it.

We used the card set, for example, in a workshop with our industrial partner *iSOFT* in the first phase of the re-design of medical software. The software supports radiologists in storing and annotating radiographs. Moreover, the software also features a demonstration mode. This is used for presenting radiographs on a big screen for consulting with a team of medical specialists. Interviews with radiologists revealed that these demonstration meetings are quite a

special moment in their daily work – their "big show": This is the moment of deciding patients' future treatments, with the radiologist being in the center of attention and wishing to communicate her or his full degree of expertise. Based on this, we set feelings of *competence, popularity* and *security* as experiential goals.

The card set provided a pool of matching experiential aspects, such as feeling competent, popular or secure, with links to specific attributes of interaction. Competence and security require interaction attributes, such as *fast, direct, and stable*, i.e., typical attributes of efficiency-oriented business applications. The radiologist's need for popularity, however, asks for qualities that business software usually does not focus on, i.e., fascinating and impressing others, underlining one's "supernatural" capabilities (here: seeing more in a picture than others). The card set informed that this need may be supported by elements of *covered* and *approximate* interaction. This set of central requirements then served as input for a brainstorming on possible interaction concepts featuring these qualities. The presentation of design concepts is beyond the scope of this paper. However, the outlined considerations already demonstrate, how our tool helped to generate a clearer picture of the intended experience and the potential tension between security/preciseness/radiograph data on one hand and performance/presentation/ audience on the other hand.



Figure 8. Tool-like representation: *Interaction Vocabulary* and experiences card set.

LIMITATIONS

The presented overview on relations between attributes of interaction and experience is a first step in tying high-level experience and meaning to specific low-level attributes of interaction. Of course, our approach has its limitations. First, the relationships are certainly not deterministic, that is, a particular interaction attribute may not always automatically evoke a certain experience. Second, those relations obviously may be modified through situational aspects. Take the meaning of the color red as an example: it grabs attention and may be a warning or stop signal. Obviously, one can still like a red tablecloth and not understand it as a warning or stop signal. "Red as warning" is just one meaning, which is not purely idiosyncratic but culturally shared, but nevertheless does not emerge every

time an object is red. The same may hold for interaction attributes. Because of the fact that particular attributes were more likely to be related to particular experiences and meaning, we may assume them to be culturally shared – at least to some extent. This does not necessarily exclude that other experiences and meanings emerge in specific situations. Third, so far we focused on links between single attributes and experiences. It is likely that specific experiences emerge from *combinations* of attributes (i.e., a particular interaction profile). As it stands, we view our results as a set of heuristics, which provides a first basis and orientation to support the designer's own responsible, situation-specific design decisions.

CONCLUSION

In the present paper, we argue for a notion of an "aesthetics of interaction", which acknowledges different conceptual levels. The interaction itself happens on a low level, close to the product (the *How*), and can be understood as a sequence of perception and action – pressing buttons, tapping screens, voicing or even thinking commands. This level calls for a modality- and technology-free description of interaction. Actually, only a minority of approaches to the aesthetics of interaction addresses this level, and we added the *Interaction Vocabulary* as a systematically derived and tried out descriptive tool to facilitate thinking and talking about interaction and its attributes.

The majority of approaches actually focus on emerging experiences (the *Why*-level) rather than the interaction *per se*. While the *Why* is certainly important, these approaches are more or less silent about how experiences actually emerge from interaction (see [10, 20], for exceptions). The present study demonstrates, however, the existence of at least stereotypical relationships between interaction attributes and emerging experience. Neither can we focus on the interaction alone, without taking the experience and meaning that will inevitably be created into account. Nor can we possibly design (for) experience, without acknowledging the experience-inducing powers of concrete interaction. It is not only about the stories we tell, but also about how they are told.

In line with our notion of Experience Design [12], we believe that designer should first clarify and specify the desired experience and later match interaction attributes. We believe that beauty in interaction emerges, when the actual interaction is in line with the overarching experience, when the interaction is successful in supporting the story to be told. This makes a general striving for certain attributes meaningless, since judgments about more or less appropriate interaction attributes can only be made with the intended experience as reference. Whether "fast" interaction feels good, depends on the experience to be created, and whether this experience is "good" may depend on many different psychological aspects, such as the provision of psychological need fulfillment [11]. What is, thus, needed is design-oriented knowledge of the relationships between

interaction attributes and experiences. The present study is just one step towards this. As a student in a recent course on interaction design at our university put it: "*Defining interaction attributes helped me to stick to what I really wanted to create. Usually, I get lost at some point during the design process, switching from one idea to the next, always coming up with new possibilities, thinking: it also could be like this or that. But having that interaction profile specified beforehand really helped me to stay focused. I knew there was a good reason why I specified it like this and that - because of a particular experience I wanted to create.*"

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APPENDIX

Experience	Interaction attributes		Experience
Esteem, focus on the interaction itself, significance of the present moment, relaxing, calming, accuracy, care, appreciation of interaction/product	slow	fast	Animating, stimulating, activating, efficiency, focus on instrumental goal of interaction, expression of willpower.
Ritualization, every step is meaningful, rewarding, emphasis on progress and advance of the process, approaching a goal step by step, clear structure, being guided through the process	stepwise	fluent	Autonomy, continuous influence, power and right to change what's happening at anytime of the process, no barriers, fluent integration in running process, spurring instead of interrupting
Instant feedback makes own effect experiential, competence, feeling of own impact creates a feeling of security, you see what you do, makes immediate correction possible, nothing in between, you experience what you do, increase of competence, the instant feedback creates a feeling of recognition.	instant	delayed	Emphasizing the moment of interaction, creating awareness. Centering on the interaction itself rather than its instrumental effect.
Influence by intuition, control	uniform	diverging	Unusual, unnatural, amplified, grasping for attention
Creates feeling of security	constant	inconstant	Liveliness, suspense, you can't adapt yourself to it, unreliable, chance as an idea generator
Uncertainty, ambiguity, magic, handing over the responsibility (the interaction happens somewhere else), you don't put much of yourself in it	mediated	direct	Significance of your own doing, face-to-face contact, experiencing affinity, self-made, close relation to the product, feeling of constant control
not feeling as a part of it, feeling of distance	spatial separation	spatial proximity	Personal contact, feeling of relatedness, safety (you know exactly what you did), being a part of it, intensive examination of details
Deeper analysis is needed, room for variation = room for competence, room for new ideas, exploration	approximate	precise	Safety, no changes = room to concentrate on something else/competence in other fields, exact idea of result, always exact the same
Carefulness, awareness, appreciation, making a relationship with the thing (being gentle with it), being a part of it, reevaluation of the action, raises the quality, allows to perform a loving gesture	gentle	powerful	Archaic interaction, sign of strength, power, effectiveness
Low challenge, no room to experience competence, no room for improvement, becomes side issue, doesn't matter	incidental	targeted	Appreciation, significance of interaction, worthy of attention, high challenge, high concentration, room for competence
Conscious of the significance of your own doing, assurance, security, goal-mode, seeing what is going on, expressive, very easy	apparent	covered	magic, excitement, exploration, action-mode, witchcraft, deeply impress somebody

Table 1. Relations between attributes of interaction and experience.