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Measurement problems and measurement strategies for capturing the rich experience of art

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Abstract

Art experience is per definition a dynamic way of processing: While perceiving the artistic object, the film, the music play, we undergo complex affective as well as cognitive experiences interactively changing the entire processing. Elaboration, understanding, aesthetic aha-insights etc. change the view on the to-be-processed entity—psychologically interpreted, the entity becomes a part of ourselves. Most methods of measuring art experience are not able to reflect on these dynamics; most of them are just object-based, e.g. correlative approaches of bringing statically assumed object-properties together with simple ratings on these "objects". Here, I will demonstrate the limitations of such approaches, accompanied by the introduction of some simple principles to be followed when art experience is the focus of research. I will then introduce some methods which can assist in unfolding the process character of art experience without interfering too much with the experience as such: For instance, by using posturography, the Continuous Evaluation Procedure (CEP) or automatic facial expression routines. When these techniques are employed with clear rationales in mind, and by deriving concrete hypotheses from a well-grounded theoretical approach, we can come much closer to the rich experience people have when encountering and elaborating art. This will assist us in our human-history-encompassing endeavor of deciphering what and how art is processed and appreciated.

Objectives

The current paper has three main objectives:

1) To sensitize the audience in thinking about the common usage of mostly inappropriate ways of getting into the experience while perceiving / processing art,

2) To show concrete possibilities for capturing dynamics of art perception,

3) To make clear the limitations of some of the methods employed in art research including the sophisticated methods introduced in this paper.

Art experience—experiencing art

Research on usability, cognitive ergonomics and product usage is often marked by an important construct which seems to be essential: "experience". Often, however, the kind of experience which is researched in current empirical studies on aesthetics is quite distant from the concept which we have in mind when it is about real "experience"—about "experiencing" something artistic. Although we know that experiencing art is a very complex and dynamic (for instance "user experience" is technically defined as all the perceptions and reactions of a user when using and handling a product, system or service, see ISO 9241-210 [1]), interactive way of handling, most researchers use simple questionnaires or singular questions to capture experience in an explicit way.

The situation is even worse in the specific domain of the arts, especially when it is about experiencing artworks of contemporary styles, where art processing is clearly *not* to be characterized by a linear process which yields a definite "solution" of the artwork [2]. Contemporary artworks often show "Semantic Instability" (*SeIns,* [saɪns]) [3], for instance via ambiguity, indeterminacy or high levels of abstractness [4]. Importantly, with such artworks we cannot come up with a definite dissolution which would often lead to a so-called "Aesthetic-Aha" [5]. On the contrary, with partial dissolutions towards the "meaning" of an artwork, even more questions often arise that challenge our already-found answers and dissolutions. Interestingly, *SeIns* is not just one single construct but subsumes a variety of different categories which we have empirically found to consist mainly of 1) Integrative blend, 2) Multistability, 3) Indeterminacy, and 4) Contradiction to habits[6], making it even harder to investigate it with a simple standard method.

Furthermore, the pleasure of processing such works of art is mainly determined by the "promise of success after a period of processing" [7, p.2]—the artworks will always remain, to a degree, indeterminate so that visual searching will continue even after cues have been detected [8].

All these perceptual and cognitive processes, as already mentioned, are reflected and accompanied by highly dynamic and recurrent feedback loops [see for the haptics domain, 9, 10], especially by not always fulfilled, unforeseeable properties of an object that can lead to a surprise reaction in the viewer [11] or which yields so-called "prediction errors" [12]. But how to capture such dynamic experiential processes then?

Capturing dynamics of aesthetic experience

The main focus of the current paper is how to capture dynamics of aesthetic experience. The main challenge in capturing dynamic processes is that we should have points of measurement along the trajectories of significant events within the stream of experience. If we were to just directly ask participants at that special moment, we would change, bias or even destroy the emerging art experience, and so traditional measures often used in art perception – mostly questionnaires, direct questions, think-aloud techniques – are not as goal-leading as is often believed [13].

I will describe some new techniques which we have developed over the past few years in my cognitive laboratory which can assist our understanding of such dynamic processes. These methods show very different time resolutions, different depths of analysis. Some of them can be considered as invasive, other as non-invasive.

System of capturing methods

To get a better idea how these methods can be ideally applied to specific research questions, I will systematize these methods in accord with a simple scheme consisting of two essential dimensions: 1) time resolution and 2) depth of analysis (see Figure 1).

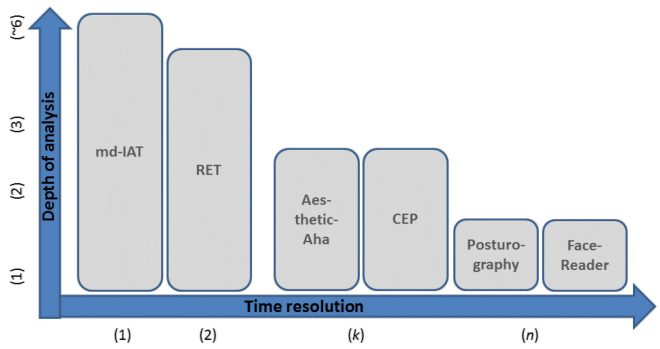

Figure 1. System of different methods for capturing dynamics of aesthetic experience according to two essential dimensions: 1) time resolution (x-axis), and 2) depth of analysis (y-axis).

I will now discuss all the methods portrayed in Figure 1 in detail, one after another, starting with md-IAT and ending with the FaceReader technique.

Md-IAT: multi-dimensional implicit association test

Many researchers in the domain of aesthetics rely on explicit assessments, mostly questionnaires—the main reason seems to be their ease of usage and the wide variety of already established inventories, mainly stemming from market, social and personality psychology. Although the complexity of such inventories can be quite high and the assessment accordingly very fine-graded, any kind of explicit question faces one essential problem: the questioned people can easily build up a theory of mind about what the experimenter wants to hear from the participant. So we clearly and strongly face problems, such as social desirability and political correctness partly or even fully biasing the participants' assessments. In 1998, Greenwald and colleagues introduced the so-called IAT (the implicit association test) [14] which has become one of the standard tools to test for automatic associations which are often characterized as "implicit associations" or even "attitudes" [15]—but see, for instance [16]. Some years ago we extended the standard IAT with a multi-dimensional perspective, the so-called "multi-dimensional IAT (md-IAT) [17]. The md-IAT is capable of providing detailed information on the multifaceted nature of an artwork's associations, with reliable possibilities for measuring the viewer's attitudes. Due to its implicit nature, people's associations need no conscious access, which is especially helpful when people are indeed not aware of their associations, when they are not able to express them or when they are not willing to share them with the experimenter.

The md-IAT is quite effortful in its execution—typically 4-6 dimensions are asked for, which leads to a test lasting about 15-25 minutes. Ideally, any kind of reaction-time-based method such as the md-IAT is dependent on the very accurate measurement of reaction times, so typically md-IATs are conducted in lab-based research and not in an online test context or even a field context (e.g. museums) where the accuracy of capturing RTs cannot always be assured. Due to these time and cognitive effort constraints, it is also clear that md-IATs can typically only be used once or twice within an empirical study, so the time resolution during an ongoing experience of art is quite limited. Furthermore, the specific logic of an IAT yields only relative data, so researchers have to find opposing conceptual categories which can only be interpreted by contrasting them. A typical outcome from an md-IAT can be retrieved from Figure 2 where we were interested in contrasting assessments of BMW brands vs. Audi brands regarding six factors (assessment dimensions) which are interpreted as being essential for a successful automobile company in Europe.

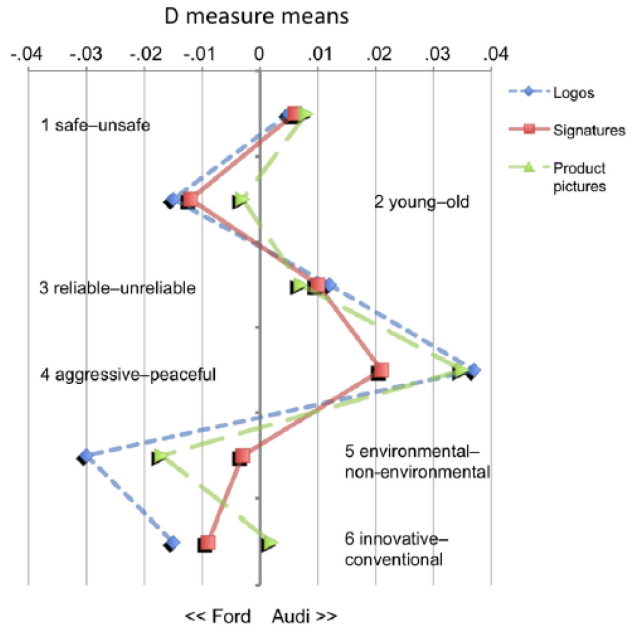

Figure 2. A typical outcome of an md-IAT study. In the concrete example, we were interested in the assessments of two big German automobile brands, BMW and Audi, regarding six essential factors (safe, young, reliable, aggressive, environmental, and innovative)—see for details [17].

RET: Repeated Evaluation Technique

One essential problem in measuring aesthetic experience – especially of innovative, uncommon or unfamiliar art – is that we do not have the adequate (visual) habits to validly assess the quality of such material [18]. As soon as we obtain knowledge, use standard routines to evaluate such objects and link them to already known material, we develop multi-faceted, differentiated and, importantly, stable assessment strategies which are much more valid than so-called single-short measurements out of the blue. For instance, if we face participants with new and challenging artworks, they are often very reluctant to look at them, which as a consequence devalues the material shown. Only after deep elaboration do people start assessing deeper qualities, the meaning or complex associations [19]. A decade ago, we developed a standardized, easily employable procedure in elaborating such innovative material as is unfamiliar to the involved persons. In the so-called Repeated Evaluation Technique (RET) [18] our participants are forced to elaborate on the material via standardized routines where they have to reply to pre-defined sets of variables

which cannot be answered without deeply processing the material [20]—see Figure 3.

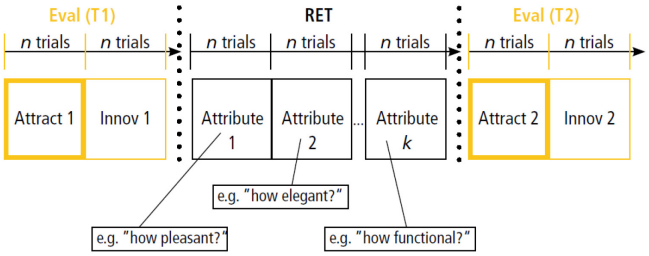

Figure 3. Illustration of a typical RET procedure; in the RET phase, several attributes are asked for in order to force participants to elaborate on the material (figure from [21]).

Typical RET paradigms need about 10-15 minutes for the material to be elaborated on, so the number of such valid measurements is clearly limited to one or two per test session.

Capturing Aesthetic Ahas

The stream of art experience is characterized by a series of insight moments [22], some of which are substantial, some preliminary and still others illusory. Whenever we experience such insights, which we have started to call "Aesthetic Aha"-insight moments [5], we feel pleasure [23]. Most interestingly, such moments are preceded by a complex series of cognitive and affective sub-events as sketched out in Figure 4.

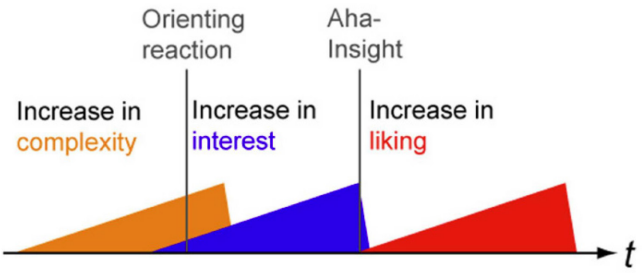

Figure 4. A model describing the sub-events leading to the final increase in liking ("pleasure"). First the cognitive apparatus detects an increase in the complexity of the visual display, then an orientation reaction follows in order to cope with the increased complexity. This orientation reaction triggers an increase in interest in order to allocate the cognitive energy needed to decrease or dissolve the increased complexity. This yields an Aesthetic Aha-insight moment which is accompanied by an increase in appreciation. See for details [22].

Most processing of artworks is regarded as very dynamic, in which aesthetic ahas are followed by even more occluded post-events. Such post-event often lead to new insights, so the aesthetic aha paradigm is quite interesting for analyzing such a continuous and ongoing process in a systematic way. Aesthetic aha events can be referred to as very significant events within the entire experiential process—and, more importantly, these events trigger important mechanisms such as the increase of liking and so are of utmost importance for the understanding of the process (see for this process Figure 5).

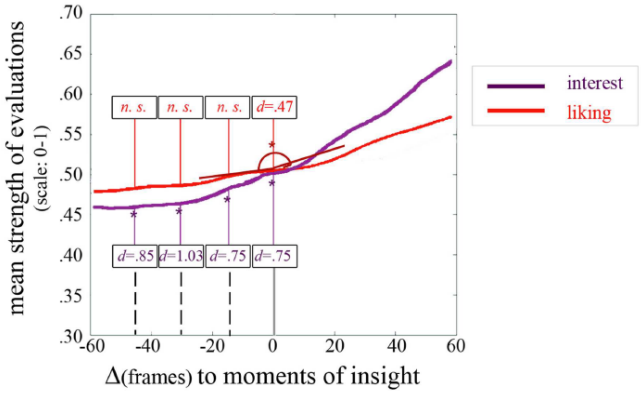

Figure 5. Just before appreciation increases, interest has already begun to increase, supporting the model depicted in Figure 4. Data and further details can be found in [22].

Such rewarding processes—reward being provided by pleasure—are quite influential in understanding how we maintain a high level of interest, vigilance and the motivation to further process a hard-to-decipher, challenging or very uncommon artwork. To identify aesthetic aha moments, only one click by the participant is needed. Nevertheless, such a little click can allure an observer from the genuine aesthetic processing mode, so even such a simple method should be applied to very carefully as it might induce artifacts in the data.

CEP: Continuous Evaluation Procedure

Sometimes knowledge of the aesthetic aha and potential sub-events before and after such an insight moments is just too raw, especially in terms of the time resolution it can offer. Therefore, we have developed the so-called "Continuous Evaluation Procedure" (CEP) which allows continuous assessment of the material on a single variable [22]. For high usability, an analogous lever is employed which can be used even under very restricted viewing conditions – in fact it can be used even blindfolded due to its good haptics quality. Typical data emerging from CEP, here in regard to the assessment of the variable *appreciation* (operationalized by "liking") while watching an artistic film, can be seen in Figure 6. Although we recommend letting participants assess only one variable at a time, the usage of more than one variable can easily be realized by the usage of studies conducted in parallel focusing on different variables when looking at the very same material, mostly sequential stimuli such as film sequences, audio snippets or continuous tactile stimulation.

CEP is of course also capable of capturing experiences when processing physically static material, such as visual artworks or other visual displays [24].

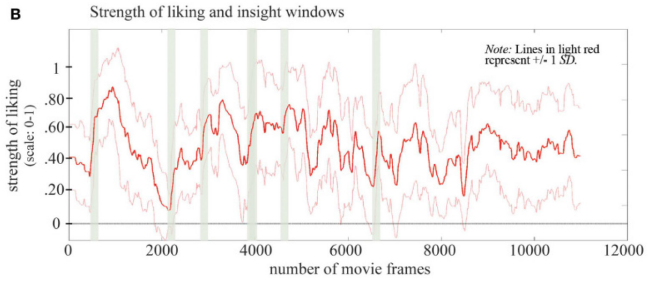

Figure 6. Original data from [22] with assessed liking regarding an artistic movie running for a period of nearly 12,000 frames (at a speed of 30 frames per second). Medium gray bars indicate the aesthetic aha events which are always followed by an increase of assessed appreciation. Clear increases of appreciation can be observed just after such aesthetic aha moments do occur.

Posturography: Implicitly measuring body sway

The theory of "Ur-Affekte" (ur-emotions) by Kafka [25] is interested in respect to a view on affects in terms of motoric responses. Parrot [26] has referred to and expanded on this perspective some 60 years later. These authors interpret an object: here, an artwork—as a stimulus which shows affordances *sensu* Gibson [27]—these affordances are classified with regard to attraction (being attracted to an object) which Kafka calls "Ingestion" (e.g. greed), or aversion ("Ejektion", e.g. reluctance). He also differentiates between fleeing from an object ("Rezession", e.g. if we are frightened) and moving towards an object / a subject ("Profusion", e.g. in the case of loving something or somebody). Some time ago, we started applying his rudimentary concept to a posturographic device, based on the consumer product Nintendo Balance Board ©.

The usage of such a frequently produced end consumer product has two clear advantages: 1) a low price, 2) a variety of available very useful software tools and interfaces which make the programming of such a device very cheap and simple. The Nintendo Wii and its external components have been internationally available since 2006 and use high time and physical resolutions: for just 80 Euros, the BalanceBoard is capable of measuring the weight of a person at four independent locations (top left, top right, bottom left, bottom right of a rectangular area) with high accuracy at a 100 Hz time resolution.

In a series of measurements, we detected a linearly increasing measuring error of about 100 g per 15 kg which is fairly good compared with much more expensive posturographic solutions.

Interpreting the results is quite challenging as the balanced stationary standing is already signed by the compensatory activation of several muscle groups all over the body [28]. To compensate for such movement jitters, we calculate for the event-related sections higher-order Fourier-transformations which are related to the ideal curves. This makes it possible to analyse the fast and event-related motoric reactions apart from any harmonic oscillations. Such residuary motoric reactions seem to reflect the involuntary parts of attraction and aversion. We call this method consequently the "Emotional Footprint" (see Figure 7) as it is capable of capturing simple affective reactions.

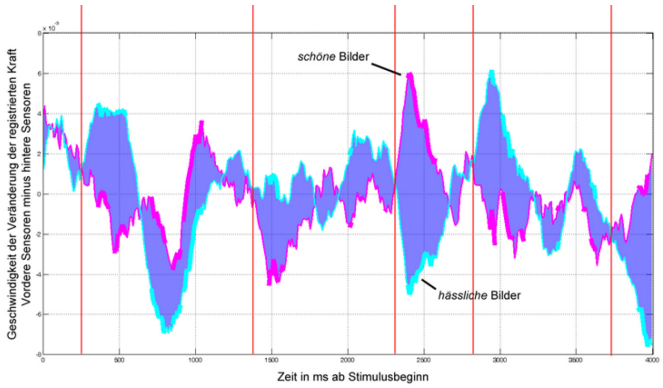

*Figure 7. Typical data from a posturographic device, the so-called "emotional footprint". We have fed beautiful (*schöne Bilder: *"attractive") and ugly images (*hässliche Bilder: *"aversive") into this experimental design where participants spontaneously responded with motor responses without having been explicitly instructed to behave so [13].*

FaceReader: Capturing emotional states

The last technique which I will refer to is also a minimally invasive one as the emotional footprint. The FaceReader technique works with the emotions expressed by the face itself. In fact, we have known for a long time since Darwinian times that among non-verbal signals, facial expressions arguably play a very prominent role in the valid expression of emotions [29]. Besides some general problems that some cultural or societal penalties do exist for showing our expressions directly and besides the partial problem that some participants are actually not capable of expressing emotions clearly, "reading faces" is a very intuitive but also high-quality approach in recruiting information about the inner affective states of a participant. Ekman and colleagues have developed a system of innervating facial muscles which is capable of validly showing a number of discrete emotions that are represented by distinct facial expressions [30]. Usually, such facial expressions are decoded by specifically trained "FACS decoders" which makes the whole procedure extremely expensive in terms of time and personnel [31]. More recent developments in the field of software engineering have made it possible to apply the FACS knowledge to visual parsers such as Noldus FaceReader ©, which we have been successfully employing in our lab for some time now [32]. FaceReader is based on trained artificial neural networks operating on a statistical learning algorithm which is modeled after biological neural networks. Such an approach is often used in cognitive science and machine learning tradition.

The big plus for using FaceReader or comparable software which enables the analysis of expressions is the ease of use. Additionally, facial expressions are automatic and spontaneous, although of course participants can also mimic or fake their expressions. Social desirability seems here to play a much more minor role than in other more invasive procedures, as people just listen to music or watch a film without having to do anything further—this helps to induce states of flow and immersion.

We do of course also face some specific problems with this particular technique, especially when sporadically losing the signal or if the face is occluded by the hands or by unfortunate light conditions. Despite these problems, we can measure continuously over a long period of time without any effort on the participant's side.

Conclusions

The most important message that this paper aims to deliver is that every research question needs a very thorough conceptualization of the employed method. The method should capture the core concept of the aesthetic phenomena under investigation. If we need very deep analysis of the entire process and not continuous assessments during the process, we can definitely go for classic questionnaires operating quite explicitly or we should employ more implicit measures such as the md-IAT [17] which is more optimized to capture automatic responses assumed to be linked with attitudes or motifs. Such an md-IAT is, however, time-demanding and very challenging for the participants. Therefore, I would like to recommend its use only once or twice, but no more frequently than that. As soon as such an md-IAT starts, the aesthetic experience definitely becomes strongly biased. For such a bias to be prevented, more affectively non-"invasive" methods should be looked into and consequently employed, e.g. the continuous evaluation procedure (CEP) [22]. However, although CEP is much reduced in terms of cognitive allocations, it still needs a participant's active role during the utilization of CEP. Thus, fully non-invasive methods can be employed. By employing such measurement devices, of course, dimensionality or complexity and depth of analysis are clearly minimized, but people won't be biased during data acquisition as they do not have a real relatedness to the measurement. Posturography can provide some simple data on the general affective status while experiencing art—I have shown in more detail our so-called Emotional Footprint tool. FaceReader on the other hand can provide very complex – and mixtures of circumscribed – emotional states, while participants dive into experiencing works of art. Nevertheless, even the latter tools, very powerful in incidentally capturing experiential states, are very much limited by technical and practical constraints. For instance, the Emotional Footprint needs people to stay relatively stable on one specific physical spot, while FaceReader needs an non-occluded view to the face. Sometimes, these constraints ask for the application of a mixture of techniques, better known as the multi-method approach. We have had very good experiences in this respect over the last decade in employing such a complex mix of measures, especially if the research questions are quite complex to begin with—and, this also becomes evident after some time investigating phenomena of art experience: art experience is most generally a very complex, still hard to capture process which brings us to the limits of cognitive and affective sciences.

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