MedienPädagogik
Zeitschrift für Theorie und Praxis der Medienbildung
www.medienpaed.com
ISSN 1424-3636

Themenheft Nr. 36: Teilhabe in einer durch digitale Medien geprägten Welt – Perspektiven des wissenschaftlichen Nachwuchses
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Imagination by Design

Imagineered agency and the question of self-determination within digitally designed environments

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Abstract

With the notion of the zero-level digital divide, questions of technological structure have become more pressing for matters of agency. In this, design plays a major role, as it is assumed to be of structural significance, predetermining the architecture of a given technology and, thereby, what one can actually do with it. When also considering the daily importance of digital technologies, the question arises, regarding how these designed technologies impact the way we come to realize reality and, ultimately, the self. How self-determinedly does one utilize digital technologies? As digital products, such as apps lack material elements, which could be adjusted to suit one's personal needs, they are very much dependent on design being available to the senses. Building upon this insight, designers aim at creating user experiences. As experience is a highly personal process, design is dependent on the subject's compliance to cognitively realize such experience. This paper will theoretically explore how design is individually constituted and how education can provide for possibilities to self-determinedly act within the designed environments of digital technologies. Starting with the notion of ‹imagineering›, it will be suggested to conceptualize design as a mental image in order to better understand how design can be cognitively adjusted once it is constituted.

Imagination by Design. Imagineered Agency und die Frage nach Selbstbestimmung in designten digitalen Umgebungen.

Zusammenfassung

Mit dem Zero-Level Digital Divide rücken strukturelle Fragen von digitalen Technologien in den Vordergrund von Teilhabe. Design von digitalen Technologien stellt hierbei einen sehr wichtigen Bereich dar, weil davon ausgegangen wird, dass sich das Design einer Technologie aufgrund seiner strukturalen Rolle in der jeweiligen technologischen Architektur signifikant auf die Nutzungsweisen auswirkt. Wird bedacht, dass digitale Technologien heute einen essentiellen Bestandteil des täglichen Lebens darstellen, so stellt sich hiermit auch die Frage, welchen Einfluss diese designten Technologien auf die Art wie wir Wirklichkeit und damit auch unser Selbst wahrnehmen besitzen? Wie selbstbestimmt nutzen

Fischer, Felix. 2019. «Imagination by Design. Imagineered agency and the question of self-determination within digitally designed environments». *MedienPädagogik* 36, (November), 1–17. https://doi.org/10.21240/mpaed/36/2019.11.09.X.

wir eigentlich digitale Technologien? Weil digitale Produkte, wie z.B. Apps, keine physischen Elemente besitzen, die an die individuellen Bedürfnisse anpassbar wären, bedürfen digitale Technologien eines durch die Sinne erfahrbaren Designs. Da Erfahrungen als individuelle Prozesse auf die Kognition des Subjektes angewiesen sind, bedarf auch die Konstitution von Design der ‹Compliance› des jeweiligen Nutzers. Der vorliegende Beitrag versucht zu klären, wie Design konstituiert wird und an welchen Punkten Bildung ansetzen muss, um ein selbstbestimmtes Agieren in designten Welten sicherzustellen. Mit Verweis auf die Idee von ‹Imagineering› wird vorgeschlagen, Design als mentales Image zu konzeptualisieren, um ein Verständnis davon zu erlangen, wie Design-Images verändert werden können, ohne dabei die materiellen oder sensorischen Elemente zu verändern.

A designed issue

In the way digital technologies allow for the reception and production of information, they carry inherent potentials for shaping one's perception of reality, and in the process, of self (cf. Wohn and Bowe 2016; Bürdek 2015, 9). In this, design plays an important role, as it predetermines how humans interact with and via digital technologies. Hence, it is striking that in German (media) pedagogy, scholars are only gradually querying the full impact of design on the human condition, especially in terms of securing agency within highly networked and designed environments (positive: cf. Jörissen and Verständig 2016; Jörissen 2018).

Unlike the prevailing everyday notion of design, commonly understood as the aesthetic arrangement of (surface) elements, in this contribution, design is conceptualized in a much broader sense by also considering its structural quality: In this, design has the potential for transforming personal behaviour and, in the process, culture (cf. Jörissen 2016). Let's take smart watches, for example: At a first glimpse, they seem to be somewhat regular digital watches. However, when looking at the way the software is designed – their technological architecture – these watches function as much more than that: They can be set to remind one to regularly exercise, when and how much to drink, when and how long to sleep, and they record specific behavioural parameters. In this, a watch's design has the potential for changing users behaviour and turning them into habits. An example for this would be providing for data about one's workout that allows for monitoring of individual progress and adjustment of workout sessions. In the bigger picture, such tendencies of *monitoring* personal behaviour and habits has the potential for transforming culture, as becomes perceptible with the example of the ‹quantified self› movement, which aims toward learning about the self through self-produced data (cf. Lupton 2017; Wolf 2009).

Habit forming and habit transforming design has become a major branch of product design, as it aids in securing customer loyalty by making the product an integral part of daily life (cf. Liu and Li 2016). Though, the question is: How many of these habits are consciously noticed and, thus, welcomed? And how many remain unnoticed and, therefore, are a potential threat to self-determined action?

In order to tackle these queries, this piece argues that design must be seen in a much broader context than the mere surface design of smartphones or apps. In fact, the underlying processes, codes, and the overall employed logic, running a given system, are as much of importance as the arrangement of sensory elements or the social interaction taking place within these designed environments (e.g., Baym 2015). This paper will plea for not allowing technological design to fall short in pedagogic research. With the notion of the *zero-level digital divide*[1] (cf. Iske, Klein and Verständig 2016), it could be argued that knowledge of infrastructural design and its implications on interactions predetermines how self-determinedly a user interacts with a given technology or platform.

As will be shown throughout this article, to solely query the design of digital technology won't serve the matter any justice, as design can be no end in itself. It requires a subject with whom it can enter into a cognitive symbiosis, transforming design into what designers refer to as ‹big-D›: a designed experience (so-called ‹UX›). Therefore, this article calls upon investigations, which bring together two lines of inquiry: the design of technology and the individual grounds upon which this symbiosis is cognitively undertaken.

As most contributions are concerned with the empirically perceptible aspect of design, which is, in its essence, the arrangement of sensory elements, the article at hand will concentrate on the implications of design in its entire capacity at the ‹human end›. That being said, ‹human interfaces› or ‹user interfaces› (UI) and the way users interact with such is of especial interest as UI can be understood as the common ‹gateway› for humans to a particular technology (cf. Hartevelt and van Vianen 1994). Deriving from this, the operating hypothesis is, that in order to maintain agency over one's interaction in digital environments, one must be aware of the UI design and the interwoven ‹design agenda›. As Jörissen (2016), with regard to Mareis (2011) argues, design is always imbued with particular forms of knowledge (e.g., usage scenarios), thus carrying epistemic potential that is realized in the moment of ‹affirmative usage› (cf. Jörissen 2016, 28; 2018). Under *hyperconnected conditions*[2], design shifts away from a mere aesthetic arrangement of physical elements and toward a process of making the abstract world of codes, digital processes, and networks *experientially* accessible (cf. Bürdek 2015).

1 The notion of the *zero-level digital divide* addresses issues of divide and thereof resulting inequalities due to the internet's architecture – so to speak, its *‹infrastructural-technological design›* (cf. Verständig, Klein and Iske 2016, 52). For example, code of software may regulate usage behavior by providing for filtered information (e.g., by means of algorithms) or by allowing for certain actions (e.g., restrictions of function). In this, code is already predetermining what can be done by whom. As a result, the internet is not the same for everyone.

2 The notion of hyperconnection refers to the ascending «primacy of interactions, processes and networks as opposed to the current ‹stand-alone things, properties, and binary relations» (cf. Floridi 2015, 2).

At a first step, this paper elaborates on the employed notion of design. It will be argued that design can be conceptualized as an experiential process. As a pragmatic framework, the concept of ‹mental imagery› will be introduced in order to place emphasis on the cognitive basis of design as an experience. Due to design's implicit forms of knowledge, it will finally be argued that for securing agency within designed communicative spaces, it is not so much of importance to physically redesign designed environments, but to develop the ability to create and reshape the designed conditions, purposes, and norms, independent from design's material, medial, or technological form (cf. Jörissen 2017). This process will be referred to as ‹imagineering›. In this, education plays a major role. It introduces a higher cognitive counterweight to the otherwise evolutionary and automated mechanisms (e.g., habits), which design builds on in order to be mentally constituted.

A cognitive account on design

Digital products rely considerably on design: Unlike material objects, ‹digital things› are purely informational, making it necessary to provide for experiential access (cf. Jörissen 2016). As a result, design discourse has undergone a radical shift from traditional design, which is often referred to as ‹small-d›, addressing a rather *inventive* process out of which (material) products are developed, to so-called ‹big-D›. ‹Big-design› aims at creating user experiences, which interpret and visualize the abstract world of codes and algorithms in order to make them available to the senses (cf. Bürdek 2015, 243). As interpretation processes are always directed from a certain world view (based on a ‹model of reality›) with certain knowledge and under the impression of specific ideologies – with an agenda in the broadest sense – design and designed experiences are always imbued with a variety of knowledge forms.

When conceptualizing experience as an autonomous and individual process – after all, experience is a private matter that varies between individuals and can consist of the flow of perception, bodily sensations, emotions, and much more (cf. Pope and Singer 1978, 1) – designing an experience is reliant on the subject's willingness to *comply* with the implied usage scenarios, models of reality, and ideologies, which are part of the design. Hence, designers must, first and foremost, establish a basic relationship between the available sensory elements of a product and the subject in order to provide for a basis upon which the intended experience can be generated (e.g., Hogue 2005). Pragmatically speaking, this must be accomplished by addressing basic cognitive processes in which ‹evolutionary mechanisms› are triggered and automatically executed, so that no conscious decision, as to if and how one should interact with a product, is necessary. As a consequence of such theoretical framing, the sole investigation of the perceptible arrangement of sensuously available elements won't do the matter any justice. Instead, one ought to also consider the cognitive mechanisms involved in generating and maintaining a designed experience.

At a first step, it appears valuable to commence with the question of what designers mean by the notion of ‹designing a user experience› and how they pragmatically work on the issue. From here, light is shed onto the neurocognitive processes involved (cf. chapters 3 and 4).

Garrett (2006) provides for a pragmatic account, in regard to creating a designed experience. To him, designing an experience means addressing the subject's experiential abilities from a multitude of sensuous, cognitive, and conceptual planes. He differentiates these into:

1. Sensory design (manifest level/ surface)
2. Information design (skeleton level/ arrangement of design elements)
3. Interaction design and information architecture (structural level)
4. Functional specifications and content requirements (scope level)
5. User needs and product objectives (strategy level)

On the *sensory plane*, or ‹surface› (e.g., UI), sensory elements stimulate the senses, which are regularly of – but not limited to – visual, auditory, or tactile quality. In order to be of any interest, the surface must attract the subject's attention and elicit motivation for further engagement with the designed object. This is usually realized by means of aesthetic form. Neurological studies indicate that aesthetic appreciation is a two-step process: First, the individual performs a general evaluation of the aesthetic value of an object (‹beautiful› vs. ‹not beautiful›) – often via visual perception. This usually occurs within the first 300-400ms of perceiving the stimulus. In a consecutive step (400-1000ms), the object is further aesthetically judged by comparing it to other known (non-)aesthetic stimuli (cf. Righi et al. 2017). In his theory of the neurobiological foundations of aesthetics and art, Rolls (2017) points to the great importance of emotions in the process of aesthetic judgement. According to evolutionary theory, emotions decode a stimulus as either being rewarding or punishing, thus, generating a goal for further actions (e.g., further engagement with the object).

The fashion in which the sensory elements are arranged, and thus, which emotional reaction they provoke, is predetermined by the *information design* (‹skeleton plane›). The information design resembles concrete expressions of the underpinning *structural level* (the underlying ‹blue print›) and, hence, articulates the intended ‹flow of experience› (cf. 36).

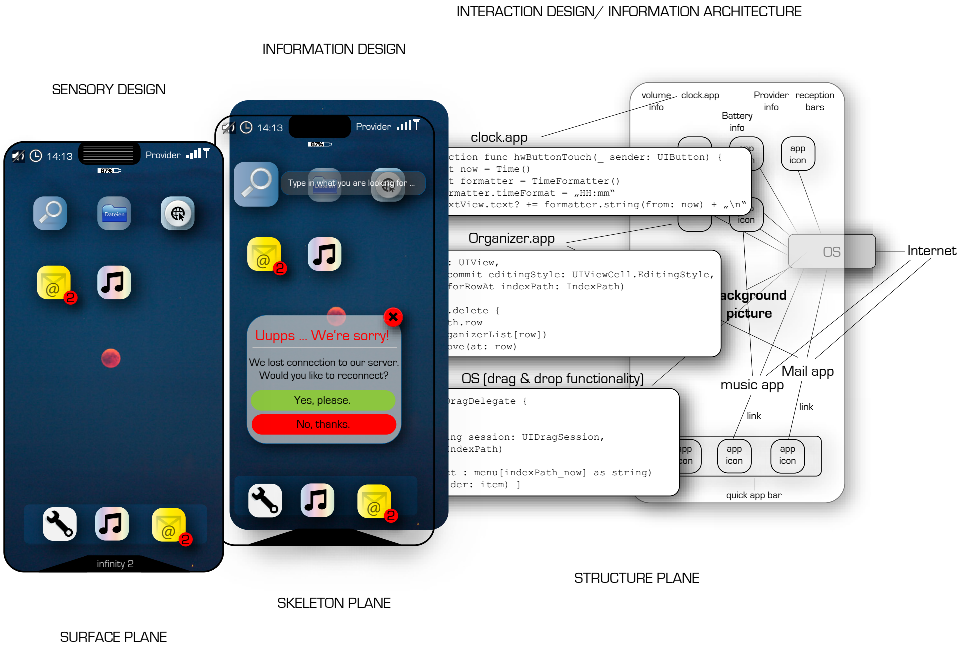

Fig. 1.: Three important planes of UI design for ‹engineering› an experience (cf. Garrett 2006; Kofler 2019, 385, 731, 1087; graphic F.F.).

Figure 1 visualizes the different forms of ‹micro designs› involved in UI design: When imagining all three planes stacked behind each other, the surface plane would be in front of the skeleton plane, which would be in front of the structural plane. Both the surface and the skeleton planes, are important for actually initializing an experience, whereas on the structural plane, the interaction design and information architecture allow for engineering of the intended experience on a theoretical level. However, it is the surface that evokes interaction with a given design, as it provides for sensuous stimuli that raise one's interest and, perhaps, cue habitual responses.

At a very basic level, the ultimate goal of design is to trigger, transform, or even create habits (cf. Liu and Li 2016). Habitual responses (also known as stimulus-driven control behaviour) are executed upon a perceived stimulus, no matter the action's consequences (cf. O'Doherty, Cockburn and Pauli 2017, 74f.). Such model-free behavioural routines are hard-wired into the brain, making it possible to automatically execute them without taking up valuable cognitive capacities (cf. ibid., 88). In this quality, habits are often difficult for the individual to control or even notice. From a design point of view, habits are valuable, as they secure interaction with a given product without the subject consciously reflecting on its usage.

As for the design of UI, the elicitation of habitual responses or the (trans-) formation of such is of great significance, not only because habits allow for automated (‹intuitive›) usage of UI, but also because habits can be shared in social groups. By addressing these social or communal habits (e.g., reception preferences), a design can be embedded within given cultural norms (e.g., Pietrass and Ulrich 2009). This makes the acceptance of a product more probable.

Thus, for design to be intuitively accessible, designers must not only provide for aesthetic stimuli, which raise interest and guide perception, but they also ought to anticipate users' habits, embedded into specific nonmaterial cultures[3]. By doing so, different usage scenarios can be implied through the arrangement of sensory elements, essentially drawing upon individual, as well as commonly shared habits (‹conventions›).

When considering habit eliciting design, a simple process of cues, routines, and rewards are at the onset of the creation of a user experience. Whereas cues (e.g., triggered by sensory stimuli) provide for a necessity to act (e.g., message buzz as an external trigger), the reward (e.g., positive emotional response) for the successful execution of a behavioral routine (e.g., interaction with others) can be considered as an emotional ‹building-block› for creating a further motivational foundation for an ‹experience›. However, design may also contradict established habits, therefore, ‹cognitively› challenging the individual to transform existing habits.

Marketing research has identified a variety of different experiential domains, which are of potential interest to commercial product designers:

1. *sensory domain* (e.g., products with aesthetic and sensory appeal),
2. *affective domain* (e.g., products that trigger emotions),
3. *cognitive domain* (e.g., products that engage with customers on a creative problem-solving level),
4. *physical domain* (e.g., products that encourage to act and foster habits), and
5. *social domain* (e.g., products that target the desire for a specific way of life or to relate to a group identity) (cf. Schmitt 2015).

The commercial interest in designing ‹rewarding› user experiences, which address a variety of sensuous, cognitive, as well as social modalities lays in the simple hope that consumers can be manipulated in their behaviour and, ultimately, create habits in favor of the product (cf. Levy 1959; Sametz 2006, 26) or in favour of an underpinning idea, such as sustainability, to name one example.

Habitual adjustments, elicited by design, can be understood as a very basic ‹educational process›, best resembled by the notion of *upbringing* (cf. Jörissen 2016, 2018a): In this way, design educates individuals in that it conditions them on what to do and what not to do. The notion of design as some kind of an *‹educating force›* is not new, as it can be found in prior architectural debates, such as that of ‹Bauhaus›

3 Although the concept of culture is quite complex, it is traditionally differentiated into (1) material culture, which encompasses architecture, paintings, fashion, theatre and alike, as well as (2) nonmaterial culture, including values, belief systems, rituals, worldviews, and so forth (cf. Ahmad 2008, 23).

(Bürdek 2015, S. 27). Through emerging digitalization, however, the matter has risen to heightened importance (cf. Jörissen 2018), as by means of algorithms and artificial intelligence, designs of UI are provided with a prodigious potential for greater adaptability and, of course, for greater possibilities to influence users' habits. These technological developments shouldn't lead to the promise of a ‹technical fix› in education, however. Instead, they rather require education for self-determined action.

When speaking of ‹educating›, it seems inevitable to consider design in its processual capacity (cf. Ehn 2013). Thus, taking the designer's claim of creating user experiences seriously, it appears reasonable to assume design as being of chief *cognitive quality*.

The imagineering of design

The notion of design as experience encompasses a triangulation of both the design in its perceptible manifestation (e.g., aesthetically arranged elements, pixels, etc.) and the ‹human end›, meaning the person generating and maintaining the actual experience. In this, design is constituted in a complex relationship between the perceptible form of a product and the individual's compliance to experientially, as well as cognitively realize the designer's anticipated forms of knowledge. Thus, Bürdek (2015) refers to this complex process of designing as one of ‹*imagineering*›[4] (cf. p. 152, 243ff.).

The word-play may seem a bit peculiar at first. However, at a second glance, it captures quite vividly the transformation of increasing complexity, which (digital) design is confronted with: The term ‹imagineering› refers to this new task, which should «allow others to see and experience the [often diffuse] ideas involved» (ibid.; ad. F.F.) in digital products. As a process, it addresses both the rational side, as well as the emotional side of users by providing for a meaningful experience that triggers the imagination as a powerful processing tool (cf. Kuiper and Smit 2014, 9). In the context of digital design, this is important, as design is confronted with the highly complex task of marrying the abstract world of codes and networks with the experiential reality of humans. As Nijs (2019) points out, ‹imagineering› as an «experience-driven design approach» (p. 22), is ideal for such complex tasks, as it accounts for the lack of simple deterministic cause-and-effect relationships in complex matters and allows for new ways of design and reasoning by capitalizing on experience-based abilities, such as creativity (cf. ibid., 23). In this, ‹imagineering› is no sole tool for product designers, but it is a form of experience-driven reasoning in the broadest sense.

When disassembling the term ‹imagineering› into its two word-components, ‹image› and ‹engineering›, the following implications arise in terms of design:

4 The term ‹imagineering› was brought to public awareness and later was registered as a trademark by US movie maker Walt Disney. Currently the term is used in design discourse to describe «a new style of design thinking» (Lichtenstein 2019, XII).

1. The term ‹image› refers to design as a cognitive structure (format), which must be *imagined* (cognitively realized) by the subject.
2. This act of imagination, however, is not left to the subject's choice or to chance, but has to be carefully ‹engineered›, meaning that the subject must be motivated to imagine the forms of knowledge and usage scenarios anticipated by the designer and expressed in the arrangement of forms, elements, and pixels.

In the following, the ‹format› of experiential design is explored. It will be argued that the cognitive structure of mental imagery could be a valuable commencing point, as suggested by the term ‹imagineering› itself. So, the question is: What is a mental image? And how is it connected to design?

A brief review on empirical work concerning mental imagery

Psychological investigations often define mental imagery as a multisensory (cf. Spence and Deroy 2013; Lacey and Lawson 2013; Kosslyn, Thompson and Ganis 2006, 4) «experience like perception but in the absence of a percept» (Holmes et al. 2016, 250). More specifically, mental imagery can be thought of as a cognitive process (cf. Kaufmann 1996, 101; Zvyagintsev et al. 2013), which primarily accesses perceptual information from memory (cf. Cartwright et al. 2019). Although mental imagery can be generated, as well as sustained in the absence of exteroceptive stimuli (cf. MacNamara 2017; Lewis et al. 2013, 391) by retrieving information from long-term memory, there is another route via which images can be generated: Sometimes short-term memory is utilized, drawing directly from immediate perceptual information (cf. Pearson et al. 2013, 6). Unlike ‹afterimages›, which are the result of photochemical processes in the retina, mental imagery can be relatively prolonged and it can also contain novel perceptual information by means of modified perceptual information or new combinations of perceptual information (cf. Cartwright et al. 2019, 2). Furthermore, mental imagery can be consciously generated by the subject in an act of imagination or unconsciously, as a result of an external stimulus (cf. Lewis et al. 2013, 391).

Traditionally, psychologists differentiate mental imagery into two means of representation:

1. *Depictive representation* (cf. Kosslyn, Ball and Reiser 1978), as well as
2. *propositional/ descriptive representation* (cf. Kosslyn, Thompson and Ganis 2006, 10; Reisberg 1996, 165ff.).

Both types of representation are coded in different formats: The depictive format addresses the experiential quality of mental imagery, that is to say the sensory modality, having been well-researched with visual mental imagery. At this level, representations are explicit and accessible in every aspect of shape, size, orientation in space, texture, color, (special) relations of different points or elements, and so forth (cf. Kosslyn, Thompson and Ganis 2006, 14). Some individuals have been found to represent ambiguous objects accordingly as ambiguous mental imagery (cf. Mast and Kosslyn 2002). As Pearson et al. (2015) point out, this must be achieved at the depictive level (cf. p. 596), as at the descriptive level (verbal thinking), ambiguity is not possible, due to the propositional format (cf. Reisberg 1996). In contrast, descriptive representations (propositional format) encompass symbolic, that is to say, abstract concepts (cf. Kaufmann 1996, 103). In propositional format, representations are explicit and accessible on a level of *semantic relations* (cf. Kosslyn, Thompson and Ganis 2006, 14), providing for specific descriptions about shape, size, pitch, and so forth. Consequently, descriptive representations only specify what was included at the moment of the creation of depictive representation (cf. ibid.). For matters of design and designed experience, the depictive level, and especially its phenomenological characteristics (that is the way they are consciously experienced by the subject) will be of especial interest in understanding how design is not only mentally constructed, but how it is also *experienced*. Thus, the rest of this article will deal with the depictive representational format.

As Behrmann (2000) points out, mental imagery plays a key role in day-to-day tasks, such as processes of learning, reasoning, problem solving, as well as language comprehension (cf. p. 50). In addition, mental imagery has been found to be important in memory, creativity, and emotion (cf. Kosslyn, Thompson and Ganis 2006, 4).

The phenomenological characteristics of mental imagery are commonly described and measured by the vividness of a mental image (cf. Pearson et al. 2013, 7; Marks 1999). Vividness is defined as «a combination of clarity and liveliness. The more vivid an image, therefore, the closer it approximates an actual percept» (Marks 1999, 570 cit. a. Marks 1972, 83). An important aspect of vividness are emotions that share a profound link with mental imagery (cf. Wilson et al. 2018). Experiencing emotionally vivid mental imagery typically triggers much of the same physiological reactions as actual perception of stimuli with a comparable emotional valence (cf. Cartwright et al. 2019, 2), thus, underlining the intense experiential character of images. Additionally, clinical studies suggest that people with a strong ability to self-directedly generate and experience mental imagery, especially of the visual kind, are more emotionally regulated, as they are able to mentally pre-experience and, thus, simulate the likely outcome of a given event (cf. Maxwell et al. 2017, 274; Holmes et al. 2016; Marks 1999). In this, mental imagery plays an important role in emotional regulation, motivation, goal planning, as well as readiness for action (cf. Laing, Morland and Fornells-Ambrojo 2016; Marks 1999).

Where the magic happens: How design becomes a designed experience

So, how does design become a designed experience? To answer this question, the concept of mental imagery provides for a theoretical perspective and allows for better comprehension of the cognitive format of a designed experience. Whereas more basic mechanisms, such as aesthetically guided perception or habitual responses, have been discussed as establishing a mental connection between product and subject, mental imagery allows for insight on how design is actually experienced and maintained as a cognitive process. As indicated, mental imagery is not ‹just› one form of cognitive representation of the sensory elements of a given design, it is *the* format in which humans reason, creatively solve problems, or plan future actions. By means of emotions, for instance, mental imagery can be vividly experienced and, thereby, approximates actual perception. Through this, mental imagery becomes an experience in the conventional sense.

In relation to a design image, the mental image itself cannot be an objective representation of the arrangement of sensory elements per se, but is already the structured outcome of the way in which the sensory elements have guided perception. The design image is, so to speak, the suggested interpretation, via the arrangement of the sensory elements that represents the intended ‹flow of experience›, arranged by the designer. Thus, the generated mental image is potentially ambiguous in meaning, as this interpretation is – despite its suggestive nature – one of many that can be derived from the arrangement of sensory elements.

Consequently, ‹engineering› an image, as suggested by the term ‹imagineering›, means to experientially guide the individual to cognitively realize the anticipated forms of knowledge, accepting and realizing the underpinning model of reality (‹world view›), as well as the implied ideologies, which in turn logically structure the according design and provide for its very identity. This may be achieved by creating ‹aesthetic incentives› (e.g., aesthetic arrangement of sensory elements) in order to evoke the subject's interest in the object (e.g., Rolls 2014; 2017), as well as to guide the perception process of the elements (e.g., Arnheim 1980). Other factors may include habitual stimuli, which allow for automated usage of design and provide for rewarding experiences.

Based on the perceptual outcome, which is stored in short-term memory, a mental image is constructed. As indicated by an ERP-study[5], positive emotions may influence the bottom-up modelling process of the according representation (Righi et al. 2017). This insight may be important in understanding the subjective nature of image construction and the delicate tasks designers are confronted with, when trying to elicit a certain design image by providing for the proper perceptual, as well as emotional stimuli.

5 ERP stands for ‹event-related potential›. ERP-studies typically measure brain responses to immediate sensory, cognitive, or motor events.

As evolutionary-based cognitive theories on aesthetic reception argue, most mental processes are part of evolutionary-developed mechanisms and automated routines (cf. Rolls 2014; 2017; Dutton 2005), which mostly occur beyond conscious control. Consequentially, if sensory elements are arranged in the proper manner, they function as strong stimuli, leading to design image creation by the individual. This includes the implicit realization of different forms of knowledge, world views, and so forth. With respect to the opening question of this article, concerning how self-determined action can be possible in designed environments, the answer must be: self-determination seems less probable at the point of image constitution. Though, as theories on mental imagery show, this is not the end of the story. On the contrary, theories about mental imagery teach us that such are not photo-like entities that cannot be changed. In fact, the adaptability of images can be considered as one of the most important characteristics of mental imagery, which humans utilize for creative thinking, problem solving, and so forth.

Thus, for pedagogy, understanding the construction process of mental imagery is one part, but what seems to be even more important is the question regarding what one can do with a designed image, once it has been constituted. To put it in different terms: It seems less important to physically alter a given designed environment or object – which is oftentimes not easy to achieve – but rather to develop the ability to create and reshape the designed conditions, purposes, and norms independent from the design's material, medial, or technological form (cf. Jörissen 2017). When recalling the different characteristics of mental imagery, it was reported that mental imagery is an ideal format for the individual to simulate future scenarios, in order to prepare for future actions. This is done by *transforming* and *manipulating* existing images. Image manipulation has been found helpful in problem solving, by means of taking on different perspectives. This involves the restructuring of an image, and thereby reconstructing an alternative meaning (cf. Maxwell, Lynn and Lilienfeld 2017, 271; Pearson et al. 2013, 5-8).

In educational terms, the process of image transformation and manipulation can be seen as the essential representational form for critical reasoning, in which the established design image can be reevaluated and reinterpreted without actually altering the physical structure of sensory elements. It may be argued that the cognitive redesign of a design image could be the first step toward (inter-) acting with a product on an informed basis: not on the designer's, but on the individual's terms. All the individual requires, as mental imagery teaches us, is one's ability to imagine.

Closing remarks: Education and imagination in designed environments

The aim of this article was to show that research on design and designed structures of digital technologies is not an end in itself, but is the necessary foundation upon which interaction on social platforms, with digital technologies in general, or in designed environments must be interpreted. It was further argued that, in educational research, it is worth it to not only focus on the actual physical arrangement of sensory elements, but also on the cognitive act of constructing and transforming design as a mental image.

The proposed focus on mental imagery allows for a more individual-centered perspective, as it motivates to query and understand design as an individually constructed mental image. Commencing from this theoretical frame, a variety of new questions arise for educational scientists, such as: How is design established as an experience within one's mind? And, how can one use mental imagery to secure one's autonomy while operating designed technologies? For media pedagogy, this perspective comes with far-reaching implications, as it demands focus on the cognitive dimension, that is the manipulation and transformation of mental imagery – or better: ‹imagineering›. This is not to say that physical engagement with the material dimension of media or scientific investigations toward media's material form are obsolete. On the contrary: Cognition, and more specifically experience, is profoundly linked with our physical world, as it provides – psychologically speaking – for the stimuli that regularly elicit cognitive processes. But it is suggested that in digital environments, the cognitive ability to work with design images both critically and reflectively is of especial importance, particularly in light of experiential design, as it allows for critical investigation toward ‹design's agenda›.

The perspective of ‹imagineering›, hence, forces one to query: How is a design image engineered? How and at which stage does design impact the choices individuals make? When glimpsing at the habitual, as well as evolutionary-directed mechanisms that guide interest and perception and thereby the construction of the design image, one could, indeed, come to understand that the cognitive construction of implicitly interwoven design is inevitably a design-directed process. However, the concept of mental imagery shows that this is not the end of the story. It is more so that one must acknowledge that the transformation and manipulation of such designed images is possible, although such must be learned, and that autonomy can be strived for by experimenting with these designed images. Here, education comes into play, as it can prepare the individual to critically reflect upon these images and to make transformational changes, independent from the conditions, purposes, and norms set by design's material, medial, or technological form (cf. Jörissen 2017).

As Jörissen and Verständig (2016) note, the consideration of code and design as constitutional aspects of education in the digital world of ours comes with many new implications, questions, and unknown constellations, not only for the tech-industry, but much more-so for educational science. In this, new competencies must be taught to account for these transformational changes. One of such competencies, thus this article's main argument, is imagineering. As shown throughout this article, imagineering is no one-sided tool, which designers only employ to provide for their designed experience. It is rather a process that carries inherent epistemic potential, in that it allows for the individual to redesign a design image: a competence that appears of chief quality in increasingly designed digital environments.

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