REDUCING UNCERTAINTY IN THE DESIGN PROCESS: THE ROLE OF AESTHETICS

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ABSTRACT

Uncertainty in the design process is a common situation in which, designers and users are making decisions that are uncertain with respect to the (degree of) fulfillment of their goals. Therefore, design-participants (designers and users) need to develop ways that will handle and reduce their design-uncertainty in order to choose the best action before learning and prevent the possible failure of the interaction. Providing an explanation for the general role of aesthetics in an interaction, we suggest that aesthetics through their emotional dimension (aesthetic emotions) are implicitly associated with the design process by inducing the reduction of design-uncertainty. From our perspective aesthetics are about action. They are a fundamental aspect of design that enhances the communication between the design-participants by promoting the achievements of goals in the design process.

Keywords: aesthetics, aesthetic emotions, design-uncertainty, design process, emotions.

INTRODUCTION

Everyday life problems make us stand in front of many complex decisions, and that for the most of them we are not aware of their direct consequences. In fact we live and act only by knowing something about the future; while the problems of life and its manipulation arise from the fact that we know so little about them (Knight, 1964). Living in such uncertain environments we develop ways to minimize the risks of such decisions. As such, we use functions that aid us in anticipating the implications of our future actions and in choosing the best alternative that will bring us one step closer to our goals, always with respect to the current conditions. Hence, we view the uncertainty as an aversive state that we are motivated to interact with in order to reduce it, most of the times by anticipating or learning (Bar-Anan, Wilson, & Gilbert, 2009; Bickhard, 2000; Osman, 2010). Generally, the best way to eliminate this uncertainty is to act-and-learn by your failure (Bickhard & Campbell, 1996), making the next same or similar interactive step much safer.

The interactive uncertainty is a common path that designers and users have to pass through in their road towards fulfilling their goals in the design process. From the designer’s perspective, there is uncertainty with respect to deciding the ways to better offer/provide the ways of interaction with the environment, through the artifact, and according to his goals. From the user’s point of view, there is uncertainty with respect to deciding which are the available ways of interaction with the artifact, according to his personal goals (Beheshti, 1993). Therefore, design-participants (designers and users) should develop ways that they allow them to choose the best action before learning and prevent the interactive failure.

In this direction, considering design as a cognitive process that supports anticipatory and purposeful (goal-directed) actions of the design-participants, our aim in this paper is to argue that aesthetic experience, through its emotional dimension, functions as an evaluative process that affects our anticipation for
stable interactions or in other words, for successful
design decisions. What we propose is that aesthetics
are a crucial aspect of interaction, and as such, they
reduce the uncertainty of the design process.

THE UNCERTAINTY OF THE DESIGN
PROCESS

DESIGN PROCESS AND MEANING-MAKING
Generally, in the evolution of human beings, design
process is considered the central activity through
which we attempt to change the existing situation into
one that better serves our aims and goals. According
to Banathy (1998), “design is a creative, decision-
oriented, disciplined inquiry that aims to: formulate
expectations, aspirations and requirements of the
system to be designed; clarify ideas and images of
alternative representations of the future system;
device criteria by which to evaluate those alternatives;
select and describe or ‘model’ the most promising
alternative; and prepare a plan for the development of
the selected model” (p. 169). In this way, the term
‘design’ is usually referred to a goal-oriented process,
in which the designer forms a web of representations
concerning the design problem space (e.g.
understanding needs) and the design solution space
(e.g. solving problems and improving situations)
(Bonnardel, 2000; Friedman, 2003). Almost all the
theoretical approaches for the design process share a
common aspect; the design process exhibits an
interactive nature and it supports the meaning-based
actions of the design-participants, thus design should
primarily be considered as a process of cognitive
construction (Arnellos, Spyrou, & Darzentas, 2007a,
2007b, 2010).

Accordingly, in our view, any analysis and modeling of
the design process needs to shift from the perspective
of problem framing or/and solving, to the perspective
of meaning-making. In a dynamic context of design,
the process of meaning-making is interactive and
future-anticipatory, and is explicitly related to the
construction and/or choice of appropriate functions for
a specific interaction with the environment. In other
words, meaning-making is considered as the process
of constructing ways of interaction with the
environment. These ways of interaction are
constructed as functions (the functional substratum) of
each system (i.e. designer and user) participating in
the design process (figure 1). In particular, the designer aims to communicate its
meaning (range of possible ways of interacting with
the environment) to the user, through the artifact. The
designer offers/ provides ways of interaction with the
environment through the artifact, and according to his
goals. In parallel, the user interacts with the artifact in
order to understand those ways of interaction and in
order to select and to use them according to his
personal goals. In other words, users and designers
are interacting through the artifacts. Therefore, the
artifact is the medium of the design process.

DESIGN REPRESENTATIONS AS ANTICIPATION
We consider design as an interactive and constructive
(cognitive) process by which, each of the design-
participants select among a range of available ways of
interaction (Arnellos, Spyrou, & Darzentas, 2007a),
which are indicated by the environment (artifact) in
connection to the design-participants’ inner
capabilities. The problem of action selection – all those
ways of interaction, which make us aware for the
appropriateness of a function or a combination of
them for a specific interaction with respect to our
goals–, is related to the construction of a design
representation. Accordingly, design representations
are the content of the design process (Arnellos,
Spyrou, & Darzentas, 2007b; Arnellos, Spyrou, et al.,
2010). It is important to note that those design
representations are directed towards the future, where
successful outcomes of interactions are anticipated, always with respect to the goals of the design-participants. Therefore, and considering the interactive and future-anticipatory nature of the design process, we suggest that the awareness of the interactive alternatives is explicitly related to design representations, which are constituted as *anticipation* of the design-participants.

Therefore, the design-participants anticipate those design representations; hence, design representations become anticipations. In other words, design representations, are emergent in anticipation of what further actions and interactions are indicated as possible in the particular environment through the artifact. Moreover, those anticipations have a positive or a negative value, which is dynamically determined based on the *presuppositions* of interaction (i.e. the conditions under which the interaction will succeed, that is, it will bring a design-participant closer to his goal). Those presuppositions are consisted of the conditions of the environment, of the properties of the artifact, and of the design-participants’ past experiences, overall cognitive capacities, and physical capabilities (what is usually reduced to what we call ‘target group’ with respect to users). Therefore, presuppositions of interaction exhibit a dynamic nature that came from the properties of the design-participant and the environment he acts.

To summarize, design-participants try to communicate and to use their design representations, which provide a complex of ways of interaction with the environment, through the artifact. The artifact is the medium of the design process. The designer provides a range of actions with the artifact, and as such, he provides ways of interaction with the environment. Accordingly, the user selects from that range of actions with the artifact and, in this way, he selects his own ways of interaction with the environment. The provision and selection of actions, and consequently, the realization of the respective interactions, is related to the functional substratum (already existing or/and dynamically constructed and modified through interaction with the artifact) of the design-participants. The design representations are the content of the design process. Those representations are formed as anticipation, which has a value. This value is related to the presuppositions (conditions) of each interaction, whose dynamic nature implies that the anticipation can also be false. Therefore, the deeper understanding of the functionality of such anticipation, how it is created and how it contributes to the design problem of action selection should be an essential component in any theory of design (Arnellos et al. 2007b, 2010; Zamenopoulos and Alexiou 2007).

**THE VIRTUAL FALSIFICATION OF THE ANTICIPATION INTRODUCES DESIGN-UNCERTAINTY**

Anticipation can be false in the sense that the respective representation that is formed by this anticipation could recommend the design-participant to choose an action that will be proved unsuccessful for his goals. This virtual falsification of the anticipation introduces uncertainty in the design process. As it is already mentioned, from the designer’s perspective, there is uncertainty with respect to deciding the ways of interaction with the environment, through the artifact, and according to his goals. From the user’s point of view, there is uncertainty with respect to deciding which of the available ways of interaction with the artifact would be the best according to his goals. Therefore, there is uncertainty in the design process, a situation that we call *design-uncertainty*.

More specifically, design-uncertainty is considered a situation in which, design-participants are engaging in a design process by making decisions (i.e. provision and selection of actions with the artifact) that are uncertain with respect to the (degree of) fulfillment of their goals. Therefore, design-participants need to develop ways that will handle and reduce their design-uncertainty. A very important process resulting in the reduction of uncertainty, as we already mentioned, is learning. Through learning the designer could develop ways to anticipate the result of his decisions, by for example, structuring and following, design methodologies or specific methods (Cross, 2006). Additionally users learn to avoid all those interactions that will lead them to failure.

However, most of the times, design participants do not experience situations that are familiar with or already
known. This means that most of the design-decisions need to be taken in uncertainty, and design-participants have to act before learning. What we suggest in this paper is that aesthetics (aesthetic experiences or what we consider in the next section as aesthetically-oriented emotional reactions) is another aspect/process that reduces design-uncertainty before and/or during learning.

THE AESTHETIC EXPERIENCE IN THE DESIGN PROCESS

ON THE SCOPE OF AESTHETIC EXPERIENCE

The nature of aesthetic experience has a long history of discussions, which are mainly centered on concepts and aspects related to cognitive and emotional processes. Most of the authors in aesthetic philosophy suggest and argue in favor of the involvement of possible emotional reactions of pleasure and pain in aesthetic experience (Dewey, 1929, 1980; Cupchik, 1995; Santayana, 1955; Kant, 2000; Higgins, 2008). However, any attempt to clarify the nature of the aesthetics runs up against the problematic role of the aesthetic experience, which also comes from the puzzling and elusively vague nature of the underlying emotional activity. Generally, as Budd (2008) claims, in aesthetic philosophy there are different conceptions of the role of the aesthetics and no one seem to be the right one.

Nowadays, even though researchers from several fields combine our aesthetic experience or what we like or dislike with emotional responses (Ortony 1991; Zangwill 1998; Norman 2002; 2003; Denton et al. 2008), or define the emotional experience of pleasure or pain as a type of a process that mostly refers to our hedonic experiences (Frijda 2009; Berridge and Winkielman 2003), the scope of the aesthetics in our everyday life is still unspecified. Additionally, although it is a common conclusion in the design society that aesthetics emerge in our interaction with products, or that it is much more probable that we interact better with beautiful designs (Norman, 2003; Leder, Belke, Oeberst, & Augustin, 2004; Overbeeke & Wensveen, 2004; Hekkert & Leder, 2007; Locher, Overbeeke, & Wensveen, 2010), it is still vague why or when aesthetics are elicited in the interaction and consequently in the design process. Therefore, an understanding of the link between aesthetic emotional responses and the design process is particularly important in order to clarify how aesthetics affect the decision making of the design-participants (Schwarz, 2000; Kumar & Garg, 2010).

Following an evolutionary perspective of aesthetics Hekkert (2006) claims that the notion of adaptation is behind our aesthetic preferences. Survival is the goal that pushes humans to solve adaptive problems. So, pleasure derives from those features that are advantageous to this adaptation. As he states, “beauty exists in the adaptations of the beholder” (p. 161). In the same evolutionary direction, Desmet (2007) argues that our emotions of pleasure or pain are elicited when in a specific interactive situation it is not sufficiently clear to us what we should choose as the next interactive step. Since we are motivated to make such a selection, emotions prepare and motivate us to “contend with the adaptational implications of the eliciting situation.” (p. 385). In other words, pleasant emotional experiences pull us to situations that will be beneficial, whereas unpleasant will push us away from possibly harmful ones. Moreover, as Desmet claims, we have an emotional experience not only in response to an actual goal achievement, but also in response to a anticipated goal achievement, giving to emotional experience a future-oriented perspective.

Similarly, studies in neuroaesthetics have shown that what we perceive as aesthetically pleasurable is based on recognizable patterns linked to our survival mechanisms, providing to such experience functionality, by which it serves our capacity to manage uncertain interactions with the environment and gain from them in our future steps. Specifically, neurologists propose that the solution of the fundamental aesthetic problem (i.e. the origin and the role of aesthetics) lies in the deeper understanding of the connections between perception, the emotional neural structures, and the respective representational content of the objects that we interact with (Ramachandran & Hirstein, 1999; Barry, 2006; Jacobsen, Schubotz, Höfel, & Cramon, 2006). Hence, an important step towards explaining the role of aesthetics is to ground the functionality of aesthetic experience in emotional activity; what we call

According to many theorists, emotions of pleasure or pain are considered as a monitoring mechanism or as a feedback system that regulates the effectiveness of a potential or chosen interaction. Under this conception, such emotions are there to notify us with respect to moving towards the incentives and away from possible threats. In addition, through the respective feedback system, emotions compare and rate signals, which correspond to the progress that we make against our prior emotional states (Schwarz, 2000; Nelissen, Dijker, & de Vries, 2007; Brehm, Miron, & Miller, 2009).

Hence, the scope of aesthetic emotions (pleasure or pain) is firstly to detect interactive opportunities and threats, i.e. the possibility of a successful interaction or not, and secondly to signal other cognitive or biological functions, which control our actions and plans. As such, aesthetic emotions are related to our goals by means of their influence in our representations, since they function as an input into our decision and behavior regulation processes (Baumeister, Vohs, DeWall, & Zhang, 2007; Damasio, 2000; Xenakis et al., 2012).

Our perspective adopts this view of aesthetic experience as a process which is functionally related to emotional activity, and which elicits basic emotional values such as pleasure and pain. As it is argued in Xenakis et al. (2012), these basic aesthetic emotions are considered to be the result of the appraisal of events with respect to their implications for well-being or for the satisfaction of our goals, motives and concerns. Through those values, as Xenakis et al. (2012) claim, we generate complex, dynamically flexible action patterns, which are related to our representations, in order to learn and cope with specific environmental conditions. Considering that the appraisal process is a function, which detects opportunities and threats in a given interaction then, according to the model they suggest, the outcome of the appraisal process (emotional states of pleasure or pain) can also been seen as a function that strengthens or weakens the anticipation for the respective dynamic presuppositions. At the same time, this function implicitly informs us about the current internal or external conditions supporting our representational content.

Summarizing, such basic aesthetic emotional values emerge as a feedback system in the interaction process, when goal fulfillment is anticipated or not (Panksepp, 1992) and their intensity (i.e. the strength of the aesthetic value) proportionally influences our representations and our potential motivation to pursue our goal.

This conception of aesthetics is not limited in our sensory perception. As Oscar Wilde (2006) very effectively has said, “no object is so beautiful that, under certain conditions, it will not look ugly”, (p.107) and those conditions are not always related to our senses or the physical characteristics of the object (Xenakis et al., 2012). What we aesthetically think or feel about something could change even though our senses perceive it as unchanged. Therefore, aesthetic experience is a highly complex phenomenon grounded in bio-cognitive processes, whose emotionally-related activity is fundamental for the development of our whole interactive experience (Wilson & Gilbert, 2008).

Accordingly, our claim is that the scope of aesthetics in design process is highly related to the functionality of these aesthetic values and to the way they influence the anticipatory system of the design-participants. More specifically, in the following section, we provide a functional explanation of the way an aesthetic experience is generated through the emotional values of pleasure and pain, and resolves (and in a way reduces) the design-uncertainty by providing at the same time values to the anticipation of the design-participants.

**AESTHETICS REDUCE DESIGN-UNCERTAINTY**

So, the question is what aesthetic pleasure or pain stands for in the design process, and what then, an aesthetic experience provides to the communication between the design-participants?

Following the above-mentioned conception of aesthetics, when we talk about ‘aesthetic pleasure’ we refer to a range of basic emotional outcomes of an
appraisal that are positively valued, that is, that are associated with a positively valued anticipation of the plans (provision and selection of actions with the artifact) of the design-participants, with respect to the fulfillment of their goals. In contrast, when we talk about ‘aesthetic pain’, we refer to those emotional outcomes, which are characterized by a negative value, which emerge when designer and user are anticipating problems with their plans regarding the fulfillment of their goals. Consequently, these basic aesthetic values of pleasure and pain influence design-participants towards creating, communicating and using those design representations that will bring them closer to their goals.

As it is already mentioned in the beginning of this paper, those representations are formed as anticipation of ways of action with the artifact, and consequently, of ways of interaction with the environment. Furthermore, that anticipation has a value related to the conditions (dynamic presuppositions) under which the respective ways of interaction will succeed or not. As previously explained, it is the dynamic nature of the conditions in their design-uncertainty that positive and negative emotions with aesthetic values are elicited. Specifically, when a positive aesthetic value is elicited the respective anticipation for the resolution of a particular design-uncertainty is positively valued. In that case, an aesthetic experience functions as a recommendation based on which, the respective interaction could result, if selected and if successful, in the elimination of the design-uncertainty. Correspondingly, when a negative aesthetic value (pain) is elicited the anticipation for the resolution of the design-uncertainty is negatively valued. Now, the outcome of aesthetic experience recommends the avoidance of the interaction, thus again, reducing design-uncertainty.

At this point, we must have in mind that aesthetic values could differ from the pleasure or pain that we feel in our senses. Someone could ascribe a positive aesthetic value in a painful (sensual) experience that recommends a goal fulfillment. This painful experience (with positive aesthetic value) could strengthen our anticipation for goals success. This means that pain (acquiring in this context a positive aesthetic value) could also signal our anticipatory system that there are the appropriate conditions for a successful interaction, thus forming a positive

Figure 2. Aesthetics, in a way, evaluate the interactive alternatives aiding the user to construct such meanings that will make clearer the way (action pattern) to goal achievement. On the other hand, designers provoke the aesthetic experience by enhancing their artifacts with such characteristics that will enable users to construct those meanings that will bring them closer to their goals.
aesthetic experience. However, there are other
cognitive aspects (e.g. past experiences, other related
meanings) that also affect our anticipatory system in
the formation of the final design representation. This
means that the aesthetic experience only partly affect
the design representation and not entirely.

In general, based on the account sketched above,
aesthetic emotional values are elicited in the design
process and particularly, in action selection.
Therefore, we suggest that an aesthetic experience
resulting in the values of pleasure and pain, functions
as a recommendation mechanism, providing the
design-participants with the ability to resolve the
design-uncertainty regarding the success or failure of
an anticipated interaction. Hence, the feeling of
anticipation for a successful resolution or not of a
design-uncertainty is suggested as a model of minimal
aesthetic experience (figure 2).

Through aesthetic experience the designer evaluates
the interactive alternatives in order to form the proper
design representation and to incorporate them in the
artifact as indications or affordances that confirm the
presuppositions of interaction and reduce the design-
uncertainty. In parallel, the user through his personal
aesthetic experience reduces the design-uncertainty
by assigning values to those affordances that support
or not the presuppositions of interaction that are
indicated to him. These aesthetic values will be
functionally useful to the user in order to form his
design representation. Finally, this design
representation aid him to select the proper actions
that will lead him (safely) in a goal fulfillment

Aesthetics provide the design-participants with a
recommendation of a future interactive outcome
regarding an action they are about to provide or/and
select on an artifact. As such, aesthetics, among other
things, provide values to the design representations
affecting the whole design process. Hence, every time
a design-participant is in front of an uncertain situation
and has to decide which action is the best with
respect to his goals, aesthetics are there to aid him in
making such selection by reducing design-uncertainty.
This means that a design-uncertainty could be
reduced by both positive and negative aesthetic
experiences. A negative experience, for instance, may
reduce the design-uncertainty by protecting the user
from a harmful interaction making clear that the best
action is to seek for safer or better alternatives,
always according to his goal. However, even though
an aesthetic experience reduces the design-
uncertainty, this does not imply that the design-
participant will choose the proper action for his goal.
This is because aesthetic experiences and the
respective anticipation have always the possibility of
failure in the design process.

CONCLUSIONS

Since the anticipation of goal success is related to the
ways of interaction that design-participants chose
independently, it follows that aesthetics are not
properties of the artifact but they belong to the content
of design, that is, they are part of the design
representations. Therefore, aesthetic experience and
its values are emerging in the design process and in
particular, in the interaction of each design-participant
with the artifact. In general, aesthetics are constructed
in the design-participant’s cognitive and emotional
realm, and they are not pertaining to the artifact but to
the whole interaction with the environment. Overall,
we suggest that aesthetic experience serves our well-
being, since it functions as a feedback system in order
to prevent the interactive error. This feedback system,
by affecting the values of future anticipation, is directly
engaged in the formation of our design
representations. Hence, aesthetic experience is
implicitly associated with the design process.
Aesthetics are about action by promoting the
achievements of goals in the design process.

Finally, regarding the question of what an aesthetic
experience serves in the respective communication
between design-participants, we argue that
aesthetics, in a way, evaluate the interactive
alternatives aiding the user to construct such
meanings that will make clearer the way (action
pattern) to goal achievement. So, designers should try
to provoke the aesthetic experience by enhancing
their artifacts with such characteristics that will enable
users to construct easily those meanings that will
bring them closer to their goals. Therefore, our claim
is that aesthetics enhance the communication
between the design-participants by reducing design-
uncertainty. Accordingly, every modification in a
product that aims at the reduction of the design-uncertainty has always implications to our aesthetic experiences with products.

REFERENCES


