

## Perception theories and kansei design

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# Perception theories and kansei design

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**Abstract:** Approaches to create artifacts taking kansei into consideration are multiple and are shared among various disciplines, such as kansei engineering, kansei science, and kansei design. In this paper, I focus on the discipline of kansei design and show that various approaches exist within this discipline. These can be characterized based on their focus: either the physical or the interactive materiality of the artifact. Indirect kansei design, mostly focusing on the physical materiality, is based on indirect (or mediated) perception theories. It often relies on representations, models, and metaphors to provide meaningful input to the design. Direct kansei design, mostly focusing on the interactive materiality, is based on direct (or ecological) perception theories. It mainly relies on the designerly attitude of the designer in the process, and apprehend design meaning to emerge from the reflection upon design exploration within the process. Describing and differentiating these two approaches show how kansei is considered differently by different approaches of kansei design, looking forward a dialogue between these approaches in order to obtain a greater insight on kansei and on its consideration for designing.

**Keywords:** perception, interaction, perception theory, kansei design, direct kansei design.

## 1. INTRODUCTION

Recent works have shown the multidisciplinary quality of the field of kansei research, in which kansei engineering, kansei science, and kansei design are non-exhaustive disciplines related to the making of artifacts (Lévy, 2013a). After mapping the discipline of kansei design in the field of kansei research, in this paper I intend to explicitly focus on the discipline of kansei design, to address the theoretical foundations of the two major approaches existing in kansei design, and to propose these foundations as a means to categorize kansei design projects.

## **2. DISCIPLINES IN KANSEI RESEARCH**

The topic addressed in this section can be examined more in detail in previous works (Lévy, 2013a, 2013b). The literature shows three main disciplines related to the creation of artifacts: kansei engineering (Fukuda, 2011; Nagamachi, 2011), kansei science (Harada, 2003; Lévy, Yamanaka, & Tomico, 2011), and kansei design (Gentner, Bouchard, Esquivel Elizondo, & Favart, 2012; Lee, Harada, & Stappers, 2000; Lévy, 2013a). I briefly introduce here these three disciplines and explicit the way they differ from each other.

Kansei engineering was mainly initiated by Nagamachi in the 1980s (Nagamachi, 2002). kansei engineering is part of a family of engineering methods aiming at translating user's feelings into concrete product parameters. However, Schütte (Schütte, Eklund, Axelsson, & Nagamachi, 2004) clearly explains that "kansei engineering does not develop new theories or tools in the different areas at all. Rather, it is an all-embracing methodology containing rules for how different tools can interact with each other in order to quantify the impact a certain product trait has on the users' perception". Kansei engineering collects and organizes tools coming from other fields of research (mathematics, computer science, psychology...) in order to evaluate users, impressions. This structure explains both why and how kansei engineering evolves over time, and why it has been claimed not only in the discipline of product engineering, but also e.g., in marketing or robotics. Kansei engineering is defined by a structure and a purpose; tools, technologies and topics follow.

Kansei science was first proposed by Harada during the same period as the creation of kansei engineering (Harada, 2003). While kansei engineering has been a meeting between kansei and engineering, kansei science is a trans-discipline at the crossing of kansei and cognitive sciences. The research initiated in the 1980s by Harada aimed at describing holistically users' cognitive processes related to preference and choice of products. Kansei science is built upon brain science, mostly cognitive neuroscience and psychophysiology, and relies on related philosophies. Human's thinking and resulting behaviors can be best understood by using a model involving mental representational structures and mental procedures that operates on these structures (Thagard, 2011). These models and structures can be studied by psychophysiological approaches (Yagi, 2000, p. 364). In this academic context, kansei science research aims to characterize and to evaluate emotional experiences and creativity, to contribute to a better understanding of the mind based on physiological and psychological approaches. Moreover, kansei science has very often been relevant to design research by developing conjointly new methods for design and communication (Lévy et al., 2011).

Kansei design is, on the other hand, an emergent discipline in the field of kansei research. Although kansei engineering literature has often used the term 'kansei design' to characterize kansei engineering works which have output actual industrial products, in the present work kansei design is introduced as a novel kansei approach based strictly on design and design research (Koskinen, Zimmerman, Binder, Redstrom, & Wensveen, 2012). In our perspective, kansei design requires a designerly attitude towards the making of artifacts.

## **3. APPROACHES IN KANSEI DESIGN**

Approaches in the discipline of kansei design can be characterized based on their focus: The first type of approaches focuses on the physical materiality of artifacts (i.e., their intrinsic properties), and their evaluation or preference by the user (Kushi, Kitani, & Fujito, 2005; Lee et al., 2000). This type is very close to kansei science in terms of domains of application and tools (often

based on semantics), but differs by its attitude towards ambiguity and uncertainty. While kansei science intends to avoid it or to “solve” it by means of logic reasoning, kansei design deals with it by means of design skills. The second type of approaches focuses on the interactive materiality (Stienstra, Alonso, Wensveen, & Kuenen, 2012) of artifacts (i.e., the qualities of the artifact in interaction) (Lévy, Deckers, & Restrepo, 2012). However, underlying their foci, it is the theoretical standpoint they take that clearly differs these two approaches. These theories will therefore be described in order to clarify their influence on the kansei design approaches.

The notion of sensory perception relates to the way one recognizes and makes sense of the surrounding world. Theories of perception are often categorized in two groups. The first group, more conventional and by far dominant, is called the indirect (or mediated) perception theory, as it assumes that perceiving is an animal faculty which requires information processing to make sense of the surrounding. Perception is mediated, and therefore indirect. The second group is called direct perception theory, as it assumes that the world is perceived directly (without the need of information processing such as inference, memories, or representations) and that perceiving is an animal-environment system.

Based on these two categories of perception theories, kansei design approaches can be also be categorized in two groups. The first group focuses on the physical materiality of artifacts (i.e., their intrinsic properties), and their evaluation or preference by the user (e.g., in textile design (Otomo, 2012; Yahaya, 2012), and in automotive design (Kushi et al., 2005)). The second group focuses on the interactive materiality (Stienstra et al., 2012) of artifacts (i.e., the qualities of the artifact in interaction).

Both perception theory approaches will be introduced here, together with their related kansei design approach. The specificities of these design approaches will also be discussed.

### **3.1. Indirect approach**

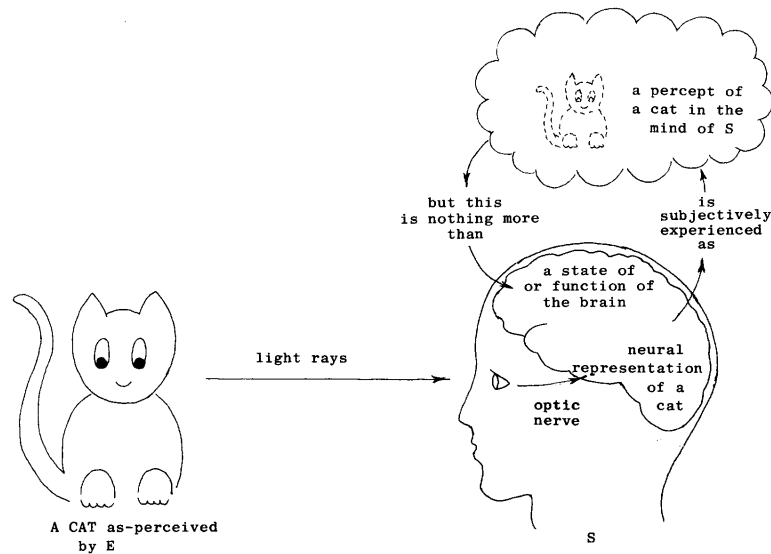
#### **3.1.1. Indirect perception theory**

The perception flow described by indirect perception theory is well known. Sensory receptors capture stimuli (i.e., environmental changes) and convert them into neural information (this conversion is called transductance) to be processed by the central nervous system. Each sensory organ is capable of converting a certain type of stimuli into neural information. In the case of sight, visible light is captured by the photoreceptor cells at the surface of the retina, creating the retinal image. This retinal image is then converted into a neural signal. However, this captured input is meaningless as is: a complex set of cognitive processes is required to translate this signal into a meaningful perception of the surroundings.

This approach suggests three aspects which are important to understand the relation between the subject and the world. First, the capture input is not the world itself, but – in case of sight - the retinal image of it. This image is a distorted two-dimensional projection of the three-dimensional world on the retina. The visual cognition process has to be able to rearrange the retinal image and the reconstruct the lost dimension. Second, the retinal image is a mosaic of stimulations, leaving to the cognition process the role of reconstructing the spatial continuity of the worlds. Third, experience is composed of perceptual moments (Smith, Gosselin, & Schyns, 2006), leaving to the cognition process (highly involving iconic memory) the role of reconstructing the continuous flow of events (i.e., the continuity of the temporal dimension) as we experience it.

From this, a couple of reflections can be pointed which have consequences for indirect kansei design. First, it is a representation (i.e. the retinal image) of the world that is perceived, and not the

world itself. This aspect explains well the value of representation, metaphors and models often present in indirect kansei design approaches. Second, a unique retinal image is senseless on its own. Iconic memory needs some retinal images captured in a series of perceptual moments to make sense of the dynamics of the world. This suggests that perception is not a continuous but somehow discreet process, and that memory plays a crucial role in the 'reconstruction' of the continuous flow of a perceived event. Third, in the description of the perceptive process, the body is quasi absent. As show in Fig.1, the body is 'just' the carrier of the senses which transform information towards the central nervous system. However, the motivity of the body appears irrelevant in this process. The Cartesian nature of this theory is therefore obvious.



**Figure 1:** A dualist model of the causal sequence in visual perception (Velmans, 1990)

### 3.1.2. Indirect kansei design

Different works have been done to support the development of indirect kansei design. Two notorious ones are the work well presented by Lee (Lee et al., 2000) and the work developed by Toyota Motor Europe.

According to Lee (2000), the designer has to balance between objective and subjective properties, between functional technology and emotional expressiveness, between information and inspiration. Kansei design is proposed as an approach to implement these considerations in the design of a product in order to trigger a certain type of affective reaction. The result of this implementation is described and the *subjective properties* of the object.

The attempt developed by Toyota Motor Europe (TME) constructs an upstream phase integrated to the early design process phases of the company (Gentner, Bouchard, Aoussat, & Esquivel Elizondo, 2012; Gentner, Bouchard, Esquivel Elizondo, et al., 2012). Kansei design was initially described as the way to introduce kansei engineering approaches into the scope of design thinking (as described by Gero (2010)). The aim was to determine the design space (understanding), create propositions fitting in this space (creating) and to assess propositions based on users' kansei (assessing). TME uses kansei engineering techniques for assessing, but has come to recognize the need for a design approach in the first two parts: understanding and creating, i.e., the need for a kansei design approach to create a *kansei space*. The kansei design approach developed by TME

aims at bringing users' experience earlier into the creation of the design space.

### 3.1.3. Case study

The *Colourful Rain project* (Lévy, Kim, Tsai, Lee, & Yamanaka, 2009) is the kansei design of an umbrella letting the user experience a synaesthetic perceptive phenomenon: all the sounds of the environment in which the umbrella is being used are also perceived as colors (visually) on the umbrella canopy (cf. Fig.2). To do so, the synaesthetic phenomenon was detailed from a psychophysiological point of view, which was used both as an inspirational starting point for the design activity (Lévy et al., 2011) and as a means to determine the design requirements for a consistent synaesthetic experience.



**Figure 2:** The *Colourful Rain umbrella*, an indirect kansei design

This project illustrates how representations are involved in the design towards, in this case, an augmented experience of the auditory surrounding of the person. The colors on the canopy are a representation of the sound of the environment. Based on the psychophysiological approach taken as a model in this project, this representation is believed to be a reliable expression of how sound could be seen by the synaesthetes. What is interesting to notice here, which I may conjecture for indirect design approaches, is that the substantial meaning of the design is an input in the design process. It is brought by powerful means such as of interdisciplinary inspiration, metaphors (Lévy & Yamanaka, 2008; Saffer, 2005), etc., and does not originate and emerge from the design process. If so, this appears to be a fundamental difference with the direct approach.

## 3.2. Direct approach

### 3.2.1. Direct perception theory

The direct perception theory is radically different in the way it considers the richness of what is perceived. Whereas indirect perception theory considers the retinal image, being a poor stimulus enriched by the cognitive processes, direct perception theory considers richness to relies directly from the stimulation itself.

A major direct perception theory (also called ecological psychology), mainly developed by J.J. Gibson, reformulated the notion of stimulus and showed how richness can be located in the animal-world couple (i.e. human-artifact from a design perspective). The notion of stimulus, described by indirect perception theory as an energy captured by the senses, is described in direct perception theory as an information being *the structure that specifies an environment to an animal*. Consequently, direct perception theories do not regard cognitive processes as the place where meaning arises. However, direct perception does not refute the existence of cognitive processes involved in the perceptual activity. Differently, cognitive skills contribute to the perceptual activity,

but is not the place of the construction of the perceptual richness, i.e., the place where meaning is constructed. Meaning is constituted in between the animal and the world, and cognition is one of the crucial activities taking place on the animal side of this coupling.

From this perspective, perception is not limited to a perceptual moment delivering and impoverished stimulus, but is the determination of (rich) information through an extensive length of time during which an event - itself nested in other events - is perceived. This way, perception is a continuous activity of determining information within a continuous flow of events in space and time.

This consideration leads to a second significant difference between the two perception theories: the active nature of the perceiver. For indirect perception theory, the stimuli are captured automatically, effortless for the perceiver. The perceiver is passive (although some theories would claim that the perceiver is cognitively active to reconstruct the richness of what is been captured). For direct perception theory, the perceiver is engaged, and therefore active in obtaining the information of its environment.

This fundamentally impacts the way perception theories consider the perceiver-environment relation. Indirect perception theories consider the dualism perceiver-environment, i.e., the perceiver and the environment are separate and independent entities. Consequently, indirect perception psychology focuses on the on-going processes taking place "inside" the perceiver (from stimuli capture to behavioral response), and the environment is "just" considered as input for the inquiry. Differently, direct perception theories consider the ecological system perceiver-environment, i.e., they are part of one system which needs both to function and to be comprehended. Perception is about understanding the perceiver's environment, in which her/his body is, and actually is part of. Therefore, considering the relation between the perceiver and the environment in the inquiry addressed by ecological psychology, and considering the fact that understanding the environment requires the perceiver to be active in the environment she/he is engaged in, it seems impossible to consider these two entities separately. Moreover, because understanding a perceiver can be done by describing her/his environment from her/his unique perspective, and the other way around, I can conclude that according to direct perception theories, the perceiver and the environment are not only dependent on each other: their relation is mutually constitutive.

In this being-environment eco-system, information is also present. Relevant information, i.e., the one that can be perceived by the being, can be so depending on the composition of the environment, on the sensory system the being is equipped with, and on the way this being engaged in the environment. However, one supplementary fundamental condition is necessary for the information to be relevant: what Gibson calls the *affordance*.

Affordances are what can be done in interaction with the objects, the places, or the events. Gibson (1979) describes "the affordances of the environment as what it offers animals, what it provides or furnishes, either for good or ill". However, it is important to look at affordance from the ecological system perspective, that is to consider both the constitution of the environment and the animal to understand this notion. A chair can be seated on only if it has the physical properties (surface, steadiness...) and if the being is capable to sit on it. The capability depends on the physiological qualities (corpulence), the strength, and the skills of this being. Looking at the object qualities, we can imagine that a chair, a bench, a table, or a guardrail may be seated on. It is not the intention of the designer, nor the intended primary function of the object, nor the term used to label an object that dictate how the object can be used. It is the way it stands in the world, the way it is structured, the way it appears to the being that influence the way it can be used. Moreover, it is not these qualities alone that condition the way it can be used. A priori, a small child cannot sit on a

table or on a bar stool on her own. The purposely behavior of the being is called *effectivities*. If one can walk, run, swim, or fly will influence the way one engages with the world, and therefore the relevant quality of the information available in the environment varies.

Gibson argues that it is affordances that are perceived. In other words, the one perceives (i.e., makes sense of) the world by what one can do or behave within it. One does not perceive chairs, benches, tables or guardrails, but places to sit on. This perception is therefore dependent on information available in the environment and on the effectiveness of the being. That means what is perceived is relevant (and rich) information available, detectable, and usable in the perceptive ecosystem.

### 3.2.2. Japanese theory on direct perception

The Japanese world of philosophy and psychology does not escape from this debate between indirect and direct perception theories. However, the Nishidian philosophy brings a strong and relevant perspective on perception for the discussion stressed in this paper. Three Nishidian notions can be very instructive on this perspective: *action-intuition*, *pure experience*, and *basho*. “We see a thing by action, and the thing we see determines us as much as we determine the thing. That is action-intuition” (Nishida, 1952/1987, p. 131). *Action-intuition* describes the view that intuiting entails acting, and acting intuiting. Both the world and the subject are formed mutually and are reflected in one another (Maraldo, 2010); *pure experience* corresponds to the notion what the primal undifferentiated form that subsequently dirempts into differentiated forms including: experiencing subject and experienced objects, intellectual intuition and reflective thought, objectified nature and objectifying spirit—all on their way to a higher unity (Maraldo, 2010); *basho* is described as the place where individuals are located in terms of their substance and attributes. This *basho* is not the world of actual, concrete beings but an initial and partial reflection that abstracts part of that world so that it can become intelligible (Heisig, 2010).

These notions obviously appear to be constitutive of the Japanese approach on *kansei*, as well as on perception, on experience, and on context. Moreover, the notions introduced by Nishida can be considered in regards to the Gibsonian ecological psychology. The Nishidian philosophy suggests that the subject and the environment (or *basho*, being fundamentally the *experienced object*) are related by essence (*pure experience*) and are ‘formed mutually and are reflected in one another’ (*acting-intuition*). This approach appears therefore as an ecological nature and is close to the Gibsonian psychology.

### 3.2.3. Direct *kansei* design

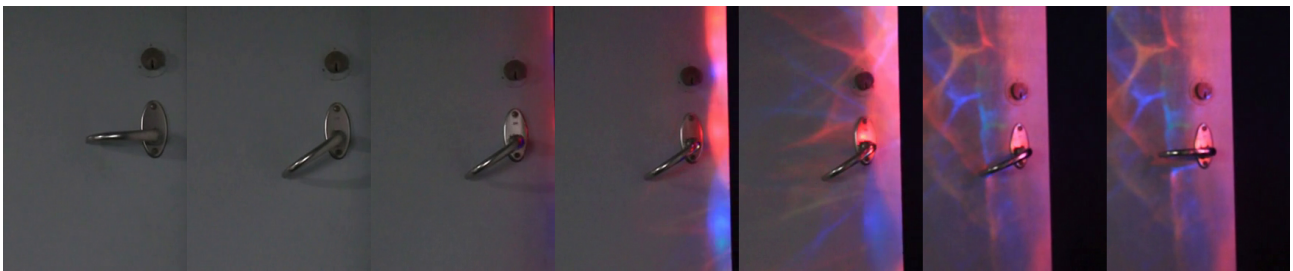
A direct *kansei* design approach is therefore also possible as it can be supported by an inquiry in Japanese philosophical or cultural works related to *kansei*, using them as inspirational means for design. Therefore, I suggest here that direct *kansei* design explores Nishida’s philosophy (and other related philosophies and Japanese cultural traits) as a source of knowledge and opportunities to be handled by design.

With its roots in Japanese culture, direct *kansei* design takes the Japanese tradition for craftsmanship into highest consideration (Sennett, 2008; Yanagi, 1989) and reaches end users through the relationship between craftsmen and their artifacts. The stance of an artifact is not revealed only by the experience of the users. It also acquires meaning through the intention of the designer. This is how *kansei* should be explored in the design process, incorporating all the varieties of points of view held by designers and users.



### 3.2.4. Case study

The *passage* is the design of transition in between space. The design draft was in the in-between space. During a course on kansei design, Eindhoven University of Technology students were asked to design for an experience in between two spaces, without designing for one of the two spaces. This brilliant result proposes an indirect light projection on the door. A series of light-emitting diodes (LED) light on aluminum foil, which reflects the light on the door. If the door is closed or open to the maximum, the projection is invisible. From an experiential point of view, none of the two spaces are directly involved in the interaction. Moreover, depending on the way the user opens the door, the air flow generated by the door influences the movement of the aluminum foil, which influences the light behavior. That is, the qualities in interaction emerge from the interplay between the person and the artifact, and therefore can be described only from an ecological perspective.



**Figure 3:** *Passage*, a direct kansei design, designed by Gracia Goh, Chiyong Lim, and Kate Vermeyen

Differently from the conjecture proposed for the indirect design approaches, the meaning in interaction has emerged from the design process itself, and the artifact appears to have an identity on its own (which can be associated to the famous ‘metaphors suck’ of Djajadiningrat’s pamphlet (Djajadiningrat, Overbeeke, & Wensveen, 2000). Here as well, I would conjecture that beauty in interaction design based on a direct approach comes from the design exploration itself, which therefore requires a design process involving iterative reflections upon design explorations. The Transformative Reflective Design Process (Hummels & Frens, 2009), involved in the design of the *passage*, provides such a framework.

## 4. CONCLUSION

Although the discipline of kansei design is still in an emerging phase, looking for its position and its role in both the research fields of kansei and of design, it is possible to identify different types of kansei design approaches. The first one, indirect kansei design, is based on an indirect (or classical) perception theory, and is consequently close to kansei science from a theoretical perspective. The second one, direct kansei design, is based on a direct (e.g., ecological) perception theory, and is close to interaction design as described by Overbeeke (2007).

Therefore I argue here that a primary fundament of kansei design is the perception theory on which the notion of kansei is approached. An indirect kansei design approach relies on knowledge created by indirect perception theories and on external input for the creation of meaning. Kansei is then defined as a high function of the brain related to emotions, sensitivity, feelings, experience and intuition, including interactions between them (Lévy, Nakamori, & Yamanaka, 2008). Beauty is evaluated from the way the design is experienced in the user’s mind. A direct kansei design approach relies on designerly iterative explorations from which meaning emerges. Kansei is then described as the ineluctable and affective experience of “being-in-the-world” (Lévy, 2013a). Beauty

is in interaction between the user and the artifact, i.e., as a quality of the interplay.

This primary structure provides a set of means (theory, approaches, tools...) for various kansei design processes. However, it also opens numerous questions (e.g., applicability and relevancy of each theory depending on the nature of the design project). I expect that the attempt to answer these questions will help the kansei design community to explore and to clarify further the discipline, to gain insights on kansei, to better differentiate and associate kansei design with other types of design disciplines, and to progressively create tools and frameworks to better operate kansei design projects.

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