About the nature of Kansei information, from abstract to concrete.

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Abstract: Designer's expertise refers to the scientific fields of emotional design and kansei information. This paper aims to answer to a scientific major issue which is, how to formalize designer's knowledge, rules, skills into kansei information systems. Kansei can be considered as a psycho-physiologic, perceptive, cognitive and affective process through a particular experience. Kansei oriented methods include various approaches which deal with semantics and emotions, and show the correlation with some design properties. Kansei words may include semantic, sensory, emotional descriptors, and also objects names and product attributes. Kansei levels of information can be seen on an axis going from abstract to concrete dimensions. Sociological value is the most abstract information positioned on this axis. Previous studies demonstrate the values the people aspire to drive their emotional reactions in front of particular semantics. This means that the value dimension should be considered in kansei studies. Through a chain of value-function-product attributes it is possible to enrich design generation and design evaluation processes. This paper describes some knowledge structures and formalisms we established according to this chain, which can be further used for implementing computer aided design tools dedicated to early design. These structures open to new formalisms which enable to integrate design information in a non-hierarchical way. The foreseen algorithmic implementation may be based on the association of ontologies and bag-of-words.

Keywords: Kansei information, Abstract-Concrete, Formalisms, Early design.

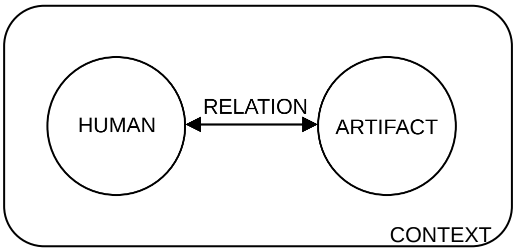
1. INTRODUCTION

Kansei studies refer to the holistic consideration of the cognitive and affective processes which occur during user experience. Historically, kansei engineering has been firstly focused on the semantic differential approach of Osgood applied in pro-active design contexts [Nagamashi, 1995, Schütte, 2004, Lokman, 2010, Nagamashi, 2011]. The semantic differential enabled to evaluate products and then to generate automatically design rules and solutions with semantic input data. Afterwards, emotions were integrated into kansei approaches. Progressively, evaluations have been completed by physiological measurements in order to reduce the subjectivity involved in those evaluations and also to capture some real time unconscious reactions [Lee & Harada, 2002, Yamanaka & al, 2002, Tomico & al, 2008, Levy & al, 2011]. This trend developed firstly in Japan and more recently in Europe [Kim & al, 2011, Rieuf & al, 2014]. These objective measures help in the interpretation of emotional evaluations and adding physiological and behavioral information is still in process. This completion is made possible only through the current convergence of various disciplinary perspectives.

Indeed, kansei studies have been much enriched from the disciplines of design science, marketing research, psychology, and artificial intelligence. The cross influence between these disciplines brought new dimensions into kansei approaches, such as multisensory design information, the inclusion of personality [Lee, 2005], values [Authors, 2009], and culture related items, and also new formalisms and algorithms which lead progressively towards the consideration of a whole enriched experience. Considering the whole experience from a kansei perspective is an emerging field which also takes into account new dimensions such as time and context. The measure of emotions in design provides a way of interpreting the effect of a holistic aesthetic experience [Overbeeke, 2000, Hummels, C., Overbeeke, K., 2010] including stimuli such as style, sensory dimensions, semantics and behavior and interaction. More subtle dimensions such as the adequacy of a style or semantics or sensory properties to human values can also be extracted from emotional measures. As kansei information is rich, heterogeneous and refers to a complex system between human and artifact, it is crucial to structure this information in the form of theoretical models that will help designers and researchers to better understand kansei information systems. These models will also facilitate the use of kansei information as generative or evaluation operational matter in order to improve the experience of users and designers in design projects. Finally, we propose a theoretical model which purpose is to link abstract and concrete dimensions of kansei, and which constitute a focal point for collaborative research between the disciplines of design science, marketing research, psychology, and artificial intelligence.

2. KANSEI INFORMATION

The kansei information, exchanged for instance by a design team, refers to a complex system between human beings and artifacts. Human beings can be, depending on the context, designers or end-users, and artifacts are the products or services to be developed. The intended experience may be taken into account, defined, and discussed at the various stages of the research and development process. The artifacts to be designed play the role of stimuli with which human beings will develop physiological, cognitive, and behavioral response. The exchanged kansei information can be related to the human, to the artifact, and to the physical context, as well as to the relation between them (i.e. interaction, temporal context, situational context) [Gentner et al., 2013].



- Human related information,
- Artifact related information,

- Human-artifact related information,
- Context related information.

Figure 1: Entities and flows related to kansei information

2.1. Human related information

As intrinsic dimensions on the human side, we consider parameters which characterize the targeted population. As such, sociological values are highly structuring in the kansei information systems. Indeed, previous experiments proved that sociological values impact the emotional reactions of subjects in front of specific semantics [Authors, 2009b]. The cultural factor is also impacting in so far as the perception of design information is very influenced by cultural ways of perceiving and interpreting design information. Gender, age, values (e.g. terminal and instrumental), and personality are other significant factors that influence the kansei experience between the human and the artifact.

2.2. Artifact related information

A second entity to consider in the kansei information system is the artifact. From the product side, all information related to product attributes and behavior is to be considered into the kansei information system. For instance some attributes such as colors, shapes, textures, style, materials, technical details, styles, and even the production process, provide relevant information from product side. As kansei information and kansei rules are often field-dependent, the product sector must also be taken into account (e.g., automotive, tableware, packaging…).

2.3. Human-artifact related information

There is a reciprocal relation between the human and the artifact. This relation includes every dimension which is difficult to distinguish one from the other. For instance, semantics is depending on both the human and the product. The product can be seen as a system of signs which will convey a specific image and the human will perceive this image through the filter of his/her subjectivity, according to individual characteristics such as values, culture, or experience. This way, semantics is a bilateral dimension that cannot be seen on one side or another. Emotions can also be considered as a main dimension of human-artifact related information. Emotions are resulting from the perception of static or dynamic artifacts. They can be related to the real time and short time situation and eventually to more persistent psychological state. Sensory information is also covering the human-artifact relation (i.e. sensory pleasure). The perception will convey a feeling of warmth or roughness coming from product parameters but this perception is also linked to the inner temperature of the subject and its physical capabilities (e.g. tactile abilities). Similarly, interaction attributes are linked to both the human and the artifact. They encompass the degrees of engagement and of immersion. These degrees evolve in a continuous relation of interaction that will transform them progressively into sequential states (which can be seen as mutual behaviors). Other interaction attributes are the interface characteristics, the action enabled, the gesture of the users and the feedbacks of the artifact [Gentner, 2014].

2.4. Context related information

Context related information relates any potential circumstances of the situation where the experience takes place. It can be summarized as time (temporal context), situation, location (situational context), space, and environmental conditions (physical context) [Ortíz Nicólas & Aurisicchio, 2011]. The temporal context encompasses the notions of pre-experience, experience and post-experience [Ocnarescu & al, 2012]. The situational context is about the moment, location, and the situation in which the interaction occurs (e.g. work-state, play-state) [Hassenzahl, 2010]. Finally the physical context is about the place where the experience takes place and the other elements the interaction considered (e.g. other humans, other artifacts).

3. KANSEI STRUCTURE

In the previous part, we describe kansei information by explaining the reciprocal human-artifact relation and the various dimensions involved in the kansei experience. On the other hand, kansei information can be positioned on an axis between abstract and concrete dimensions. It is true that designers' skills lie mainly in this ability to establish intuitively a relation between abstract and concrete dimensions. For instance, which colors will give the feeling of freedom, or how to express power into styling lines for a sport vehicle, or finally how to provide an aesthetic experience to a user of sports competition devices? So every kansei dimension may be positioned on an axis going from high-level information to low-level information. High-level information encompasses the most abstract dimensions such as values or semantics. Low-level information includes the most concrete dimensions such as product attributes. As this information structure turns to be relevant in various disciplines such as design science, artificial intelligence and marketing research, we finally formalize a theoretical model which follows this structure.

3.1. Abstract-concrete information structure in design science

According to designers, some major dimensions processed in early design are emotions and personality of artifacts. Even if designers recognize that their activity deals with emotional content, this process is not necessarily explicit [Bouchard, 1997]. The concept of kansei in the framework of early design activity brings theoretical support for formalizing the core skills of the designers, which are highly linked to semantics and emotions. Kansei can be seen as both a subjective and objective process which enables to link high-level abstract information, as semantics, emotions (affectivity), or sociological values, with low-level information such as shape, color and texture, and artifact's behavior related data. All of these dimensions apply in early design stages, both when selecting inspirational materials and also when generating or evaluating new design solutions. As current evolution in design is going towards the involvement of end users at an increasingly early stage, Kansei information system potentially address to a whole system including users and designers. The emotional impact and the hedonic dimensions are partly due to quality of design solutions such as aesthetics, freshness, coherency, and more or less pleasure in interaction. Coherency depends on inter and intra-relations between high-level and low-level dimensions. For instance aesthetics entails harmony rules that may apply to the low level with color harmonies, or color-textures-shape harmonies, but also to low-level and high level semantics.

We investigated in some founded research projects which aimed at elaborating new tools for early design [Bouchard, 2009; Kim, 2010], but also in industrial design projects [Gentner, 2013], the possibility to formalize the semantic relations the designers carry out in their activity. The experiments led in those projects confirmed that the designers may employ different type of design information which consisted of different levels: high-level (values, semantic words, analogy, and style), middle-level (sector name, context, and function), and low-level information (color, form, and texture). These levels of information can be seen as the position of an axis going from abstract (high-level information) to concrete (low-level information). The structure of design information enabled the construction of a design domain ontology used in this project for an image retrieval function. In order to gather and formalize Kansei information in relation to the earliest stages of design, we adopt a two-way approach. The first way is based on the extraction of kansei information by annotation or purge related to previous design projects. The second way is based on experimental observations and analysis from fictive design tasks [Bouchard, 2009, Kim, 2010]. From this dual approach, we proposed a model which structures kansei information from abstract to concrete dimensions. According to this model (see table 1), kansei information in early design can be structured according to the three levels high, middle, low and the 10 categories (Semantic words (Hs), Values (Hv), Analogy (Ha), Style (Hy), Emotions (He), Sector name (Ms), Context (Mc), Function (Mf), Color (Lc), Form (Lf), et Texture (Lt)).

Level	*Categories*	*Code*	*Description*	*Examples*
High level (H)	Values	*Hv*	Final or behavioral values	Security, Well-being, Freedom, Ethics
	Semantic adjectives	*Hs*	Most of these adjectives are related to color, shape and texture	Romantic, Aggressive, Muscled, Fluid, Robust, Balanced
	Emotions	*He*	Emotions as effects of design stimuli	Amused, Enthusiastic, Ill at ease
	Analogies	*Ha*	Objects, entities from other sectors from which some design elements are transferred into the reference sector by similarity	Rabbit → quick, fast
	Style	*Hy*	Characteristics of every levels through a specific style	Edge Design, Work wear.
Middle level (M)	Sector names	*Ms*	Objects names describing a sector or a sub-sector representing a specific trend	Sport devices, automotive design, interaction design, cosmetics
	Context	*Mc*	Moment, place, activity	Family leisure
	Function	*Mf*	Function, usage, component	Modularity
Low level (L)	Color	*Lc*	Color properties	Yellow, light blue, pale indigo
	Shape	*Lf*	Shape combinations, size	Square, corrugated, geometric, tight lines
	Texture	*Lt*	Motifs (abstract, figurative) and texture	Plastic, metallic

Table 1: Design information [Bouchard & al, 2009, 2011, Kim & al, 2010]

Defining a theoretical model of kansei information going from high level=abstract to low-level=concrete dimensions enables to provide a common model and format for the disciplines of design science, artificial intelligence, and marketing research. We emphasize in the next parts why the abstract-concrete structure makes sense in all of these disciplines.

3.2. Abstract-concrete information structure in artificial intelligence

A major problem in *artificial intelligence* is how to match information features such as shape, color or textures with semantics. This problem occurs particularly while developing new Content Based Image Retrieval systems (CBIR). While CBIR is a well-developed research area, there are very few information retrieval systems dedicated to industrial designers. This is due to the nature of design information, which includes low-level information (visual and image information) and high-level information (semantics and emotions). Linking high-level information with low-level information is a main issue, due to the semantic gap [Ferecatu & al, 2008]. The semantic gap illustrates the difficulty to relate two object descriptions at two different levels (see figure 1, in which semantic is very different even if the image descriptors are similar). High-level is more described by linguistic representations coming from design tasks while low-level is more a computational representation founded on color numeric descriptors. Considering that there is no automated way of translating from one language into another, image retrieving tools are so far mainly based on low-level features.

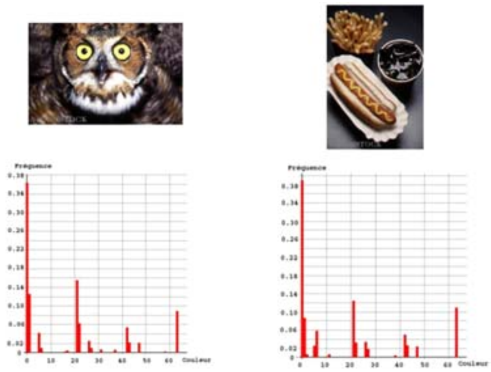


Figure 2: Semantic gap [Ferecatu & al, 2008]

Recent studies in the area of CBIR concentrate on extracting semantics from images using color features or lexical databases and adopting Kansei Engineering perspective. Kansei engineering methods enable to assess evoked feelings on the base of impression words including frequently semantic adjectives (urban, romantic, aggressive…) and more rarely affective or emotional adjectives (amused, astonished) describing the viewer. Even though they are not really formalized and externalized, the rules which enable to link low-level attributes with high-level dimensions are used on daily basis by the designers. This linking task is very subjective and varies from person to person. New systems are being developed, which integrate high-level information in their processes. These systems are often based on a strong interaction between the end-users and the system itself, with for instance the possibility for the user to choose among multiple images. Likewise, rules automation is frequently done with the intervention of the end-users through the use of neural networks or genetic algorithms, completed by semantic based indexing and annotation [Naphade, 2006, Shibata & al., 1999]. This approach follows both a bottom-up and a top-down process which allows matching semantics and impression words with physical features (color, shape, texture, regions, size effects) in a reciprocal way [Black, 2004, Hayashi & al. 1997]. This strategy applies to different sectors of application: professional images databases, clothing and fashion design [Shieh & Cheng, 2003]… We can assume that the structure of information based on abstraction levels is also relevant and operational in the field of artificial intelligence and more precisely in CBIR. Moreover, this structure may make further progress to face the technological issues to be solved in the development of CBIR systems. The interest in high-low structure for the discipline of marketing research is discussed in the next part.

3.3. Abstract-concrete information structure in marketing research and in engineering design

In the field of marketing research, the method of cognitive chaining of means-ends [Valette-Florence, 1995, Authors, 2007a, 2007b] aims at structuring product information according to more abstract values. This method enables to highlight how values influence consumer behavior. It formalizes the value-product relation through a chain of hierarchical cognitive sequences following various abstraction levels. The high-level corresponds to values and the low-level corresponds to products attributes. Concrete product attributes such as shape, color, texture, material, in relation to abstract dimensions such as semantics bring all together psycho-sociological consequences for the consumer in helping him to attain his end-values. Values are instrumental (specific behavior modes, such as courage, honesty or romantic attitudes) or end values (aims of life to be attained through instrumental values, such as self-fulfillment or hedonism).

Rokeach has defined a list of values in a list [Rokeach, 1973] which provides a finite number of values such as comfort, pleasure, etc. Each of these values may be defined into words following the values-functions-solutions chain. This way, formalizing the values-functions-solutions may support the production of relevant relations and solutions both in the products and values spaces. Current applications are associated with products segmentation and advertising. Consumers associate the attributes determining their choices with behavioral or end-values. This method is of considerable interest because of its predictive aspect concerning product consumption and brand names [Young & Feigin, 1975]. The semantic space is determined by considering the number of occurrences of individual items in the various types of chains, then by carrying out a multiple factor analysis dealing with the compatibility between individual items and types of chaining. This method is of great support for the translation of abstract values into concrete product attributes or vice-versa.

In design science, it provides more inspiring paths to be followed in an intuitive way by the designers during creative sessions, when working with images, mood boards or when sketching new concepts. Mood boards including user's values, products and their attributes constitute a good representation through which the values-functions-solutions chain can be expressed. We investigated the value-function-attributes chain in the framework of car design projects. For instance, to improve a technological innovation linked to an automotive dashboard, the technological innovation related value proposed by the marketing team was expressed in the following way: family, cohesion, family unit, cocooning, peace, smoothness. This approach was used for the elaboration of inspirational boards and design concepts (see table 2).

Terminal values of Rokeach	*Related values*	*Semantic descriptors*	*Related semantic descriptors*	*Low-level descriptors*
Pleasure	Well-being	Pleasing	Comfortable Nice Sympathetic	Curves
Security	Safety	All-land	Robust Powerful	Oversizing
Exciting life	Dynamism	Sport	Fast Light Resistant High-quality Reactive Alive	Tensed and dissimetric lines

Table 2: Design information [Bouchard 2007ab]

This table shows a representation where the value-function-solution chain appears at the top of the table, and the values are listed in the first column. The terminal values are defined into words following as well as semantic descriptors which are linked to the values. Semantic descriptors are highly used by the designers when working with images and sketching new design concepts [Kim & al, 2010]

To conclude this part, the value-function-attributes chain provides an explicit formalization on a concrete-abstract axis of the link between marketing and design universes (see table 2). In the previous part we show from the literature the relevance of a concrete-abstract structure for kansei information in the disciplines of design science, artificial intelligence and marketing research. In the following part, we investigate some formalism which can be used for the implementation of information systems towards computer supported technologies.

4. KANSEI FORMALISMS

Kansei information refers to a complex system between human and artifact. Kansei information calls for heterogeneous forms of data. Indeed, if we step back from the methods and concentrate on the nature of information, we can recognize this information may encompass various dimensions under a variety of formats. Qualitative data are naturally involved in the design process by the designers from generative tasks. Quantitative data are mainly involved in design research or sometimes in design contexts in the evaluative part of design. In the context of early design, the kansei information system may include a set of dimensions such as color, shape, texture, sound, smell, which can be expressed or conveyed in the generative phase of design through different formats such as sample pallets, multi-sensory compositions, keyword's sets, mood boards, sketches and prototypes. In addition, kansei information may be conveyed in the evaluation phase through quantitative data, coming from physiological measures or from differential scales with keywords or labels used in order to grasp the user state in front when experiencing specific static or dynamic design stimuli. To summarize, the main formats through which kansei data are potentially expressed are threefold (see table 3):

- Qualitative data (categories of words from various categories: brand or human values, semantics, sensory characteristics, emotions, styles, design elements, product sectors, multisensory design elements such as shape, color, texture, sounds, smells, and behavior).
- Quantitative data from differential scales associated to keywords (emotions, semantics, sensory, values, familiarity, numbers or icons, or from design elements digitization and description (global and local descriptors of shape and color),
- Quantitative data used in direct quantitative user measures (galvanic skin response, brainwaves…).

Kansei information	*Dimensions*	*Formats*
Qualitative data related to product	Color	*Keywords* *Sample Pallets* *Multi-sensory compositions* *Mood boards* *Sketches* *Prototypes*
	Shape	
	Texture	
	Sound	
	Smell	
Discrete quantitative measures related to user cognitive appreciation through product perception	Emotions	*Keywords* *Icons* *Numerical values from Lickert scales*
	Semantics	
	Sensory	
	Values	
	Familiarity	
	Shape descriptors	*Numerical values from region, contour, 3D descriptors*
	Color descriptors	*Numerical values from dominant color, color histograms*
	Texture descriptors	*Numerical values from edge histograms, Fourier descriptors*
Continuous quantitative measures related to user emotional response	Galvanic skin conductance	*Numerical values from electro-dermal activity*
	Brainwaves	*Numerical values from cerebral activity frequency*
	Posture	*Numerical values from momentum*
	Gesture	
	Facial expression	
Relations	Inter-dimensions rules	*PCA, FA, ANOVA, MDS* *Algorithms (GA, NN, FS, RS, …)*

Table 3: Kansei dimensions and formats

Kansei vocabulary provides valuable formats because it makes possible to communicate every kansei dimensions, and it is such a language which is daily used by the designers. It is also well adapted to the early design phases, the generative and the evaluative ones. We will focus more in the following parts of this paper on kansei vocabulary, keeping in mind the limits of this format in terms of subjectivity, dependency to context, and necessary consciousness of the users. Kansei formalisms, on the other side, must involve formats that are possible to implement with algorithms. Consequently, two formalisms which enable to formalize kansei design information into a lexical format are explored: ontologies and bag-of-words. Finally we propose a format which may be implemented by a hybrid technology.

4.1. Ontologies

Ontologies can be used in early design for formalizing kansei data in order to establish a classification and a conceptualization of designer's knowledge on the base of semantic relations [Authors, 2008, Setchi & al, 2010]. The applications affect essentially the indexation of non-structured information in image databases or multimedia and digital libraries, in order to design and implement new information systems able to link semantics with this visual information. In addition, some authors studied how to structure kansei information through a kansei vocabulary which conveys human feelings and shapes or colors [Baek & al, 2005a, 2005b]. Their research aimed at formalizing design knowledge with an ontology based on visual information (colors, shapes, textures, motives) and kansei vocabulary. The Wordnet thesaurus was used as a lexical database and principal component analysis was applied to establish relations. Results showed a big influence of the factor curved/straight line more than whole silhouette. In addition a similar approach was applied to color. Some similarity measures enabled to link Wordnet adjectives between kansei color and queries. Target words of Wordnet may be disambiguated with Lesk's algorithm [Banerjee & Pedersen, 2003], by selecting the definition of the dictionary and by examining its sharing with the biggest number of definitions of neighbors words. This algorithm compares the definition of a pair of concepts and calculates a score by counting the number of shared words. This approach does not make difference between a simple word and one sentence and process each definition such as a bag of words by removing empty words. The best relations found were those which were proposed by the user queries with descriptors such as pleasure, pained, angry, happy. Natural language was used to characterize this language because natural language is understood quite universally [Kobayashi, 1990; Nagumo, 2000]. Results enabled to find systematically the relevant colors from semantic descriptors. Wordnet is a thesaurus which organizes information according to groups of synonyms called synsets. The most frequent relation for adjectives is similarity: *is similar to*. The other possible relations for measuring similarity between kansei color and a query are: *attribute of*, *also see*, *similar to*, *pertainym of, participle of* and *antonym of*. Some relations characterize two sets of adjectives which have a semantic proximity but which are not sufficiently close to belong to the same synset. This relation which is the most open is called *also see*. It is very representative of the relations the designers naturally do. As ontologies so far involve mostly hierarchical relations, this format still may be constraining when dealing with designer's knowledge.

4.2. Bags of words

Some studies were led in order to formalize semantic information in inspirational phase of design. The purpose of these studies was the development of computer aided design tools [Bouchard, 2008, Setchi & al, 2010]. These researches aim at defining and developing new semantic formalisms that can be implemented into data processing models and which can relay designer's skills. The aim is to formalize data and rules under particular formats which can be further implemented by ontologies or Bags-of-Words and computerized into algorithms (see figure 3).

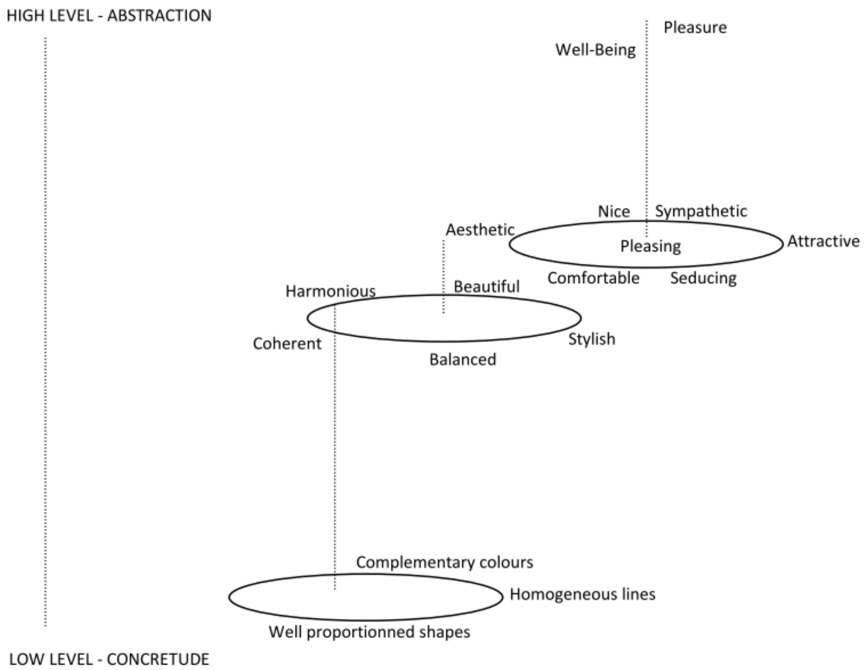


Figure 3: Examples of bags of words

The Bags of Words offer a more flexible structure and are open enough for earliest phases of design. They are based on semantic proximity which is fuzzier than the notion of synonymy or antonymy (*also see* relation). Considering that they do not obey to hierarchical formats, they are so better adapted to design information. Indeed, they are more based on the property to belong to a same group, than to be an attribute of, in a top-down or bottom-up relation. BOW can be combined to ontologies to provide better results in the context of semantic search engines. Anyways, they constitute an important filter which enables to increase significantly the relevance of results processing after semantic requests [Setchi, 2010]. In the context of design formalisms, there are two different kinds of Bag of words. The first category can be seen as horizontal BOW. This case, every words of a bag are at the same level of abstraction. For instance, *dynamic=intense, fast, enthusiastic, energetic, sportive, undertaking, effective, active…* The second category is more vertical. This means that the words inside may characterize different levels of abstraction. For instance, *aggressive= violent, imposing, speed, irritated, stressed, choleric, sport, brutal, provoking, dangerous, sharp, angular, edge, tensed, energetic, …* This second category relates to kansei rules which formalize by essence vertical relations by linking high-level features with low-level features.

Most used adjectives for image retrieval	*Related words (synonyms and related words)*	*Impacted low-level features: possibly quantified*
Balanced	*Stable, secure*	*Shape :* symmetry
Beautiful	*Aesthetic, gorgeous*	*Shape:* use of formal harmonies *Color:* use of chromatic harmonies
Bright	*Brilliant*	*Texture:* reflectance
Classic	*Traditional*	
Clear	*Clean, pure*	*Colors:* white, light greys
Cold	*Fresh, freezing, aqua*	*Colors:* cold colors
Dark		*Colors:* dark colors
Dynamic	*Active*	*Shape:* dissymmetry, tense lines, diagonal stripes
Elegant	*Refined*	
Exciting	*Seductive, appealing*	*Colors:* saturated colors
Freedom	*Irregular, unconventional*	*Shape :* Non regular forms / volumes

Heavy		*Shape:* dimensional ratios
Kitsch	*Loaded*	*Shape, color, texture:* Many reference objects
Light		*Shape:* dimensional ratios *Colors:* light colors
Original	*Fresh* *Bizarre* *Funny*	*Shape, color and texture:* Formal distance to the reference archetype
Motionless		*Shape :* symmetry
Natural	*Simple* *Authentic*	*Colors:* natural colors (green, …)
Quality	*Clean*	*Texture:* finishing, coating with visual and tactile effects
Relaxed	*Comfortable*	*Shape :* curves with big radius of curvature
Romantic	*Glamour*	*Colors:* unsaturated colors (pastels)
Simple	*Basic, clean*	*Shape:* elemental geometrical volumes *Colors:* plain colors
Soft	*Light*	*Shape:* curves *Colors:* pastels *Texture:* smooth matter
Warm		*Colors:* warm colors (orange, …)

Table 4: Kansei Dictionary

5. TOWARDS AN EXPERIENCE ENTITY DIMENSION?

A research composed of several experiments also identified another dimension, complementary to the abstraction dimension, permitting the description of kansei information exchanged by pre-development team: the experience entity dimension [Gentner, 2014]. This second dimension corresponds to the entity of the experience (as detailed in section 2) to which the design information is referring. The related scale is composed of three disjoint levels: human related kansei information, interaction related kansei information (human-artifact related and dynamic context), and environment related kansei information (artifact and static context). The original design information categories (see Table 1) were enriched with new ones. The original *context* category was for instance extended into *physical* and *temporal context* and the *texture* category was extended to *tactile attribute*. The extensions permitted to cover more accurately these context and artifact related attributes. In order to enhance the coherency of the model some original categories were also combined: *form* and *colour* were combined into *visual attribute*, and *analogy* and semantic word were combined into *semantic descriptor*. Finally, several categories were also added that correspond to the design information that was observed during the different experiments but was not originally described. The new categories are *emotion*, *lifestyle*, *culture*, *morphology*, *auditory attribute*, and *olfactory attribute*. Figure 4 shows the position of all these categories on the related two-dimensional kansei information model.

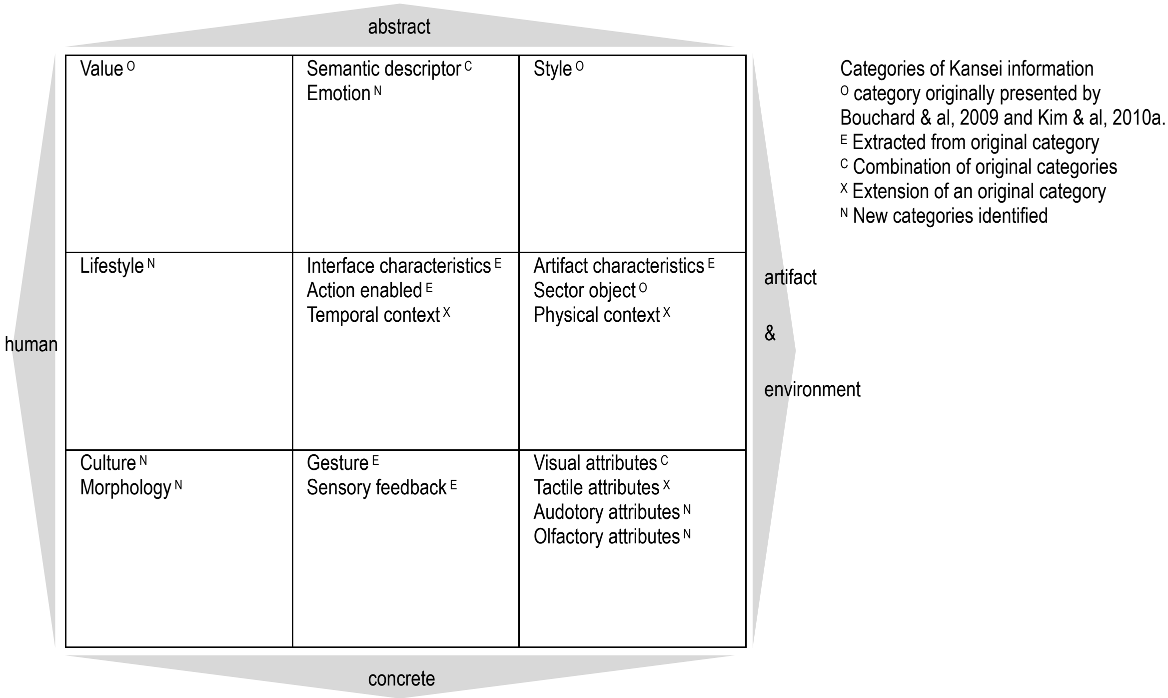


Figure 4: Two-dimensional kansei information model [Gentner, 2014]

6. CONCLUSION

In this paper we provide a definition of kansei information. We first describe the entities and reciprocal relations related to kansei experience: human, artifact, relation, and context. Then we specify the kansei dimensions inherent to these entities.

In a second time we discuss about how to structure all of these dimensions according to a format that would benefit to various disciplines, i.e. design science, artificial intelligence and marketing research. Indeed all these disciplines are now focusing on kansei information systems and trying to propose relevant formats. Finally, by examining some information structures in these disciplines, it becomes obvious that a structure on a concrete-abstract axis is relevant in all of them. Indeed this structure reflects some methods that have been developed on the base of linking high-level information with low-level information. After considering the various dimensions and related formats which can be found in kansei information systems, we propose to explore some formalisms involving kansei vocabulary. Indeed kansei words enable to refer to every dimensions of kansei and correspond to one of the modalities which are daily used by the designers.

We investigated two formalisms which can be implemented by semantic technologies: ontologies and bag-of-words. We then propose a schema which consists of a combination of both. The vertical dimension is an abstract-concrete axis. The horizontal dimension is that of bag of words. This way, the resulting structure includes both a value-function-solution chain, and more fuzzy bag-of-words at the level of semantic descriptors.

Finally the discussion was also opened to the consideration of the entity dimension as additional way to describe kansei information. It indeed permits to better transcribe the complex system occurring during a human-artifact interaction. This consideration also permitted to identify additional categories of kansei information that should now be taken into account in further studies.

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BIOGRAPHY

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Daniel Esquivel is Engineer and Senior Manager in Kansei department at TOYOTA Europe. After a master research in Engineering design, he adopted a pioneering approach and contributed to the implementation of Kansei methods by a continuous transfer of research advances into industry.