What Are You Telling Me? How Objects Communicate Through Dynamic Features

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Abstract: Product sensory features are handled by designers to convey implicit messages to users. However, thanks to technology advances, traditional static product features are becoming dynamic, able to actively change over time. Exploring how these new properties can communicate a different layer of information is the aim of the study presented in this paper. To achieve the goal, a case study analysis was performed, by collecting real products, prototypes and concepts which present dynamic sensory features. The analysis of the selected samples led to the identification of a number of categories of dynamic products, within which it was possible to stress some parameters and criteria useful for designing such artefacts. Relations among the senses activated, the contents of the communication and the source of the information have been identified, and insights have been proposed as results.

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1. Introduction

Artifacts have the ability to communicate messages to users through different languages and media. Product form has always been considered as a communication means: products convey messages to users through their sensory properties (visual, tactile, auditory, etc.), and their communicative potential has been widely investigated in the last decades by the field of product semantics (Krippendorff 1989, 2004; Demirbilek and Sener 2004). However, as Krippendorff and Butter (1984) affirm, products convey messages not only through their physical features, but through three main channels: information displays, graphic elements fixed to product surface and product form, shape and texture.

We can thus affirm that the information which products convey is static and related to the product itself (affordance, mode of use, symbolic meaning, character) when the medium is the product form. But such information can also be *dynamic* and connected to external situations, phenomena and sources: this happens when the medium is a display or an interface. Indeed, displays and interfaces are able to communicate information that change over time, but in order to do this, they traditionally use a language that is outside the domain of product semantics (Krippendorff and Butter, 1984): the verbal, iconic or numeric language.

However, recent advancements in electronics, computation and material technologies, revolutionized the concept of product aesthetics and form as traditionally conceived. Sensory properties (shape, colour, sound, smell, texture, surface, etc.) of artifacts can in fact be transformed over time, becoming dynamic (e.g. a kettle which indicates that water is boiling by showing a texture on its surface. Fig.1). These new features actively transform artifacts forms in response to either external stimuli, users' interactions or automatic pre-programmed schemes.

Fig. 1. One Kettle by Vessel Design. The product changes its own surface when the water boils.

From the product design point of view, the possibility to create dynamic features gives designers additional material to work with:

> Designing such products and systems requires an aesthetic that goes beyond traditional static form aspects. It requires a new language of form that incorporates the dynamics of behavior. (Ross and Wensveen 2010)

The emotional content of these dynamic products seems to be very high and stems from their capacity to surprise and delight users' senses. For this reason, in many cases,

where dynamic sensory features are embedded into products, the aim is mainly to engage, surprise, or provoke users. Nonetheless, changes in the product form (intended as the mix of product's sensory properties) may be a language through which it is possible to convey information and messages to users in a more intuitive and less conventional way than using verbal and iconic language. The advantage is that the communication, even if less complex, may become more engaging for users, and the interaction with products more pleasurable.

The potentials of this revolution in the design field are very high, but it seems that research in this area is still lacking a theoretical base that could support the adoption of these new communication possibilities by the design practice.

1.1. Objectives

The present study analyses, through the collection of a number of case studies, the possibility to communicate messages through product dynamic and active sensory features. The final objective is to shed some light on the issue of dynamic sensory features from the product design perspective, in order to outline a first theoretical framework in this area of research. In more details, our study intends to answer the following questions: is it possible to communicate to users through dynamic changes in the product features? What kinds of contents can be conveyed? To what extent different senses can be activated in conveying a message? Have senses different roles in the transmission of the message?

The answer we intend to give is theoretical and in form of hypothesis. In the next section, the research process we followed is described in details.

2. The research process

Our starting assumption was that nowadays, in order to communicate a message to the final user, the designer can exploit also a product physical change. Indeed, in recent years, a number of commercial products, prototypes and concepts showing dynamic sensory features have been developed, and the interest towards this topic seems always growing. However, research in this field is still at a embryonic stage, and there are no theoretical approaches to the analysis of this new artefact category.

In order to have an overview of what has been occurring in this area, we decided to adopt a case-study strategy, through the collection and examination of a number of concrete examples. As Baglieri et al. (2008) state, this research strategy is appropriate "when the research subject is still emerging, to suggest some propositions to be verified afterwards in different contexts, in order to reach a shared theory." Through this procedure, we intended to extrapolate some theoretical insights by an inductive process, starting from what has already been done in the design field in terms of both products and concepts.

The case-study research process followed three steps:

1. Selecting samples
2. Describing and classifying samples
3. Analyzing results and shaping hypotheses

2.1. Step 1 : Selecting samples

The samples selection was performed among design concepts, prototypes and commercial artifacts. The samples sources were the following:

- papers and journal articles (i.e. the International Journal of Design and Design Issues).
- concepts that have entered international design contests (i.e Red-Dot and Samsung Young Design Award)
- design blogs (i.e. Design Boom, Core77, Yanko Design)
- well-known design universities and design research centres (i.e. TU Delft, TU Eindhoven, Cambridge Consultants).

At the end of the first selection process, 70 samples were collected. In figure 2 some examples are shown: *solid poetry* concrete tiles (fig.2a) change their colour when wet, creating different patterns; *flower lamp* (fig. 2b) changes its shape on the basis of the electricity consumption in the house; *scent of time* (fig. 2c) clock releases a different smell in the environment at each hour; *wearable detect air* (fig. 2d) is a jacket that lights up and vibrates when detecting too much pollution in the air.

Fig. 2. **a.** Solid Poetry by Studio Molen; **b.** Flower lamp by Interactive Institute Swedish ICT; **c.** Scent of time by Hyun Choi; **d.** Wearable detect air by Genevieve Mateyko and Pamela Troyer.

On these 70 samples, a further selection process was performed, on the basis of a number of parameters hereafter described.

First of all, we evaluated the communicative intent of the product. This way, we identified two different categories of dynamic products:

- *communicative* products, which aim at transmitting a message to users through changes in their sensory features (e.g. Flower lamp, which indicates the electricity consumption through its changing shape; fig. 2b)
- *expressive* products, in which the dynamic change has just an expressive, aesthetic or emotional aim (e.g. Solid Poetry is not designed to convey a specific message, but just to pursue an aesthetic intent; fig. 2a).

Thus, we decided, on the basis of our objectives, to discard expressive products and to focus our analysis on the category of communicative products, that were further evaluated on the basis of the novelty factor. This way, we discarded products which adopt standardized dynamic signals, such as common LED lights or sound alarms embedded in appliances. At the end of the selection process, we obtained 45 samples.

2.2. Step 2: Describing and classifying samples

In this second step, our aim was to identify some parameters useful for the classification of dynamic products. The three parameters we considered were: who or what is sending the message (i.e. the message source); the nature of the message; the stimulated senses.

The classification of the samples according to these three parameters helped us in understanding in what situations dynamic products can be adopted to inform the user, what kinds of messages they are able to convey and which senses can be activated in order to convey a message.

2.2.1. The source

The information source is the sender of the message. According to this parameter, samples were classified into three different categories:

- products transmitting messages coming from the product itself (e.g. when they communicate their internal states, the progression of their works, their energy consumptions, and so on. An example is the Coral cooking, a pot that changes color from blue to red to indicate the increase of its temperature; fig. 3a)
- products transmitting messages coming from the external environment which they are part of (an example is the E-Plant, that lights up and changes colour to indicate the electricity consumption in the house; fig 3b)
- products transmitting messages coming from a person that wants to keep in touch with another one or wants to communicate his/her own emotions to others (in this case we talk about human-human interaction. For instance, Firefly is a soft sphere which reproduces the heart bit of the beloved person, emitting a pulsating light; fig. 3c)

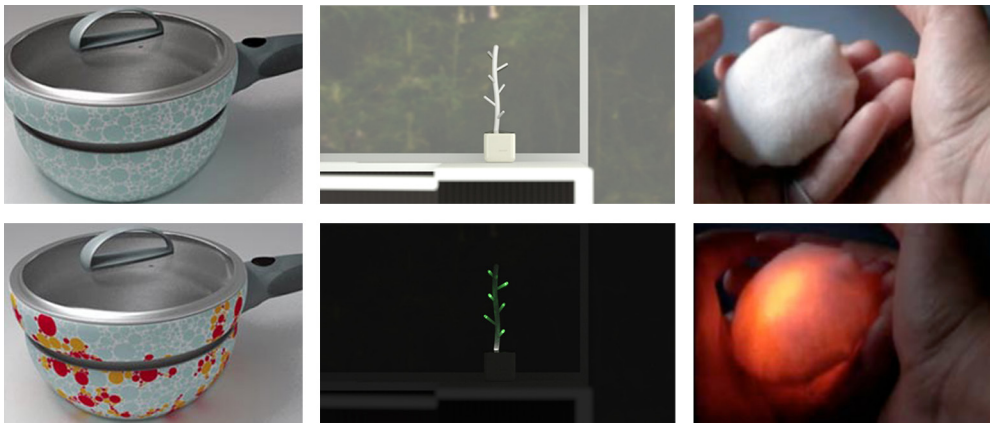

Fig. 3. **a.** Coral cooking by William Spiga & Juliana Martins; **b.** E-Plant by The Signers; **c.** Firefly by Secil Ugur

2.2.2. The message

The content of the message can vary a lot, going from the temperature of a room, to the emotion of a person, to the reminder of an action that has to be undertaken by the user. Even though the content is so varied, messages can be classified on the basis of their purposes. Indeed, from our analysis, it emerged that a message can be aimed either at just

informing the user about something (in this case, we talk about *cognitive messages*) or at exhorting the user to take an action (in this case, we talk about *exhortative messages*).

In the first case, the product aims at transmitting an information that does not demand any immediate intervention (e.g. “the room is warm”, fig. 4a). In the second case, the product requires the user to do something (for instance “you are dehydrated, drink water!”, fig. 4b).

Fig. 4. **a.** Heat-sensitive wallpaper by Shi Yuan **b.** I-Dration by Cambridge Consultants.

2.2.3. The stimulated senses

Human beings decode information with their senses, thus, in the communication process, senses can be defined as the receivers of the message (Crilly 2004). For this reason, in the selected samples, we analyzed which senses are stimulated by the dynamic features. To do so, we divided all the samples into sensory categories, identifying visual, tactile, auditory and olfactory products. Then, for each sense, we classified the stimuli adopted by the products to activate it; for instance, the visual modality is stimulated by changes in product colour, shape or light, while the tactile modality by changes of temperature, pressure, position and vibration (fig. 5).

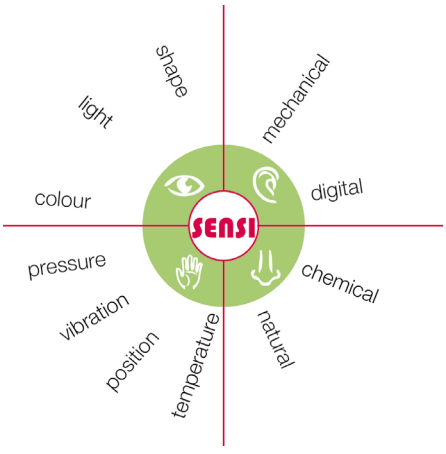

Fig. 5. Map of the sensory stimuli.

2.3. Step 3: Analyzing results and shaping hypothesis

In order to extrapolate results and shape hypothesis from the case-study analysis, we summarized each sample into a card (fig 6). In it, the source, the kind of message and the activated sense are indicated. Subsequently, graphics were created in order to link both the source and the message to the activated sensory modality. From this, hypothesis were shaped and, finally, some considerations on the differences between prototypes and commercial artifacts have also been made (fig 7).

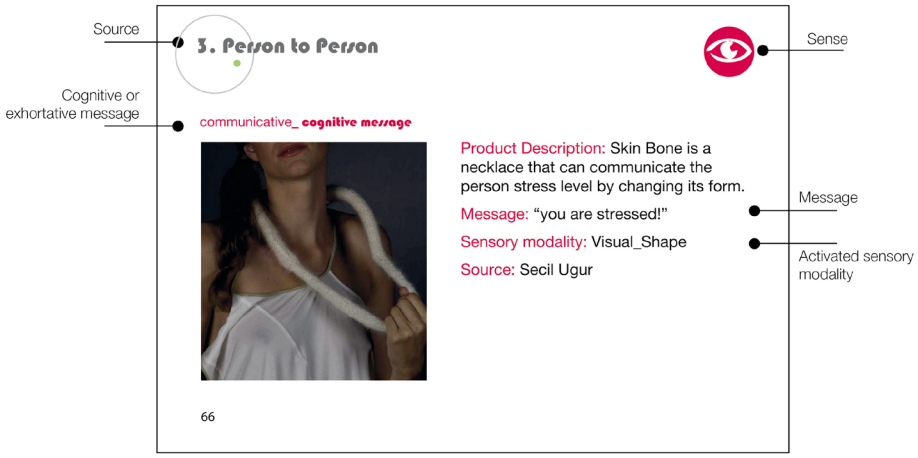

Fig. 6. Card sample.

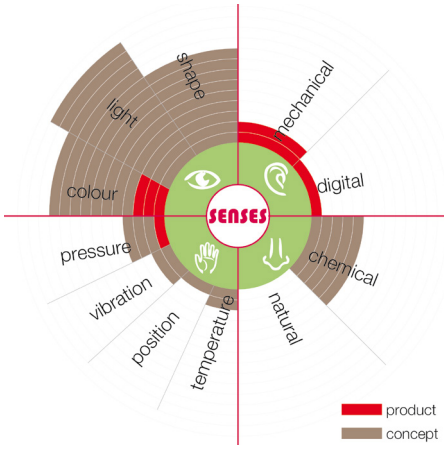

Fig. 7. Products and concepts distribution. Each coloured area corresponds to a sample.

Source vs. senses

Each sample has been represented on the sensory map according to the source of the message and the sense it activates (fig. 8). Hereafter, for every sense, some considerations are drawn.

Fig. 8. Relations between the sensory stimuli and the messages sources.

VISUAL STIMULI. The majority of the case studies uses visual stimuli to transmit messages. The change of light intensity is the most used stimulus in the selected samples, but it is employed just to convey messages coming from environment and person; indeed, messages coming from products (e.g. internal state or work progression) are conveyed only by shape and colour changes. Colour is an important stimulus as well, but it is not adopted to transmit personal messages. To investigate if these results are casual or depending on semantic reasons, a further study may be necessary.

TACTILE STIMULI. Tactile stimuli are the second in use and they are mostly adopted to transmit messages coming from a person; in this case, the employed stimuli are pressure and temperature changes. Basing on the studies of Gallace (2010), who describes the touch stimuli like an affection expression, we can interpret pressure and temperature like a simulation of the beloved person's touch. Vibration is employed when the sender is the environment, for instance to communicate that there is too much pollution in the air (fig. 2d).

AUDITORY AND OLFACTORY STIMULI. Sound and smell turned out to be the less used senses in our selected samples. In regards to sound, this can be explained by the fact that one of the parameters for the selection was the novelty factor: since the use of sound is already well established in the market, it is likely that, when developing new concepts, its investigation results less stimulating. Indeed, sound is used just in commercial products. On the contrary, smell is used only in concepts and prototypes (fig.7). Generally, smell is the most overlooked sense in design, despite its ability to convey messages and its high emotional potential. In olfactory products, the fragrances used to communicate messages are chosen by the user; this can stem from the assumption that smell is strongly connected to people's memories (Cavalleri 2009): by choosing one's favorite fragrance, one can more easily remember the information the product wants to convey. This is, for instance, the case of Scent of Smell (fig. 2c), in which every hour releases a different fragrance chosen by the user.

Message vs. senses

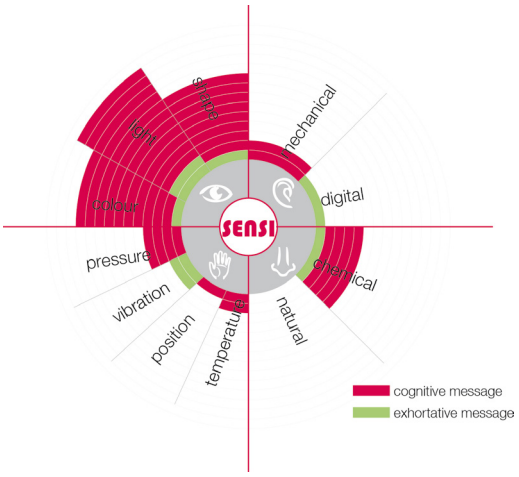

Fig. 9. Relation between sensory stimuli and message nature.

According to figure 9, most of messages conveyed by dynamic sensory features are cognitive, i.e. aimed at transferring some knowledge, instead of exhorting to do something. Specific sensory stimuli are associated to a particular kind of message. For instance,

within the touch category, vibration is used in order to exhort users to take an action, while pressure is chosen to convey exclusively cognitive messages.

3. Conclusions

The samples analysis confirmed us that the designer, in order to communicate a message to the final user, can design a product physical change. Through such changes, the product can transmit messages that originate from either itself or the environment or a person who wants to communicate with someone else.

The case studies analysis confirmed that dynamic products can rely on all the sensory modalities. Indeed, also transformations in tactile and olfactory features can communicate specific kinds of information to users. However, sight is still the most employed sense, likely because it has always been the dominant modality in human perception (Hekkert 2006). Moreover, it emerged that designers do not pay equal attention to the different sensory modalities. Touch and vision, linked to the materiality of the product, are usually the main focus of designers' activity. Hearing and smell, on the contrary, perceive qualities that are linked to immaterial features, and are often added to the product in the final steps of the design process (e.g. for digital sound). This might be the reason why, so often, these two senses are overlooked in product design practice and are left to specialists, that design these features as added properties (this is the case for sound design).

The results we propose in this work are based on the case studies analysis, with references to previous research. The direct verification of these hypotheses, for instance through tests with users, may be a subsequent step of the study.

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