ICED13
INTERNATIONAL CONFERENCE ON ENGINEERING DESIGN, ICED13
19-22 AUGUST 2013, SUNGKYUNKWAN UNIVERSITY, SEOUL, KOREA

DESIGNERS' PROMISES OR USERS' EXPECTATIONS?

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ABSTRACT
Several frameworks describe the design process, such as the FBS model and its extensions. Some of them present a designer-centric view, while the most recent ones are more based on the user's point of view. This paper investigates and seeks to explain the different perspectives between designer and user after the first interactions with the product. In particular, the paper models how the designer's promises of functionalities match (or mismatch) the user's expectations. Thus twenty-four examples, including misuses, unperceived functions, hidden functions, failures etc., are mapped in a table.
The paper provides also a formal model based on Function-Behavior-Structure approach to describe the possible cases of misunderstanding between the user and the designer. Such a model formally links the designed product, as it is conceived by the designer, and the perceived product, as it is understood and interpreted by the user. Finally a series of redesigned actions are proposed to try to overcome some of the cases of misunderstanding between the user's and the designer's perspectives.

Keywords: design theory, functional modelling, design cognition, FBS model

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1 INTRODUCTION AND STATE OF THE ART

The paper focuses on the design activity of products which have a direct interface with their final users. It does not consider subsystems used within other products (e.g. electrical motors in household appliances). In effect, even if they also can affect the final product performance, the interaction between the subsystem and the user is mediated through the product itself and in particular through its user interface or interactive interface (for more details see Cascini et al., 2010). On the opposite side we have to cite situations where designers and customers work very closely together and therefore can come to a shared understanding of users' needs and product functionalities.

The model the authors are going to present is conceived to describe cases of a limited or a mediated connection between user and designer. It can be extended also to the case of subsystems and to cases of co-developed products.

The analysis of the different perceptions and interpretations of product functionalities can bring to opposite results: a satisfied and pleased user vs. an annoyed or frustrated one.

Such an approach is only partially described in Function-Behavior-Structure (FBS) original models (Gero, 1990; Umeda et al.,1990) and in their modifications (Gero and Kannengiesser, 2004; Cascini et al., 2010; Cascini et al., 2012). However, even if some attempts exist in literature (mainly in Cascini et al., 2010) a complete mapping of the user's perspective vs. designer's perspective is not provided.

The attempt of this paper is to link the user's perspective with the designer's point of view, that sometimes do not exactly coincide. Indeed, the designer conceives and designs a product to satisfy some requirements that are his/her personal interpretation of the user's needs.

Therefore the paper tries also to untangle the two perspectives and to highlight the main problems linked to the misalignments. Taking into account the two different perspectives, a broader and more complete representation of the possible scenarios can be foreseen. Therefore a description of the genesis of the possible incomprehensions is provided and formally modeled.

The work starts from the analysis of the definition of the need, goal, requirement, perception, interpretation, function and behavior. The idea is to move from the definitions and then to reconcile and situate some past efforts to explain the possible reasons of misunderstanding between users and designers.

The Function-Behaviour-Structure (FBS) framework (Gero and Kannengiesser, 2004) has been considered as the starting point, since it constitutes a reference in the description of the design processes from the designer point of view. In its original version (Gero, 1990), the FBS model introduced three types of variables: "Function", "Behaviour" and "Structure" and eight elementary processes of a design activity. Such processes modify variables transforming one kind in another or transform a variable within different worlds (external world, interpreted world and expected) (Gero and Kannengiesser, 2004).

Gero's perspective is design-centric and many extensions of his ontology focused on the designer's world. In the last years some attempts to clarify or extend the framework appeared (see for example Vermaas and Dorst, 2007, Cascini et al., 2010 and Cascini et al., 2012). Indeed, Cascini et al. (2010) extended FBS framework to product use context. Such an extension brought to the introduction of new elements in the picture. These elements are misuses, failures and alternative uses, and are connected to the realm of behaviors and to their interpretation by both the users and the designer. In particular some of these elements derive from the user's and designer's different perspectives.

According to Cascini et al. (2010) the definitions of these elements are the following:

1. **Failures** and their perception. Failures can be observed by several points of view: a device could stop working, its performance could be reduced, its use could be not intuitive, there are undesired side effects and the consumption of resources is excessive etc.. (Becattini et al., 2009).
2. **Alternative uses** are all the possible uses of a device for other purposes. Thus, the alternative uses are the possible behaviors B interpreted by the user as possibilities of achieving different goals (G_u) than those the product was designed for by the designer (G_d). As detailed in Cascini et al. (2010), alternative uses can be described as $G_u \neq G_d$, $Bs_u \neq Bs_d$.
3. **Misuses** are defined as those conditions, in which the user manipulates the product in ways that were not intended by the designer, still keeping the same goal. According to the notation proposed by Cascini et al. (2010), misuses can be described as: $G_u = G_d$, $Bs_u \neq Bs_d$,

Working on Gero's FBS, Cascini et al. (2012) wanted to strengthen the FBS by supporting a more careful and detailed investigation of the processes occurring in the early stages of design (customers' needs elicitation and translation of the voice of the customers into Requirements). Therefore they stressed the modeling of the design activities necessary to a clear identification of the Needs to be addressed and to a careful definition of the Requirements specification. Their definition of Needs and Requirements were the following:

Needs (N_d): "an expression of a perceived undesirable situation to be avoided or a desirable situation to be attained [..] [that can be] perceived by any of the actors involved in the product life [cycle]".

Requirements (R): a measurable property related to one or more Needs. They "are structured and formalised information about a product" and "consist of a metric and a value".

Actually, while the term "expression" takes into account the user's perspective, the term "situation" is more neutral and close to the concept of states (see below). In fact, users have needs they try to satisfy by buying and using products. In using such products they have goals they intend to achieve. The definition of a goal as described by Baber and Stanton (1999) is the following:

Goal: "the desired state the user wants to achieve" by using a product.

Certainly needs can be defined also from an user perspective (N_u). They are more related to user phycology than to engineering design, but from a design point of view they can be defined as "a desirable situation to be attained or an undesirable situation to be avoided".

Not far from this approach, Sasajima et al. (1995) refer to desirable states as those that each product is expected to achieve (and can be considered the product's goal or the user's goal in using the product). Thus, the result of an interaction with a product is a **behavior** that is observed and interpreted by the user. The interpretation of each behavior is conditioned by the desired goal, and is called **function** by Sasajima et al.(1995). The interpretation aims at ascribing a goal to a behavior. Therefore functions are considered as an indissoluble set of behaviors and goals (Gabelloni et al., 2011).

For the sake of completeness, state can be defined as:

State: A state complete description of a system in terms of parameters. In more detail a particular set of entities, attributes of entities, and relations between entities (Umeda et al., 1990). Alternatively, Gero and Kannengiesser (2004) defined **structure** (**S**) as the physical constitution of the product, its components and their relationship. Such definition is more intuitive but less precise than that of state.

While Gero and Kannengiesser (2004) adopted a designer centric approach, a user centered perspective is followed by Umeda et al. (1990) and Erden et al. (2008). Erden et al. (2008) stated that a "**behavior**" can be defined as a sequential change of states over time, and therefore pertains to the objective, physical world. Actually a behavior (Bs) is the set of the observable attributes derived from the structure (S), i.e. what the product does (Gero and Kannengiesser, 2004). When some of the behaviors are "recognized as functions" we switch from objective to subjective realm (Umeda et al., 1990).

Let us to try to untangle two interlinked problems:

1. Opposite to behaviors, certain states can be subjective. It means that they are or (i) affected by the interpretation of the user or (ii) biased by the user intention and goal (in general the user sees only what he/she is interested in).
2. the term "to recognize" in Umeda implies two facts: (i) the state change has to be **sensed** and (ii) has to be **interpreted**.

Following the works of Umeda et al. (1990), Sasajima et al. (1995) and Erden et al. (2008) sensing, perception and interpretation are the key elements to be treated as separate items. The following definitions can be provided:

Sensing: user acquisition of signals in the nervous system. Internal signals are the result of physical stimulation of the sense organs (Goldstein, 2005). For example, visual signals are due to light striking the retinas, to food molecules that interact with smell receptors and taste papillae, etc.. Hereinafter, sensing is the passive reception of these signals by the user.

Perception: the action of decoding row data (sensory signals) or the assignment of meanings to various signals. Interpretation is not passive, but it is affected by learning, memory and expectations or in other words by soft skills as experience, background and social integration.

Interpretation: the action of ascribing a goal to a behavior thus generating the concept of function.

Using the above defined concepts, the next paragraph will start with an overall intuitive picture of the model and follow with its formal representation. Then all the cases of possible match and mismatch will be presented and described with an example. The paper ends with a series of re-design actions that could be applied when a negative case emerges.

2 THE ANALYSIS OF THE POSSIBLE CONDITIONS OF MISMATCH

In case of direct contact between users and products, it is important to analyze both the designer's and the user's worlds, since various problems originate at the interface between the two. On one side the designer supposes to know what the customer wants and therefore he designs particular features to satisfy the user's desires. In other cases, the designer would like to avoid some functions that can be harmful for the user or for the environment. However, often the product does not perform the desired functions or, conversely, it carries on the functions unwanted by the designer. Both these cases can cause customer's dissatisfaction or even damage the user. Unfortunately sometimes the user is not aware of the real potential of the product because he does not perceive the function or because it is hidden. Also these cases are a lost opportunity. The analysis aims at reconciling the user perspective with the designer's perspective. The purpose is to describe it by focusing on:

- The functions the designers want the product performs. Those functions are designed to satisfy the requirements (R) interpreted on the basis of users' needs (N) as understood by the designer (N_d). Generally the designer assumes that his/her interpretation is correct.
- The functions actually perceived by users. As briefly introduced before, the user perceives functions on the basis of his/her goals and expectations and wants to use them to satisfy his/her needs (N_u).

On one side the product is the real entity that links the two perspectives, on the other hand the users' needs are the elusive elements that close the loop. Figure 1 shows how the two perspectives can be linked through the past studies.

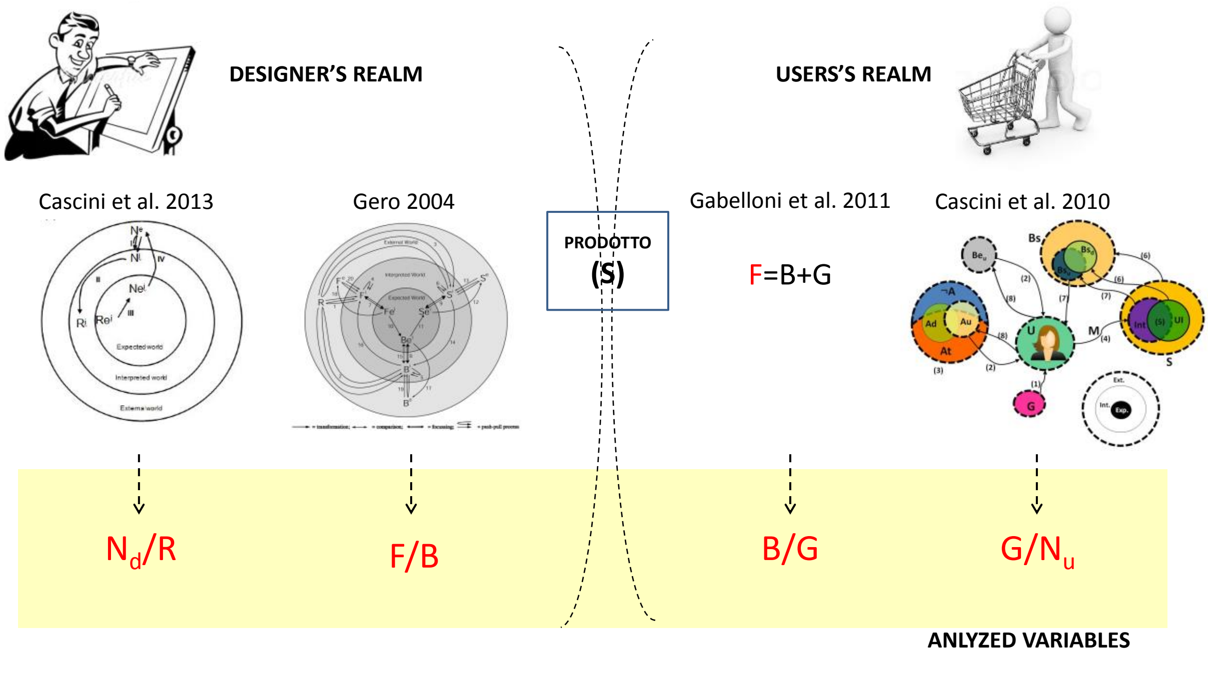

Figure 1 Reconciling the two perspectives: designer centric on the left and user centered on the right

Figure 1 supplies just a qualitative representation of the designer's and user's realms (as done by Erden et al, 2008), but it can not explain quantitatively the number and reasons of mismatches. Therefore we try to adopt a more formal model to describe them. The following table can help the reader with the used notation.

Design perspective:

The designer believes the user has a need (N) and translates it into a requirement (R_d), where the user's goal (G_u) is interpreted by the designer (G_d). The designer thinks that a particular behavior Be_d

(behavior expected by the designer) of the product will be interpreted as the wanted function F_d where $F_d=Int_d(Be_d,G_d)$. Actually in designer's mind the function F_d meets the requirement R_d.
Therefore he/she does a design action on the initial product structure S. The result of his/her action can assume three different values: S_d, $\cancel{S_d}$ and $\xcancel{S_d}$ that mean structures designed to produce a certain behavior Be_d, designed to avoid a certain effect $\cancel{Be_d}$ (that can be harmful for the user or perceived as a failure), and not designed, respectively. The designer believes that S_d and $\cancel{S_d}$ will generate Be_d and will prevent Be_d from happening.
However, for several reasons, S (composed of S_d, $\cancel{S_d}$ and $\xcancel{S_d}$) behaves in a certain way, thus generating Bs. The real behavior derived from the structure (Bs) and the behavior expected by the designer (Be_d) can be the same or can be different.

Table 1. The adopted notation

N	Need	R_d	Requirement
N_u	User's need	N_d	N_u as understood by the designer
G_u	User's goal	G_d	G_u as understood by the designer
F	Function	F_d	F from the designer's point of view
F_u	F from the user's point of view	S	Structure
B	Behavior	S_d	S as designed to generate Be_d
Be_d	B expected by the designer	$\cancel{S_d}$	S as designed to prevent Be_d
$\cancel{Be_d}$	B the designer wants to prevent	$\xcancel{S_d}$	S not designed
Bs	B derived from the structure S	Int_u	Interpretation from the user
Bs_u	Bs as perceived by the user	Int_d	Interpretation from the designer

User perspective:
First of all the user has to perceive a behavior Bs from S. Therefore three cases are possible: Bs is correctly perceived ($Bs_u=Be_d$), it is not perceived or it is wrongly perceived ($Bs_u \neq Be_d$) (e.g. visual, auditory, etc.. hallucination). The adverb "correctly" and "wrongly" are referred to the designer's hypothesis: correct means the user's perception and designer's hypothesis are the same, wrongly means the opposite. The cases "not perceived" and "wrongly perceived" can be treated as an unique case where $Bs_u \neq Be_d$.
Finally, the user interprets the Bs on the basis of his/her goals G_u That process transform the Bs into Bs_u. It can be formally described as: $F_u=Int_u(Bs_u,G_u)$. Where F_u is the function as it is interpreted by the user, Int is the transfer function (in mathematical terms) that describes the user's interpretation and that links Bs_u and G_u. Also the function Int can assume only two values: aligned or misaligned with respect to the designer's hypotheses.
The results are the following: from the designer point of view, 3 cases at the structure level exist S_d; $\cancel{S_d}$; $\xcancel{S_d}$, which can generate a Bs equal or different with respect to the one expected by the designer Be_d. It means 6 cases in all.
Signals (Bs) coming from such features can be "correctly" ($Bs_u=Be_d$) or "wrongly" ($Bs_u \neq Be_d$) perceived by the user. The class wrongly perceived contains also those cases when the Bs is not perceived by the user. It means 2 new alternatives for each of the 6 cases mentioned above for a total of 12 cases we represented
Table *2*.
At this point, for a more complete but more complex picture, user's goals can be introduced. The user's goal can be aligned ($G_u=G_d$) or misaligned ($G_u \neq G_d$) with designer's intent, therefore each of the 12 elements has two states. The final 24 cases are shown in Table 3.

3 THE MAPS

As stated before, after the user had used the product, a comparison of the designer's intention and the user's perception and wishes was carried on. Thus a map of the possible scenarios was created. This is the first step to understand the correlations and the differences between the designer's perception and the user's one.
The numbers in
Table *2* are related to the cases shown and explained in the second table.
The explanation of the cases shown in

Table *2* will be provided after the presentation of the extended table. In fact it contains and expands the cases in
Table *2*. However the main advantages of
Table *2* is to introduce the general picture and to show the cases in a synthetic way. Its columns take into consideration the design perspective, while the rows describe how a function is perceived by the user.

Table 2. Synthetic map of the possible scenarios

		function designed to exist	function designed to not exist	function not-designed
existing function	perceived	FUNCTION (1-2)	MISUSE OR FAILURE (9-10)	NOT-DESIGNED FUNCTION (17 -18)
	unperceived	UNPERCEIVED FUNCTION (3-4)	UNPERCEIVED FAILURE (11-12)	UNPERCEIVED NOT-DESIGNED FUNCTION (19-20)
absent function	perceived	UNPERCEIVED FAILURE (5,6)	PERCEIVED FALSE FAILURE (13-14)	PERCEIVED FALSE FUNCTION (21-22)
	unperceived	FAILURE (7-8)	INTERESTING MISSING MISUSE, AVOIDED FUNCTION (15-16)	NO FUNCTION (23-24)

Considering users' goals allows us to map the perception and goals of both the designer and the user. Therefore a more complete description of the real picture is given in Table 3. It can help the designer to compare product promises and the users' expectations (Be_u) in order to define which re-design actions are necessary.
Table 3 presents all the 24 possibilities only as a mere combinatorial result. Of course from a practical point of view some of them can actually be related (or even identical) and the borders between them can be rather blurred.

Table 3. Extended map of the possible scenarios

Designer's intention $F_d=Int_d(Be_d,G_d)$	**Does the product (S) generate $Bs=Be_d$?**	**Does the user perceives $Bs_u=Be_d$?**	**Does the user desire the function? (G_u)**	**Final Result**	
designed to be present	Yes	Yes	Yes	1. Function	Main functions carried on by the products
		Yes	No	2. Uninteresting Function	Fresh air of the hair dryer (useless for most of the people)
		No	Yes	3. Interesting Unperceived Function	Keyboard shortcut, Impatient passenger
		No	No	4. Uninteresting Unperceived Function	Ticking for a deft person
	No	Yes	Yes	5. Unperceived Failure	Reebok easytone
		Yes	No	6. Uninteresting Unperceived Failure	?
		No	Yes	7. Failure	Wrong Apple maps
		No	No	8. Uninteresting Failure	A waterproof watch where the gasket is damaged but the user is not able to swim
designed not to be present	Yes	Yes	Yes	9. Misuse	Use of microwave to cook eggs, Mix of medicines to produce dangerous drugs (e.g desmorphine)
		Yes	No	10. Failure	The square glass conveys water from the

					corner but spills it if used from the side
		No	Yes	11. Interesting Unperceived Failure	?
		No	No	12. Unperceived Failure	Plastic products that release noxious substances
	No	Yes	Yes	13. Interesting Perceived False Failure	?
		Yes	No	14. Uninteresting Perceived False Failure	Fake knife
		No	Yes	15. Interesting Missing Misuse	The skip of the safety device of the blender is desired
		No	No	16. Avoided Failure	All the functioning safety devices of the products (e.g. Child lock)
not designed	Yes	Yes	Yes	17. Alternative Not-Designed Function	Rust removal by coke, use of kettle to cook pasta
		Yes	No	18. Uninteresting Not-Designed Function	The laptop screen attracts dust
		No	Yes	19. Unperceived Interesting Not-Designed Function	A car can protect from the thunderbolts
		No	No	20. Unperceived Uninteresting Function	Any alternative use not interesting for the user: e.g. hammering nails with a brick
	No	Yes	Yes	21. Interesting Not-Designed False Function	Power balance bracelet, horseshoe
		Yes	No	22. Uninteresting Not-Designed False Function	Jetta car and objects that bring bad luck
		No	Yes	23. No Function (Promising Function)	-
		No	No	24. No Function	-

In the fifth column of Table 3 a classification of the possible scenarios is shown. Each scenario is described from a designer point of view. It describes how the designer understands the user’s reaction to the product, after its use.

When the user does not desire a specific function, that actually is carried on by the product, s(he) can remain indifferent or feel frustrated or even damaged (at least s(he) paid for something s(he) does not desire). All the cases with examples are enumerated and briefly described in fifth and sixth columns. A deeper description of the new most complex cases of Table 3 is presented below.

It is necessary to underline how the sixth column shows a collection of example rather than a series of real cases study, it is more as a support column to better explain column five.

Designed functions

Analyzing the first class of examples (when the designer designs a product that has to perform a particular function), if the user does not understand the presence of an existing function, an unperceived function is present. This is the case of devices with hidden affordances. Therefore, if the user does not have the adequate knowledge, he cannot benefit of that function, that remains hidden.

As an example, the average customer does not care and know the function of “impatient passenger” in a car door, even if the 95% of cars have such a functionality. The “impatient passenger” acts when the passenger, outside the car, tries to open the car door, when it is still locked. In this case a spring prevents the opening and assures the latch does not stuck and come back in its initial position. When the driver opens the car (all the latches), the passenger can open it again. The users notice such hidden function only when he misses it(e.g. in very old cars).

A more common case is represented by the keyboard shortcuts. For example most of the user does not know that pressing WIN+L the Windows session will close or that, holding down the shift key and tapping on F3, the selected text cycles through lower and upper cases**.** In this latter example many users miss the necessary knowledge to exploit such a function. However also when the user can not perceive a function (because of the physiological limits of human perception) a hidden function is

present. For instance, in the antibacterial fabrics, silver particles can not be seen by the naked eye, thus the antibacterial property can not be perceived by the user at first sight, but only after a comparative test.
The most particular cases of this class are: the uninteresting unperceived function, and the unperceived failure. In both the cases the user does not perceive the existing function or the missing function (therefore a failure), due for example to the limitations of his/her perceptual organs. For example a deaf person does not perceive the alarm of a timer and, therefore, it is useless for him/her. Unfortunately sometimes a user does not perceive also a failure (unperceived failure), and therefore he is not able to understand that the products does not work properly. Reebok shoes is an example of an unperceived failure. In fact the company claimed the shoes helped to tone the legs' muscles. Actually they do not reshape customers' bodies as advertised (and indeed the company has been condemned for false advertisement, but the suite was promoted by a limited number of users: those who perceived the existence of the failure).
In Europe many cars have the double lock, a functionality that, when enabled, prevents the possibility of opening the doors even from inside the car (in USA it is not adopted to prevent legal actions). In this way a car thief can break the window but he can not open the door. Therefore this functionality is known more by the thieves than by the car owners. Sometimes it happens that the double lock does not work, but, since the double lock is an hidden function, also its failure remains hidden. In such a case the latch does not work as the designer thought, but the user can not perceive the failure since the function is unknown by the user or hidden.
The uninteresting unperceived failure is a very rare case and difficult to be identified. It occurs when the designer designed the product, so that it carries on a function, but actually it does not, and the user neither perceives the defect nor wants the function.

Not designed functions

One of the most interesting class of possible scenarios is when a product can carry on a particular function but the designer is not aware of it (in other words the designer didn't design the product to carry on some particular functions, but anyway the product embeds them). Sometimes neither the user is aware of such functions (unperceived interesting not-designed function). For example when there is a storm, a car protects the driver and passengers from the thunderbolts. This is a hidden interesting function that most of the users does not know and notice. On the other hand the user could be not interested in a unperceived not-designed function: in this class all the possible alternative uses of the product (not-designed) neglected by the user (uninteresting) are included.
The following example belongs to the same class: if the user perceives the function that he does not desire, an uninteresting not-designed function occurs. Often it can be also perceived as a failure. For example the laptop screen generally attracts the dust: this is perceived as a failure by the user, even if it is not designed by the designer, but is a mere consequence of the screen behavior.
A particular and apparently strange case is when actually the product does not perform a function, but the user recognizes it (not-designed false Function). This situation could seem impossible, but actually it occurs in several circumstances, such as when the user has some particular beliefs, superstitions, psychological biases, cerebral illness or he/she is watching an optical illusion. Indeed a superstitious person confers for example "magic functions", that belong to non-technical function class (Metzler and Shea, 2011), to a red horn amulet or to a horseshoe. It is different when the user is a "victim" of perceptual illusions, that are particular perceptions that do not have an exact correspondence with the real data. Other interesting cases happens when–the human brain is deceived by his senses and perceives reality that does not exist or that is distorted from the real one. For example, a bedroom with an incredible amount of light, caused by a big fluorescent lamp, could seem more an hospital than a bedroom because the covers appear sharp and the floor cold. This is caused by the shadows that have a key role in the evaluation of the three-dimensional world around us. Even the psychological conditions can lead to a distorted perception of reality. For example, when a strict vegetarian watches a piece of raw meat, he perceives a more bluish color (and therefore the meat seems even less attractive).
Sometimes a distorted perception of the product functions is desired by the designer himself. It can be reached through conferring a particular feature (for example through a particular color or an optical illusion), or acting on the advertising of the product, such as the case of the power balance. It is a hologram bracelet once claimed by its vendors to increase sporting ability. Studies of the device found

it to be worthless in improving athletic performance. Therefore the company was forced to retract its claims.
Finally an interesting case happens when the user perceives a false function and he does not want it (Interesting not-designed false Function). This case is similar to the red horn amulet one, but here it is unwanted by the user. Jetta car is an example: indeed in Italian the word “jetta” reminds the word “jettatore”, related to bad luck. Therefore of course such name is not attractive, at least for superstitious people.

Designed to not to be

When the designer designs a product in order to remove a harmful or undesired function (failure), the most critical scenarios occur. The safety devices belong to this class, such as the lid of a blender, that blocks the device if it is not coupled correctly.
Some of them are rather unusual and no meaningful examples have been found, such as the Interesting Unperceived Failure and the Interesting Perceived False Failure.
If the designer’s action is not able to avoid the harmful function, the failure remains (Unperceived Failure). This is the case of some plastic materials that release noxious substances. The designer changed the material, but the production continues to use old materials stored in the warehouse. The user is not able to perceive neither the hidden failure (old material) nor the hidden function (new material that does not release any noxious substance).
Also the Uninteresting Perceived False Failures belong to the third class. They are really uncommon and they happen when both the designer and the user do not want a function, but at the same time they desire the object seems to have it (the fake knife in the movies is an example).
Finally a very interesting case is when the user and the designer disagree on a function: the user would like it, conversely the designer does not want it (Interesting Missing Misuse). For example, someone might want to add food into a blender while it is in use. Thus the safety device is considered boring by the user, but it can not be skipped by the designer (for safety and regulation reasons).

4 RE-DESIGN ACTIONS

For each of the negative cases among the 24, the designer can act on the product to transform the bad case (i.e. problems at the user’s level) into new design possibilities. Indeed for the good ones some guidelines to stress the product potentialities can be provided. In this process the most critical aspect is to understand where the analyzed product is positioned within the Table 3. This information can be gathered through users’ observation and feedback. When the function exists, it is perceived (1,17) and it is of interest, the designer can try to improve its performance and/or to better communicate it to the user. On the other hand, when the product performs the function, but the user does not perceive it (3,19), the designer has to re-design the product, especially if the user desires the unperceived function. In particular the designer has to re-think and improve the affordances of the product itself in order to make it self-evident.
Conversely, when the functions are not interesting for the user (2, 4, 18, 20), the designer could try to eliminate/modify the components of the product in order to reduce the product cost, according to Value Analysis methodology (Miles, 1972). Particular cases are legally compulsory functions as those related to user’s safety. They are often considered boring by the user but can not be removed.
Of course, a failure (7 o 8) must be eliminated with a re-design of the product. If it is not perceived (11, 12) the designer could be not interested in solving it, hoping the user does not notice it. However, every designer usually try his best to enhance product functionalities and performance, therefore also such cases should be redesigned. In all the other cases under the classes “design not to be” (9, 10, 14, 15) the designer has to be sure the product is not able to perform any damaging/unwanted functions.
While cases 21 and 22 are very rare, cell 23 contains all those functions desired by the user but never been taken into consideration by the designer. They are a precious source for future opportunities.
Thanks to advertising, as well as communication, the designer can also leverage the latent needs of the users and therefore make a hidden function more evident, interesting or even attractive.

5 CONCLUSIONS

The paper analyzed the link between the user’s perspective and the designer’s point of view about an existing product. And in particular it highlighted the possible mismatches between the two perspectives. The comparison of the designer’s intention, and the user’s perception and wishes brought to define twenty-four possible scenarios. The analysis of the cases has been presented through a formal formulation. Indeed this work constitutes the first step of a long term research, aimed at modeling the FBS in formal terms. The formal representation allows a better understanding of all the possible cases, but unfortunately generates also many false cases. These false cases exist only at a theoretical level, and can be manually analyzed and filtered. For each one of the identified cases, an example has been provided. Furthermore, the most interesting and complex cases have been explained.

Finally, considering all the possible scenarios, some possible re-design actions have been presented. Future work will focus on the development of a structured methodology to position existing products into the table. Furthermore a more accurate identification of real design rules may be provided.

ACKNOWLEDGMENTS

This research work was supported by LILIT Project (PAR FAS REGIONE TOSCANA Linea di Azione 1.1.a.3), MISE Project “IOTPrise: Internet Of Things: trasferimento di tecnologie e creazione d’impresa” (Bando RIDITT, DM 22/12/2009) and RobLog Project (FP7 ICT-270350).

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