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Altering the mapping between structures and functions to modify users' perspective

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Abstract

A radical product innovation can derive from a twisting of the function-structure relationship within the product. Functions are deeply linked with the structure of the product, thus an innovation of the product functions affects also the structure. However the aim of the structure is not only to perform a set of functions, but also to communicate and arouse emotions in the user. This paper is a first effort in investigating the design phenomenon of altering the mapping between structures and functions and above all how it modifies the users' perspective. The consequences of this change are investigated, and in particular the role of the affordances in such case for the product usability is studied. A case study shows an innovative and revolutionary product, that embodies a terrific change in the traditional abdominal workout. The causes of its success but also the criticalities has been investigated, especially focusing on the users' perception.

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1. Introduction

Over the past decades the reason for an industrial product to be successful in the market has usually been related to its functionalities.

For each product an overall macro-function can be identified. It is related to the main purpose for which the product itself has been designed. The macro-function can be in turn decomposed into sub-functions [1]. The main differences between two products can be derived at this level of decomposition, since the causal chains of sub-functions are related to the design solutions adopted and thus to the level of innovativeness of the products. An innovation can be incremental or radical. In the first case the chains of sub-functions are mostly similar. In the second one a radical innovation can be achieved through a reversal of some sub-functions, that however fulfil the main one.

Since sub-functions are strongly linked to the shape and to the structure of the object, the reversal implies big changes at the structure level. To date, the evolution of the external aspect of several industrial products shows that similar functions are embodied into similar structures. The radical change of such fixed pattern (of both functions and structures) would be interesting in order to make a product more attractive.

Unfortunately a change in the traditional shape (and chains of functions) of a product implies several usability-related difficulties, since customers may not understand intuitively the function of the product by its new shape. Indeed there is a strong correlation between the product structure and the user perception. The affordances are not the only element depending on the user perception affected by the change in the product structure. Also the meaning and the emotions aroused by the artefact are influenced by the adoption of a different shape.

In the literature several design methods take into account how product features are linked with the user perception, such as its affordances [2,3]. However some factors (e.g. the feelings and the emotions that can be aroused by the product in the consumer) have been neglected in the frameworks

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proposed in the engineering design field. These latter aspects, however, are more and more relevant for the success of the product and can not be overlooked in the design phase.

Therefore the research questions investigated in this paper are:

- What are the consequences on the product in terms of its usability when reversing the functioning logics of the product?
- Is it enough to make a product more successful?

The present work analyzes the relationship between functions, affordances and emotions that a user perceives during the interaction with a product. In particular, the analysis is focused on a device for abdominal workout. This product has been selected for its innovative characteristics and structures. The purpose is to understand which aspect -among the before mentioned ones- is the most critical for making a product more attractive. Finally, a first set of guidelines is presented with the aim to take into account, since the design phase, the product requirements associated with affordances, but also with the meaning/emotions that the product itself should convey.

2. State of the art

Functionalities are one of the central element in the design of a product. A product can be described through its functions. Functional analysis is the discipline that allows to represent and analyze a product from the point of view of its functions [4]. In every product a function is carried out at least by one of the product features. A feature can be defined as the specific characteristic of a single part of the product, in terms of the geometrical entities that define it and in terms of the properties of the material it is made of [1]. It is therefore clear the relationship between the structure and the functions of the product.

However understanding the fundamental functionalities that the product has to carry out is not sufficient.

The use of the product should be as intuitive as possible, so that the user is able to easily understand the actual functionality of the product itself. Such idea is expressed by the concept of affordance, proposed for the first time by the psychologist Gibson. He describes the affordances as a specific combination of the properties of the environment and its surfaces taken with reference to an animal [5]. Later Norman regained the concept and applied it to the way of design engineering. He rekindled the notion of affordances as the result of the mental interpretation of things, which is based on people's knowledge and past experiences. The term affordance, in this case, refers to "the perceived properties of the thing ... that determine just how the thing could possibly be used" [5].

Later Maier and Fadel [6] introduced also a negative bounds for affordances to emphasize not only what the artifact should afford but also what the artifact should not afford in order to safeguard the safety of the users. There are several methods and approaches to take into account affordances during the product design process, such as the Function-Task Interaction Matrix of Galvao [3].

The concept of affordance is used in several disciplines, from the artificial intelligence [7] to the design of graphical user interfaces (GUIs) as well as that of human–computer interaction (HCI) in general ([8], [9], [10], [11]) or even in product semantics ([12]; [13]; [14]). In particular product semantics was originally defined as the ‘‘study of the symbolic qualities of man-made forms in the context of their use, and application of this knowledge to industrial design’’ [15]. Krippendorff [14] later refined the definition to describe the concern for the symbolic qualities in design as a paradigm shift from ‘design for function’ to ‘design for meaning’. Indeed functionalities and affordances are not the only important aspect in a product.

Consumers base their choice not only on the technical and functional aspects of a product but also on the emotional response they have to the product aesthetic appearance [16]. It is not sufficient to design good products or services, but the designer should design experiences and generate pleasurable or exciting sensations [17]. Therefore the success of a product is related also to the semantic of the product, i.e. the meaning sent by the product to the consumer, that changes and depends on how designer use color, shape, form, and texture in designing the product.

3. Research method

The empirical analysis is mainly based on the study of an innovative abdominal equipment, the “abdo gain”. Its structures indeed redefines the shape of the traditional products for performing abdominal workout at home.

The work is organized in a series of ordered steps. First, a functional analysis is carried out both to get deep into the functions of the device and to link the functions to the features of the structure. A benchmarking analysis with other devices for abdominal workout has been done as well. The result is the demonstration of how different the structures and the functionalities of the analyzed product are if compared with products that belong to the same merchandise cluster.

After that, a survey is done in order to investigate:

- The emotions that the user feels during the interaction with the product;
- The affordance of the product, hence its usability;
- The opinion of the users before and after having used it.

Therefore which aspect has determined the success of the product and which are the functions that are carried out in a unusual manner are investigated.

All the above mentioned analyses allow to define some preliminary guidelines to design more attractive, innovative and usable products.

4. Case study

Recently Domyos (Decathlon) is come to the market with a product designed for performing abdominal workout at home. Its name is Abdo-gain: a sitting device where users have to keep the balance in order to not fall down. For performing the best exercise, users have to balance their body in order to remain in a stable position. The product is interesting since it