

AN INVESTIGATION ON FACTORS TRIGGERING SURPRISE

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Abstract: Scholars argue about the role played by surprise in making new products creative. Different perspectives evaluate surprise as a nuance of novelty, an independent dimension or an emotional reaction to new products. The paper illustrates the outcomes of an empirical investigation about surprising artefacts, resulting in the individuation of factors impacting the manifestation of unexpectedness in terms of individuals' interpretations and/or modifications of products' behaviour and structure. Such factors have been checked by interpreting the motivations leading to the presence of surprise in 12 new lamps described in the literature. The experiment states the reasonability of the described factors and, as a consequence, the paper provides a contribution to better articulate the debate in the research arena.

Keywords: *surprising products, novelty, diversity*

1. Introduction

Creativity in engineering design is a complex phenomenon that regards, but it is not limited to, people, procedures, products, environments. According to the study conducted by Demirkan & Hasirci (2009), products hold the highest importance among all the elements that characterize the creativity of design processes. From this viewpoint, the design community is currently paying significant efforts to establish terms and formalities to assess the creativity of new products or services. Recent proposals suggest some metrics (Sarkar & Chakrabarti, 2011; Borgianni et al., 2013) and discuss about the multidimensional nature of the task, however these approaches base creativity assessments only on two terms: novelty and usefulness. Said dimensions are undoubtedly the most acknowledged aspects pertaining to product creativity. At the same time, Gero (2011) points out how surprise is sometimes included within qualitative evaluations, while Brown (2012) urges to better investigate such a factor.

The unresolved conflicts concerning the concept of surprise within creativity are likely to jeopardize any attempt to formalize its computation and subsequent employment. This is especially true within engineering design, while a major understanding has been achieved in other fields. For instance, the emergence of surprise during the design process and the means to generate deliverables arousing unexpectedness are investigated in (Dorst & Cross, 2001; Rodríguez Ramírez, 2014), by obtaining insights about approaches and tactics of outstanding industrial designers.

According to the open issues about the role played by surprise within the creativity of new products, the present paper holds the objective of better characterizing this concept with a particular emphasis to engineering design. Section 2 documents the debate about the phenomena that enable the display of people's surprise, the influence of such a perception to the extent of creativity, the mutual

relationships between unexpectedness and novelty. Section 3 proposes a set of dimensions which are claimed to characterize surprising artefacts, emerging from empiric observations of available examples gathered from the Internet. Products considered surprising in literature sources are subsequently discussed with respect to such dimensions (Section 4), showing that characteristics typifying novelty are insufficient to describe phenomena of unexpectedness. The final remarks are drawn in Section 5.

2. Related art

The present Section widely illustrates how the literature about creativity and design has discussed the theme of surprise. Reference definitions are provided at first, and then the review outlines the different views with respect to the supposed prerequisite of creative products to arouse surprise.

2.1 Surprise: definitions and fundamental concepts in creativity literature

In Section 1, the words “surprise” and “unexpectedness” have been employed with the same meaning. The possibility to interchange the terms is somehow supported by the literature, whereas the most common definition of surprise consists in the violation of expectations. Brown (2009) and O’Quin & Besemer (2006) explain how surprising products present unexpected information to the evaluator. This means that they seem implausible or even impossible to be embodied and developed according to so far accepted knowledge, generating a sense of astonishment and bewilderment (Boden, 1994). In this perspective, it is worth noticing that surprise arises not just when expectations have been contravened, but also in those events for which no clear expectation has been formulated (Ortony & Partridge, 1987). At the same time, the amount of surprise is qualitatively linked with the degree to which a transformed aspect of the product is deemed usual, typical or even immutable (Brown, 2012). Although rooted in the creativity field, the above explanations do not clarify how the emergence of surprise affects the perception of creativity. It is besides clear how just new kinds of products or the design of unprecedented situations can lead to surprise. In other words, surprise can take place just when novelty is ensured, i.e. whereas one of the most acknowledged dimensions of creativity is manifestly displayed. Hence, with respect to the supposed overlapping of the concepts undermining “surprise” and “novelty”, two diffused different visions can be extrapolated from the literature:

- surprise is a particular characterization of novelty, or even a well-identified level of the same dimension (see Subsection 2.2);
- surprise is an independent factor, which can however take place when the product is novel in a certain context and according to a definite background (see Subsection 2.3).

Other perspectives are documented in Subsection 2.4.

2.2 Surprise as a characteristic of novel products

As already remarked, novelty and usefulness (sometimes indicated as quality, meaningfulness or value with similar meanings) are the most diffused terms to evaluate or rank creative ideas and products (Oman & Tumer, 2009). Whereas the concept of surprise has been firstly introduced, it has been typically considered as a nuance of the former. Hoffman et al. (2007) report how, in the seminal studies performed by Bruner (1962), the concepts of novelty and surprise even overlap.

More diffusedly, surprise is considered as a degree or a particular cluster of novelty (Chiu & Shu, 2012). This assumption is made also in formalized procedures to evaluate creativity, such as Creative Product Analysis Model, whereas surprising solutions are a particular category of novel products (Besemer, 2000). According to the model, novel products are indeed grouped into surprising and original artefacts. Additional characterizations are added in later publications, consisting in style (Horn & Salvendy, 2006) and germinability (O’Quin & Besemer, 2006).

2.3 Surprise as a separate dimension

Boden (1994) observes that creative ideas are surprising in essence. However, few studies include surprise as a prerequisite to obtain, or a separate dimension to evaluate, creative products. According to Maher (2011), the difference between novelty and surprise stands in the reference artefacts or concepts to compare against. While the former emerges when the new product differs from the

existing descriptions of artefacts, the latter ensues when deviations are observed with respect to the expected projection of values and features of designs belonging to a definite conceptual space (Maher et al., 2013). In other words, novel deliverables are essentially unprecedented, while surprising ones deviate from the trajectory drawn by a family of products. On the same wavelength, the scholar introduces a binary scale to distinguish surprising and predictable products, by including in the former:

- the ones showing new attributes if compared with the items known in the recent past (Maher, 2010);
- the ones whose performances represent outliers in a time-dependant function obtained through a statistical regression analysis (Maher & Fisher, 2012).

Nevertheless, the proposed approach can be currently considered as a preliminary proposal to include surprise in the relevant dimensions of creativity, because of the lack of an appropriate validation activity. Besides other scholars individuate surprise as an independent factor of design creativity, but their purpose is limited to the building of a theoretical framework (Nguyen & Shanks, 2009) or to qualitative evaluations extrapolated from testers' reactions to new artefacts (Goodwin et al., 2013). The assessment of surprise is further complicated by the issue raised by Bruner (1962), who observes the temporary nature of unexpectedness, quickly ceasing after the initial so called "Aha! moment".

2.4 Other interpretations of surprise within product creativity

According to different views, surprise does not pertain to the product level of creativity, being considered as an emotional reaction to different phenomena. Wiggins (2006) explicitly denies the unexpected dimension of creative artefacts, by considering surprise an emotional reaction of people as a consequence of novelty or outstanding value. Similarly, Silva & Read (2010) focus on the display of surprise as a resultant of products' creativity, but, from their viewpoint, novelty is the unique source of the phenomenon. Eventually, Im et al. (2014) take into account novelty and usefulness as constituents of artefacts' creativity, but argue that such dimensions are ineffective to ensure future market success. Indeed, they show the relevance of an additional factor, i.e. coolness, to make products attractive or exciting. Coolness is contextually meant as the capability to arouse positive surprise, whereas the mere presence of novelty can lead to the design of absurd deliverables.

2.5 Open issues and objectives of the work

The proposed overview elucidates how the concept of surprise is intrinsically connected with design creativity, but several aspects are not shared by the scientific community. Basically, surprise can be interpreted as a characteristic of novel artefacts, a fundamental facet of creative products or an emotional reaction to original and valuable designs. A deeper knowledge about surprise is hence required, especially with regards to engineering design and within the perspective of evaluating the creativity of new ideas and products. The possibility to recognize and assess the determining factors of creative design outputs is a prerequisite for establishing the contribution of these measures to achieve market success.

According to the above open issues, the objectives of the present paper are thus:

- identifying and verifying the existence of distinguishing traits of surprise which are overlooked by most of the schemes of product creativity, that limit their scopes just to novelty and usefulness;
- provide a major understanding about phenomena related to the perception of surprise in order to enhance the available models for assessing design creativity and, in the long term, predicting the potential of new products in terms of market appraisal.

3. A model to point out the characteristics of surprising products

Consistently with the different contributions highlighted in section 2, it clearly emerges that the emergence of surprise can be also characterized by two of the 4Ps of Rhodes' dimensions of creativity (1961): Product (or the idea) and the Person. It means that there cannot be any surprise (if any) in case there is no visual or functional interaction between a product and a person who can judge it (or the idea behind it) surprising.

Figure 1 proposes the authors' understanding of the potential dimensions of surprise and tries to specify which ones mostly pertain to the product itself (here seen as a carrier of creative surprise by one of its features) or by the interpretation of the features according to the expectations one can build according to owned personal systems of values. Examples (pictures collected in Figure 2a-n) will be discussed in the following that clarify the meaning of the details at the end of each branch.

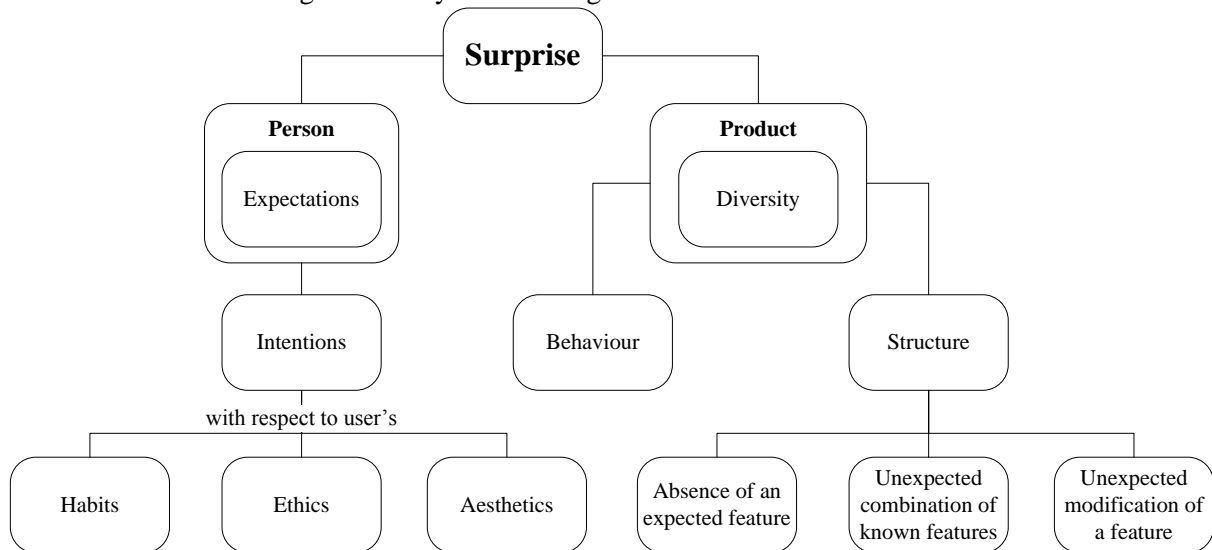


Figure 1. The authors' vision about the characteristics potentially triggering the emergence of surprise as pertaining to two of the main dimensions of creativity: Person and Product

The left branch of Figure 1 mainly deals with the personal interpretation of a product feature, which triggers an unexpected reaction by violating the set of values owned by the individual (people) that judges according to the mindset of the context (press) he/she is immersed in.

Inversely, the right branch of Figure 1 mainly deals with the presence of tangible or, more in general, sensible features embedded into the product. It does not mean that the product by itself can be considered as surprising, since the personal interpretation is still required of which features of the product do not match the expectation of the surprised person. However, such surprising features are peculiarly embodied into the product.

In these terms, the two main factors characterizing the emergence of surprise are, specifically, the person's expectations and the different features the product owns and that may result unexpected. The former are related to personal- or environment-induced system of values, and the reaction of surprise depends on the individual's mindset. Such a reaction would be more positive the higher is the matching of the surprise with values and beliefs, beyond the degree of mismatching with expectations.

3.1 Surprising intention as perceived by the person

This dimension of surprise deals with the interpretation of the intentions underlying a "proposal", as perceived by people. More precisely, a person might get surprised by the mismatch between his interpretation of the motivation behind a certain product or feature and his expectations in the specific context the product is immersed in.

Such mismatching may deal with three main domains:

Habits: Match/Mismatch with social routine, with what is familiar/unfamiliar in a given context. An essential component of the surprise that the toilet roll hat (Figure 2a) might arise is certainly due to the unexpectedness to show in public the use of a toilet device. It may happen, as well, that something conventional, such as embedding Braille characters to aid visually impaired people, appears as surprising on a certain product (such as Rubik's Cube, Figure 2b), due to the lack of specific habits.

Ethics: Match/Mismatch with the concept of morally right and wrong in a given context. The suite that makes a baby a mop (Figure 2c) generates surprise also because it goes against what people consider right. Besides, despite it is considered right providing support to impaired people, the above-

mentioned example of the Braille Rubik's Cube might generate surprise at a first sight. Is such surprise diminished, or at least vanishes more quickly due to the alignment with the ethical expectation?

Aesthetics: Match/Mismatch with the perception of beauty, with what is considered nice or ugly. Surprise appears as conditioned by aesthetic factors as witnessed by examples such as the sidecar in Figure 2d and the Longaberger headquarter building in Figure 2e. In both cases, something with a well known and appreciated look is proposed out of context, but with opposite outcomes, as far as most people describe the former as nice and the latter appears in the top positions of several rankings on the ugliest building ever. Such out-of-context proposition of aesthetic features can bring surprise to people, but it is still to investigate how much the surprise perception is influenced by the appraisal of the resulting aspect.

3.2 Surprise deriving from product features diversity

The mismatch between the product features and the related expectations may also depend on specific characteristics the product owns by design (what can be called as a surprise carrier within the product) and these specific characteristics are the ones collected by the right branch of Figure 1.

Such features can occur at two different levels: the way the system works (Behaviour) and what the system is made of (Structure). It is worth noticing that these two aspects can be also mutually tangled, since a change occurring at a structural level may impact the behavioural and vice versa. For instance, an invisible (to the interacting people) product structural change may result in a sensible diverse behaviour for an already existing product. The floating man (Figure 2f) surprises at a first glance because it seems to behave against the laws of physics (or in popular terms, he is not affected by gravity) and intuition highlights that some structural element is missing. On the other hand, one cannot even imagine at first what the transparent toaster (Figure 2g) is for, since the structure does not resemble any domestic appliance. Then, while it is working, surprise might arise because of the difficulty to imagine how it does.

Structural changes can be also characterized into further details. Surprise, indeed, can be triggered by structural rearrangements of different types, as proposed hereafter.

Absence of an expected feature

A typical source of surprise is the lack of a component or a feature that is definitely expected in a certain product. In addition to the above-mentioned floating man (Figure 2f), another well-known example is the wine hold that leverages the mass of the wine bottle to stand (Figure 2h). The absence of an expected feature is likely to trigger also a wrong interpretation of the system behaviour.

Unexpected combination of existing features

A product feature is combined with one coming from a different system or context, and such a combination is unexpected. The stairs with hidden drawers (Figure 2i) and the cutting fork for pizza (Figure 2j) are two examples of this category. It is interesting to notice that in the former the feature combination emerges only when the added (surprising) feature is used, while it is visible at first sight in the latter.

Unexpected modification of a feature

A feature is modified (Change) and its specific change is unexpected. More in detail, the unexpected change of a feature may deal with the followings:

- Its aspect or aspect ratio within the product, as for the already mentioned sidecar in Figure 2, d and Longaberger building in Figure 2e;
- Its absolute or relative position within the product, as for the well-known “Coffeepot for masochists” (Figure 2k), where the surprising placement of the handle and the spout appears as without any logic. Besides, also a logical arrangement of features can result surprising, if non-conventional and unexpected. An example is the piano in Figure 2l, conceived for those who cannot get out of bed, but difficult to contextualize if seen in a living room with no beds. Also the laterally rocking chair (Figure 2m) belongs to this category and it is likely to deliver surprise, especially if an absent-minded user sits on it without noticing the difference and starts rocking. In turn, it is interesting to notice that this surprising features rearrangement may bring to the impossibility to use the object (the Coffeepot for masochists), to the use of the

object also by people who would be normally unable, or just to an unconventional usage mode (the laterally rocking chair);

- The perceived meaning of structural characteristics, thus shifting the usage of the product itself to something different, as for the Japanese Pastry Packaging in Figure 2n, where the dark hair of the character on the package is actually the chocolate pastry itself and, therefore, the surprise emerges when the pastry is pulled out, or for the Gnome Bread Packaging (Figure 2o) where the bread tip sticking out of the package is surprisingly interpreted as the gnome hat.

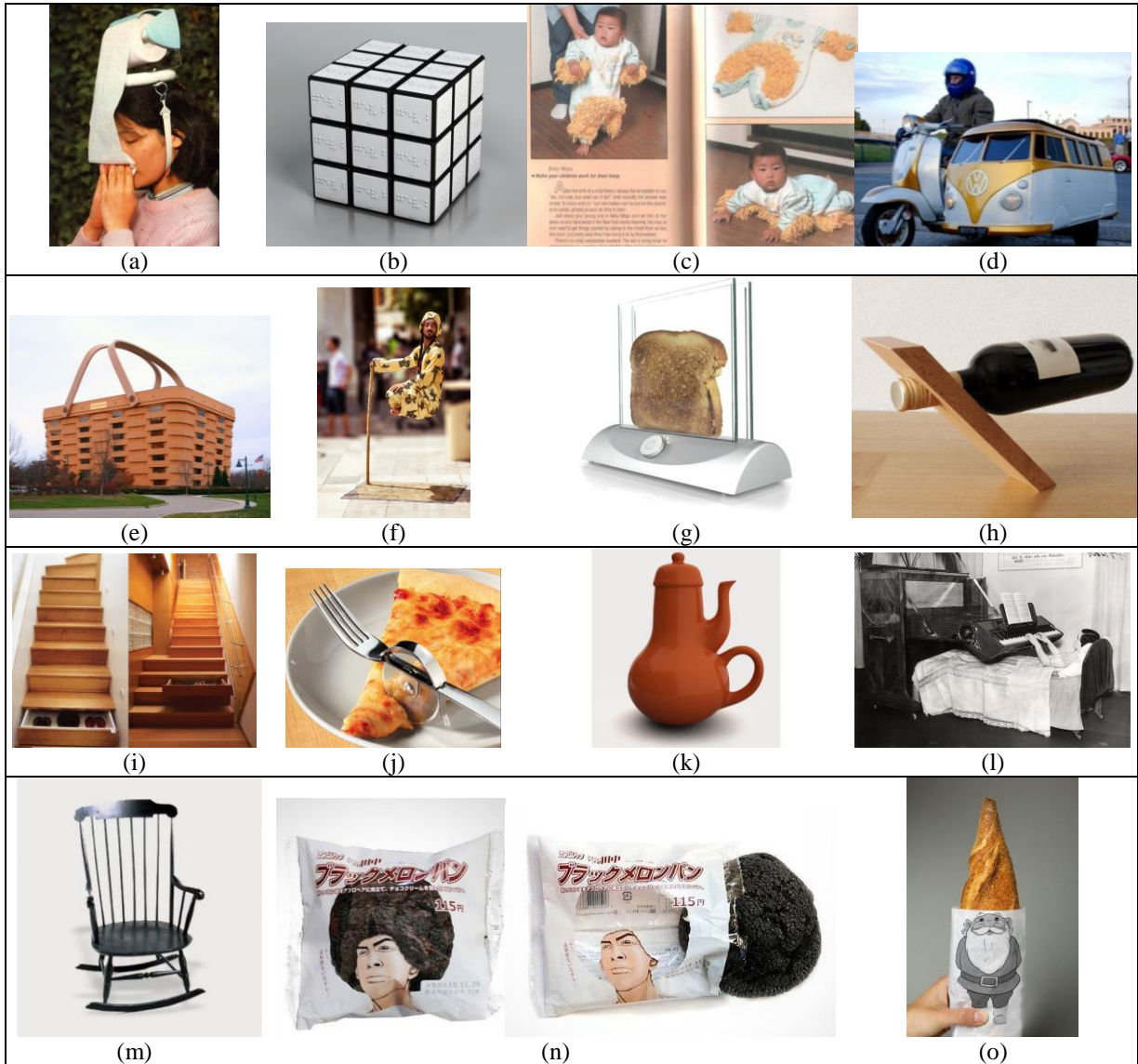


Figure 2. Examples of products presenting features directly triggering surprise or inducing surprise by understanding the intentions of the designer.

4. Verification of the model and discussion of the results

The factors characterizing the manifestation of surprise in the products of Figure 2 emerged by combining concepts extracted from the literature and empirical evidences arisen by browsing surprising products in the web. In order to increase the reliability of the framework shown in Figure 1, the factors causing surprise have been tested by analyzing products deemed surprising in literature sources. Table 1 illustrates an analysis of a subset (for the lack of space in the present paper) of available product descriptions, consisting in 12 items from lighting engineering industry. According to authors' evaluations, each factor causes the emergence of surprise for at least one product in the

sample. At the same time, any product is deemed surprising through the presence of at least two factors. Although the diffusion of forms of unexpectedness is clearly unbalanced towards some factors, it can be stated that also products from the literature can be classified through the exposed taxonomy and that the proposed drivers causing surprise are reasonable and worth of future research. Besides, the most frequent combinations of surprise triggers pertaining to Person and Product levels should be better investigated in order to relate modifications of the products and consequent perceived unexpectedness.

Table 1. Factors, marked with X, delivering surprise according to at least 3 out of the 4 authors of the manuscript. Products belonging to the lighting engineering industry are deliberately stated surprising in Grimaldi (2008), Ludden et al. (2008) and Rodríguez Ramírez (2014) with regards to artefacts #1, #2-4 and #5-12, respectively

#	Product name	Habits	Ethics	Aesthetics	Behaviour	Absence of an expected feature	Unexpected combination of known features	Unexpected modification of a feature
1	On-Edge Lamp	X			X	X		
2	Porca Miseria!			X			X	X
3	Flex Lamp	X		X	X			X
4	Konko			X				X
5	Lamp On/Off for Luceplan	X			X	X		
6	Lacrime del Pescatore			X			X	
7	Euro-Condom		X				X	
8	Fly Lamp			X				X
9	Titania Lamp				X		X	
10	Levitating lamp				X	X		
11	Leaf lamp	X		X	X	X		
12	Workstation lamp Angel	X		X	X		X	X

5. Conclusions and future activities

The paper proposes a set of triggers capable to determine the manifestation of surprise, whose dimensions and causes are of particular relevance in the field of creativity assessment. These drivers of surprise include evident modifications of product characteristics with respect to existing systems in the reference industrial domain. However, said shifts do not seem to justify by themselves the display of surprise. Indeed, the not negligible role played by human interpretation of creative products contrasts with the vision of scholars that see surprise as a mere dimension or measure of novelty.

However, the results of the investigation are biased by the existence of any trigger of surprise which has not been identified by the authors, the number of analyzed products which does not provide statistical reliability to the results, the set of examined items belonging to a single industrial field. The authors will dedicate future work to overcome the above limitations.

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