A UX Model for the Communication of Experience Affordances

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Introduction

Companies and designers have increasingly paid attention to their potential users to help them define products or services that have a positive market appraisal. To this end, several approaches are used to capture the so-called "voice of the customer" and to drive the development processes with a user-oriented perspective.[1] However, designers and engineers who seek to propose solutions that enhance the user experience (UX) cannot rely on a tailored and prominent method. This issue is critical, in that interactive artifacts can, to a certain extent, affect users' habits and behaviors: From this perspective, every designer and design engineer who develops interactive artifacts acts as a UX designer. However, designing the UX is a complex task and carries several risks.[2] Therefore, providing methodological support to those who have to manage the design of the UX is a relevant research objective, even for researchers who are not expert UX designers.

From this perspective, structured design methods can constitute a valuable support.[3] As an alternative to intuition-based approaches (e.g., brainstorming), structured methods can be an effective and efficient means to drive both the ideation and the development process.[4] Hence, we argue that structured methods could support designers and design engineers in efficiently and effectively designing for the UX.

In the context of research that aims to develop a systematic design method for the UX, this paper outlines a theoretical model that constitutes the framework for said method, grounded in experience affordances. In the next section, we introduce UX and explain the reasons for adopting experience affordances so as to clarify the research question we address. In order to define a suitable model to describe experience affordances, we argue that the design-as-communication perspective could be adopted. Therefore, after an analysis of some of the most prominent design-as-communication models, a model to represent experience affordance is proposed and critically discussed.

1 Abbie Griffin and John R. Hauser, "The Voice of the Customer," *Marketing Science* 12, no.1 (1993): 1–27.

2 Johan Redström, "Towards User Design? On the Shift from Object to User as the Subject of Design," *Design Studies* 27, no. 2 (2006): 123–39.

3 Japp Daalhuizen and Petra Badke-Schaub, "The Use of Methods By Advanced Beginner and Expert Industrial Designers in Non-Routine Situations: A Quasi-Experiment," *International Journal of Product Development* 15, no. 1 (2011): 54–70.

4 John S. Gero, Hao Jiang, and Christopher B. Williams, "Design Cognition Differences When Using Unstructured, Partially Structured, and Structured Concept Generation Creativity Techniques," *International Journal of Design Creativity and Innovation* 1, no. 4 (2013): 196–214.

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UX and Experience Affordances

Experiences emerge "through situations, objects, people, their interrelationships, and their relationship to the experientor,"[5] yet they are created and remain in the user's head. In recent years, several models have been proposed to describe how experiences are formed.[6] Some models reflect a phenomenological approach while others have been based on cognitive psychology.[7]

Redström contested that the design for the UX might lead to the attempt to design what is not there to be designed and to the risk of trapping people into over-determined designs.[8] To overcome this risk, this paper aligns with the stance of Hassenzahl. Although every experience is unique, experiences present some common traits in that they can be categorized by the psychological need they fulfill.[9] Therefore, while not reducing UX to this single aspect, in the remainder of the paper, we address UX from the viewpoint of the satisfaction of users' psychological needs. In addition, we consider and build on formalization in affordances.[10]

An affordance can be defined as "what it [the environment] offers the animal, what it provides or furnishes, either for good or ill."[11] Because affordances connote something in reference to both the environment and the animal, they can be used to represent the subjectivity of humans, as well as user experiences.[12] Therefore, just as a stairway offers the possibility of being stepped on only to certain persons (e.g., not infants, or persons with certain physical disabilities or injuries), an artifact affords an experience to a user who has a psychological need it can fulfill.

However, experience affordances, as possibilities for needs satisfaction, can have different natures. In some cases, they might simply be a support in the performance of a task; in others, they can be explicit invitations to an experience, so that the possibility for an experience is intentionally designed. For example, driving a car in a race-like mood was already possible, even without features dedicated to it. Nevertheless, by means of an intentionally designed feature, such as the "Sport Mode," (e.g. changing the car balance and shifting car control from electronics to the driver) a product facilitates the experience of sporty driving to users, becoming to a certain extent responsible for them.[13]

Experience affordances are constituted by the coupling of an artifact feature and a user's psychological need. However, if we have to develop a systematic approach to the design of an experience affordance, the simple coupling of a feature and a need is far from being sufficient to describe the emergence or creation of a positive UX. Therefore, a model providing a better understanding of how an experience affordance *works* is needed.

5 Experientor is the person who undergoes an experience, see Marc Hassenzahl, *Experience Design: Technology for All the Right Reasons* (San Rafael, CA: Morgan & Claypool, 2010).

6 Marc Hassenzahl and Noam Tractinsky, "User Experience: A Research Agenda," *Behaviour & Information Technology* 25, no. 2 (2006): 91–97.

7 Among the studies reflecting a phenomenological approach, see John McCarthy and Peter Wright, *Technology as Experience* (Cambridge, MA: MIT Press, 2004); see also Jodi Forlizzi and Katia Battarbee, "Understanding Experience in Interactive Systems," in *DIS '04 Proceedings of the 5th Designing Interactive Systems Conference: Processes, Practices, Methods, and Techniques* (New York: ACM, 2004), 261–68. For a cognitive psychology approach, see Marc Hassenzahl, "The Thing and I: Understanding the Relationship Between User and Product," in *Funology: From Usability to Enjoyment,* ed. Mark Blythe et al. (Dordrecht, NL: Kluwer Academic Publishers, 2003): 31–49; see also Evangelos Karapanos, *Modeling Users' Experiences with Interactive Systems* (Berlin: Springer, 2013).

8 Redström, "Towards User Design?," 129.

9 Hassenzahl, *Experience Design,* 47.

10 Francesco Pucillo and Gaetano Cascini, "A Framework for User Experience, Needs, and Affordances," *Design Studies* 35, no. 2 (2014): 160–79.

11 James J. Gibson, *The Ecological Approach to Visual Perception* (Boston: Houghton Mifflin, 1979).

12 For the former, see Julka Almquist and Julia Lupton, "Affording Meaning: Design-Oriented Research from the Humanities and Social Sciences," *Design Issues* 26, no. 1 (2010): 3–14. For the latter, see Pucillo and Cascini, "A Framework for User Experience, Needs and Affordances," 3.

13 Hassenzahl, *Experience Design,* 52.

The development of a design method should be grounded in an understanding of the factors that play a role in the situation in which the design proposal is required.[14] From this perspective, modeling can be a way to build this understanding.[15] As a result, we consider defining a model to be the first step toward the development of a structured method for supporting the design of the UX. On the basis of these premises, this article aims to define a model that is capable of describing the characteristic elements that contribute to the emergence or creation of a positive UX out of the user's interaction with an artifact.

Experience affordances can be a starting point for overcoming the issues and challenges of the design for a UX already identified. Therefore, this study is motivated by the following research question: *How can the elements underlying experience affordances be modeled, so as to highlight the mechanisms that play a role in the emergence of a positive UX?*

Experience affordances previously have been compared to proposals for psychological-needs satisfactions. Therefore, we argue that if experience affordance can be seen as proposals for needs satisfaction, the process by which the artifacts offer these possibilities and consequently trigger a reaction in the users can be described as a communication path. From this perspective, the next section reviews the leading design-as-communication models, with particular emphasis on the models that deal with the user–artifact interaction.

The Interactive Communication Between Artifact and User

Designs are means of pleasing, instructing, and passing information: In this sense, they can be regarded as rhetorical. Buchanan depicts designers as message senders trying to persuade the end users (receivers) that their solution is a valuable one.[16] This perspective places great emphasis on the way the message is composed: Unlike verbal communications, the message is based on *materials* and *processes*.

The reasons for analyzing design from a communication perspective, as well as the criticisms such approaches have received, were discussed critically by Crilly et al., who concluded that representing design as communication may be useful for *relating intention to interpretation*.[17] They argued, nevertheless, that diagrams depicting products as communicative media emphasize certain aspects of the situation while deemphasizing others. For example, diagrams often do little to illustrate the mechanisms by which consumers construct meaning with products;[18] such mechanisms are investigated in greater depth by semiotics approaches.[19]

14 Lucienne T. M. Blessing and Amaresh Chakrabarti, *DRM: A Design Research Methodology* (Berlin: Springer-Verlag, 2009).

15 Anja Maier et al., "Perceiving Design as Modelling: A Cybernetic Systems Perspective," in *An Anthology of Theories and Models of Design*, ed. Amaresh Chakrabarti and Lucienne T. M. Blessing (London: Springer), 133–49.

16 Richard Buchanan, "Declaration by Design: Rhetoric, Argument, and Demonstration in Design Practice," *Design Issues* 2, no. 1 (Spring 1985): 4–22.

17 Nathan Crilly et al., "Design as Communication: Exploring the Validity and Utility of Relating Intention to Interpretation," *Design Studies* 29, no. 5 (2008): 425–57.

18 Nathan Crilly, Anja Maier, and P. John Clarkson, "Representing Artefacts as Media: Modelling the Relationship Between Designer Intent and Consumer Experience," *International Journal of Design* 2, no. 3 (2008): 15–27.

19 Susann Vihma, *Products as Representations: A Semiotic and Aesthetic Study of Design Products* (Helsinki: University of Art and Design, 1995); see also Toni M. Karjalainen, *Semantic Transformation in Design: Communicating Strategic Brand Identity Through Product Design References* (PhD Diss., University of Art and Design, Helsinki, 2004).

Crilly et al. conducted a review of the communication-based design models that represent the relationship between how designers intend artifacts to be experienced and how consumers, users, and other stakeholders experience them.[20] The models they analyzed extend the basic structure of *sender* (designer)–*message* (artifact)–*user* (receiver) by adding different features, according to the main issues the models deal with. Eight key issues were recognized.[21] Among these eight, two deal with the use and the consequent interpretation of the artifact by the users: *interactive interpretation* and *collective consumption*. While the latter depicts users as belonging to a broader public whose members interact and thereby influence each other's interpretation, the interactive interpretation is defined as the "iterative process by which interpretations are formed as consumers interact with the artifacts they encounter."[22] The collective consumption feature does not explicitly involve the phase of the artifact's use.

Given the aim of representing the process through which experience affordances are offered from artifact to users, a suitable communication model for representing the process should consider the phase of use. To our knowledge, no further design-as-communication models, besides those reviewed by Crilly et al., describe the phase of use.[23] To identify a suitable candidate to serve as a framework for a UX model, the *interactive interpretation*-related models Crilly et al. highlight, in which users are "depicted as acting on the artifact within an environment and receiving feedback which prompts further action," have been preliminarily analyzed in terms of their capabilities of representing experience affordances. The models proposed by de Souza and by Krippendorff and Butter appear to be the most suitable ones.[24] To evaluate their suitability for such a purpose, in the next section we conduct two applications in which the selected models are used to represent the processes.

The Communication of Experience Affordances According to Existing Models

To more thoroughly assess the suitability of the two models, we selected two artifacts designed for providing users with experiences of psychological need satisfaction and that represent the experience affordances they are supposed to offer according to the described models. The first one is a successful existing product, the Wake-Up Light produced by Philips. The second one is Clique Trip, a prototype system designed for creating "a feeling of closeness and relatedness among friends when being in a motorcade," as described by Knobel et al.[25]

The Philips Wake-Up Light is an alarm that aims to wake up the user by simulating the sunrise. It starts to gradually light up the room half an hour before the time for which the alarm

20 Crilly, Maier, and Clarkson, "Representing Artefacts as Media," 15.

21 Ibid., 18.

22 Ibid.

23 Ibid., 19.

24 See Clarisse S. de Souza, "The Semiotic Engineering of User Interface Languages," *International Journal of Man–Machine Studies* 39, no. 5 (1993): 753–73; and Klaus Krippendorff and Reinhart Butter, "Product Semantics: Exploring the Symbolic Qualities of Form," *Innovation: The Journal of the Industrial Designers Society of America* 3, no. 2 (1984): 4–9.

25 Martin Knobel et al., "Clique Trip: Feeling Related in Different Cars," in *DIS '12 Proceedings of the Designing Interactive Systems Conference* (New York: ACM, 2012), 29–37.

has been set. At the set wake-up time, the lamp reaches its maximum luminosity. Moreover, natural morning sounds (e.g., birds singing) are reproduced to contribute to the user's sense of morning. In terms of experience affordances, the lighting body of the lamp affords the satisfaction of the user's psychological needs of being snuggled.

Clique Trip, meanwhile, provides users with the experience of being part of a group, even when they travel in different cars, by offering them a communication medium.[26] Briefly, when the two (or more) cars are close enough, the other car(s) is displayed on the screen of the users' navigation system, and a communication link is established between the cars. Clique Trip thus affords the satisfaction of a need for relatedness by connecting people travelling in different cars.

We now use the models of Krippendorff and Butter and of de Souza to check their suitability to represent the processes by which these proposals for experiences are communicated to and interactively interpreted by users.[27] Note that such a representation is an adaptation of models that were not conceived for the purpose of this research. In addition, we do not suggest their application here represents the whole UX, or the several possibilities of interaction between user and artifact; the goal instead is to see how the model allows for framing the possibility of need satisfaction through the artifact, and consequently how said possibility is interpreted by the user.

Krippendorff and Butter Model

Krippendorff and Butter offer a comprehensive model to represent how product semantics emerge in both the design activity and the interaction. Moreover, they represent user–product interaction as an iterative loop, as users' interpretations evolve "in the circular process of their involvement with the product."[28] Figures 1 and 2 show its application to the selected examples. The part of the model that relates to the flow of activities leading to the realization of the products has been excluded from the representation because it is not directly involved in the communication of the experience affordances. The product is characterized by its features, distinguished between symbolic and technical ones. According to our interpretation, in the case of the Wake-Up Light, features such as the automatic dimming system can be regarded as technical ones, whereas others, such as the natural sounds, as symbolic features. For the Clique Trip, the GPS and the dialing feature can be seen as part of the technical features, while the appearance of friends' avatars on the screen could be considered a symbolic one. The features compose the products, which are, in turn, placed in a context (e.g., the wake-up in the bedroom and a driving experience). The user is framed as interacting with the product (e.g., through her or his

26 Ibid. 32.

27 Krippendorff and Butter, "Product Semantics: Exploring the Symbolic Qualities of Form," 6; and de Souza, "The Semiotic Engineering of User Interface Languages," 756.

28 Krippendorff and Butter, "Product Semantics," 6.

Figure 1
Krippendorff and Butter's Model used for the Philips Wake-Up Light Experience Affordance.

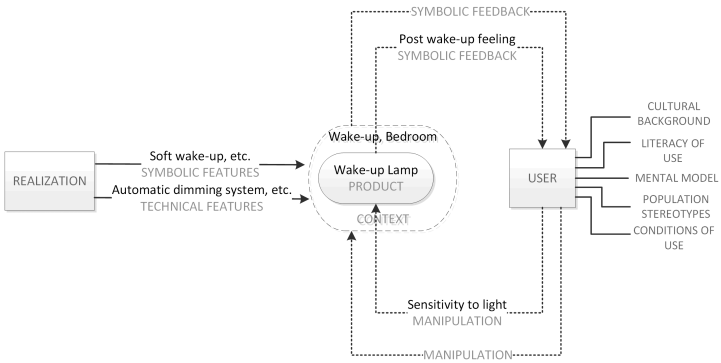
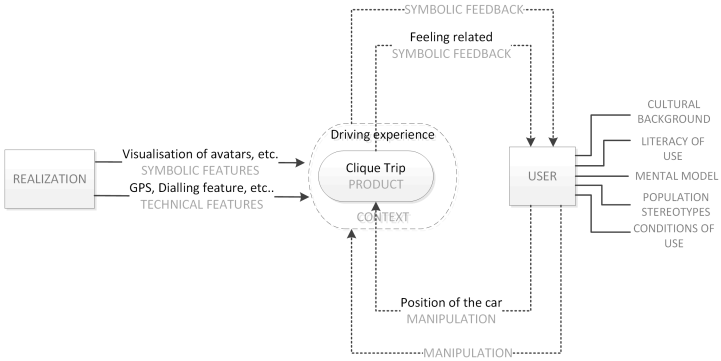


Figure 2
Krippendorff and Butter's Model used to represent the Clique Trip Experience Affordance.



sensitivity to the light or by modifying the position of her or his car to be close enough to communicate with friends), as well as with the context. Both products provide a symbolic feedback to the user. However, the interaction within the context is heavily subjective (e.g., sleepless night because of a baby's feedings, high-traffic road, etc.), and the factors involved in the user–context interaction have not been identified. The same logic applies to the several factors indicated by Krippendorff and Butter as influencing the user.

De Souza Model

De Souza's model of human–computer interaction (HCI) proposes a representation of connections between programmers and users provided by software interfaces.[29] The model frames artifacts "as message senders and receivers at the immediate interface level."[30] De Souza depicts a one-shot communication between designer and user through a so-called performing message (system). Hence, she recognizes a coder and a decoder in the one-shot communication between the designer and the user. In our interpretation the coder should be represented as the designer's intention, and the decoder as the psychological need of the user. Indeed, the intention of the designer (coder) guides the "coding" of the message (the system), which is experienced by the user in light of her or his needs (decoder).[31] With reference to the Wake-Up Light, the coder

29 De Souza, "The Semiotic Engineering of User Interface Languages," 756.

30 Ibid., 753.

31 Clarisse S. de Souza, *The Semiotic Engineering of Human–Computer Interaction* (Cambridge, MA: MIT Press), 2005.

Figure 3
De Souza's Model used to represent the Philips Wake-Up Light Experience Affordance.

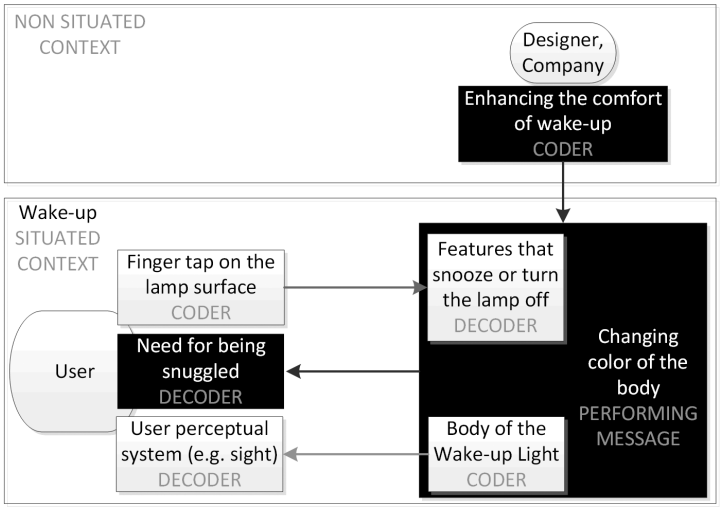
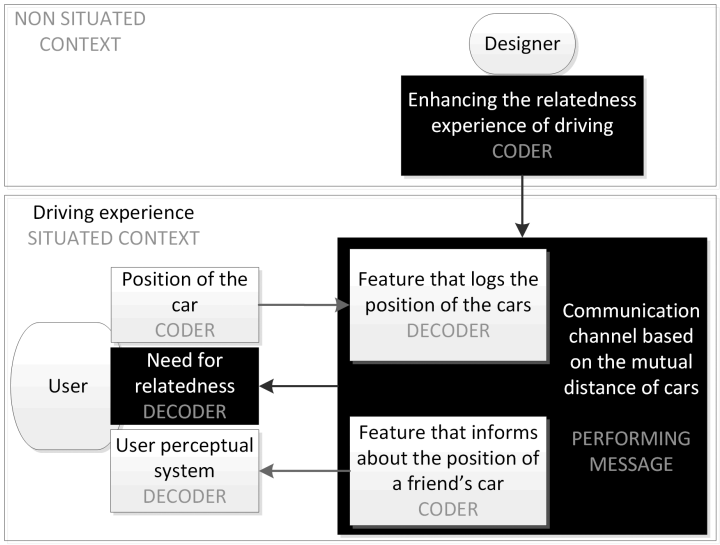


Figure 4
De Souza's Model used to represent the Clique Trip Experience Affordance.



between designer and receiver could be the enhancement of the comfort of the wake-up (Figure 3), and for Clique Trip, the relatedness experience when driving (Figure 4). The performing message is then constituted by the changing color of the light for the Philips product, and by the communication channel based on the mutual distance of cars for the Clique Trip. The user's psychological needs (e.g., being snuggled or feeling related to someone else) allow her or him to "interpret" the message coded by the designer.

In the context where the interaction occurs, an interchange occurs between the user and the system. Figure 4 depicts in greater detail the feature that informs the user about the position of the friend's car, and such information is received by the user's system of perception. The user reacts by modifying the position of her or his car to keep the distance between cars in a range that

maintains the activation of the communication channel; the system, in turn, logs the position of the cars. In Figure 3, the body of the Wake-Up Light is the coder of the message, and the user's system of perception can be framed as the decoder. The user gives her or his own feedback by touching the lamp to snooze it or a button to turn it off.

A Critical Discussion on the Outcomes

The models described are quite comprehensive and helpful for understanding the processes whereby users act on an artifact within an environment and receive feedback, which prompts further action.

Krippendorff and Butter's model provides a valuable description for defining the information flow in the communication of a certain symbolic feedback to the user because their main interest was in product semantics.[32] However, their model does not establish the roles of the actors involved in the transmission process in a univocal fashion. Indeed, although the model makes possible identifying the relevant components of the artifact–user communication process, the arrows that link the components define mainly a flow of information, with no or scarce attention to the role the information plays. For instance, the user manipulates the product, which in turn provides her or him with a symbolic feedback. However, a description of how this symbolic feedback is achieved and how it triggers a reaction in the user goes beyond the original scope of the model. Ultimately, the model seems not to offer the space for representing the user's psychological need.

De Souza's model also offers a detailed description of the experience affordances communication process, incorporating the definition of two different contexts and introducing coders and decoders.[33] The arrows linking coders and decoders solely determine the path by which the information flows. Meanwhile, the transformations this information undergoes, as well as the modalities through which the information is transformed and processed, are missing. The only transformations inferable from the model are the ones represented by the arrows linking coders and decoders, which presumably and respectively give form and interpret the information. Nonetheless, coding and decoding are quite broad descriptions.

From the perspective of this study, the models analyzed provide neither clear definitions for the constructs involved, nor the functional roles they play in the satisfaction of a user's need. Therefore, if they had to be used for modeling the elements underlying experience affordances and thus to highlight the mechanisms that play a role in the emergence of a positive UX, these

32 Krippendorff and Butter, "Product Semantics," 6.

33 De Souza, "The Semiotic Engineering of User Interface Languages," 756.

Figure 5
Jakobson's perspective on the Communication Process: Elements and Functions.

limitations could cause ambiguity and lead to inconsistent outcomes. Given the limitations, the next section presents a new model that aims to describe how the possibilities for experiences are transmitted and how they cause a reaction in the users. Jakobson's model of communication serves as a basis for the development of the model.[34]

A New Communication Model for Experience Affordances

As shown in the previous section, existing communication models that describe users' interactive interpretation present some drawbacks for modeling the elements underlying experience affordances. These limitations, stemming from the different purposes of the analyzed models, relate to the lack of a clear definition of both the entities involved and the roles they perform.

In our opinion, a suitable model should provide its users with a more precise identification of the entities involved, the transformations they cause or undergo, and how they convey and achieve an intended effect for the artifact user. From this perspective, a mono-directional engineering vision of signal transmission processes might not be sufficient to describe the user's interpretation of the design intent.

Jakobson's model relies on the same overall structure proposed by Shannon, in which a sender (addresser) delivers a message to a receiver (addressee).[35] The model also involves the notion of a channel, which is the physical or psychological medium that links the sender and receiver together. In addition, Jakobson overcame the mono-directional vision of communication processes by introducing the concepts of context and code. The context represents the set of knowledge elements to which both the addresser and the addressee refer during the communication process. The code is the set of rules that drives the communication between the addresser and the addressee. Figure 5 shows on the left side a general scheme of these six main factors and on the right side how each of these elements holds ("determines," in the words of Jakobson) a different function of language.

Thus, Jakobson recognizes six functions characterizing the communication process and involving the six factors identified. Although the functions pointed out by Jakobson should refer to

34 Roman Jakobson, "Closing Statement: Linguistics and Poetics," in *Style in Language,* ed. T. A. Sebeok (Cambridge, MA: MIT Press, 1960).

35 Ibid., 353.

Table 1 | Functions in the Communication Process, According to Jakobson's Model

Function	Description
Conative	Aims at triggering a reaction in the addressee and therefore often occurs through the use of the vocative or the imperative verbal form
Emotive	Meant to let the sender/addresser express his or her feelings about the topic being referred to
Metalingual	Checks to see whether the sender and receiver are using the same code or if a common one must be established
Phatic	Oriented to the verification of the existence and proper functioning of the communication channel, as well as to simply maintain contact between the sender and receiver
Poetic	Aims at producing a pleasant message, for the sake of the message itself
Referential	Focused on the definition or characterization of the context to which both the sender and receiver should refer

specific purposes of the communication, connoting an entire verbal message with only one of the functions of Figure 5 is impossible. Table 1 summarizes schematically Jakobson's perspective on the meaning of the functions, when the considered function becomes predominant in the communication.

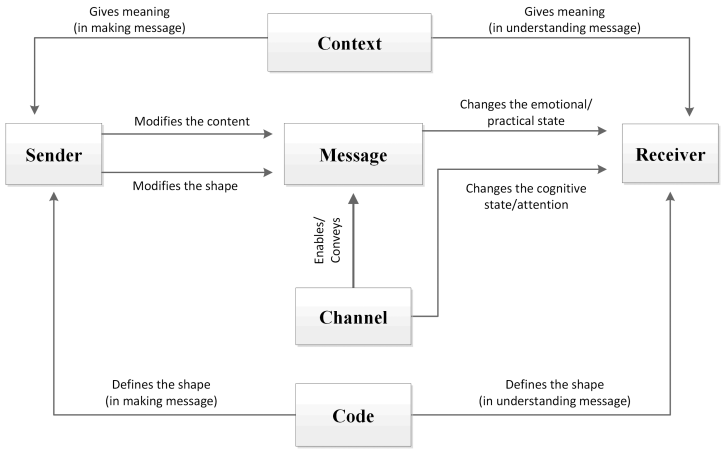
This functional description is inconsistent with the process-based logic of transforming (input) flows of energy, material, or signal into desired outputs.[36] It also inadequately conveys the vision of a function as a triad in which an agent changes a characteristic of an entity through an action it directly carries out (subject-action-object logic). However, note that each of the functions mentioned in Table 1 involves at least one of the elements included in the communication process (Table 1, in italics). We thus propose an interpretation of Jakobson's model that reshapes its functions according to the subject-action-object formalism. This juxtaposition is meant to establish a structured formulation capable of describing not only the elements involved, but also the roles they perform and the transformations they cause or undergo.

Figure 6 combines both the elements and the functions of Figure 5 and Table 1 into a single model to show how effective communication between the sender and the receiver requires all the different contributions and the different functions.

In this framework, the sender directly carries out both the expressive and the poetic functions, aiming at respectively changing the content (meaning) and the shape (structure) of the message. On the one hand, the message, with the content and shape conferred by the sender, delivers the conative function, so as to trigger a practical or emotional reaction in the receiver. On the other hand, a simple change in the receiver's attention can be achieved through a non-verbal communication (e.g., poking the receiver's shoulder). In other words, the channel cannot simply deliver the phatic function by conveying the message, but it also

36 Gerhard Pahl, et al. *Engineering Design—A Systematic Approach*, 3rd ed., (London: Springer, 2007).

Figure 6
Jakobson's Model, adapted to a Subject-Action-Object Functional Logic.



has to induce an adequate cognitive state so that the receiver can capture the essence of the message. Finally, the context and the code play similar but different roles in that they respectively deal with the meaning and the shape of the message, although not directly affecting it. In fact, a shared context supports the sender in conferring a meaning in the message that the receiver will be able to interpret. In addition, a shared code allows both the sender and the receiver to structure and interpret the shape of the message consistently, using the rules they both know. The next section clarifies how the presented framework for a generic communication process can be used for experience affordances, applying it to the examples previously discussed.

The Communication of Experience Affordances

To describe the "communication" of experience affordances, we have to identify the relevant factors involved and, thus, which function of communication they perform. Given that the designer generally is not present during the interaction, and considering that experience affordances are proposals for experiences, the communication occurs between the artifact, conceived by the designer but now immersed in the user's context, and the user.

According to this model, the context is constituted by the information that provides both sender (the artifact) and receiver (the user) with meaning. The meaning is heavily influenced by the user's motivation and goals structure.[37] Therefore, in the case of the Philips Wake-Up Light, the context, which provides with meaning both for the artifact features and the user, can be the user's needs for being comfortable and snuggled. However, experiences cannot be communicated unless the sender and receiver "speak" in accordance with the same rules. Given the perspective of this paper, the code can be thought of as the set of principles the sender exploits for defining the shape of the message, as well as the set of principles the receiver exploits for understanding it. For instance, such a code might be the change in luminosity, as well as

37 Mark Ligas, "People, Products, and Pursuits: Exploring the Relationship Between Consumer Goals and Product Meanings," *Psychology & Marketing* 17, no. 11 (2000): 983–1003.

Figure 7
Jakobson's Model, adapted to model Experience Affordances: Exemplary Application of the Philips Wake-Up Light.

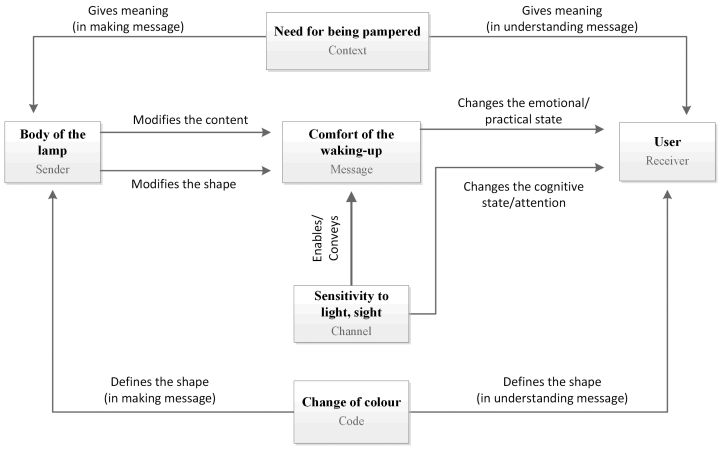
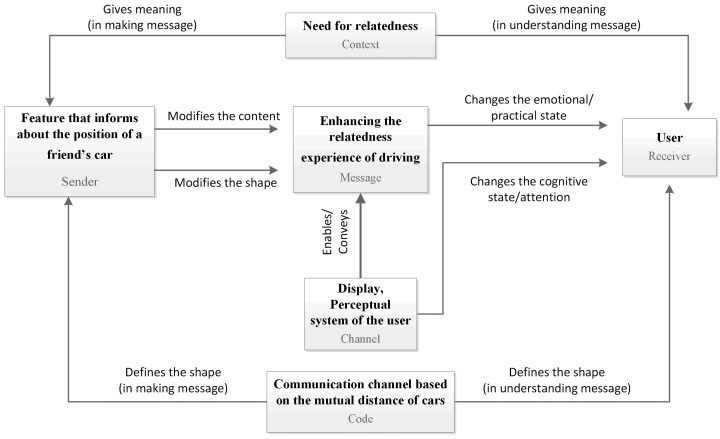


Figure 8
Jakobson's Model, adapted to model Experience Affordances: Exemplary Application of the Clique Trip.



the natural sounds. The code performs the metalingual function, defining the rules underlying the realization and the understanding of the message.

A feature of a product is therefore to be seen as the "sender" of the message. The message is constituted by the change of state that the feature achieves. If we consider again the Philips Wake-Up Light, its body as it becomes increasingly lighter (the *sender)* composes a message that is constituted by the comfort of the wake-up signal. The feature realizes the message through the poetic and emotive functions. The message hence causes an emotional and/or practical reaction in the user (receiver of the message) through the conative function. The transmission of the message between sender and receiver occurs by means of a channel, which conveys the message and keeps the communication alive; in this example, a channel can be the user's sensitivity to the light.

Figure 7 depicts Jakobson's model as adapted by the authors and applied to the description of the communication process of an experience affordance for the Philips Wake-Up Light. The same modeling logic applies to the Clique Trip example, as shown in Figure 8.

Table 2 | Schematic Summary of the Advantages and Limitations of the Proposed Model

	...with respect to Krippendorff and Butter's Model (1984)	*...with respect to de Souza's Model (1993)*
Advantages of the proposed model...	Possibility of representing user's psychological needs Formalization of the roles the elements play by means of functional relationships	Clearer and more structured formalization of the roles the elements play by means of functional relationships
Limitation of the proposed model...	Absence of feedback Factors influencing the user are still implicit	Absence of feedback Does not represent the coding and decoding activities

Advantages and Limitations of the Proposed Model

All the analyzed models are capable, in different ways, of representing the actors involved. Nevertheless, the model proposed in this article overcomes several of the limitations the two existing models present in light of the goal of this study. Indeed, the roles of the actors involved are clearly defined by means of structured functional relationships. For instance, in the de Souza model, the body of the Wake-Up Light could be regarded as a coder that communicates with the user's perceptual system, which in turn acts as a decoder (Figure 3 and 4). Conversely, in the proposed model, the body of the light defines the shape and content of a message (i.e., the comfort of the wake-up signal) that, when received by the user's perceptual system, triggers a reaction in the user (Figure 7). This model also helps to reduce the degree of ambiguity and allows for more consistent descriptions. Moreover, in the proposed formulation, framing the psychological needs and the motives of the user is easier because they have been highlighted as fundamental aspects of a positive UX.

However, the proposed model does not describe the interaction loop between context and user, as outlined by Krippendorff and Butter.[38] Although this loop enriches the description, it is less useful when the eventual aim is to design new product features. This interaction loop, indeed, involves factors that depend heavily on users' subjectivity. For example, the pleasurable post–wake-up feeling could be jeopardized by a spouse's restlessness during the night. Nonetheless, these situations are hardly predictable, as well as arguably not there for us to be designed.[39] Finally, the proposed model does not take into account the factors that, according to Krippendorff and Butter, influence the user.[40]

Unlike de Souza's model, the Jakobson model does not include the coding activities performed by the user and the decoding ones required of the system.[41] In contrast, Krippendorff and Butter describe user–artifact interactions as iterative loops, in that users' interpretations evolve in circular processes. Also, de Souza represents the response sent by the receiver as a message to the system itself. Further developments of the proposed model could put a greater emphasis on the interactive nature of the process—

38 Krippendorff and Butter, "Product Semantics," 6.

39 Redström, "Towards User Design?," 129.

40 Krippendorff and Butter, "Product Semantics," 6.

41 de Souza, "The Semiotic Engineering of User Interface Languages," 756.

for instance, by framing the receiver (i.e., the user) as a sender transmitting a "reply" message to the artifact, which in turn becomes the receiver. Linking more instances of the model itself would enhance the capability of representing interactive experiences. Table 2 summarizes the advantages and the limitations of the proposed model compared to the models of de Souza and of Krippendorff and Butter.

In this section, Jakobson's model of communication, as adapted by the authors, has been used to describe the communication of experiential possibilities from the features of an artifact to the user. Moreover, we have discussed the advantages and limitations arising from its application. In the next section, we analyze and discuss the outcomes of the current study, including its possible applications, limitations, and potential future development.

Discussion and Conclusion

In this paper we seek to define a model that can represent the characteristic elements that actively influence the satisfaction of users' psychological needs, as well as the roles these elements play. We have achieved this goal by showing that experience affordances, considered as proposals for experiences, can be modeled in the form of communicative acts.

The benefits are twofold: First, the model offers a clear schematization of how an artifact offers the possibility of an experience to a user during the interaction. Second, the model can be especially valuable in its development of a structured method for the design of the UX. As previously discussed, the proposed model allows for an understanding of the factors that play a role in the situation for which the design proposal is required.[42]

Several design approaches conceptualize design processes as comprising an exploratory stage followed by a synthesis stage, where the generation of the solution occurs.[43] An evaluation stage then ensues, which can lead to reformulations of the previous two steps. Eventually, the solution should be communicated to others—for instance, through an appropriate documentation. As discussed by Cross, the "questions that are useful in expanding and clarifying objectives are the simple ones of 'why?' 'how?' and 'what?' For instance, ask 'why do we want to achieve this objective?' 'How can we achieve it?'… 'What implicit objectives underlie the stated ones?'"[44] This underlying logic seems suitable also for the design for the UX. According to Hassenzahl, UX design "starts from the Why, tries to clarify the needs and emotions involved in an activity, the meaning, the experience. Only then, it determines functionality that is able to provide the experience (the What) and an appropriate way of putting the functionality into action (the How). Experience design wants the Why, What, and How to chime together, but with the Why, the needs and emotions, setting the tone."[45]

42 Blessing and Chakrabarti, *DRM: A Design Research Methodology:* 9–10.

43 Nigel Cross, *Engineering Design Methods: Strategies for Product Design* (Chichester: John Wiley & Sons, 2008). Meanwhile, Gero refers to the exploratory stage as to the formulation stage. See John S. Gero, "Design Prototypes: A Knowledge Representation Schema for Design," *AI Magazine* 11, no. 4 (1990): 26–36.

44 Cross, *Engineering Design Methods,* 63.

45 Marc Hassenzahl, "User Experience and Experience Design," in *The Encyclopedia of Human–Computer Interaction,* 2nd ed., ed. Mads Soegaard and Rikke Friis Dam (Aarhus, Denmark: The Interaction Design Foundation, 2013). Available online at https://www.interaction-design.org/encyclopedia/user_experience_and_experience_design.html (accessed September 15, 2015),

Krippendorff and Butter's and de Souza's models, which had not been developed for purposes of the current research, have become valuable tools for analyzing the communication process underlying users' interactive interpretation of artifacts. Nevertheless, when we embedded the two models into a structured method, the lack of a clear formalization of the functions, which are relevant to the communication process, did not allow the designers to define the entities involved. How, then, could they effectively trigger an intended effect for the user? Meanwhile, the modified Jakobson model seems to offer a framework for a structured method that can synthesize novel features addressing users' psychological needs. We argue that it does because the model allows us to identify the entities that answer the questions of why, what, and how. The receiver and the context can help answer the "why" question; the message addresses the "what" question, and the code and the channel answer the "how." This approach could eventually be translated into a step-by-step design procedure; moreover, a software application might be developed that further supports designers by generating appropriate design stimuli for fostering creativity.[46]

However, as Maier et al. argue, what makes a model a good model is not so much how accurately it represents its "target."[47] From, this perspective, the accuracy of representation of the proposed model is even less detailed than that of the other models. Instead, the key to evaluation, they say, is the degree to which it enables decision-making that turns out to add value, given a certain purpose and context. From this point of view, the new model we propose seems to offer its main benefits: It clearly allows for the identification of the factors that address the why, the what, and the how, and in doing so, it enhances the decision making in UX design process. This benefit might be particularly valuable for non-expert UX designers.

At its current stage, the model presents several limitations. For instance, it does not consider the whole UX, but only the satisfaction of users' psychological needs. It thus enhances designers' understanding by establishing functional relationships among some of the main factors involved in user–artifact interactions, even if it does not unveil novel facets of the UX. This over-simplification leads to the following, further limitations.

First, at its current stage the model offers a static representation and does not show the changes occurring in the user, and in the artifact itself, over time.[48] In addition, the model does not consider the dynamic and diverse use situations.[49] For instance, it is not capable of describing the cases where different contexts provide meaning to a single feature over time. Similarly, those cases where a single feature may provide users with different messages cannot be represented. Future refinements of the models should

46 Thomas Howard, Steve Culley, and Elies Dekoninck, "Reuse of Ideas and Concepts for Creative Stimuli in Engineering Design," *Journal of Engineering Design* 22, no. 8 (2011): 565–81.

47 Maier et al., "Perceiving Design as Modelling": 141.

48 Sari Kujala et al., "UX Curve: A Method for Evaluating Long-Term User Experience," *Interacting with Computers* 23, no. 5 (2011): 473–83.

49 Mieke van der Bijl-Brouwer and Mascha van der Voort, "Understanding Design for Dynamic and Diverse Use Situations," *International Journal of Design* 8, no. 2 (2014): 29–42.

enhance its versatility and thus allow the representation of multiple possibilities in a single communication process. The model also does not include in its framework the users' usage mode (e.g., if the user interacts with an artifact to fulfil a goal or, conversely, for the sake of the interaction), which is fundamental to the perception of an experience affordance.[50] Further studies should clarify the representation of the mode of use—for instance, as part of the context.

Future studies and refinements also might be used to represent situations where the experience affordance either is not perceived or is refused by the user. This representation could be achieved by considering harmful or insufficient functions.[51] This possibility could further enhance the decision making and thus the effectiveness of the model.

Finally, the conative function of the model is framed as changing the practical or emotional state of the receiver; in other words, it causes a reaction in the user. However, the ways in which the user constructs the interpretation of a certain effect are not discussed. This lack has been presented as a general limitation of design-as-communication models.[52] Integrating studies such as those from design semiotics, or with the frameworks for product emotions, could be beneficial to a more precise characterization of how reactions are formed.[53] Eventually, they can result in valuable suggestions and guidelines for the designer.

At this point, we might conclude that this model eventually will be used by designers and design engineers either to represent existing situations or to envision future situations. Therefore, designers need to speculate on users' interpretations when filling in the model, keeping in mind that "it is not that there is nothing in actual use that corresponds to the intended use, but that there is so much more to it and that this complexity to a significant extent comes as a result of people making their own interpretations when incorporating objects in their lifeworlds and their everyday practices."[54]

50 For an account on the concept of usage mode, see Michael J. Apter, *Reversal Theory: Motivation, Emotion and Personality* (London, UK: Taylor & Frances/Routledge, 1989); the importance of the usage modes for the perception of Experience Affordances is discussed in Pucillo and Cascini, "A Framework for User Experience, Needs and Affordances," 10.

51 Gaetano Cascini and Paolo Rissone, "Plastics Design: Integrating TRIZ Creativity and Semantic Knowledge Portals," *Journal of Engineering Design* 15, no. 4 (2004): 405–24.

52 Crilly, Maier, and Clarkson, "Representing Artefacts as Media," 23.

53 For an account on product semiotics see Vihma, *Products as Representations* and Karjalainen, *Semantic Transformation in Design*. For product emotions refer to Pieter M. A. Desmet and Paul Hekkert, "Framework of Product Experience," *International Journal of Design* 1, no. 1 (2007): 57–66.

54 Redström, "Towards User Design?," 129.