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Web usability revisited: a situated approach

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ABSTRACT

The lack of usability is a problem for developers and companies: different studies of user behavior on the Web find a low tolerance for unusable sites. There is a simple motivation for this behavior: on the Internet, switching costs - how much effort it takes to switch from one provider to another - are low. If you don't find what you want, the competition is only a couple of mouse clicks away. Nevertheless, if most people agree about the need of usable web sites, there are no general theories about how web usability should work. If we check the most influential books on this topic we found different usability guidelines coming from authors' experience but no general theories to justify them. The aim of this article is to defining the starting points of a web usability framework based on the viewpoint of ecological realism. The framing assumptions of this new approach are one form of a general theoretical stance, which can be called *situativity theory, in* which cognitive processes are analyzed as relations between agents and other systems.

Keywords: *web usability, ecological approach, activity theory, usability guidelines.*

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1. Introduction

What is usability? In 1998 the International Organization for Standardization defined *usability* as the effectiveness, efficiency, and satisfaction with which specified users achieve specified goals in particular environments (ISO, 1998). More in detail, *effectiveness* measures the accuracy and completeness with which specified users can achieve specified goals in particular environments; *efficiency* measures the resources

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expended in relation to the accuracy and completeness of goals achieved; *satisfaction* measures the comfort and acceptability of the work system to its users and other people affected by its use (ISO, 1998).

In 2001, the International Organization for Standardization identified *usability* as one of the six characteristics (functionality, reliability, usability, efficiency, maintainability and portability) of software quality. In the document usability is defined as the capability of the software product to be understood, learned, used and attractive to the user, when used under specified conditions (ISO, 2001).

In this second definition we found three new concepts: *understandability*, the capability of the software product to enable the user to understand whether the software is suitable, and how it can be used for particular tasks and conditions of use; *learnability*, the capability of the software product to enable the user to learn its application; *operability*, the capability of the software product to enable the user to operate and control it (ISO, 2001).

The rationale behind these two definitions is clearly expressed by the Human-centered design (HCD) approach, whose main goal is incorporating the user's perspective into the software development process in order to achieve a usable system (ISO, 2001; Maguire, 2001). According to the ISO 13407 standard (ISO, 2001), human-centered design requires the following processes:

- Understand and specify the context of use;
- Specify the user and organizational requirements;
- Produce designs and prototypes;
- Carry out user-based assessment.

In the HCD approach, that has its origin in the seminal work of Norman and Draper (Norman & Draper, 1986), the focus is the “human”, also called “subject”, “user” or “customer”. As clearly stated by Vredenburg, Isensee & Righi (Vredenburg, Isensee, & Righi, 2002) “the centered part of User-Centered Design refers to the fact that aspects of UCD revolve around one center, the user.” (p. 20). Starting from him, the ISO 13407 standard (ISO, 2001) arranges separately different experimental conditions and analysis - related to the context of use, user requirements, design and evaluation of the tool (Maguire, 2001) - to obtain information about the different usability subsystems: effectiveness, efficiency, satisfaction, understandability, etc. It is hoped and expected that conclusions from these different processes can be used to build up understanding of the level of usability of a given tool. As noted by Gamberini & Valentini (Gamberini & Valentini, 2001), in this vision “the human cognitive system is

seen as a hierarchical structure made of various units, each of which handles a specific function." (p. 112).

2. Ecological approach and Activity Theory

The last 50 years have been marked by strong scientific achievements in the study of perception and social interaction, including concepts and methods of ecological psychology, ethnography, ethnomethodology, discourse analysis, symbolic interactionism, and sociocultural psychology, which we refer to as *situativity approach* (Clancey, 1997; Greeno, 1998; Greeno & Moore, 1993; Suchman, 1987). According to this vision, cognitive processes are analyzed as relations between agents and other systems. As noted by Greeno (Greeno, 1998), "paradigmatic situations in this research include people communicating with each other as they plan and evaluate their activities and coordinate their interactions with each other and with material and technological systems… In particular the research focuses on interactive systems of activity in which individuals participate, usually to achieve objectives that are meaningful in relation to their more general identities and memberships in communities of practice" (pp. 5-6).

This theoretical shift does not imply a denial of individual cognition as a theoretically important process. It does, however, involve a shift of the level of primary focus of cognitive analyses from processes that can be attributed to individual agents, as usually happens in the Human-centered design approach (Maguire, 2001), to interactive processes in which agents participate, cooperatively, with other agents and with the physical systems that they interact with.

This vision is also the core of the *Activity Theory*. According to this theory basic unit of analysis of all human experience is "*activity*", a broader concept than individual goal-oriented actions (Leontjev, 1981; Vygotsky, 1978). An activity is undertaken by a human actor motivated towards an object and mediated by a tool (also called "artifact"). Activities are distinguished from each other according to their *motives*, also called "objects" (hence the term "object-oriented activity") (Kuutti, 1996). Activity Theory identifies two general kinds of objects: real, physical (material) objects and ideal (mental) objects, present in the subject's mind. Each activity is performed by several goal-directed conscious actions, that in turn are composed by task-oriented operations, usually non-conscious.

Another key feature of the Activity Theory is the active nature of the subject of an activity. The actors bring with them different characteristics that affect how they approach the activity: previous experience, cognitive skills, personality and culturally

determined traits. These will continue to evolve as the person undertakes the activity (Hasan, Gould, & Hyland, 1998). Finally, human activity always involves the use of tools: physical/material tools - such as computer - or psychological/cultural tools - such as language and ideas. The link between the actor and the tools is a two-way relation. On one side, tools shape the way human beings interact with reality. On the other side, tools usually reflect the experiences of other people who have tried to solve similar problems at an earlier time and invented/ modified the tool to make it more efficient. So, the use of tools is a means for the accumulation and transmission of social knowledge.

Another theory related to the situativity approach is ecological psychology. Key feature of this vision is that the environment is perceived in user-relevant terms, that is, in terms of what the user can do with and in the environment (Gibson, 1979). Perception is seen as an active pickup of meaningful information that specifies the behavioral possibilities of the environment, also called *affordances.* According to Gibson, affordances can be described as potential complementary relationships between the *actor* – a subject with specific goals - and environment. They indicate how the world could be acted on by the subject. Thus, action, viewed as the realization of affordances, is intimately related to perception (Greeno, 1994). A possible affordance of a web site could be "the ability to find the company fax number."

The affordances perceived have their counterparts in *effectivities* of the actor, the abilities required for exploiting the affordance. More precisely, effectivities are ”the dynamic capabilities of that individual taken with reference to a set of action-relevant properties of the environment” (Zaff, 1995).

3. Web usability: a situated approach

Up to now, the study of complex actions such as the interaction with a web site has not been the focus of attention in the ecological approach. It has dealt primarily with immediate perception-action couplings such as posture maintenance and spatial orientation (van Leeuwen, Smitsman, & van Leeuwen, 1994). For this reason, can an ecological based usability approach deal with the characteristics of Internet interaction? The concept of affordances is not new to the world of usability. In a recent paper Don Norman, a well known name in the field of usability, wrote (Norman, 1999): “I originally hated the [affordance] idea: it didn't make sense. I cared about processing mechanisms, and Gibson waved them off as irrelevant. Then, Gibson started spending considerable time in La Jolla, and so I was able to argue with him for long hours (both

of us relished intellectual arguments). I came to appreciate the concept of affordances." (p. 38). In particular this concept, strictly linked to other two dimensions – conceptual models and constraints - is used by Norman in his book “Psychology of Everyday Things” (Norman, 1988) for understanding how to operate a novel device.

Later, Norman shifted the focus of his analysis from the concept of affordance to the one of *perceived affordance*: “When I get around to revising Psychology of Everyday Things I will make a global change, replacing all instances of the word "affordance" with the phrase "perceived affordance." The designer cares more about what actions the user perceives to be possible than what is true.” (pp. 38-39).

Even if this position underlines a key idea for usability - designed, perceivable affordances can directly influence usability - this theoretical change is resisted by different researchers. As Flach (Flach, 1995) underlines, “[This] confuses the affordances of an object with the information that specifies the affordances.” (p.6).

Following this point, our position differs from the Norman one in a key feature: affordances have a relational ontology. They do not exist as a function of either the web site or the actor alone, but *have existence in the interaction* between the capabilities and properties (goals, knowledge, resources, context, etc.) of the actor and the properties of the web site (contents, interface, links, etc.). For example the Sony web site may afford technical support by a MP3 user searching for the latest drivers for his/her player, or media relations by a journalist interested to the photo of the new portable computer.

Following this position, the production of affordances is the result of a complex interaction between behavioral, cognitive, and environmental factors. And this makes the definition of empirically measurable relationships between the actor and the web site a difficult achievement.

However a first step towards this goal is provided by Amant (Amant, 1999): affordances can be interpreted “in terms of the costs associated with the generation and execution of operators in a plan” (p. 317). More in detail, “Each operator in our representation has an associated execution cost. This is an extension of the classical planning problem space, in which a planning agent searches for a sequence—*any* sequence—of operators that satisfies the goal it is given. By taking cost into account, an agent can search for the least expensive course of action that satisfies a goal.” (p. 327).

Extending this vision we can say that affordances can be interpreted in terms of the costs associated with the generation and execution of goal-oriented actions: affordances allow a reduction in the costs - physical and/or cognitive .- needed for planning and executing a goal-oriented action.

However, affordances are only opportunities. The passage between the perception of the affordance and the action is mediated by a particular type of intention called *implementation intention* (Brandstätter, Lengfelder, & Gollwitzer, 2001; Gollwitzer, 1999; Gollwitzer & Brandstätter, 1997). In an implementation intention, an anticipated future situation (affordance) is linked to a certain goal-directed behavior. It has the following structure - *when situation x arises, I will perform response y* - and thus links anticipated opportunities with goal-directed responses.

If we integrate all the previous theories in a single framework we have the following model (see Figure 1):

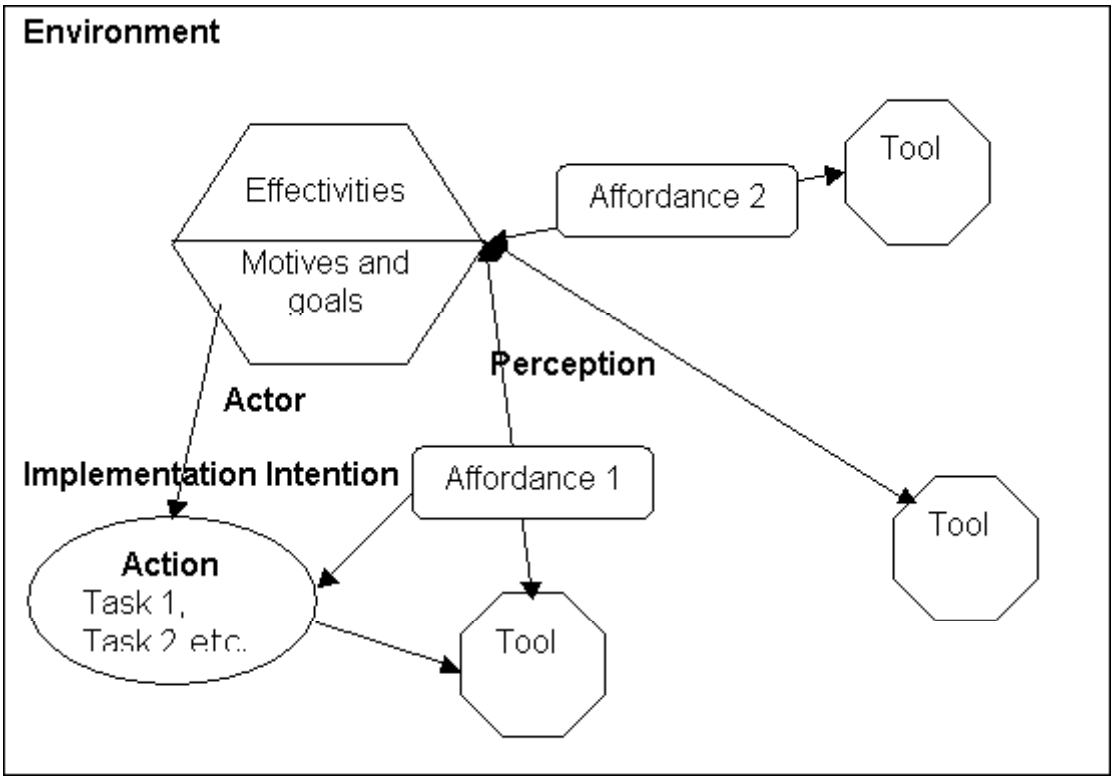

Figure 1: The situated evaluation model

- **the actor**, with specific motives and goals: *e.g., a journalist, during the preparation of an article on new technologies that could allow him to win the Pulitzer prize (motive), is searching for the fax number of Sony Europe (goal).*
- **an environment**, surrounding the actor, filled of different **tools/artifacts**: *the journalist is in his office, located in the journal main building. On the desks there are the yellow pages, a telephone, the Sony brochure received by mail a month ago, a computer connected to the Internet, etc*.

- the actor **perceives** some of the different tools around him: in his/her visual field he can see the computer and the telephone but not the yellow pages and the Sony brochure, covered by other books.
- the perception of the different tools informs the individual of **affordances**. An affordance is a value-rich ecological object that reduces the costs of a goal directed action by means of a tool: *Using the computer connected to the Internet the journalist can access the Sony web site and find the fax number easily. Otherwise he has either to search for the Sony brochure or the yellow pages. In this second case he also has to find the Sony Europe number, contact them, ask for the press office, contact it and asking for the fax number.*
- The perception of the affordances is related both to the motives/goals of the actor and to his **effectivities**. Effectivities are the possibilities/abilities to act on the tool for exploiting the affordance: *The journalist uses Internet every day and knows how to orient himself in corporate web sites in order to find easily the required information. However, a journalist without a previous experience of the web could find the research task impossible to accomplish.*
- The passage between the perception of the affordance and the action is mediated by **implementation intentions**. Holding an implementation intention commits the individual to the performance of a certain goal-directed behavior once the critical situation is actually encountered: *If the journalist cannot find easily the Sony brochure will use Internet for obtaining the fax number*.
- If different objects afford opportunities for action, the choice of the final action is related firstly, to the **relevance of the motive/goal** orienting it and secondly, to its **cost** – the more is the affordance, the less is the cost: *If the journalist, surfing on the Sony site find an interesting news, relevant for the preparation of the article (high level motive), can decide to stop the research of the fax number (low level goal) and read it. Moreover, if the research of the fax number on the web site is not effective may decide to stop it and search again the Sony brochure in the office.*

Following this approach we can propose a new definition of web usabilty: a web site is *usable* if it *allows a low cost exploitation of a significant affordance*. This definition, even if very simple, clearly identify a five-step framework for a web usability analysis:

1. *the subject should be able to perceive the affordance*: If I don't know that the XY web site offers a 50% reduction on portable computers I will never visit it
2. *the subject should evaluate this affordance as significant*: If my colleague who work in a computer shop can offer me a 45% price cut on portable computers I will probably skip the affordance offered by the site. The same if I just bought a new

portable computer last week. However, If I have to buy a new portable computer and no one can offer me a relevant price cut, the affordance becomes very interesting.

3. *the subject shoud be able to understand how to exploit the affordance:* If the 50% reduction is offered only by entering a promotion code I have no idea of where I can get it, after visiting the web site, I will probably pass by.
4. *the subject should be able to evaluate the effort required for the exploitation of the affordance as cost effective*: if the promotion code is given just after completing a registration form I can evaluate the effort required as adequate and fill the form. However, if I get the code just after buying electronic equipment for the same value of the discount offered, I may consider this effort as non cost effective.
5. *the subject should be able to effectively exploit the affordance*. Even if I evaluated the 50% reduction as significant, I understood how to get the promotion code and evaluated positively the effort required, I effectively exploit the affordance only after the successful purchase of the portable computer.

4. Conclusions

If we check the classical web usability books, it is easy to verify that most of the analyses done by usability experts is related to step five of the proposed framework. For instance, the well know Krug's first law of usability (Krug, 2000) – don't make me think – is not related to the perception or to the evaluation of the affordance but only to its final exploitation. For Krug, the main focus of the usability intervention is to create a web site in which the user can exploit the affordance without any conscious effort.

At the opposite, in our approach the focus of the usability expert is the perception and evaluation of the affordances: his main role is the perception of the affordances of a situation for others. This task is often underestimated because people are so proficient at judging affordances for themselves that they fail to recognize the difficulty in accurately assessing the affordances for others. In this sense the usability analysis is a process that requires simultaneously taking into account the structural and dynamic properties of individuals who will be using the web site and the structural and dynamic properties of the site.

In this paper we identified as key theoretical paradigms for a web usability theory the ecological approach and the activity theory. More in detail, we suggested some ways in which an extended version of Gibson's concept of affordance can be used in a situated theory of web usability. Gibson's theorizing was seminal in the development of ecological psychology and is likely to be seminal in a more general development of a

usability theory viewed as interactive relations of an actor with other agents and physical systems. The next step is a broader theory that merges these perspectives, along with the insights and methods of information-processing cognitive science.

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