Affordance in Interaction

Dhaval Vyas
Vrije Universiteit Amsterdam
De Boelelaan 1081a
1081 HV Amsterdam
The Netherlands
dvyas@few.vu.nl

Cristina M. Chisalita
Twente Universiteit
Drienerlolaan 5
7522 NB Enschede
The Netherlands
c.m.chisalita@gw.utwente.nl

Gerrit C. van der Veer
Open Universiteit Nederland
Valkenburgerweg 177
6419 AT Heerlen
The Netherlands
gerrit@acm.org

ABSTRACT
The concept of affordance has different interpretations in the field of Human-Computer Interaction (HCI). However, its treatment has been merely as a one-to-one relationship between a user and a technology. We believe that a broader view of affordances is needed which encompasses social and cultural aspects of our everyday life. We propose an interaction-centered view of affordance that can be useful for developing better understandings of designed artefacts. An interaction-centered view of affordance suggests that affordance is an interpretative relationship between users and the technology that emerges during the users' interaction with the technology in the lived environments. We distinguish two broad classes of affordances: affordance in Information and affordance in Articulation. Affordance in information refers to users' understanding of a technology based on their semantic and syntactic interpretation; and affordance in articulation refers to users' interpretations about the use of the technology. We also argue that the notion of affordance should be treated at two levels: at the 'artefact level' and at the 'practice level'. Consequently, we provide two examples to demonstrate our arguments.

Keywords
Affordance, HCI, Interpretations & Meanings, Structuration Theory, Technology-in-Practice

INTRODUCTION
The concept of affordance has been used in HCI to solve problems related to the usability of designed systems. The concept was originally coined by Gibson (1986) and introduced to the HCI field by Norman (1988) and was further appropriated by Gaver (1991), Bærentsen & Trettvik (2002), amongst others.

Gibson's original emphasizes for affordance were,

- "the affordances of the environment are what it offers the animal, what it provides and furnishes, either for good or for ill";
- "something that refers both to the environment and the animal in a way that no existing term does"; and
- a thing that "implies the complementarily of the animal and the environment" (p.127).

Based on Gibson's description on affordance, it might not sound sensible to title this paper "Affordance in Interaction", since affordances by definition are *in the interaction*. But, there are two reasons why we want to differentiate our views from others. First, not all conceptions about affordance believe that affordances are 'in interaction' especially the cognitivist accounts on affordances (Norman 1988; Gaver 1991). Second, the approaches that conceptualised affordances 'in interaction', e.g. the activity theory approach by Bærentsen and Trettvik (2002), do not provide sufficient information about what 'affordance in interaction' actually is and what it means for designing. It was noted that a difficulty with the original conception of affordance was that Gibson used this term merely in the context of visual perceptions – as only a receptorial relationship between users and artefacts, leaving the users' actual interaction with the artefact unattended (Bærentsen, Trettvik, 2002).

We view the affordances of an artefact as the possibilities (for both: thinking and doing) that are *signified* by the users during their interaction with the artefact. Acknowledging the work of Baerentsen & Trettvik, we propose an interaction-centered view of affordance, which we call *Affordance in Interaction*. From this view, affordances of an artefact are not the properties of the artefact but a relationship that is socially and culturally *constructed* between the users and the artefact in the lived world. This view strongly suggests that affordance emerges during a user's interaction with the environment. In addition, the affordance in interaction view focuses on the 'active interpretations' of the users interacting with the artefact. From this view, users are actively participating in the interaction with the artefact and continuously interpreting the situation and constructing and re-building meanings about the artefact. We suggest that affordances can be better understood as an *interpretative* relationship between users and the artefact.

We believe that current notions on affordances merely focus on affordance as a one-to-one relationship between a user and an artefact, leaving several important contextual issues unattended. We draw from Giddens' (1984) Structuration Theory to view

affordances in a broader socio-cultural context. In the rest of the paper, we first describe our reasons behind introducing the notion of 'affordance in interaction' and define it in three steps. We especially focus on the notion of emergence in affordances and its effects on the technology-in-practice. We then provide a classification of affordances from a designer's perspective: affordance in information and affordance in articulation. Utilizing this classification we provide two examples where our notion of affordance and its classification are used first at the artefact level and then at the practice level.

AFFORDANCE IN INTERACTION

The concept of affordance has been around for a long time in the HCI community. Gibson's original emphasis on affordance has lead to different interpretations, some more cognitivist (e.g. Norman 1999; Gaver 1991) and some activity-centered (e.g. Baerentsen, Trettvik 2002). Although these approaches are valid within the disciplines that they come from, we strongly believe that an interaction-centered view is required in order for the concept of affordance to be used for designing. We believe that there are two main reasons why the interaction-centered approach should be given importance: Historical and Socio-cultural.

Sengers and Gaver (2005) noted that historically, in HCI, systems and their features are designed mainly to convey the designers' meanings and interpretations to the users. The designers and other organizational stake-holders would decide what possibilities and opportunities should be offered to the end users. From this cognitivist view, the system affordances were determined by the authoritative focus of the designers. Over the years, approaches such as usability engineering, participatory design, ethnography, etc. have been the driving force for designing systems with more user focus. The concept of affordance, however, faced only minor changes through some activity-centered perspectives (e.g. Baerentsen, Trettvik 2002). However, the authoritative view of designers remained the same.

For example, Bærentsen & Trettvik suggest,

> "The fact that Affordances are constituted in the interaction between organisms and objects in the environment implies that Affordances exist independently of the individual organism in the sense that as long as the possibility of a particular activity exists for a particular species in an environment then the affordance can be said to exist. It does not matter whether a specific organism actually picks up information about the specific Affordance and actually realizes it or not. What matters is that the possibility exists for the affordance to be realized." (p. 52-53)

From a design perspective, Bærentsen & Trettvik's above view suggests that the designers can premeditatedly decide what affordances (possibility for a particular activity) of a system should be offered to users. During the technology use, however, users do not just passively receive information. They actively participate in the interaction and also add to this interaction, something the original designers may never have imagined about. Clearly, there is a need for better understandings of affordances from a design point of view. The current cognitivist and rationalistic views on affordance limit the scope of affordance as being merely designer centric.

The cultural notions on affordance are necessary since the technology, such as mobile and pervasive systems, is becoming part of our every-day lives. The way in which these technologies affect people has changed over time. The forms of these systems and their use are becoming more and more complex and it is likely that they may be perceived and acted upon in different ways by different groups of people. More importantly, the goals of interactive system design are shifting from the mere functionality, usability, productivity and effectiveness to enjoyment, pleasure, fun, and curiosity to other experiential aspects. Hence, what these systems offer and how users *signify* and *use* the systems is also changing. As the technology becomes a part of our work, home and leisure environments, the limited and redusive notions of affordances (Norman 1988; Gaver 1991) need to be reconsidered. The social notions on affordance are now necessary since users and other relevant agents collectively play an important role in defining meanings of technological systems. During the technology use, users continuously interpret and re-construct the meanings related to the technology, which makes it difficult to understand the phenomenon behind affordances. Clearly, none of the current notions on affordance address this cultural and social shift.

A cognitivist would describe affordance as a set of observable technology attributes provided by the designer. An interactionist would describe affordance as the *actively interpreted* emergent property of *'a'* user's interaction with the technology. The two issues that we want to address using our interaction-centric notion of affordance are: the focus on users' active involvement with the technology; and consideration of users' social and cultural contexts.

We develop our notion of 'affordance in interaction' in the following three steps.

I. Affordance refers to both: users and their environments

One of the foremost characteristics of affordance is that it refers to the *complimentarity* and *interaction* between the user(s) and the environment. (Baerentsen & Trettvik 2002) Affordances cannot be thought of as user-only or environment-only views. It is the "user-environment" system as a whole that is inseparable. Affordance is not a property of an environment but it is better thought of as the common ground between the user and his environment. E.g. a 2 feet fence surrounding a house will afford an adult 'climbing' but not a 6-month-old baby. However, the notion of 'affordance in interaction' goes beyond this physical phenomenon. It is about the compatibility of users' knowledge, skills, cultural

background and some times goals and needs and the environment's accuracy, precision and appropriateness.

II. Affordance emerges from activities and practices

Dourish (2001) defines the concept of affordance as a three-way relationship between an environment, an organism and an activity. I.e. when we talk about affordances it shows the compatibility between the environment, the organism and also an activity. In the previous example, the activity of 'climbing' is as important to the affordance phenomenon as the baby, the adult and the fence. More importantly, users actively participate in the interaction with the environment. They might be carrying out different activities with what the environment affords. However, different people or the same people at different times may use or experience the technology in different ways. They might adapt or even re-define certain technology use that may not really be intended by the original designers of the technology.

III. Affordances are culturally and socially 'constructed'

The emergent nature of affordance suggests that affordances are best understood in the real use and practice. Use of the technology, however, cannot be determined only through activities and their work practice scenarios. As noted by McCarthy & Wright (2004), practice- and activity- based approaches do not adequately focus on how technology affects users' everyday lives in a holistic manner. In fact, during the user-technology interaction, users actively interpret the situation and make sense of the technology while being involved in certain activities. Users' 'active interpretation' is central to the emergence of affordance that is socially and culturally determined. The next section is devoted to address the issue about how affordances emerge through users' construction and appropriation of technology during the use.

AFFORDANCE, THE NOTION OF 'EMERGENCE' & TECHNOLOGY-IN-PRACTICE

Gibson's (1986) original notion of affordance was heavily criticized for providing minimal relevance to the users' social contexts. According to his view, ways of using a complex technology, for example, and semantic and syntactic understandings about it are directly perceivable from the technology itself. In order to understand the technology use and improve design practices, we believe that a holistic view of affordance is required. In this section we will discuss the emergent nature of affordances as users adapt and re-structure their (shared) working practices. We will draw on Giddens' (1984) structuration theory to develop our understandings of affordances.

Giddens (1984) claimed that all human actions are *enabled* and at the same time *constrained* by our social structures. His "structuration theory" is one of the most employed frameworks for investigating the use of technology by groups or organization. It is outside the scope of this paper to talk about the structuration theory in detail but very shortly, structuration theory focuses on human interaction and shows that 'in interaction' social structures (such as signification, legitimation and domination) are reinforced or changed. When acting we put into practice our social structure by communicating, using power and giving sanctions.

There are two views in structuration theory: 'appropriation' and 'enactment'. *The appropriation view* was employed by the approaches that focused on structural properties of the technology. These approaches study how, during the interaction with technology, users appropriate the social structures embedded in the technology (which represent various social rules and political interests). Drawing on Giddens, Orlikowski (2000) considers that there are no structures external to human action; *structures are instantiated only in practice*. So, properties of a technology cannot be seen as structures, because they are embedded in the technology, something external to the human mind. Therefore, Orlikowski proposes the concept of *enactment* of technology as a more suitable one than the concept *appropriation* of technology structures. This means that users do not only *use* the technology as *given* as it was designed (with the structures embedded within) but they might ignore some properties (Pliskin et al. 1993), working around, inventing new properties sometimes even contradicting designers' expectations. People modify technologies and their concepts of technologies after these were designed. The repeated and on-going interaction of people with a technology (people shape the structure and then the structure shapes their action of use), in certain conditions determines the production of structures of technological use, so-called *"technology-in-practice"* which will have consequences (intended and unintended) for the conditions.

We can say that technology-in-practice refers to the *behavioral* and *interpretive* template for people's situated use of technology. Technology-in-practice may become institutionalized as the taken-for-granted modes of using the technology. In this way they become stabilized. However, as structuration theory states, these social structures may *change* through human action. Therefore, as actors change (in knowledge, experiences, motivations, power, time etc.) the technology-in-practice may change as well.

The main distinction between *enactment* and *appropriation* is that although a technology has certain properties that inscribe in it the designers' assumptions (these are the structures of technology), the way in which these properties will be used is not something that can be pre-determined, and it depends on *what people do with the technology in a particular situation*. Users can even modify or change properties of technology if they choose to do so. They may have breakdowns in using the technology or they can improvise a new practice alternative to the use of that technology.

Affordance and Technology-in-Practice

On the one hand, our notion of "Affordance-in-Interaction" resembles very much the notion of "technology-in-practices". We refer here to the fact that like affordances, technologies-in-practices emerge within activities and practices and refer to both: users and their environments and are socially and culturally constructed. Moreover, technology-in-practice as well as affordance comprises both: the interpretive and the behavioral dimensions.

On the other hand, the two concepts present some differences. Being based on a sociological theory, the concept of "technology-in-practice" has a strong social orientation while the concept of affordances, being primarily developed in the area of visual perception, has a rather individualistic orientation (where already built cultural meanings are considered). "Technology-in-practice" is defined as social structures and it describes the emergence of a certain use of a technology within a group of users. The focus is placed on the *social interaction within a group*, and not on individuals. The notion of affordance as treated in most literature does not focus on the creation of meanings related to a technology within a group.

To overcome this limited view of affordances, we attempt to differentiate the affordances that are constructed at individual levels and at the group levels. We believe that the notion of affordance should be treated at two levels: artefact level (focusing on design elements of the technology) and practice level (focusing on the socio-cultural context in which the technology is used). This broader view of affordance is useful when we discuss affordances in relation to the use of technology by a *group of users*. The implications of such a view is that we can use aspects of context (culture of the group/organization, power, users' knowledge and meanings related to technology and technology properties: cultural-symbolic and material) in which technologies-in-practice emerge in order to understand what the technology *affords* for its users, how and why this affordance was generated and what implications such an affordance has on working practices and technology use. An illustration of this view will be provided in 'example 2' of the Design Cases section.

A CLASSIFICATION OF AFFORDANCES

During users' interaction with the technology, it is important to consider exactly what aspects of the technology are made available to the users. Using an interaction-centered view, we focus on users' interpretations to determine what the technology affords. Clearly, what they see, what they understand and what they perceive, will in the end matter to them. We classify affordances into two broad categories: affordance in Information and affordance in Articulation.

- Affordance in ***Information*** refers to the users' understandings of the technology based on their syntactic and semantic interpretations. Affordance in information may change or be re-constructed over time as users develop more familiarity and knowledge about the technology. These are users' interpretations about the "What" aspects of a technology.
- Affordances in ***Articulation*** are the interpretations about the use and manipulation of the technology, i.e. users' procedural understandings about the technology. Affordance in articulation may also change or be re-constructed over time as context of the technology use changes. These are users' interpretations related to the "How To" aspects of a technology.

In this classification, it is important to note that both the affordance in information and the affordance in articulation are users' own interpretations about the technology itself and its use. There is a strong connection between these two affordances, which may affect each other over time and also when the contextual aspects change. I.e. the overall understanding of the technology may change the way the technology should be used and vice versa. It is important from a designer's point of view to observe how users interpret both the classes of affordances.

DESIGN CASES

In this section we show two examples of our work were the notion of 'affordance in interaction' and its classification is applied in design projects. In the first example we show how the classification is used in an early design phase (at the artefact level) and in the second example we use our classification to observe what implications for design should be made when the technology is used in a big organization (at the practice level).

Example 1: Affordance at Artefact level

Two of the authors worked on a project (Puerta-Melguizo et al. 2002) of evaluating the design of an innovative personal technology called Digital Ink Pen (DIP) (Kasabach et al. 1998). Here we provide some results of that study. The focus of this study was on understanding users' interpretations while interacting with the DIP to gather 'corrective' and 'creative' feedback from the subjects for making design decisions at an early concept design stage.

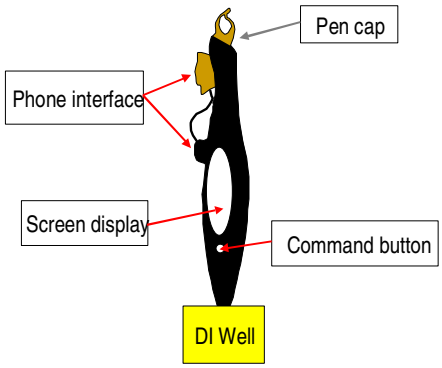

Figure 1: Digital Ink Pen

The DIP (figure 1) is an envisioned design concept that allows users to write & store textual documents and send & receive fax and emails. The study used a method called Teach-back. Using the teach-back method, 88 subjects were confronted with a low-fidelity, semi-formal prototype and were asked to 'teach' to an imaginary colleague how to solve the problem stated in the teach-back questions. To respond participants were allowed to write, draw and make diagrams. In the study two types of questions were used: "what is" and "how to".

The aim of the "what is" questions was to understand the participants' conceptual understanding about the DIP, i.e. how they understood the affordance in information. See Figure 2 for an example.

> We would like to know how you imagine the "Digital Ink Pen" after seeing the low-fidelity prototype. Therefore, please explain to your friend "Lucas" what the "Digital Ink Pen" is. You can use text, drawings, etc.

Figure 2. A "What is" question

The aim of the "how to" questions was to understand the participants' interpretations about the procedure and usage of the technology, i.e. how they understood the affordance in articulation. See Figure 3 for examples.

- Your friend "Lucas" wants to send a fax to the administration of the faculty. Explain to him how to do this using the Digital Ink Pen. Remember you can use text, drawings, etc.
- "Lucas" has five messages in his "Digital Ink Pen" and he is not interested in the third one. Try to explain to him how to delete this e-mail from the list of e-mails he has.
- "How could Lucas dictate (speaking) a letter to Digital Ink and download it later to his computer?

Figure 3. The "How to" questions

In order to support our views on affordances, in this paper we reinterpret the results of the original study.

By answering the 'how to' and 'what is' questions subjects provided details about their interpretations related to the information and articulation of this DIP. They described the systems as *...DIP is a pen that can record everything you write and draw with it. Furthermore, you can e-mail and fax the things you recorded, and/or download them into your computer*. The authors discovered some aspects of the DIP that were confusing, where the subjects had to make assumptions about them. In this category features that were uncovered during the study were the mechanisms for "file management" and "message dictation". Importantly, in some cases subjects used their previous knowledge and experiences for reasoning about the current system. For example, they thought of the DIP system as *a kind of database for handwritten inputs*. This showed their metaphorical understandings about the DIP.

Regarding the articulation of the DIP, the subjects provided details about how they thought to put the DIP in the record mode, how to put it on the Fax and email mode, etc. They also discovered different ways of activating, for instance, the 'email facility': 1) by pressing a button and 2) by utilizing the voice activation command. The authors also found certain interpretations about the articulation as not being explicitly related to the actual 'dialogue' but about how to work with the system. These were in fact the details about their conceptual knowledge of the procedures of using the DIP. For example, they figured out that the DIP can be attached with the computer and the fax machine in order to download messages and fax, respectively.

The result in general showed us how the subjects understood a new system and what aspects of it were misinterpreted. As a matter of fact, different subjects offered different solutions for the questions the authors asked, which in fact provided them with subjects' different interpretations. For example, some subjects considered it necessary to access to the DI Well to complete the task of sending a fax while others did not. Some of the solutions the subjects offered were totally different from those intended by the original designers of this DIP (Kasabach et al. 1998).

Example 2: Affordance at Practice level

Chisalita (2006) investigated, using an interpretive approach, the use of a technology that supports the budgetary process within a large governmental organization. The process of budgeting is of great importance for a government of a country and several aspects of this process are subject of discussion in the Parliament when laws are voted upon. The whole process is supported by a certain system used by people who are proposing a certain budget (the "controlled group") and people who are controlling this budget to make sure that the numbers and policies behind the budget are correct (the "controllers group"). Both groups input data into the system. The data is used by the controllers to make reports about the status of the budgeting processes. Based on the data, negotiations about the budget take place, decisions are made and changes in the budget are approved or not.

We will reinterpret the results of this study using our affordance classification: information and articulation.

The results of the study show that although the system was extensively used in practice, the functionality of the system, and its goal for practice were still somehow ambiguous and gave room for different interpretations. In this way some of the controllers perceived the system as a *communication system* while others understood it as a *passive database*. Those who saw the system as a communication system, indicated that the system supports the communication *of* the budget numbers as

well as the communication (discussion/ negotiation) about the numbers. In doing so the system makes the communication more stable, concrete and fast. However, others did not see it as a communication system but rather as a passive database which offered them at least two types of data:

- Historical data (information about the data over time)
- Overview of data (information of data across the sections and the budget of the controlled directorates).

On the other hand, the group that was controlled perceived the system mainly as *a communication system.* From their point of view the system supports the communication in two ways:

- It makes the communication fast and easy
- It represents a standard in communication

How can such finding be relevant for design? Because both groups (controllers and controlled) interpret the most relevant "what" feature of the system as a communication system, one obvious design recommendation is to follow this interpretation by developing more communication facilities (e.g. e-mails).

The perception of this system as mainly a communication system has consequences on how it is actually used by users (i.e. affordance in articulation). Interpreting the system as a communication system, users expect that the system will provide interaction facilities in line with this functionality. For example they expect the system to provide the possibility of adding text (explanations of why a certain budget number was proposed) to the numbers (originally, the system had no such facility). The lack of this facility forced users to obtain this information through other channels, e.g. telephone, face-to-face discussions (i.e. affordance in articulation). Acknowledging this situation, the controllers' group managers took a decision to implement this facility in the system. Still, these fields were considered too small and the information received was not complete. Therefore, a design recommendation in line with supporting communication was to develop these fields so they can serve adequately the need for information of the controllers.

The results of the study also show that users constructed meanings related to what the system *symbolized* for them *within* a certain context – the so-called symbolic meanings. Using our classification this category of meanings can be seen a specific type of interpretations that describes *what* the system is, not from the functionality point of view but *within a certain context*. To give an example: the system was interpreted by the controllers as a "history pool for employee mistakes", within their practice of controlling. We found out that this interpretation was based on at least three aspects: 'design feature', 'power' and 'culture'. When one of the controllers makes a mistake in relation to a certain budget amount, the system allows just one way to correct this mistake: nullifying the amount by subtracting the same amount and then specifying the correct amount. (I.e. if the budget was incorrectly inserted as 40 million instead of 30 million, then to rectify it, first a new value of - 40 million needed to be inserted and then a new correct value of 30 million should be provided). Each of these actions was logged in the system. The managers of the controllers could at any moment see all the mistakes made related to a certain budget. These mistakes (however small) give a bad impression about the work of the controllers, because the culture of the controller groups (an "elite" culture) does not allow people to make mistakes. An obvious consequence of this situation was that the controller group felt 'stressed' when working with the system. A possible design recommendation, related to this symbolic meaning, is to re-design the way in which an action is revoked: an action repaired within a certain time frame should not be logged.

DISCUSSION & FUTURE WORK

The focus of our description on affordance has been on the users' active involvement in the interaction and their continuous construction of meanings related to the technology. We believe that by getting access to users' interpretations about how they *perceive* and *use* the technology, designers can build technologies more effectively. We demonstrated some design implications in the two examples we discussed in the previous section. Affordance, however, being an interpretative relationship between the user(s) and the technology, challenges designers to understand different interpretations evoked by their system. We discuss the usefulness of our 'affordance in interaction' concept in two parts.

Affordance at Artefact level

The artefact level view for affordances can be useful at the early design stage of an interactive technology where designers are focused merely on defining the form, function and dialogue.

Using our affordance classification in the DIP example, we came across different user interpretations related to the information and articulation of the DIP. The Teach-back method, with the use of "what is" and "how to" questions, proved to be important for developing better understanding of the DIP from the users' point of view. The important aspect of our classification was not only to assess what was interpreted correctly and what was misinterpreted, but also to identify unexpected interpretations that might be utilized for better user experiences. Certain "new" interpretations suggested adding new functionalities to the original design e.g. the 'file management' facility.

The goals for technology design sometimes shift from productivity and efficiency to more unconventional goals like challenge and struggle (in gaming), curiosity and ambiguity (in museums and interactive performances), etc. allowing users to make their own

interpretations about the technology. Designers may attempt to provide unclear (ambiguous, exaggerated, etc.) or clear (right or wrong; true or false) representations about the technology to be able to articulate users' interpretations. In table 1, we describe our classification of 'clear' and 'unclear' representations of both Information and Articulation, using some example from arts.

	Affordance	
	Information	**Articulation**
Unclear	Information that is imprecise or ambiguous which leads to multiple interpretations of what the system actually offer to the user. E.g. - *Post Modernism*: Providing imprecise details in an artwork, using different techniques, which initiates multiple interpretations amongst the viewers about what the artwork is exactly telling. - *Mona Lisa by Leonardo da Vinci:* the character, mood, and intentions of the depicted lady	Articulation that is imprecise or ambiguous which leads to multiple interpretations on how to use the system E.g. - *Musical Art*: A script of 'Jazz' music asks readers to come-up with their own interpretations and appropriations about how to play the particular Jazz music.
Clear	Information that is precise and unambiguous, which leads to a very clear interpretation (right or wrong; true or false) to what the system actually offers to the user. E.g. - *Graphical Art*: Hendrik Willem Mesdag's (1831-1915) Panorama provides a 360° view of 19th century Dutch village Scheveningen. For different visitors the artwork depicts an almost identical "photographic" interpretation of the architecture and seascape of Scheveningen 125 year ago.	Articulation that is precise and unambiguous, which leads to a very clear interpretation (right or wrong; true or false) on how to use the system. E.g. - *Musical Art:* The scores of Johan Brahms (1833-1897) are so precise that they do not allow its players or readers freedom of interpretation and execution in their performance.

Table 1: The Affordance Classification for Designers

Our updated classification suggests that designers could exploit users' interpretations using either or both, 'clear' and 'unclear' representations on information and articulation, or even their specific combinations. Several design strategies have already emerged that try to articulate users' interpretations utilizing defamiliarization (Bell et al. 2005), ambiguity (Gaver et al. 2003), exaggeration (Djajadiningrat et al 2000), etc. Although in this paper we do not provide any specific details of design strategies or principles, we intend to develop on the current work in the future.

Affordance at Practice level

We also showed in this paper that approaches such as Structuration Theory and its application to understand the technology use can provide a good insight into how affordances emerge when a group of users interact with a certain technology (within or between work organizations). Different aspects of context (such as culture of the group/organization, power differences, users' knowledge related to technology, and the cultural-symbolic and material properties of the technology) can bring their contribution to the understanding of what the system affords for its users and how, why this affordance was generated and what implications such an affordance has on working practices and technology use. If culture is considered in relation to affordances, 'power differences' seem to be a relevant social aspect and its relation to affordances needs to be investigated further. For example, some groups in power can facilitate the emergence of affordances (see example 2 presented in the paper, where the system was perceived as a "history pool for employees' mistakes") or in the same situation different affordances could emerge depending on the status and power of the group/person. This means that when trying to understand affordances of technology within groups/organizations, we need to consider not only the interpretations of different group of stakeholders but also their power differences and status.

Besides the emphasis placed on contextual aspects, application of the Structuration Theory in understanding the technology use focuses on 'change'. Technologies-in-practice can be reinforced (and institutionalized) or changed depending on changes in contextual conditions. These changes (e.g. arrival of a new employee) in the interaction with technology could introduce different interpretations and different affordances of the same technology.

In relation to our framework, the affordance at practice level helped us refine the category of affordance in information, not only with functionality based meanings but also with symbolic meanings (Chisalita, 2006). These symbolic meanings describe what the system is *within a certain context*.

Another issue raised by the investigation of affordances at practice level is what we can call the "emotional consequences" of the system being interpreted in a certain way. E.g., in example 2 we showed that due to interpreting the system as a "history pool for employee mistakes", some employees expressed *stress* and *fear* when using the system, which then made them use the system in a different, more cautious way (affordance in articulation).

CONCLUSION

Gibson's original notion of affordance has evolved as different academic disciplines have added their views to it. In this paper, we attempt to broaden the scope and the treatment of affordances from a socio-cultural side by introducing *affordance in interaction* view, specifically, to improve the design practices. We demonstrate the usefulness of our 'affordance in interaction' notion by two design cases. We suggest that the notion of affordance should be treated at both levels: the artefact level and the practice levels.

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