Those psychological tools inside the design process

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Those "psychological tools" inside the design process

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Abstract: In this paper we present an interaction-oriented approach to the process of designing a document for the end-user. We emphasize exchange between subjects and the subjects' relationship with their environment. The analysis of verbal exchanges offers a way to apprehend such a situated collective. We attempt to unveil the cognitive processes underlying this task with special attention paid to the collective's ability to find in its environment the resources permitting the emergence of shared knowledge. We focus on this object's role as a vehicle for emergence and on its inscription in an interactional dynamics.

Keywords: situated action, distributed cognition, object.

Introduction

This paper intends to present a "situation-oriented" view on the cognitive processes that exist in any design activity. We will consider activities that are

both *situated and distributed* in order to emphasize the fact that knowledge is spread out over individuals and objects. Knowledge is thus socially co-constructed through collaboration and dialogues. It is then possible to study verbal productions as well as certain kinds of actions that result from a subject's interacting with his or her close environment. Such an approach permits us to see how social psychology considers Man's relations to his work environment, especially in the case of design activities.

"Defining an action as situated usually means that the organization of action must be conceived as a system emerging from the dynamics of interactions itself. But this dynamics may be the result of two distinct processes: either the understanding each participant has of the others actions, either the perception of signs present in the participant's close environment"[1]. Our aim is to observe how a work group will collaborate when confronted with the presence of objects and artefacts. These may orientate action as well as facilitating the construction of knowledge. So, in this paper, we wish to focus on the socio-cognitive aspects of cooperation in the case of a particular design activity. Our domain of study is thus no longer the indivual, but the system formed by men and objects [2].

Our study deals here with the cognitive process of design. We analyze verbal interchanges but also take into account the actional aspect of context. We define context as the local and perceptual framework of an activity. If verbal exchanges, together with subjects' interactions with their environment, do structure the mental activity of a group, a detailed, step-by-step analysis of activity as it unfolds should reveal the dynamical structure of cognitions. The study of this system of interactions should enable us to pinpoint the emergence of knowledge.

This study is part of a project whose goal is the design of a document for the end-user. After presenting the specifics of this setting, we will analyze a work sequence involving three actors and a computer running a program. We will consider both what the words used enable to realize and which actions emerge from the interactions with the environment. This will lead us to a special kind of consideration: the co-construction of shared knowledge that will sustain a forhcoming decision.

1- The setting of a new design paradigm

We already have devoted several publications to the activity of design [3] [4] [5]. We particularly insisted on the innovative character of a new paradigm, called "concurrent engineering". This concept, initially proposed in the United States in 1989, promotes a work organization where all engineering activities are integrated and run in parallel [6]. The success of this approach necessitates cooperation in a multi-expertise team where every member of the team is individually involved in the realization of the same project.

This new organization of work for design implies not only that activity is decompartmentalized, but also that cooperation is to be seen as an emerging property of this new paradigm, given the collective nature of such actions. Design had to become collaborative and abandon the Taylorian organization. This former organization was based on the separation between pratical intelligence and conceptual intelligence. In turn, this led to a distribution of activity where communication had the central, inescapable role. We view design activity as a process of collective elaboration consisting in an "a transformation of a set of specifications for a material or symbolical device into the description of an artefact" [7]. However we wish to emphasize that this activity is distributed. Such a view implies that the joint presence of actors and their interactions in "real-time" facilitate the search for a common meaning. In other words, cognitions are truly distributed and this contributes to the emergence of a co-construction that results from the individual viewpoints being outgrown. We then have a "mutual modeling of a common world through joint action" [8]

This new research paradigm is the groundwork for the "Processus Interactifs Complexes" project (Complex and Interactive Processes) common to research laboratories in the Universities of Nancy2, Caen, Rouen and to a private society, Métaphora. This latter member is specialized in the writing of documents for the end-user (user's manuals, user's guides, etc.). Our case study deals with the documentation for a program called *IUT Note* that is installed in a Institut Universitaire et Technologique in Caen.

The design of such a document is indeed a distributed activity given that multiple actors cooperate: the writer, specialized in technical writing, the developer of the software product in question and the user of the program. All actors take part in the design process as soon as it starts and as long as it lasts. This is in contrast with the traditional scheme where the technical writer is the only architect of the documents. The experiment we relate here gathered the writer, the developer and the end user as well as a computer where the program was installed. The actors had to interact, in "real time", starting from experience with the program, in order for the writer to take into account the questions and observances from the others. The meeting lasted two hours. During that time, the actors were supposed to get acquainted with the features and abilities of the program and also to propose observations and comments. This meeting was taped. So we have access to what the actors both did and said. The video tape recorded how the actors interacted but also what was displayed on the computer screen (situated in the top right quarter of the recorded image).

2- The intersubjective nature of Man's relation with his environnement

There are essentially two facets to explore when dealing with Man's relation to his environment. First, we will emphasize the concept of *situated cognition* presently pursued by various researchers [9] [2] [10]. Then we will examine the socio-cognitive aspect of an ongoing design process. We will underline the social orign of knowledge and the fact that this point cannot be understood without analyzing the tools and signs that mediatize it.

Nowadays the concept of situated action is frequently used in cognitive science. This leads to describe the relations between man and machine or man and computer as "interaction", "communication" or possible "cooperation". This interest for situated action originates from social sciences approaches, namely interactionist approaches [11] [12]. In his work, Schutz views knowledge more as a byproduct of interaction rather than prerequisite for it. However his contribution is modest as compared to the real innovation brought about by the constructivists, on the one hand, and by the

ethnomethodologists, on the other hand. In *The Philosophy of the Act*, Mead [13] clearly exposes his wish to root the problem of meaning in action itself. For Mead, action is where meaning unfolds since subjects are engaged in activities where they are in relation with others and their common environment. Interaction neither actualizes, nor unveils a meaning or an intention that would already belong to an actor, i.e. that would be previously deposited in him or her. On the contrary, interaction produces meaning as soon as subjects enter an intersubjective dynamics. Mead uses in this regard the concept of emergence [12]. The innovative points brought to light by Mead are mainly the social and actional of meaning. The ethnomethodologists [14] [15] emphasize the individual practices, which must be studied in situation. "The following studies seek to treat practical activities, practical circumstancies and practical sociological reasoning as topic of empirical study, and by paying to the most commonplace activities of daily life the attention usually accorded to extraordinary events, seek to learn about them as phenomena in their own right. Their central recommendation is that the activities whereby members produce and manage setting of organized everyday affairs are identical with member's procedures for making those settings "account-able". The "reflexive" or "incarnate" character of accounting practices and accounts makes up the crux of that recommandation" [14]. The ethnomethodologists thus suggest to give the actor the central role in the social scene, or more precisely the interactional scene. Furthermore, insisting on the practices of members in a group tends to imply that actors are not supposed to apply rules they would have previously more or less internalized. Rather, the course of action permits the emergence of a mutually meaningful social construction. "The social fact becomes an accomplishment, or better a pratical achievement, that requires some work and that results from members interacting and negociating" [16].

To assert that Man's relation to his environment takes meaning in interaction, that it develops in an intersubjective framework is emphasizing the fact that the artefact present in the interactional scene gradually becomes "investigated object", deposited and implied in the ongoing process. The object is not neutral because it is intersubjectively defined within interactions. In other words, it is made available *hic et nunc*. It takes on the value of an active agent, of a genuine actor. By her use of the expression *situated action*, Suchman [9] refers above all to a model of actions in which each course of action depends of what materials are used and what social

circonstances are met. This concept strongly suggests the essential role of social context in the case of cooperative activities. Subjects seem to be able to identify those elements in a situation that are relevant to them. These elements that constitute a context enable them to act, to reason and to understand. The intelligibility of a situation and the ability to coordinate their actions are then based on practices in socially organized, verbal and non verbal communication

Taking into account subjects' activities in the setting we just presented leads us to the idea that there is no mind without «□bol□», in the sense of Vygotsky [17] gave to that word. He meant that the cognitive activity underlying any design process should not derive from an individualistic and monologic view of mental activity. For instance, language or objects are present and active: they are no amorphous, passive means to construct knowledge. Such "psychological tools" are central in a dialectic where social construction of knowledge is not only the result of activity as shared with others and their environment, but also a means to an end, that of its own cognitive activity. This relationship between intersubjective and intrasubjective activities is the bedrock where knowledge necessary to the ongoing design process is gradually and collectively constituted. That is why we are going to develop further the idea that the object present in the interactional scene litterally accompanies the group's thinking as a whole and structures each group member's thinking individually. We will consider this object as a medium for emergence.

3- The "psychological tools" inside cognitive activity

3.1 Conversational analysis as a method "revealing" cognitive processes

The analysis of verbal exchanges between the various actors in the design setting presented earlier will focus on a fact in particular: the construction of shared knowledge as a medium for choice making. We claim that verbal interaction is where cognitions develop. Therefore, in this work, we take a conversational approach based on interlocutory logic. Such an approach

implies first that we put a premium on the verbal aspect of interactions and, secondly, that we postulate that any production of an utterance in a conversation is the realization of an action. Such an action is called *speech-act* or *illocutionary act*. It is accomplished through an actual utterance. Any speech-act is composed of an illocutory force (F) and a propositional content (p). The illocutory force applies to the propositional content (written F(p)). For example, saying "What kind of medium do you prefer?" is the production of an utterance, but is also the performance of the act of asking. To put such a question is to apply a directive force on the propositional content. The force F of an illocutory act is what its utterance amounts to do. In our example, the locutor makes an attempt with the aim that the listener performs the action of giving him or her the prefered medium.

Conversation is the sequential accomplishment of an extension of illocutory logic. This particular logic has been formalized by Searle and Vanderveken [18] [19]. The emphasis is placed on the relations between both representational and actional properties of illocutory acts. Such relations are the fabric of conversations. Illocutory logic is usually interpreted in a monologic model, but we interpret it in a dialogic model. This, we hope, will allow us to understand how conversation as an object can be constructed. Illocutory logic deals with the following properties of language acts:

-*success* of performing an illocutory act (when uttered).
-*satisfaction* of an illocutory act (effects it has on the world).

By integrating satisfaction conditions, we incorporate the perlocutory act. A dialogic stand permits us to position ourselves at the crux of interactional dynamics. We go further than the literal: we tackle pragmatics. We aim to account for the dynamics of exchanges, how the sequence ties up, through the logical and combinatorial properties of components. An attempt to comprehend how mutual understanding develops necessitates a fine-grain analysis of verbal exchanges. Our objective is to show how cognitions are gradually constituted through mediations between individuals and their social environment. This mediation system causes a reorganization of activity and thus a transformation of cognitive processes. This leads us to consider that not only language, but also artefacts are genuine "psychological tools" whose function is to aid knowledge construction.

3.2 The object at the heart of cognition

The three interlocutors of this conversation are the technical writer (RED), the end user (UTI) and the developer (DEV). The design meeting lasted two hours and had two periods. First, the technical writer gathered the user's expectations about the fonctional side of the document to be written. Then, the three interlocutors interacted over a long period of time about the software product trying to come to grips with its features. The excerpt below is taken from the first period, beginning at around the 10th minute of work

RED1	alors (.) vous préférez les documentations en ligne ou les documentations papier c'est-à-dire les livres ou vous savez les les aides en ligne classiques vous appuyez sur un petit point d'interrogation ça ça vous donne une fenêtre pour accéder à des écrans successifs euh qui vous donnent une documentation *(fait des gestes avec les mains en direction de l'écran)*
UTI2	sur les icônes directement
RED3	pas pas alors ça peut être soit des petits boutons euh j'sais pas si y'en a une là
DEV4	j'sais pas si y'en a une *(prend la souris)*
UTI5	ah si voilà *(en tapant sur le clavier)*
DEV6	si *(montre l'aide en ligne sur l'écran)*
RED7	voyez vous avez toujours accès à une aide ici (écran en haut à droite) *(montre l'écran)*
UTI8	à une aide oui
RED9	qui vous donne: alors c'est ce qu'on appelle ça de l'aide en ligne
UTI10	ça j'aime pas trop
RED11	vous aimez pas trop donc vous avez vous aimez plutôt un support papier un petit manuel *(prend des notes)*
UTI12	voilà

From this sequence, we are going to show according to what interlocutory processes events in the group happen. First we will study the general structure of this exchange. This will highlight the unfolding of a decision following from a phase of co-construction of shared knowledge. As

we will see, it is a complex structure that is hierarchically organized and comprised of substructures that enable the realization of an action. The organization of this exchange will reveal the essential role played by the object in cognitive processes. Then, we will attempt to show how, as utterances follow one another in the conversation, new knowledge gradually emerges from a distribution of cognitive activity among the entities in presence.

Here we have a conversation regarding the choice of a medium for the user's manual. The technical writer proposes two types of documentation to the end user, either a printed manual, or online help. The end user has to give a choice. We selected this excerpt because it has an indisputable value concerning the role of "psychological tools" as media for emergence. This excerpt has two parts: a request is expressed by the technical writer and is addressed directly to the end user, then an exchange starts with a phase of co-construction of the meaning of *online help* ("aide en ligne"). This will eventually allow the end user to satisfy the technical writer's initial request.

RED1 is the utterance of the technical writer's direct request to the end user ("vous préférez", you prefer). The illocution supports request ("vous préférez les documentations en ligne ou les documentations papier", you prefer online help or printed manuals) and its explicitation ("c'est-à-dire les livres ou ... les aides en ligne classiques vous appuyez sur un petit point d'interrogation..." meaning booklets or ... online help when you click on a small question mark). As we previously mentioned, an illocutary act is an act accomplished through an actual utterance. Here, we have a request whose propositional content is a proposition representing the action of the end user's answering the request. The request will only be satisfied if the corresponding action is accomplished. Then an exchange begins on the preliminary conditions of the request. More precisely, the preparatory conditions of a request "represent the state of things that the locutor presupposes as true when performing the act of language" [20]. Such preliminary conditions are presuppositions of the locutor. For instance, to ask to the end user to express his or her preference for a certain type of documentation presupposes that he or she is able to accomplish this action. Technically, we say that the prelimnary condition of a hearer able to accomplish the action asked from him is associated to the directive force. However, when the end user says "sur les icônes directement" (on the icons

directly), the technical writer reacts. We will analyse this reaction in two steps. First, the technical writer says "pas pas" (no no) in reaction to the UTI2 illocution. At this time in the exchange, the technical writer realizes that the end user do not correctly perceive what he calls "aide en ligne" (online help). The end user will carry on his utterance and try to make his meaning more explicit ("ça peut être soit des petits boutons euh j'sais pas si y'en a une là", could be small buttons eer dunno if there's one here). At this very time in the conversation, an exchange begins aiming at the construction of shared knowledge that is necessary to the satisfaction of the request. In other words, the interlocutors jointly construct the preliminary conditions for the act of the initial request in order for it to be satisfied. We will see that this exchange (RED3 to RED9) is the actual emergence of a new piece of knowledge that is the outcome of both verbal and actional actions of the interacting locutors. The Interlocutory Analysis Table below [21] will help us to grasp how such knowledge may emerge (annex).

In RED3b, the locutor stresses a disagreement (a misunderstanding) arising from the fact that the end user does not refer to the same content for online help. The technical writer's reaction is another explicitation ("*alors ça peut être soit des petits boutons*", *could be small buttons*) which he cannot vouch for. The anaphoric deictic "ça" does refer to the co-text, i.e. to the linguistic units immediately preceding or following it. This demonstrative refers to the two successive reformulations that explicit the content of online help.

1st reformulation , "vous appuyez sur un petit point d'interrogation" (you click on a small question mark)
2nd reformulation, "ça peut être soit des petits boutons" (could be small buttons)

Following the second reformulation, he calls on the close extralinguistic environment by uttering "*j'sais pas si y'en a **une là***" (*dunno if there's **one here***). The indefinite article "*une*" marks the object pointed to, here the online help. The adverb "*là*" is meant as an inscription of the utterance in space. At this point in the conversation, the technical writer appeals for context in order to be informative and thus allow his interlocutors to better

apprehend what online help actually is. Reacting to READ3b illocution, the developer not only speaks, but also takes hold of the mouse as a way to intervene on the workspace. DEV4 is an illocution extending the technical writer's previous statement. Then there appears a question regarding the presence of online help on screen. In the meantime, the end user acts on the software by getting hold of the keyboard and he utters "*ah si voilà*" (*oh yes there is*). The presentative "*voilà*" has two functions. First it signals the appearance of a new referent. Second it plays the role of an anaphoric element, reminding the group of what was being looked for. Also the developer validates this by uttering "*si*" (*yes*) and making a gesture toward the online help on screen.

The analysis of these four turns taking (RED3 to DEV6) allows to understand better how activity unfolds. There are a number of remarks to be made. An initial problem is common to all interlocutors, i.e. to find a way to allow for a good understanding of the phrase online help. The interlocutors will find an answer to that question in a collective way. There one cannot miss the fact that activity is distributed among all entities in presence, ont only among individuals having verbal exchanges, but also the object in the interactional scene. This object is a medium, and an active medium, for the construction of a new piece of knowledge. During the conversation, both the verbal and physical actions of interacting locutors contribute to the gradual structuring of their universe, their thinking, which allows the emergence and co-construction of shared knowledge. The presence of an artefact restructures the cognitive process as a whole and enables the subject to control his or her environment. We see here the joint construction of knowledge mediated by an artefact and the actions performed on it.

In the third phase of the exchange, the technical writer directly addresses to the end user ("*voyez*"). The imperative form supposes that the utterer and the direct reference to the contexte are all present. This utterance through which the technical writer tries to act on the end user places the utterance at the highest degree of actualization. Then the technical writer utters "*vous avez toujours accès à une aide en ligne ici*." (*you always have access to online help here*). The adverb "*toujours*" places this assertion's content in a temporal background. The adverbial locution "*ici*" refers to the extralinguistic space, summoning every circumstance that may determine this utterance.

Moreover the illocution is accompanied by a gesture of the locutor that points to the screen area where online help resides. It is worth noting that, associated with the assertive forme of RED7 ("*vous avez toujours accès à une aide en ligne ici*"), there is the preliminary condition according to which the locutor now has reasons in favor of the truth of the utterance's propositional content. The utterer can now justify his assertion, i.e. present the arguments for the proposition of which he gave the state of things. "An assertion is true if and only if its propositional content corresponds to a state of things exusting in the world" [19]. But, as Searle had it, "there are a large number of illocutory acts that necessitate an extralinguistic institution and that generally subordinate the act's accomplishment" [18]. The previous exchange therefore contributed to define the preliminary conditions for this assertion. As we just saw, the technical writer is here able to presuppose that the end user knows what is meant by online help. The UTI8 illocution signals the validation by the locutor. At this state in the exchange, the assertion whose propositional content represents the user's successive appropriations defines:

1°) *a perceptual appropriation*, where X, what is localizable on screen, is defined as online help, L. In the table, we denoted this by X=L.

2°) *a cognitive appropriation*, where X, the perceived element, in online help. This cognitive effort of assimilation allowed the end user to associate a content with the representation of the concept of "online help". We observe here an elaborate cognitive effort by the user originating from the preceding actions.

The interlocutory analysis of this exchange exhibited how a piece of knowledge was constructed in an intersubjective and intrasubjective manner, which eventually allowed the end user to satisfy the technical writer's initial request by uttering "*ça j'aime pas trop*" (*this, I don't really like*). When UTI12 is uttered, the locutor is able to satisfy the initial request (RED1). The previous turns of speech have contributed to the joint realization of the conditions preliminary to the act of request. In other words, it was necessary that the end user be able to accomplish, i.e. to satisfy the technical writer's request, which was a choice between a printed manual or online help. For this to happen, the interlocutors had to construct a shared representation of the meaning they gave to the terms of the two alternative choices. Thus an individual's action is always situated in the course of action, but also in a

specific context that makes available particular pieces of information and possible actions. That is also Hutchins [2] observation: "in the quest to learn what people know, anthropologists lost track both of how people go about knowing what they know and of the contribution of the environments in which the knowing is accomplished". Interlocutory analysis of this excerpt highlighted the role of "investigated object" during this particular design process.

Conclusion

We wished to emphasize the fact that, quite often, human cognition is apprehended in a monological way taking no account of activity being distributed among individuals and objects. We believe that human thought cannot operate alone and should not be isolated from endogenous and exogenous factors that influence cognitive processes. Design is an activity that socially co-constructed through interactions between its group's members and the environment in which they are. The mutual influences inherent to the operation of a situated collective are not imprinted on the individuals belonging to the group. Such influences are assimiliated, i.e. incorporated to the very substance of the collective. In other words, it is this structure and this mode of operation specific to the collective that we wanted to describe and, to some extend, to explain.

The expression *distributed and situated cognitions* meant for us that the construction of shared knowledge is organization of the suggested activity through both the object and the actors. The resources that create an active and dynamic complex are distributed among the individuals and the objets. We claim here that this type of intelligence inherent to the collective is accomplished rather than possessed. The analysis showed us how cognitive processes become evident in the course of action. We have seen how certain tools are actually used and how they open up the way to a productive cognitive activity. This entails a dialectic of mutual influences between Man and his environment. Human activity changes the world, which in turn changes the way the world may transform human beings. Computers, or any other object, are not only used for what they were made for. They are no mere

amplifiers but, as we have seen, they reorganize the cognitive operation of the group and its members.

Whereas the situated and distributed nature of cognitive activity in any design process is noted and acknowledge by many researchers, what consequences should have this view on design itself? What is at stake here is to know how to create and produce in an effective way in the framework of a cognition going further than the mere accumulation of information present in objects. Lastly, the relationship of Man to objects is at the core of a relation between cognition and action whose study is one of the important tasks of present day social psychology.

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ANNEXE ***Tableau 1. Interlocutory analysis of RED1-UTI10 exchanges***

Sequential	Conversational					Actional
	Illocutory	Cognitive				
		Shared	RED	UTI	DEV	
RED1a	request		L w P ?			
RED1b	explicitation		P{manuals} L{online help}			
RED1c	explicitation		L={(?-->f) -->i}			makes a gesture toward the screen
UTI2	assertion			L ={icons}		
RED3a	disagreement		L ? {icons} ¬L-->b			
DEV3b	assertion request		X {space limited to the screen } X=L ?			direct reference to the screen use of deictic "là" (there)
DEV4	request				X ?	illocution and holds the mouse
UTI5	expressive perceptual appropriation			X		illocution and acts on the keyboard
DEV6	validation				X=L	DEV shows online help on the screen
RED7	assertion		X=L L = {online help}			RED shows the screen
UTI8	assertion cognitive appropriation	X=L L={online help}		X=L L = {online help}		
RED9	assertion reformulation		X=L L{online help}			
UTI10	answer to the initial request (RED1a)			L		