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SITUATED INTERACTION AND COGNITION IN THE WILD, WILD WORLD: UNLEASHING THE POWER OF USERS AS INNOVATORS

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Taking the user into account in the design of multimedia and mobile applications is now common and accepted. However, aside from the verbal recognition of the importance of the role of users and the implementation of usability and human factors, their consequences have not systematically changed product development and design practices. Usability research and testing play a minor role in comparison to technical possibilities, process management and economic considerations in the development phase. Therefore, we take a closer look at the user and the human cognitive and interactive capabilities according to today's Cognitive Science approaches like Situated Cognition. What effect would it have if we took the Situated, Embodied Cognition view seriously? Would it really make a difference in design and development practices? And would it make a difference to the implementation of other cognitive approaches like the Symbol Manipulation (Information Processing) or Connectionist (Parallel Distributed Cognition) views that might play a background role in guiding professional practices? This paper draws parallels between the development of Cognitive Science and the fields of Human Computer Interaction and Usability and puts forward the claim that a serious consideration of current thinking and knowledge regarding the situatedness and embodiment of human cognition fundamentally changes our assumptions and actions regarding the role of schemes, situations, intentions and functions, tools and environments, and the role of cooperation in the design of mobile and multimedia applications.

Key words: Cognitive Science, Human-Computer Interaction, Situated Cognition, Usability, Multimedia, Mobile Applications
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1 Introduction

Nowadays, the user is commonly considered in multimedia design practice. Designers become increasingly aware of the importance of users for the development of innovative communication concepts and tools. However, aside from the acknowledgment of the importance of the role of the user and the implementation of usability and human factors, we maintain that their consequences have not systematically changed the development and design practices of new products to a satisfactory extent. On the contrary, Suchman [31] maintains that the spaces for design and engineering practices including user participation, for example, seem to be "closing down with the economic turns of the industry and associated retrenchments in old values of (at least apparently, in upfront costs) faster and cheaper production". This is problematic as ill-designed multimedia, mobile and web applications limit the usability and comprehensibility of information technology.

Only 50% of the world's population has a mobile device and only about 21% of the world's population use the internet [16]. In some countries, ICT is practically non-existent for financial reasons. In others, the use of the ICT is not limited by financial problems; instead, a digital divide is created through usability barriers: People with low information technology skills are excluded from the information society. These 79% of the world population represent the rapidly emerging[a] key market of the future, and they can be won over by providing them with easy-to-use and easy-to-purchase software and hardware.

When we look at information products (tools, systems, texts), it quickly becomes apparent that the principles that guide system development today do not always take our present understanding of usability into account; otherwise we would not have so many functionally overloaded, nearly unusable systems that unintentionally cut many users out.

Usability aspects often play a minor role in the development phase in comparison to technical possibilities, process management, and economic considerations. In particular, the development of mobile applications is dependent of specific technical constraints: For example, certain interfaces and solutions require substantially more resources like more storage; see [1], and this will have to be taken into account as a cogent technical restriction even if it threatens to rule out user requirements.

At times, usability even seems to be accorded a role similar to the one given to invited speeches by psychiatrists according to Hector, the main character in Francois Lelord's novels [20]: Psychiatrists are like the smoked salmon on a cold buffet – it might not always be good, but if it's not there people are bound to notice it is missing.

So why is usability not readily implemented in the practice of technology development? There is a fundamental conflict between human factors experts on the one side and developers on the other. It is a conflict that we have been confronted with in every single research and development project we have been involved in – both on a national and on an international level: The developers focus on technology only and the usability experts focus on users only. This has now become such a classic conflict that many people even think it has already been overcome. After all, did not Norman [24] postulate a paradigm change from "Science Finds, Industry Applies, Man Conforms" (Motto of the 1933 Chicago World's Fair) to "People Propose, Science Studies, Technology Conforms" back in 1993. We might be hearing the winds of change now, but there is still a lot of work in progress.

For example, since European Union funding regulations require usability to be a part of the projects, it is included – albeit often as a necessary evil; a bow to bureaucracy in the name of finance. Remember Hector: it might not always be good, but if it's not there people are bound to notice it is missing. Usability experts are thus often accorded little more than an alibi role in EU funded development projects.

[a] According to [16], the annual growth rate of mobile cellular subscribers in 2002-2007 was 24%. Worldwide, every other inhabitant was a mobile cellular subscriber in 2007. Statistics of [12] showed about 3.5 billion subscribers with mobile data access (GSM/WCDMA/HSPA).

So it would seem that developers and suppliers continue to concentrate on the latest technical possibilities, while users at times still have to battle with the old "basic version" and with outdated infrastructure. And it goes without saying that this conflict between engineering and application is set to remain with us in some form or other for a long time to come [40].

Developers and suppliers certainly need and want to counteract the criticism that they focus too much on technology and not enough on usability. But it is difficult to actually include users professionally and systematically in the development process. Some seem to be of the impression that they cannot simply approach users "empty handed": They think their product will not generate interest or will not be seen as a good solution if it is not appealing and attractive right from the very start. In other words, they have to finish their product *before* they introduce it to the users. So it is little wonder that product managers and User Centred Design experts talk at cross purposes, despite the fact that they generally basically agree on the importance of the users.

What risks and dilemmas arise from this situation in the worst case scenario? Interested *users and companies* expect new, user-centred systems, without having to spend too much time on their development – after all, that's the developers' job. *Developers and suppliers* try to involve users, but see the usability issue as a source of irritation in their carefully optimized development processes. At the same time, we *scientists and researchers* propagate exciting new concepts and methods, which include everything from the content right through to the situation, sometimes without giving heed to the realities faced by the developers and suppliers, who have to combine innovation with economics and produce profitable applications at as low a cost as possible.

What all these companies, developers and scientists actually need to do now is to sit down at one table to support the paradigm change and turn it into a practical reality. The question we have to ask ourselves is: How can we put new scientific insights to use in improving the development of communication tools?

The solution is well within our grasp. In this article, we suggest that we take a closer look at the user and the human cognitive and interactive capabilities according to today's Cognitive Science approaches like Situated, Embodied Cognition which have been going strong since the 1980s. To a certain extent, this modern image of cognition supports the developers of such tools. Here, tool-mediated communication and interaction are key factors and emphasis is placed on the role of the tools as a part of our human-made environment. These tools are accorded an almost integral role in human intelligence and – as the icing on the cake – Lévy [21] even refers to the collective intelligence imparted by such media. Brain, body, (socio-cultural) environment, and technology should no longer be seen as isolated units, but as a (complex) interactive system which only as a whole can induce intelligent action and learning.

2 Cognitive Science and Usability Research and Practice

We would like to illustrate the development of the field of Cognitive Science in a depiction of three steps (see Table 1; cf. also [25])[b]:

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[b] These three steps are an extremely simplified subsumption of existing approaches to Cognitive Science. We would like to refer the interested reader to, for example, [9] and [35].

1. Symbol Manipulation (Propositional Theories of Mind)

2. Connectionism (Artificial Neural Networks)

3. Situated, Embodied Cognition

We will try to show here how our picture of cognition – the human mind – has influenced the theoretical and practical attitude to usability and human computer interaction and thus also the characteristics of present and future information technology (see Table 2). The questions we address here are:

- Where are we now?
- How did we get there?
- Where are we going to?

Approach	Common emphasis	Classics/Examples
Symbol Manipulation (Information Processing, traditional/classical Cognitive Science, Physical Symbol Systems)	**Cognition**: Symbolic, rule-based computation **Understanding**: Explicit, universal and rational computation “What does a good cognitive system do? Represent the stable truths of the real world”	Chomsky [7], Newell and Simon [22]
Connectionism (Artificial Neural Networks, Parallel Distributed Processing, computational neuroscience)	**Cognition**: States and activity patterns in a network of units **Understanding**: Implicit, schematic/prototypical, experience-based, individual and emotional activity “What does a good cognitive system do? Develop emergent properties that yield stable solutions to tasks”	Rumelhart and McClelland [29]
Situated, Embodied Cognition (dynamic systems approach to cognition)	**Cognition**: Scaffolded, embodied social interaction between a dynamic cognitive system and its dynamic environment (cognitive system = “self-organizing processes of interconnected sensorimotor subnetworks”) **Understanding**: Constructive, tool-mediated, socio-cultural mutual triggering of structural changes between a cognitive system and its environment “What does a good cognitive system do? Become an active and adaptive part of an ongoing and continually changing world”	Brooks [4], Clark [9], Hutchins [15], Suchman [32]

Table 1 A selection of exemplary approaches in Cognitive Science, quotes: [25].

Approach	Common emphasis	Object and method of analysis	Evaluation of the usability of a system	Classics/Examples
Computational Information Processing	Performance of the computational system	Quantitative analysis of the computational system	By measuring the structural/syntactic complexity of the system/information	Shannon and Weaver [30], Thimbleby [37]
User Modelling	Rule-based simulation of the actions of the user	Quantitative analysis of the anticipated use according to a general model of human problem solving	By calculating time for user operations and selections	Card, Moran and Newell [5] GOMS (Goals, Operators, Methods, and Selection)
User-Centred Design, Contextual Design, Usability Experience	Motivational, emotional, error-prone, task- and target group specific interaction	Quantitative and qualitative analysis of the specific user group and tasks, systematic observation of use (usability testing), interviews	By measuring the accomplishment of user-relevant tasks by members of the user group	Beyer and Holtzblatt [3], Nielsen [23], Norman [24]
“User-Design”, (evolutionary) User-Driven Design	Tool-mediated social interaction	Ethnographic analysis of social contexts of use	By describing the development and adaption of systems by the users themselves in real-life contexts	Greenbaum and Kyng [11]
Collective design, (unsupervised) Participatory Design	Social self-regulation of tool development and use; user-generated content and tools	Analysis of the network dynamics (e.g. through online questionnaires, tracking e-mails, contacts, and co-authors; Social Network Analysis)	By the distribution and dynamics of the tool-mediated interaction	Antonelli [2], Web 2.0, open source

Table 2 A selection of exemplary approaches in Human Computer Interaction and usability (a non-representative sample for the purpose of exemplification).

2.1 Symbol Manipulation and Computational Information Processing

Cognitive Science started with an image of cognition as computer-like information processing (“Computational-Representational Understanding of Mind”; [35]). Cognition and interaction were seen as linguistic activities in which information was received, coded into (mental) symbols, and then manipulated using fixed rules. Basically, the brain was seen as a complex database. Cognition was modelled as code switching according to the then newly developed principles of telecommunications and data processing. User behaviour was seen as a grammatical operation: Syntactic analysis was supposed to provide the functions and meanings for the user to be processed.

The corresponding view on the interaction between humans and computers was characterized as computational information processing: The emphasis lay on the performance of the software (the computational system). No involvement of users was seen as necessary for the development: the object of analysis was the computational system itself. Thus, the usability of the system was evaluated by measuring the structural or syntactic complexity of the system or information (tasks, subtasks etc.), for example by counting the possible states of the software (computational system).

2.2 User Modelling

As models for the human mind, semantic networks and other well-ordered, well-defined systems that fit well together with the approach of Symbol Manipulation quickly reached their limits when faced with "real-life" users, primarily as a result of their ignorance of the dynamics of the actual situations and contexts [9]. The field of Human Computer Interaction raised its voice to argue that it is not possible to deduce the usability and comprehensibility of an information technology system by analysing the system itself; we have to actually take the specific and limited cognitive capabilities of the human users into account. But if concentrating on the structure of the technology does not suffice, would it be possible to model the user in a general, universal way, and then compare system functionalities and user capabilities? This is the idea behind user modelling: a rule-based simulation of the structure and behaviour of human users that enables us to analyse the anticipated use according to a general model of human problem solving, for example, the GOMS rules by [5]. These models reduce a user's interaction with a computer to its elementary actions. Interfaces are then studied and evaluated by using these elementary actions as a framework. Such user modelling approaches can be seen as one of the first serious attempts to include user characteristics and provide information on their interaction. However, they have a far-reaching drawback: they do not take user unpredictability into account. Real users are affected by all manner of different things, like fatigue, hunger, noise, disruptions or their social surroundings, and act in surprising ways as a result of unpredicted expectations, preconceptions, habits, and (mis)interpretations.

2.3 Connectionism, User Experience and User-Centred/Contextual Design

In the 1980s, the cognitive approach of Connectionism was able to explain the unpredictability of human cognition and thus changed our view of user behaviour [29]. Unpredictability actually proved to be one of the major *reasons* for human intelligence; it enables us to adapt to new situations, to learn through experience, and to find quick, new solutions. Indeed, human cognition proved to be far more flexible and constructive than had been assumed by the grammatically and semantically "correct" programmes prior to the birth of Connectionism. The brain was no longer seen as a database, but as a dynamic, holistic network able to create patterns of activation – our memories are rich with all manner of different scenes, tones, smells, tastes, motions and emotions. In addition, these patterns are always activated differently depending on the specific situation. As a result, semantic property systems were substituted by experience-based, non-linguistic and emotionally loaded examples, schemes or prototypes [28].

In Human Computer Interaction, the connectionist path was paralleled by a turn to concepts like User Experience (UX), which added value to the experience-based and emotional aspects of tool use [10]. Understanding and use of internet applications, for example, was described as a process that depended on the specific experience the individual in question had of using computers, of information technology, of technology in general and also of the rest of the non-virtual world. The process of interpretation starts long before the first icons and words on a screen are seen and read.

In connectionism, human action (and thus also tool use) is described mostly as the process of following learned schemes and putting this learning into practice. Problem solving strategies and communicative regularities guide the way from the tool functions to user behaviour, but leave room for unpredictable interpretations and misunderstandings that can only be detected by real user testing.

Thus, connectionists showed us why users will never be able to simply reproduce the functions and meanings that are “built-in” to a tool or a text by the developers. And developers and designers realized that it is not possible to model the human user in a general, universal way. To actually see what happens when real users are let loose on a specific tool, they recognized the importance of usability testing with real or potential members of the actual user group.

This is where informed usability practice is now: readily using usability heuristics, and testing products according to established methods of User-Centred Design, Contextual Design and Usability Experience [3, 23, 24]. Interaction is seen as motivational, emotional, error-prone, task- and target group specific and is studied by analysing the specific user group and tasks, carrying out interviews and systematic observations of use, and measuring the accomplishment of user-relevant tasks by members of the user group.

Acknowledging the context-dependency of user behaviour adds relevance to the development of context-aware and context-sensitive mobile applications. Nevertheless, this is not a direct correlation: Even though users act in a dynamic way, they might not automatically prefer and master the use of dynamic tools. However, there is first empirical evidence that for example context-aware functionality of Tour Guides reduces the time to assimilate information and increases user satisfaction [13]. In any case, the growth of context-sensitive functionality adds to the complexity of design: Not only the user, but also the product itself continually adapts to the present location, orientation, network connectivity and other contextual factors [1, 6, 13].

2.4 Situated, Embodied Cognition, User-Driven/Participatory Design and Actor-Networks

The Connectionist revolution brought about radical rethinking, but still maintained some of the main visions of the Symbol Manipulation approach: The primary focus was placed on the individual and, in particular, on the dynamic workings of the human brain. The next radical changes in the visions and terminology of Cognitive Science were brought about by Situated, Embodied Cognition. Here, the central concern is not the brain itself, but the fact that it allows us to interact with the environment, artefacts and other human beings. Situated Cognition not only examines individuals and their previous knowledge and skills, it also looks at their interaction with artefacts and their social environment and how the interaction is influenced by the specific situation [9, 15, 32, 36].

In Artificial Intelligence, the new catch phrase was embodiment. Brooks [4] started afresh by creating autonomous agents that were supposed to get on in the world on their own. In doing so, he had to renounce two of the basic assumptions made by Cognitive Science at the time: the assumption that the brain stores information about the environment by means of mental representations and the assumption that the brain controls intelligent action.

From a Situated, Embodied Cognition point of view, the importance lies neither in the scripts nor in the more or less flexible schemes stored in long-term memory that supposedly control our behaviour in the form of instructions for action alone. We do have destinations, but we do not only follow our internal maps to find our way [26]. We are not intelligent because we use the knowledge resident in our brain (here situation would only complement our prior knowledge). The primary concern of Situated, Embodied Cognition is the fact that individual *history* and the present *environment* form an integral part of the *processes* of thought and behaviour [9]. Here, the ultimate goal is not fluent human-computer interaction, but to blur the line between humans and their favourite tools. Good tools are part of the action itself: They are our second nature, so well adapted that we are not conscious of any border between the cognitive process and the interactive tool. Strictly speaking, then there is no "use" and "user" any more – there is only action: Action as a contextual activity, as the appropriate navigation in a specific environment.

Today, this kind of tool-mediated social interaction forms the object of study in some approaches to User-Driven and Participatory Design [11] as well as in Actor-Network Theory [19]. Here, ethnographic analyses of authentic social contexts of use are carried out and tools are evaluated as parts or even agents of action – by analysing the adaption and modification of systems in real-life contexts. This is what Edwin Hutchins was referring to in 1995, when he talked about "Cognition in the Wild" [15]: Because cultural practices are a key component of human cognition, it makes sense to study it in social, cultural, and material context.

This is where we encounter the borders of any "design" in the usual sense of the word. When not just the content, but also the tools are partly user-generated, users and consumers become producers ("prosumers" [38]), and we observe the social self-regulation of tool development and use, which is already a form of internal evaluation in itself. An adequate way to evaluate this kind of a system externally is to analyse the network dynamics, for example through online questionnaires, automatic e-mail tracking or by tracking contacts and collaboration, and thus measuring the distribution and dynamics of the tool-enabled and user-generated social network of, for example, Web 2.0 and open source.

3 Do Situatedness and Embodiment Really Make a Difference?

But do situatedness and embodiment really make a difference for the design of multimedia communication and web applications? What effect would it have if we took the Situated, Embodied Cognition view seriously? Would it really make a difference in design and development practices? In our opinion, a serious consideration of the situatedness and embodiment of human cognition fundamentally changes our assumptions and actions regarding

- the role of schemes,
- the role of situations,
- the role of intentions and functions,
- the role of tools and environments, and
- the role of cooperation

in the design of mobile and multimedia applications. Let us look at these roles one by one.

3.1 New Role of Schemes

In Cognitive Psychology there is a common assumption that learned, usual procedures (schemes and scripts) guide the use of products – so "all" we have to do is find out what users are used to and design our products accordingly. However, if Situated, Embodied Cognition was to be taken seriously, a new role would have to be given to the schemes and scripts that are supposed to guide the use of products and the notion of prototypical users: These are initially hypotheses, but always adapt to the specifics of the situation. Thus, the users will eventually create new, more or less *a*prototypical meanings in their situation. This perspective emphasises the importance of testing products in authentic situations with authentic users, immediate feedback, context-sensitive help, and non-linear and exploratory functions like undo, step back, and zoom.

The dominance of schemes and scripts depends on the target group. Simply speaking: Laypersons and beginners act according to their previous knowledge and habits in other fields of experience. This makes them a very unpredictable target group indeed. Learners and semi-professionals, on the other hand, often follow learned schemes. Thus, their behaviour is predictable to a certain extent. Those who are unfamiliar with an action or a system need de-contextualised rules, since they do not know the context and have not yet developed an "interactively emergent organisation of behaviour", a *Merkwelt* [14, 33]. This is where the explicit rules of Good Old-Fashioned Artificial Intelligence (GOFAI) come into play, if only as an aid for the subsequent learning phase. As novice users become more experienced and involved, they no longer follow the de-contextualised rules they started off with. Highly competent, professional expert users have already gone through the rule-governed phase of following learned procedures and can now rely on their reflexive, experience-based intuition [27]. The scaffolding needed for the learning process is removed and replaced instead by the flexibility and freedom gained in the process of shaping a *Merkwelt*. Expert users find it difficult to describe these activities, because they are not governed by fix, verbally expressible rules. This is why experts act in unprecedented ways: Expert action has proven especially individualised and flexible. The abilities of the expert user do not come into play when slavishly applying a previously formulated or learned plan, as Suchman [32] notes, they manifest themselves in the continuous formulation of new hypotheses.

3.2 New Role of Situation

The usual assumption is that knowledge is general and abstract, so users are able to put their knowledge and competence into practice in all situations, regardless of the context. However, it has been shown that someone who is used to manipulating one specific kind of unit or units will not necessarily be able to transfer this ability and manipulate other units in the same way, even though the actual task itself remains the same. To understand a user's behaviour and any changes to this behaviour, we need to know his/her history, environment and physical opportunities. Here, situation proves to be a decisive factor, since skills that had once been mastered can disappear overnight if the environment or the task are slightly modified [9]. The actual situation assumes a particularly important role when it comes to the way people use mobile devices: users adapt to their current situation and constantly change their activities and the way they use mobile devices in response. In doing so, they are often influenced by far more characteristics of the situation than context-aware technologies [1, 6, 13] can usually accommodate. Consequently, this also has to be carefully considered in the design and evaluation of mobile multimedia [18].

3.3 New Role of Intentions and Functions

We generally make the assumption that a user's behaviour is made up of individual actions with specific intentions and functions. We can align a certain meaning and purpose to each act. This picture of behaviour as functional acts, each with a clearly definable beginning and end, is becoming increasingly criticised and is beginning to look like an illusion – albeit a practical, useful one. According to Situated, Embodied Cognition [14], we *learn* to think of human behaviour in this way and to break up the behavioural process into discrete actions. This illusion has both an organisational and a coordinative purpose, but it does not explain the underlying cognitive process. Indeed, the mere reference to inner intention or situative function is increasingly exposed to criticism. A system developer will never really be able to "find out" the communicative intention of the users; any such explicit representation of internal intention has to be questioned. The developers and designers can (and must) construct a coherent picture of the users' situations in order to design a system in a meaningful way. But developers can never have complete knowledge of the implicit, dynamic cognitive processes, regardless of how much information might be available about the user. They will always encounter surprising user behaviour. For example, although mobile phone text messaging technology was originally developed with business purposes in mind, it has not really found acceptance there. But it has become the preferred mode of communication for young people. And we can also observe a similar (opposite) shift in direction for blogging technology: Although blogs originally started out as informal communication tools, their business possibilities are now also being detected.

3.4 New Role of Tools and Environment

Tools are cultural artefacts; a part of our environment that we fall back on, consciously and subconsciously, when we think and act. This has important implications for the power of culture as cooperatively learned and artefact-mediated behaviour. Much of the complexity of our tasks and situations is supported by such external structures (*scaffolds* [9]) like information and communication systems.

According to Situated Action, one of the main reasons for our intelligence is that we delegate knowledge to our environment and motions. Thus, we reduce the need to store it, search for it, and process it in the brain. This principle of cognitive economy manifests itself in many different ways. We design supermarkets so that we have to pass as many products as possible and fill our trolleys, we place an empty coffee packet outside our front door to remind us to get some more; and we design offices to suit the tasks we have to remember and complete. Rooms and organisations become tools in the wider sense of the word [14]. They put a framework around our actions and understanding, a cultural scaffolding. In Figure 1 and 2 [34] we see the extreme opposites of workplace structures, created by the office occupants themselves. Figure 1 illustrates the clean desk of a so-called "neat" [17]: There is a paper on each side of the keyboard and folders in different colours to the left of the desk.

Figure 1 The workplace of a "neat" [34].

So-called "scruffies" (Fig. 2), on the other hand, "are less in control. Their desks are full of all kinds of things found in an office, and they make use of ad hoc categories to a greater extent, that is, they create categories as needed" [34].

Figure 2 The workplace of a "scruffy" [34].

In the same way, the challenge facing web and multimedia tools is to design “rooms” which make us “walk past” the motivating, core possibilities of the system – and to design them so that users will be able to customize the virtual space according to their needs and personalities. Web spaces are also “activity landscapes” [17], “environmental resources that help people achieve their goals” [34].

3.5 New Role of Cooperation

Due to the major role of the environment in Situated Cognition, any attempts to explain action by only describing processes in the brain or an individual are bound to fail. The brain is only one decisive part of the story. We need to find out not only what happens in the users’ brain, but also what happens elsewhere, for example, in their hands, in their mobile devices, on their desks, in their organisations, or in their peer communities. Understanding is not done solely by the brain, but by complex systems including people, their specific social and physical environments, and all their cultural artefacts. We often only have access to certain competences in a specific situation, that is, within the context of a particular activity and the environment in which it is carried out. Our understanding is constructed differently to suit the goals we have set ourselves and the roles we play. Knowledge changes in structure and perspective, and it is not stored statically in the brain to be recalled at any time.

We always observe a number of systems at the same time, systems which affect and change each other and are themselves subject to a constant process of change – each cognitive activity involves at least two systems "simultaneously shaping each other's change" [39].

When looking for coherence, we make use of a number of situative cues, such as the occasion, the room we are in, what has been said up to now, or the people involved. We live in and with uncertainty, yet are able to deal with it; in fact, we even need it to be able to carry out complex intellectual tasks. Consequently, as Suchman [32] notes, we should not try to eradicate this fundamental uncertainty and unpredictability by looking for explanations and laying down rules, but rather concentrate on the flexibility and elasticity which allow us to deal with uncertainty and to deal with each specific case.

4 Conclusions

To grasp interaction and communication in the Wild, Wild World, we need to describe real-life work and leisure processes. We need to study in more detail when and to what extent users conform to plans, systems, guidelines, and other external, organisational aids and when and to what extent they creatively deviate from ready-made schemes. As developers, we need to consider whether we can enable both rule-governed and creative use of the product. After all, “quick and dirty” is a necessary characteristic of real-time action (but one that has to be avoided in critical environments like nuclear power plants).

We need to concentrate on the question of how something came to be there or what happened, instead of trying to determine the optimal way to perform a task [14]. Here, the reconstruction of *processes* becomes more important than the search for the most transparent ways to describe the specific status and functionality of a system [8].

In light of the above, we would like to expand on the paradigm change described by Donald Norman in his 1993 book [24]. Today, we are moving from “Science Finds, Industry Applies, Man

Conforms" (the dated motto of the 1933 Chicago World Fair) via "People Propose, Science Studies, Technology Conforms" (Norman's own new guiding principle) to

People Participate,
Networks Emerge,
Science Inspires,
Technology Enables.

At the same time, the role of users is changing from that of "information processors" via that of "target group", "participants", and "test beds" to one of "co-developers", "co-designers", and "innovators".

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