

2 The Psychology of Ambient Intelligence: Activity, Situation and Presence

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Abstract. The chapter outlines a psychological framework for the concept of Ambient Intelligence (AmI), centered on three concepts: action, situation and presence. Using this framework it is provided a psychological definition of AmI, based on the experience of the user: AmI is the effective and transparent support to the activity of the subject/s through the use of information and communication technologies. The definition points at “activity support” as the core of the AmI experience. Further, it identifies “effectiveness” - the activity reaches its objective - and “transparency” - the activity is experienced without breakdowns - as the key characteristics of an effective AmI system.

Using these features, the chapter highlights some general guidelines to support the work of AmI developers. Further, it identifies possible AmI applications related to the support and tracking of the subject’s activity: AmI may offer a guidance/support to the activity of the subject and/or provide a feedback related to its status.

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2.1 Introduction

Information technology (IT), is transforming the way people interact between themselves and with objects around them. In particular, technology's focus is gradually shifting away from the computer as such, to the user [1, 2]. This change of paradigm aims at making communication and computer systems simple, collaborative and transparent to the user.

A first sign of this change has been the creation of totally new interactive communication environments, such as Computer Mediated Communication (CMC) and Computer Supported Collaborative Work (CSCW) [3]. However, the final steps towards this vision will be allowed by three dominant trends [4]:

- The increase of *richness and completeness of human-computer interaction*, through technology extensions of the senses and of the human body
- The relevant *role of mobility*, through the development of mobile communications and extended networks
- The *pervasive diffusion of intelligence* in the space around us, through the development of advanced biosensors.

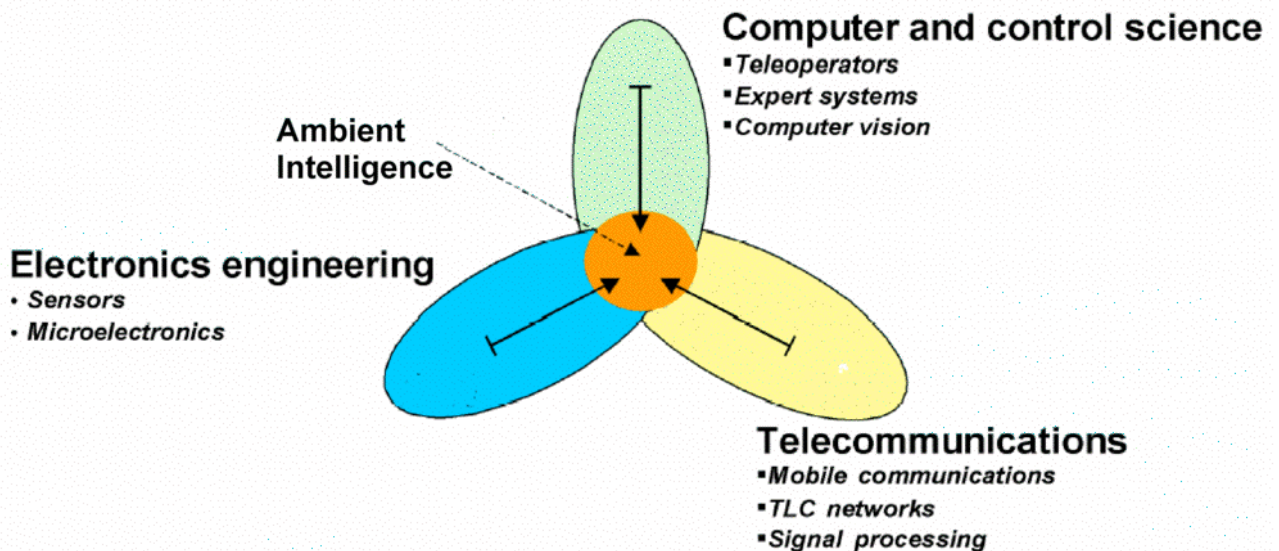


Figure 2.1 The emerging ICT trends

The merging of these trends allows the emergence of a new vision [5]: the **Ambient Intelligence** (AmI), a *pervasive and unobtrusive intelligence in the surrounding environment supporting the activities and interactions of the users*. As noted by the ISTAG group [6]:

“Such an environment is sensitive to the presence of living creatures (persons, groups of persons and maybe even animals) in it, and supports their activities. It ‘remembers and anticipates’ in its behavior. The humans and physical entities - or their cyber representatives - together with services share this new space, which encompasses the physical and virtual world” (p. 6).

AmI is the direct extension of today’s concept of ubiquitous computing, the integration of microprocessors into everyday objects. More in detail, AmI may be roughly described

as the opposite of virtual reality: virtual reality puts people inside a computer generated world; AmI puts the computer inside the world to help us.

According to the AmI metaphor, people will live in enriched environments in which the technology is sensitive to people's needs, personalized to their requirements, anticipatory of their behavior and responsive to their presence. In summary, the vision of AmI places the user at the centre of the technology focus: computers move to the background and intelligent, ambient interfaces to the foreground.

Therefore, *the AmI technology should be designed for the people rather than making people adapt to the technology*. For this reason, the AmI requirements are not just technological. As underlined by Sleep [7]:

“Seen in this light, Ambient Intelligence is the limit of a process which introduces the technology into people’s lives in such a way that the introduction never feels like a conscious learning curve: no special interface is needed because human experience is already a rich ‘Manual’ of ways of interfacing to changing systems and services. Somehow, we need to create technology that leverages this powerful human resource rather than trying to suppress it by requiring humans to participate in inflexible interaction protocols of the sort supported by current call centre technology.” (p. 9).

ISTAG recently identified different characteristics that will permit the societal acceptance of AmI [8]. AmI should:

- Facilitate human contact
- Be orientated towards community and cultural enhancement
- Help to build knowledge and skills for work, better quality of work, citizenship and consumer choice
- Inspire trust and confidence
- Be consistent with long term sustainability both at personal, societal and environmental levels
- Be controllable by ordinary people.

Further, the research on use and acceptance of information and communication technologies [9] outlined some possible end-user attitudes that may slow-down the acceptance of the AmI approach (p. 9):

- People do not accept everything that is technologically possible and available
- People need resources/capabilities to buy and use technologies (money, time, skills, attitudes, language, etc.) that are not evenly distributed in society
- People make use of new technologies in ways that are very different from the uses intended by suppliers (e.g. the Internet, SMS)
- New uses of technologies mainly emerge in interaction of users and producers
- User demands will only be met if costs are attractive for the suppliers
- There is no such thing as a typical, standard user and use but rather a diversity of users and uses
- There is a difference between ownership, usage and familiarity of ISTs. People own technologies but may not use them; people use technologies but may not have trust and confidence in them. Even today, the PC and the Internet have not gained the same degree of diffusion as television, radio and telephone.

Within this context, psycho-social guidelines have a critical role. To this aim, the chapter

outlines a psychological framework for the concept of Ambient Intelligence (AmI), centered on three concepts: *action*, *situation* and *presence*.

In particular, as we will see in the following paragraphs, the key assumptions are:

- *Any activity* is driven by a specific objective and it is structured in two different but strictly intertwined levels - *actions* and *operations* - each characterized by specific motives - *goals* and *conditions*
- *The situation* is the physical, social and cultural space (context) in which the activity is carried out. Activity is influenced by the affordances and constrains the subject perceives within the situation
- *The feeling of presence* provides to the subject a feedback about the status of its activity: the subject perceives any variation in the feeling of presence and tunes its activity accordingly. Specifically, the subject tries to overcome any breakdown in its activity and searches for engaging and rewarding activities (optimal experiences).

This framework allows a psychological definition of AmI, based on the experience of the user: *AmI is the effective and transparent support to the activity of the subject/s through the use of information and communication technologies.*

This definition has two critical advantages:

- *It provides some insight into the processes or effects of using these systems:* the definition focuses on the activity of the subject as the main object of analysis for both the development and the evaluation of any AmI system
- *It provides a conceptual framework from which to make regulatory decisions:* the definition points at “activity support” as the core of the AmI experience. Further, identifies “effectiveness” (the activity reaches its objective) and “transparency” (the activity is experienced without breakdowns) as the main characteristics of an AmI system.

During the process we will highlight some general guidelines to support the work of AmI developers. Finally, the chapter identifies different possible applications of an AmI system, related to the support and tracking of the subject’s activity.

2.2 Activity theory and AmI

The definition of AmI we have just introduced considers the activity of the subject as the main object of analysis. But what is activity from a psychological viewpoint?

One of the most interesting answers to this question comes from the work of the Russian psychologists Vygotsky and Leontjev. According to these authors - usually defined as the Activity theorists - consciousness is not a set of discrete disembodied cognitive acts (decision making, classification, remembering...) and certainly it is not the brain; rather consciousness is located in everyday practice: you are what you do [10].

Within this framework, any action is strictly related to the general and specific goals of the subject. As underlined by Ryder [11]:

“In its simplest terms, an *activity* is defined as the engagement of a subject toward a certain goal or objective. In nature, an activity is typically unmediated. Picking a berry from a bush and eating it is a simple, unmediated activity that involves direct action between the subject and object. In most human contexts our activities are mediated through the use of culturally established instruments,

including language, artifacts, and established procedures. Picking mushrooms in the forest and eating them is an activity that is ill-advised without some form of mediation. Our subject would prudently appropriate some prior knowledge - a field guide, prior education in mycology, the direct advice of an experienced mushroom forager, or some other embodiment of human experience with mushrooms. Some means is necessary to bring the prior experience of history into the current activity. Animals have only one world, the world of direct objects and situations, mediated only through instinct. Humans have the vicarious worlds of other humans that they can invoke into the present through the use of language and artifacts.”

(http://carbon.cudenver.edu/~mryder/isrcat_99.html)

Within this vision, any activity is undertaken by a subject (actor) - who is oriented towards a specific purpose (object) - and it is always mediated by physical and social tools (artifacts). This vision provides the first two guidelines for any AmI developer:

1. *An effective AmI system has to recognize the specific purpose of the user:* if the AmI system is not able to identify the specific objective of the user it will fail in supporting his/her action
2. *An effective AmI system has to identify the specific tools that mediate the activity of the user:* most of the activity of the user is mediated by physical and social artifacts. The AmI system has to identify them if it wants to support the action of the user effectively.

The Activity theory goes further in analyzing the action process. In particular, Leontjev [12] distinguished, within the general activity of the subject, three different levels.

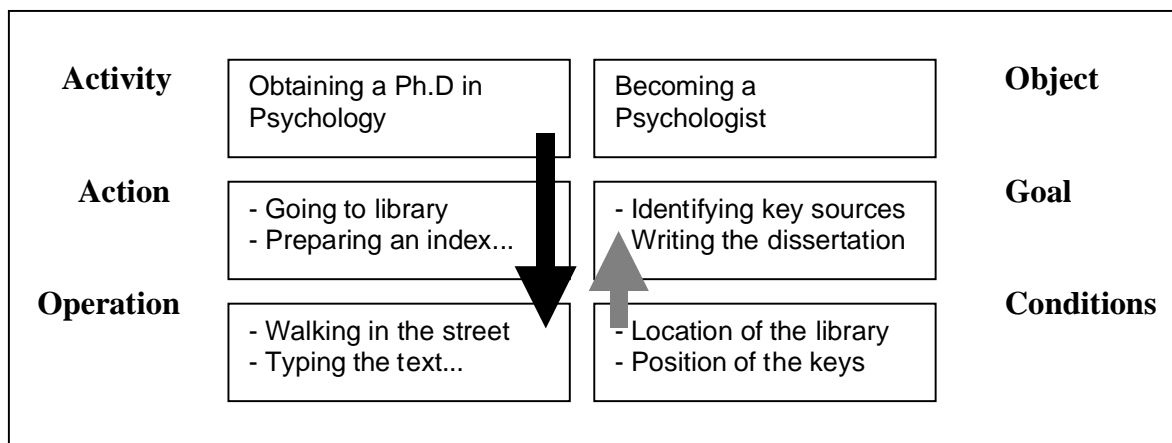


Figure 2.2 The activity levels

Activity is the highest level: the direct answers to a specific objective of the subject. The activity of the subject moves toward the object of a specific need and terminates when it is satisfied. Specifically, an objective is a process characterizing the activity as a whole. For example, in reference to Figure 1, the activity is to obtain a Ph.D. in Psychology. Any objective is closely related to a need/motive – e.g. becoming a clinical psychologist - and both have to be considered in the analysis of activity.

Each activity is then translated into reality through a specific or a set of *actions*. Each action is a process performed with conscious thought and effort, planned and directed towards achieving a *goal*. In reference to Figure 1, the activity – obtain a Ph.D. – is translated in a set of actions: going to the library for searching the sources, preparing an

index, discussing it with the tutor, etc. Each action can be then split in sub-activities, each related to a sub-goal: searching for the books about psychology of media, writing the structure of the first chapter, etc.

Actions and sub-actions are developed through *operations*: if actions are connected to conscious goals, operations are related to behaviors performed automatically. In reference to Figure 1, the operation of typing in preparing the index of the dissertation is done automatically, without a conscious focus on the movement of the fingers. All the operations, however, are oriented by some *conditions*: specific constraints and affordances related to the characteristics of a given tool – such as the position of the keys on the keyboard – that influence the outcome of the operation.

What we have just seen provides other two guidelines for the development of AmI systems:

1. *An effective AmI system is able to decompose the activity of the user in its different components*: the system has to identify the start and the end of each level and sublevel of the activity of the subject to support them. Further, each level and sublevel has its specific motive. The AmI system has to identify all the driving motives to effectively support the activity of the subject
2. *The lower is the level of activity, the easier is for the AmI system to support it*: The object of an activity is wider and less targeted than the goal of an action. So, its identification and support is more difficult for an AmI system. Further, the easiest level to support is the operation. In fact, its conditions are more “objective” and predictable, being related to the characteristics (constraints and affordances) of the artifact used: it is easier for an AmI system to autocorrect the word “psychology” during the typing (operation) than helping the user in writing the structure of the first chapter of the dissertation (sub-action).

The consciousness of the conditions of a given tool is what distinguishes actions and operations. When we learn how to use a new tool, its conditions are addressed with deliberate and conscious attention: they require actions. For instance, the first time I typed, I had to consciously check the position of the letters on the keyboard. When the activity becomes well practiced and experienced, actions do not need to be planned but are performed without conscious thought or effort: actions become operations. It is also possible the opposite process: operations become actions when the original conditions are violated. For instance, if something breaks down – pressing the key does not visualize the given letter on the screen - and/or impedes execution, the subject has to consciously address (goal) the new situation using an action.

The next step of the analysis offered by the Activity theory is related to the link between the user and the tool. Mastering a tool has two effects for the user [13]. First, the tool becomes transparent to the activity of the user: its conditions are handled automatically by the operations. Second, the tool is experienced as a property of the user: it complements or supports the user abilities improving the efficacy of the activity. Marsh [14] provides the following example to clarify this point:

“For example, a builder uses a saw to cut wood, a hammer fixes nails and joins wood, etc. In normal use, the saw and hammer become an extension of the builder rather than belonging to the external world. Consequently, the builder is able to focus on cutting the wood or driving the nail and not on the operations of (or reflect on) the saw and hammer in use.” (p. 88).

These points offer two more guidelines to the developers of an AmI system:

1. *To be effective, an AmI system has to induce breakdowns in the activity flow only to correct/improve its process:* when the AmI system requires the attention of the subject, it produces a breakdown in the activity flow: the subject has to consciously shift a part of his/her activity to handle the request. And this reduces the focus of the subject on the activity. So, the only value of breakdowns in the activity flow is to correct and/or improve it. If the breakdown is not justified by the need to correct/improve the flow, it reduces the efficacy of the activity
2. *The more the AmI system is transparent to the user, the more is its efficacy:* when an AmI system is transparent to the activity of the user, it complements and supports the user abilities improving the efficacy of the activity.

2.3 Situative perspective and AmI

The main limitation of the Activity theory is in its descriptive focus. As noted by Nardi [10]: “Activity theory is a powerful and clarifying descriptive tool rather than a strongly predictive theory” (p. 6). To overcome this issue, different authors tried to connect the Activity theory to other emerging psychological paradigms, in particular cognitive sciences, and interactional studies. The result is another approach – the *Situative theory* – that provides further guidelines to the developer of an AmI system. In particular, the Situative perspective shifts the focus of analysis from individual activity to larger systems that include behaving subjects interacting with each other and with other subsystems in the environment [15].

A first question not addressed by Activity theory but critical for the Situative theory is how subjects plan their actions. Here, an important answer comes from cognitive sciences and in particular from the Situated Cognition approach. This approach includes a family of research efforts [16-19] that counters the “symbol-processing” view of cognition, in which human thinking is seen as akin to a computer performing formal operations on symbols. In fact, this approach explain cognition - including problem solving, sense making, understanding, transfer of learning, creativity, etc. - in terms of the *relationship between subjects (agents) and the properties of specific environments (affordances/constrains)*.

This is possible, because the inside/outside relationship between subject and environment is replaced by a part/whole relationship. As noted by Clancey [20]:

“Situating activity is not a kind of action, but the nature of animal interaction at all times, in contrast with most machines we know. This is not merely a claim that context is important, but what constitutes the context, how you categorize the world, *arises together* with processes that are coordinating physical activity. To be perceiving the world is to be acting in it - not in a linear input-output relation (act>observe>change) -but dialectically, so that what I am perceiving and how I am moving co-determine each other.” (p. 88).

The final outcome of this view is that action is highly dependent upon its material and social circumstances. As noted by Norman [21], any activity is “intrinsically” connected to the particular setting in which the subject acts. Its course is influenced by the physical, social and cultural space (context) in which it happens (situation). In particular it depends on the natural and contextual characteristics (*affordances* and *constrains*) of the situation.

It is important to note that the characteristics of the situation may be perceived or not by the subject. For the action of the subject, *the only relevant characteristics are the ones he/she is able to identify*. These features allow us to identify two more guidelines:

1. *An effective AmI system is able to identify the characteristics (affordances and constrains) of the situation in which happens the activity of the user: if an AmI system does not recognize the characteristics of the situation in which the user acts - at least at a general level - it will be not able to support the activity effectively. In particular, perceived affordances and constrains are the features of the situation more relevant for the activity of the subject*
2. *An effective AmI system is able to make the characteristics of a given situation visible to the user: affordances are the actionable properties between the world and an actor. For this reason, the subject usually acts towards them. However, they influence the activity of the subject only if are visible to him/her. So, if an AmI system makes affordances or constrains visible to the subject, this may improve his/her activity.*

However, the Situated Cognition approach does not clarify how activity is influenced by the situation. In particular, it does not explain adequately how the social and cultural space influence the activity of the subject. The answer to this issue comes from the Interactional studies.

As showed by Lave & Wenger [18, 22] each social system is characterized by regular patterns of activity. These patterns, in which individuals participate, are characterized as *practices of the community* and are created over time by the sustained pursuit of a shared enterprise. According to Wenger [23], each “*community of practice*” is defined along three dimensions:

- *How it develops: through joint enterprise* as understood and continually renegotiated by its members
- *How it functions: through mutual engagement* that binds members together into a social entity
- *Its content: the shared repertoire* of communal resources (routines, sensibilities, artefacts, vocabulary, styles, etc.) that members have developed over time.

According to this vision, *a community of practice supports a shared activity when it generates ways of doing and approaching the used tools that are shared to some significant extent among members* [23]. It also needs to develop shared resources such as tools, documents, routines, vocabulary and symbols that embed the accumulated knowledge of the community.

Further, the efficacy of a community of practice is not related only to the shared activity, but also to the relationships between the member of a community: the interactions involved, and the ability to undertake complex activities and projects through cooperation, bind people together and help to facilitate relationship and trust. For this reason, a community usually tries to resist to any change to its practices. In summary, communities of practice have an important role in guiding and structuring the activity of the members of a community [23]:

- *They retain knowledge about the characteristics and structure of the activity* of the community in "living" ways, unlike a database or a manual. In fact, communities of practice preserve the tacit aspects of knowledge that formal systems cannot capture;
- *They influence the exchange and interpretation of information* within the community. Because members have a shared understanding, they know what is relevant to communicate and how to present information in useful ways
- *They define the boundaries of the community: the members of the community are the ones who share the same knowledge about the common practices*
- *They help in developing the community identity.* Sharing the same knowledge,

support the development of a common a sense of identity within the members of the community.

This vision provides two new guidelines:

1. *An effective AmI system has to recognize the characteristics of the communities of practices in which the user is in:* if the AmI system is not able to identify the community of practices in which the user participates, it will fail in supporting the shared activity. Further, a community of practices is characterized by shared resources. The AmI system has to identify them if it wants to support the shared activity effectively
2. *An effective AmI system is able to support the development of the communities of practices:* An AmI system may support communities of practice by recognizing the work of sustaining them, by giving members the time to participate in shared activities, and by creating an environment in which is acknowledged the value created by the communities.

2.4 Presence and AmI

At this stage we focused most of the analysis of the chapter on:

- *The structure of the activity and its motives* (Activity theory)
- *The physical, social and cultural background in which happens the activity of the subject* (Situative perspective).

However, we have not addressed an important question: how does the subject control the status of his/her own activity?

We will try to answer to this question by introducing a new concept: the sense of *presence* [24-26], usually defined as the “sense of being there” [27], or the “feeling of being in a world that exists outside the self” [28, 29].

What is presence? To answer this question, the European Community has been funding, since 2002, two “Future and Emerging Technologies - IST” research programmes (<http://www.cordis.lu/ist/fet/pr.htm>): *Presence Research Activities* (FP5) and *Presence and Interaction in Mixed-Reality Environments* (FP6). If we check their outcomes, we can find two different but coexisting visions of presence [24, 25, 30].

A first group of researchers describes the sense of presence as a function of our experience of a given medium [31-39]. The main result of this approach is the definition of presence as the *perceptual illusion of non-mediation* [35], produced by means of the disappearance of the medium from the conscious attention of the subject. The main advantage of this approach is its predictive value: the level of presence is reduced by the experience of mediation during the action. The main limitation of this vision is what is not said. What is presence for? Is it a specific cognitive process? What is its role in our daily experience?

To answer to these questions a second group of researchers considers presence as a neuropsychological phenomenon, evolved from the interplay of our biological and cultural inheritance, whose goal is the control of the activity [3, 24, 40-45].

Within this chapter, we will support the second vision, trying to link it with the outcome of the first one: presence is delineated as an *evolved neuropsychological process whose goal is the control of the activity of the subject*. This is achieved by filtering and organizing the streams of sensory data: the more this process differentiates the self from the external

world, the more is the level of presence experienced by the subject.

To fully understand the key ideas behind this vision, these points are critical:

- Presence has a simple but critical role in our everyday experience: the control of agency through the unconscious separation of “internal” and “external”. The meaning of “internal” and “external” is not related only to the body but also to the social and cultural space (situation) in which the self is included
- The presence-as-process (the neuropsychological process) is the continuous unconscious activity of the brain in separating “internal” and “external” within different kinds of afferent and efferent signals. It can be described as a sophisticated form of unconscious monitoring of action and experience, transparent to the self but critical for its existence. It produces, but it is different from, the presence-as-feeling (the experienced level of presence)
- The presence-as-feeling is experienced indirectly by the self through the characteristics of action and experience. In fact the self perceives directly only the *variations* in the level of presence-as-feeling: breakdowns and optimal experiences
- The presence-as-process can be divided in three different layers/subprocesses phylogenetically different, and strictly related to the evolution of self: *proto presence* (*self vs. non self*), *core presence* (*self vs. present external world*), and *extended presence* (*self relative to present external world*).

Presence is described here as a defining feature of self and it is related to the evolution of a key feature of any central nervous system: the embedding of sensory-referred properties into an internal functional space. As noted by Waterworth and Waterworth [45], the appearance of the sense of presence allows the nervous system to solve a key problem for its survival: how to differentiate between internal and external states. Without the emergence of the sense of presence it is impossible for the nervous system to experience *distal attribution* - the referencing of our perception to an external space beyond our boundaries – and effectively control its agency.

In this vision it is critical to distinguish between presence-as-process and presence-as-feeling. The presence-as-process is the continuous activity of the brain in separating “internal” and “external” within different kinds of afferent and efferent signals.

If, in relatively simple organisms, this separation involves only a correct coupling between perceptions and movements, in humans it also implies the relation of the subject with a social and cultural space [4, 42]. In fact, individuals actively interact with the environment, selecting and differentially replicating throughout their lives a subset of biological and cultural information, in terms of activities, interests and values. This vision has two important corollaries:

- It is also “external” to the subject what is not related to his/her activities, interests and values
- To be more “present” in the situation (social and cultural space) defined by a symbolic system, the user has to be aware of its meaning. Only “making sense there”, the user really experiences a full sense of presence [14, 46].

To make these concepts clearer an example may help. I’m in a restaurant for a formal dinner with my boss and some colleagues, but I don’t know how to use the many different strange forks I have around my dish. In this situation I’m physically there, but the lack of knowledge puts me outside, at least partially, from the social and cultural space of the “formal dinner”. The result is a limitation in my agency: I don’t use the forks to avoid mistakes. This example shows clearly how both physical boundaries (wall, obstacles, etc.)

and social and cultural boundaries have a strong influence on the possibility of action and the quality of experience of the subject.

So, presence-as-process can be described as a sophisticated form of monitoring of action and experience, transparent to the self but critical for its existence. As clarified by Russell [47]:

“Action-monitoring is a subpersonal process that enables the subjects to discriminate between self-determined and world-determined changes in input. It can give rise to a mode of experience (the experience of being the cause of altered inputs and the experience of being in control) but it is not itself a mode of experience.” (p.263).

For this reason, the presence-as-feeling (level of presence) is not separated by the experience of the subject but *it is related to the quality of our actions*. It corresponds to what Heidegger [48] defined “the interrupted moment of our habitual standard, comfortable *being-in-the-world*”.

In fact, a higher level of presence-as-feeling is experienced by the self as a better quality of action and experience [14, 44]. Further, the self becomes aware of the presence-as-feeling separated by our *being-in-the-world* when its level is modified. More in detail, the self perceives directly only *the variations* in the level of presence-as-feeling: breakdowns and optimal experiences.

On one side we have optimal experiences. According to Csikszentmihalyi [49, 50], individuals preferentially engage in opportunities for action associated with a positive, complex and rewarding state of consciousness, defined “*optimal experience*” or “*flow*”. Here we argue that flow is the result of the link *between the highest level of presence-as-feeling, with a positive emotional state*. In fact, it is also possible to experience high levels of presence in negative emotional states: e.g. in the battlefield during an attack from the enemy.

On the other side we have breakdowns. Winograd and Flores [51] refer to presence disruptions as *breakdowns*: when, during an action, an object or an environment becomes part of our consciousness then a *breakdown* has occurred. Why do we experience these breakdowns? Our hypothesis is that breakdowns are a sophisticated evolutionary tool used to control the quality of experience: the more the breakdown, the less is the level of presence-as-feeling, the less is the quality of experience, and the less is the possibility of surviving in the environment.

The importance of breakdowns for understanding presence is well reflected by Slater’s concept of “break in presence” (BIP) [52]: a break in presence is the moment of switch between responding to signals with source in environment X to those with source in environment Y. In a BIP the critical issue is how will the actor act? To which set of signals will the actor respond?

As underlined by Slater [53], Presence:

“is the *total response* (italics in the original) to being in a place, and to being in a place with other people. The ‘sense of being there’ is just one of many signs of presence - and to use it as a definition or a starting point is a category error: somewhat like defining humor in terms of a smile” (p. 7).

Even if presence is a unitary feeling, the recent neuropsychological research has shown that, on the process side, it can be divided in three different layers/subprocesses (for a broader and more in-depth description see [29]), phylogenetically different, and strictly related to the the evolution of self [54]:

- *Proto presence* (self vs. non self)
- *Core presence* (self vs. present external world)
- *Extended presence* (self relative to present external world).

More precisely we can define *proto presence* the process of internal/external separation *related to the level of perception-action coupling (self vs. non-self)*. The more the organism is able to couple correctly perceptions and movements, the more it differentiates itself from the external world, thus increasing its probability of surviving. Proto presence is based on proprioception and other ways of knowing bodily orientation in the world. In a virtual world this is sometimes known as "spatial presence" and requires the tracking of body parts and appropriate updating of displays.

Core presence can be described as *the activity of selective attention made by the self on perceptions (self vs. present external world)*: the more the organism is able to focus on its sensorial experience by leaving in the background the remaining neural processes, the more it is able to identify the present moment and its current tasks, increasing its probability of surviving. Core presence is based largely on vividness of perceptible displays. This is equivalent to "sensory presence" (e.g. in non-immersive VR) and requires good quality, preferably stereographic, graphics and other displays.

Finally, the role of *extended presence* is to *verify the significance to the self of experienced events in the external world (self relative to the present external world)*. The more the self is present in significant experiences, the more it will be able to reach its goals, increasing the possibility of surviving. Extended presence requires intellectually and/or emotionally significant content.

The existence of three different layers suggests that *in the real world, the feeling of presence is not the same in all the situations but can be different in relation to the characteristic of the social and cultural space the subject is in*. For instance, if I'm attending a lesson in university, my level of presence can be lower or higher in relation to the interest I have in the topic discussed. If the lesson is totally boring I can be "absent" (totally internal): in absence attention is mostly directed towards internally-generated scenarios (in imagination) which are not currently present in the world [41]. The role of "absence" is critical for the survival of the subject. Is in fact in absence that the subject defines plans and organizes future behaviors.

Further, *there are some exceptional situations in real life in which the activity of the subject is characterized by a higher level of presence*. In these situations the subject experiences a full sense of control and immersion. When this experience is associated to a positive emotional state, it can create an optimal experience, usually defined "flow".

Csikszentmihalyi [50, 55] defined "flow" as an optimal state of consciousness characterized by a state of concentration so focused that it amounts to absolute absorption in an activity. According to Csikszentmihalyi [56] when people are in a flow state:

"[they] shift into a common mode of experience when they become absorbed in their activity. This mode is characterized by a narrowing of the focus of awareness, so that irrelevant perceptions and thoughts are filtered out; by loss of self-consciousness; by a responsiveness to clear goals and unambiguous feedback; and by a sense of control over the environment... it is this common flow experience that people adduce as the main reason for performing the activity" (p72).

At this point we can answer to the question we presented at the start of the paragraph: *How does the subject control the status of his/her own activity?* It is the feeling of presence

that provides to the self a feedback about the status of its activity: the self perceives the variations in the feeling of presence and tunes its activity accordingly. Specifically, the self tries to overcome any breakdown in its activity and searches for engaging and rewarding activities (optimal experiences).

This vision provides us two new guidelines for the development of an AmI system:

1. *An effective AmI system is able to induce a feeling of presence in the activity it is supporting:* The less is the level of presence-as-feeling, the more are the breakdowns, the less is the quality of experience and the transparency of the AmI system. The more is the level of presence-as-feeling, the better is the quality of action and experience, the more is the efficacy of the AmI system
2. *An effective AmI system is able to make the subject aware of the meaning of the activity it is supporting:* The subject experiences a full feeling of presence only understanding the meaning of the activity he/she is involved. In giving sense to a situation an important role is usually played by metaphors and narratives.

2.5 Conclusions

In this chapter, we used three psychological concepts - activity, situation and presence – to provide a psychological framework to AmI (see Figure 2).

Key features of the framework are:

- *Any activity* is driven by a specific objective and it is structured in two different but strictly intertwined levels - *actions* and *operations* - each characterized by specific motives - *goals* and *conditions*
- *A situation* is the physical, social and cultural space in which the activity is carried out. Activity is influenced by the affordances and constrains the subject perceives within the situation
- *Presence* is the neuropsychological process allowing the self to control its activity. *The feeling of presence*, is the result of this process and provides to the subject a feedback about the status of its activity: the self perceives any variation in the feeling of presence and tunes its activity accordingly. Specifically, the self tries to overcome any breakdown in its activity and searches for engaging and rewarding activities (optimal experiences).

The final outcome of the framework is a psychological definition of AmI: *the effective and transparent support to the activity of the subject/s through the use of information and communication technologies.*

If we compare it with other technological approaches, this definition offers two critical advantages to both the researcher and the AmI developers:

- *It provides some insight into the processes or effects of using these systems:* the definition focuses on the activity of the subject as the main object of analysis for both the development and the evaluation of any AmI system
- *It provides a conceptual framework from which to make regulatory decisions:* the definition points at “activity support” as the core of the AmI experience. Then, it identifies “effectiveness” and “transparency” as the main characteristics of an AmI system.

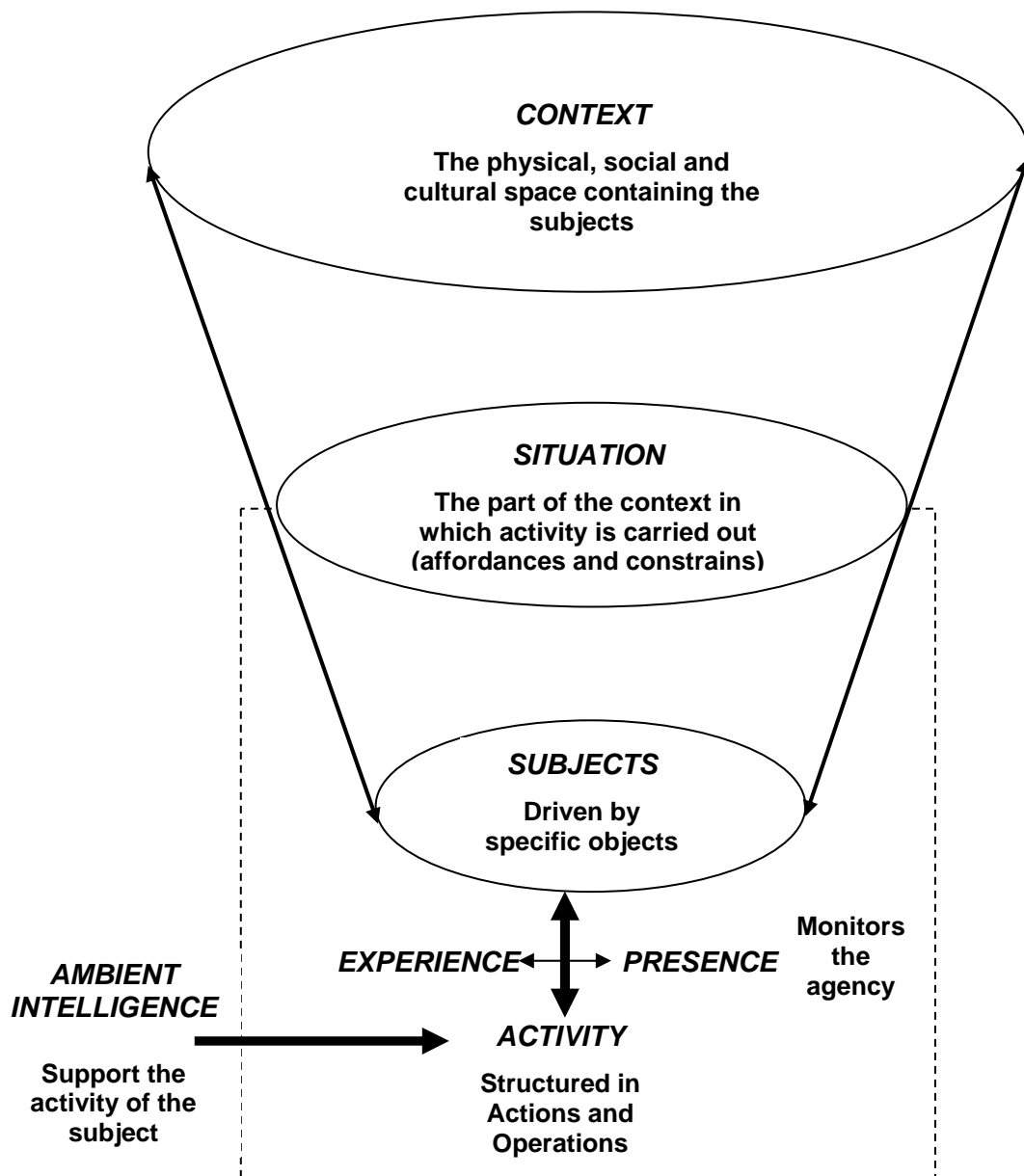


Figure 2.3 The AmI space

The framework just depicted allowed us to define a list of *twelve guidelines* that may support the development of effective AmI systems.

Further, the focus on activity and its properties also suggests possible applicative areas in which AmI may provide a competitive advantage:

- *It can provide active guidance (guidelines/suggestions) to the activity of the subject:*
 - *by composing the activity in actions and operations, it can provide a clear path towards the fulfilment of the objective:* for instance, by providing a narrative or a video describing the different steps required to assemble an IKEA table or to fix a broken engine
 - *by identifying the characteristics of the situation, it can provide suggestions to exploit affordances and/or addressing constrains:* for instance, by providing the timetable and contents of the running and forthcoming TV programmes

- *by supporting the development of communities of practices, it can improve the organization and structure of shared activities*: for instance, by indicating how the members of the same team solved a similar problem in the past
- *by giving a meaning to the activity of the subject, using metaphors and/or narratives, it can improve the sense of presence*: for instance, by providing a narrative or a video describing the history and the activities of an ancient site (e.g. the Colosseum)
- *It can provide a feedback to the activity of the subject*:
 - *by tracking the status of the tools used in the activity*: for instance, by indicating when the toner of the laser printer is almost empty
 - *by helping in avoiding and/or overcoming any breakdown*: for instance, by ordering a new toner when the old one is almost empty
 - *by checking if the activity fits well with the characteristics of the situation*: for instance, by indicating that we are shipping the product without a quality check, and this is a violation of the company rules
 - *by supporting the activation of optimal experiences*: for instance, by adapting the content of a lesson according to the level of presence of the students.

The guidelines and the identified applications may appear relatively simple. However transforming them in reality is not an easy task. In particular, they require the development of *self-adapting interfaces* which address all the possible dimensions of variation (objectives, skills, the characteristics of involved tools, the relevant aspects of the situation, etc.).

Specifically, following what we have just seen, an effective Aml system has to support:

- *User awareness*: the interface should be capable of user-adapted behavior by automatically selecting an interaction patterns appropriate to the particular end-user;
- *Activity awareness*: the interface should be capable of activity-adapted behavior by selecting an interaction patterns appropriate to the particular level of activity, its related objective and its status;
- *Situation awareness*: the interface should be capable of situation-adapted behavior by automatically selecting interaction patterns appropriate to the particular physical, social and cultural environment.

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