The Problem with 'Awareness'

Introductory Remarks on 'Awareness in CSCW'

KJELD SCHMIDT
IT University of Copenhagen, Glentevej 67, DK-2400 Copenhagen, Denmark (E-mail: schmidt@itu.dk)

At a very early stage in the course of CSCW, it became evident that categories such as 'conversation' or 'workflow' were quite insufficient for characterizing and understanding the ways in which cooperative work is coordinated and integrated. It quickly became obvious that cooperating actors somehow, while doing their individual bits, take heed of the context of their joint effort. More specifically, the early harvest of ethnographic field studies in CSCW (e.g., Harper et al., 1989b; Harper et al., 1989a; Heath and Luff, 1991) indicated that cooperating actors align and integrate their activities with those of their colleagues in a seemingly 'seamless' manner, that is, without interrupting each other, for instance by asking, suggesting, requesting, ordering, reminding, etc. others of this or that. As a placeholder for these elusive practices of taking heed of what is going on in the setting which seem to play a key role in cooperative work, the term 'awareness' was soon adopted.

Not surprisingly then, the concept of 'awareness' has come to play a central role in CSCW, and from the very beginning CSCW researchers have been exploring how computer-based technologies might facilitate some kind of 'awareness' among and between cooperating actors.

For many years, a significant effort was devoted to exploring the potential benefits of 'media space' technologies for these purposes, i.e., an array of continually open computer-integrated audio-video links between dispersed actors (e.g., Mantei et al., 1991; Gaver et al., 1992; Bly et al., 1993). It was presumed that audio and video would offer a 'rich' medium through which actors could interact in ways that were 'virtually' as unrestricted and fluently as ordinary face-to-face encounters and that the mere provision of a 'media space' between actors in different locations would enable them to cooperate approximately as if they were in the same physical space. Unfortunately, however, the expected benefits from these technologies never materialized. Something was obviously amiss in the understanding of 'awareness' underlying this line of research (cf., e.g., Gaver, 1992; Heath and Luff, 1993).

In response to these experiences as well as to findings emerging from the growing body of ethnographic studies of cooperative work, the research focus has shifted away from face-to-face interaction as the presumed paradigm of human interaction.

Abandoning the assumption that the 'high fidelity' presumably offered by video is necessarily crucial to 'awareness', and arguing that it may even be problematic due to the discontinuous nature of media spaces, other researchers began to explore whether and how 'collaborative virtual environments' could facilitate interactions in artificial but continuous environments (e.g., Benford et al., 1994). While impressive technical progress has been made, it is still not clear if and how these technologies could be used productively in cooperative work settings.

A related important body of work is takes the situated and distributed character of cooperative work as the point of departure and abandons the communicational approach altogether. Instead this research attempts to develop *computational environments* based on 'event propagation mechanisms' or similar for collecting, disseminating, and integrating information concerning cooperative activities (e.g., Fuchs et al., 1995; Syri, 1997; Prinz, 1999) or more comprehensive 'awareness models' based on a spatial metaphor (e.g., Rodden, 1996; Sandor et al., 1997) or the reaction-diffusion metaphor (e.g., Simone and Bandini, 1997).

Whether or not these approaches will ultimately succeed is of course uncertain, but for serious progress in these directions to be made, however, major conceptual issues need to be addressed. Which aspects of the world of work and interaction should feature in these computational environments? Which objects and events and at which level of abstraction and aggregation? How should computational environments and material environments interface and interact? How can computational environments facilitate embodied action and interaction?

The papers collected in this special issue on 'Awareness in CSCW' all contribute to the investigation of these issues in a variety ways, by 'unpacking' and identifying the variegated practices that have been thrown together under the label 'awareness' (Chalmers, 2002; Heath et al., 2002; Mark, 2002; Robertson, 2002); by systematic conceptual analysis of the 'elements of knowledge' at play in 'workspace awareness' (Gutwin and Greenberg, 2002); by exploring new 'sensation and interaction possibilities' offered by for instance wearable computational devices (Gaver, 2002), by studying novel mechanisms to 'produce, gather and redistribute information from everyday activities' (Fitzpatrick et al., 2002); and by exploring a radically distributed computational model of awareness based on the 'reaction-diffusion metaphor' (Simone and Bandini, 2002).

At the very same time, however, the role of the term 'awareness' as a placeholder is coming under increasing strain as the term is being used in increasingly diverse ways (Robertson, 2002). The signs of the tensions are clear.

The term 'awareness' is obviously found ambiguous and unsatisfactory. The term 'awareness' of course refers to actors' taking heed of the context of their joint effort. But this is hardly a concise concept by any standard. CSCW researchers are obviously far from confident with using the term and thus often use the term in combination with different adjectives, e.g., 'general awareness' (Gaver, 1991; Bly et al., 1993, p. 29), 'collaboration awareness' (Lauwers and Lantz, 1990), 'peripheral awareness' (Gaver, 1992; Bly et al., 1993, p. 34; Benford et al., 1994),

'background awareness' (Bly et al., 1993, p. 34), 'passive awareness' (Dourish and Bellotti, 1992, p. 107; Dourish and Bly, 1992, p. 541), 'reciprocal awareness' (Fish et al., 1990; Schmidt, 1994; Robertson, 1997, pp. 19–21, 155–158), 'mutual awareness' (Benford et al., 1994; Schmidt, 1994; Rønby Pedersen and Sokoler, 1997), 'workspace awareness' (Gutwin, 1997; Gutwin and Greenberg, 1999; Gutwin and Greenberg, 2002), etc. The proliferation of adjectives is a clear indication that the term 'awareness' is found to be equivocal, that researchers are aware that the term is being used in significantly different ways, and that it is in need of some qualification to be useful.

In fact, the term 'awareness' is being used in increasingly contradictory ways. For example, while 'awareness' initially was adopted to denote those practices through which cooperative activities are somehow tacitly and unobtrusively aligned and integrated, some researchers are now using the very same term to conceptualize even the use of instant messaging systems where an actor's deliberately typing and sending a message that then interrupts the flow of activities of other actors is taken as instances of 'awareness' (Nardi et al., 2000).

In short, it is becoming increasingly clear that the term 'awareness' does not denote a set of related practices. In fact, it is hardly a concept any longer.

The very word 'awareness' is one of those highly elastic English words that can be used to mean a host of different things. Depending on the context it may mean anything from consciousness or knowledge to attention or sentience, and from sensitivity or apperception to acquaintance or recollection.[1] One will for instance come across expressions such as 'alcohol awareness', 'cancer awareness', 'cult awareness', 'spiritual awareness', 'pagan awareness', and so forth. It goes without saying that these different uses of 'awareness' refer to quite different social and ideological phenomena. For instance, one would think that 'awareness' as in 'cult awareness' implies a radically different stance and practice than 'awareness' as in 'pagan awareness', and that 'awareness' as in 'spiritual awareness' has little in common with 'awareness' as in 'alcohol awareness' and that the latter is not the same as one's 'awareness' of acute thirst.

The first step towards some kind of conceptual clarity is to realize with the philosophers, from Husserl and Schutz to Wittgenstein and Ryle, that it does not make sense to conceive of 'awareness' as such, i.e., as a distinct (mental) entity. That is, the term 'awareness' is only meaningful if it refers to a person's awareness *of* something.

The noun form is misleading. In that respect 'awareness' is akin to 'intelligence', 'efficiency,' 'carefulness', etc. Awareness is an attribute of action. Doing one thing while taking heed of other relevant occurrences are not two parallel lines of action but a specific way of pursuing a line of action, namely to do it heedfully, competently, mindfully, accountably. In a CSCW context 'awareness' does not refer to some special category of mental state existing independently of action but

to a person's being or becoming aware of something. 'Awareness' is an integrated aspect of practice and must be investigated as such.

Since we cannot talk of awareness as an separate entity but only as somebody's being aware of some particular occurrence and thus only with reference to certain practices of which being aware of something is an aspect, we cannot even assume that the term 'awareness' denotes the *same* practices. 'Awareness' of *x* may or may not entail the same practices as 'awareness' of *y*. The first question to be addressed thus is, *of what* are actors supposedly aware when we in CSCW use the term 'awareness': *awareness of what?*

As soon as we address that question, it is evident that what in CSCW is innocuously labeled 'awareness' has little in common, besides the fact that it somehow is an aspect of human interaction.

In the 'media space' research, for which – to cite the canonical paper on the influential media space experiment at Xerox PARC – the 'motivating problem' has been to 'recreate in a working group separated geographically the sense of embeddedness that we had found working together locally' (Bly et al., 1993, p. 33), 'awareness' is typically conceived of in very general terms as relating to various aspects of members' taking heed of the social context of action and interaction:

> 'Coworkers sitting together over lunch discussing everything from the latest Super Bowl game to the knotty problems they encountered that day in their work is not particular unusual – unless the workers are separated by 800 miles. The smooth integration of casual and task-specific interactions, combined with the ability to meet informally as well as formally, is a critical aspect of productive group work. [. . .] When groups are geographically distributed, it is particularly important not to neglect the need for informal interactions, spontaneous conversations, and even general awareness of people and events at other sites' (Bly et al., 1993, p. 29).

What is immediately noticeable in this fictional situation is that the actors are only engaged in cooperative work in a very loose and broad sense, *if at all*. We meet them when they are not engaged in their work. They are having lunch. Like most people involved in the same profession or employed with the same company will do during conversations over a meal or a drink, the people in this situation chat about sports, the weather, absent colleagues, stupid bureaucrats, or unusual experiences in their work such as 'knotty problems'. As is well known, such face-to-face encounters can be quite helpful as a vehicle for 'social bonding' in general, for creating alliances, and for eliciting advice and help among colleagues. The problem with this conception of awareness, however, is that it is only peripherally and indirectly related to any *cooperative effort*. The situation above may involve cooperating workers but it may just as well involve people who do not work together at all, but who are merely employed with the same company, working in the same line of business, or living in the same neighborhood.

It is clear that awareness, as conceived of in this fictional situation, is awareness of the social context of work, not of the ongoing activities and artifacts of a joint cooperative effort:

> '***Awareness.*** Although seemingly the most invisible, the use of the media space for *peripheral* awareness was perhaps the most powerful use. The [video link] view frequently found in peoples' offices was the Commons at the other site. This view, at first glance, appeared to be nothing more than a view of an empty public space. On closer examination, however, there was rarely more than a minute or two in which there were not at least sounds from the other location giving clues about the ongoing activities there. People walked through and were in and out of offices; conversations took place. Being aware of such activities required no response; it provided an overview of who was around and what was happening (and afforded the possibility of joining in). Of course, this background awareness was not constrained to the common areas. Lab members who were working closely together often had a colleague's office on the monitor as a background view. We have seen people casually sharing jokes, show a group of friends a new toy, or move cameras to unusual positions for interesting visual effects.' (Bly et al., 1993, p. 34)

In a paper on a related research project, the Portholes experiment at Xerox EuroPARC, Dourish and Bly conceives of 'awareness' quite similarly as an aspect of so-called 'informal interaction':

> 'Awareness involves knowing who is "around", what activities are occurring, who is talking with whom; it provides a view of one another in the daily work environments. Awareness may lead to informal interactions, spontaneous connections, and the development of shared cultures – all important aspects of maintaining working relationships which are denied to groups distributed across multiple sites.' (Dourish and Bly, 1992, p. 541)

Awareness is thus conceived of as awareness *of the social context* and is seen as something that engenders 'informal interactions' and 'a shared culture' (or even the formation of collaborative alliances (Kraut et al., 1990)). There are, of course, domains in which awareness of the general social context is an important aspect of articulation work, especially in domains such as politics and management where the formation of coalitions is of paramount importance, or domains such as teaching where socialization is crucial; but in the wide and multifarious world of cooperative work such settings and situations are exceptional. Of course, awareness of the general social context ('Who is around today?' 'Why is he befriending *him*, of all people?') *may* be of import for cooperative work in any domain, but *in the coordination and integration of interdependent activities other and more urgent concerns are pivotal* ('Will he be able to do it? Can I continue as planned?' 'Is she on time, or should I reschedule my work?' 'Oh, he's ahead of schedule, I'd better hurry up now' 'What is he up to? Hasn't he noticed the problem? Well, seems like I better take care of it').

The term 'awareness' is of course also used within CSCW in precisely this sense, i.e., as a label designating various, more or less specified, practices through which cooperating actors, while engaged in their respective individual activities and dealing with their own local urgencies and troubles, manage to pick up what their colleagues are doing (or not doing) and to adjust their own individual activities accordingly (Gutwin and Greenberg, 2002). That is, in this line of research the term 'awareness' is being used to denote those practices through which actors tacitly and seamlessly align and integrate their distributed and yet interdependent activities.

It is clear that the phenomena of which actors are supposedly aware when the term 'awareness' is used in this line of research, are not merely tangential or external to the ongoing activities that constitute a cooperative effort. The term 'awareness' here denotes taking heed of unfolding events and of possibly unfolding events; of things being done, of things done, and of things in need of being done; of developments within the joint effort that may be advantageous, detrimental, hazardous, etc. for one's own work; of occurrences that makes one's own work more urgent or less so, that require action or inaction, that necessitate changes to the intended course of action, etc. – all of it directly motivated by the actors' being interdependent in their work and hence by the unavoidable requirements of coordinating and integrating their various actions.

As soon as we turn to the issue of 'awareness' as the tacit and seamless integration of ongoing cooperative activities, however, problems abound.

The problem can be seen in the uncertainty with respect to the relationship between the concept of awareness and the concept of attention. Whereas awareness, in some quarters of constructive CSCW research, is conceived of and defined in terms of 'focus' (e.g., Benford and Fahlén, 1993; Rodden, 1996), other CSCW researchers emphatically distinguish the phenomenon of 'awareness' from 'attention' or 'focus' by defining awareness as 'information' that is 'being gathered passively, while other workplace activities progress' (Dourish and Bly, 1992, p. 541). A later paper by Dourish is even more emphatic in this respect: 'The passive nature of [awareness] information is important. Information arises directly out of each person's activity, rather than having to be managed explicitly; awareness information does not need to be sought out' (Dourish, 1997). Dourish's point is well taken. When we are talking about 'awareness' we are talking about the phenomenon that actors align and integrate their activities with the activities of others without interrupting the current line of action and in a seemingly effortless way.

But the notion of 'passive awareness' (Dourish and Bellotti, 1992, p. 107; Dourish and Bly, 1992, p. 541) is problematic in its own right, in that it mystifies what we need to understand: the practices through which actors align and integrate their distributed but interdependent activities. As if an actor's 'passive awareness' of the state of the cooperative effort is the inscrutable effect of merely 'being there', the result of some kind of mental osmosis . . .

The problem with 'awareness' in cooperative work is to understand how actors so effortlessly pick up what is going on around them and make practical sense of it. In this regard, significant progress has been achieved through a range of seminal ethnographic studies such as the study of the London Underground control room by Heath and Luff (1992; 1996) and the study of air traffic control work by the Lancaster group (Hughes et al., 1988; Harper et al., 1989b; Harper and Hughes, 1993) as well as a number of other in-depth workplace studies. As a result, various practices that are crucial for actors' ongoing articulation of their activities with respect to the activities of others have been identified and described. The central findings of these studies can be briefly summarized as follows.

Actors obviously somehow '*monitor*' the activities of their colleagues in the setting – by observing or listening – so as to ascertain the state, progress, direction, etc. of these activities, that is, to ascertain whether they are being done and progressing as expected, to determine exactly how one's own activities need to be adjusted to mesh with the unfolding work of the colleagues, and so forth. Actors typically do so inconspicuously or unobtrusively or even 'surreptitiously' (Heath and Luff, 1992). That is to say, they do it in such a way that their monitoring the work of others does not require or elicit a response from them.

On the other hand, actors make their own activities appropriately 'publicly visible' (Heath and Luff, 1992) or, with a more general term, actors *display* those aspects of their activities that may be of relevance to their colleagues. That is to say, in doing their individual part of the joint effort, actors will typically and if possible 'design' or modulate their own activities in such a way that their colleagues are provided with cues and other kinds of resources pertinent to *their* monitoring these activities: 'we begin to discern how the design of particular activities may be simultaneously sensitive to the potential demands of different "recipients" both within and beyond the local physical environment' (Heath and Luff, 1992, p. 82). That is, actors conduct their own activities in such a way that colleagues can perceive *that* they is being done, *how* they are being carried out, *that they will* meet constraints in terms of time and quality, that obvious contingencies *will not* affect the work of colleagues (as if to say, 'Don't worry, I can handle it'), or that they *will* affect the work of colleagues and when and how and to which extent, so that *they* can adjust *their* part of the effort accordingly.

Displaying and monitoring are thus *complementary aspects* of the same coordinative practices. My monitoring the activities of others is facilitated by their displaying those aspects that are relevant for me and my displaying aspects of my work to others presupposes that I am monitoring their activities and thereby am aware of their concerns, expectations, and intentions.

Displaying and monitoring are subtly attuned. While individual activities *sometimes* may be 'systematically, yet unobtrusively, coordinated with the actions of colleagues' (Heath et al., 1995, p. 156), this is not *always* the case. Actors regulate their monitoring quite delicately so as to *adjust the degree of obtrusiveness* to the requirements of the situation, and they similarly display their own work in a form

and at a level of granularity which is attuned to the situation facing their colleagues. For example, as observed by Heath and Luff, one operator, while talking to a remote colleague over a telephone line, not only coordinates his talk with his remote co-conversationalist, but simultaneously emphasizes details to colleagues sitting next to him 'by volume and repetition of certain elements' (Heath and Luff, 1992, p. 82). Indeed, one of the most striking findings emerging from these studies is what we may call 'appropriate obtrusiveness'.[2] In monitoring the work of others and in displaying aspects of their own work, actors exhibit great care and much skill in choosing an interactional modality that is obtrusive or unobtrusive to a degree and in a manner that is appropriate to the situation at hand. For instance, at a critical point in the joint effort, e.g., in a hand-over situation, an actor may monitor the activity of the colleague rather conspicuously, for instance by gazing, so as to make the other aware that he or she is aware of what the other is doing, as if to say, 'Don't worry, I see what you are doing and I'm ready.' Similarly, actors may display their work in ways that are designed to attract the attention of colleagues to the activity or certain features of it, by gazing at certain objects, humming, thinking aloud, placing artifacts in certain locations or orientations, leaving traces in the setting, etc. They may even, by pointing or tapping at an item or talking to colleagues, impose an obligation on the others to notice and react accordingly and therefore disrupt current activities (which may or may not be appropriate). The repertoire is infinite and is applied deftly.

More than that, because of the fine-graded repertoire of modalities of monitoring and displaying, ranging from something quite inconspicuous to something dramatically obtrusive, no clear distinction exists between, on the one hand, the coordinative practices of monitoring and displaying, normally referred to under the labels 'mutual awareness' or 'peripheral awareness', and, on the other hand, the practices of directing attention or interfering for other purposes. In fact, by somehow displaying his or her actions, the actor is always, in some way and to some degree, intending some effect on the activities of colleagues. The distinction is not categorical but merely one of degrees and modes of obtrusiveness.

If correct, this short analysis has important implications. 'Awareness' is not the product of passively acquired 'information' but is a characterization of some highly active and highly skilled practices. Competent practitioners are able to align and integrate their activities because they know the setting, they are not acting in abstract space but in an material environment which is infinitely rich in cues (Heath et al., 2002; Robertson, 2002). They understand the processes and the issues, they know how activities intersect, they know what probably will happen and what might happen, they expect things to happen and other things not to happen, they anticipate what will happen next, they are in the rhythm, they monitor for indicators of what is expected to happen, and so on. They know the procedures, the rules, the naming conventions, the schedule (Mark, 2002). In short, they are not struggling to make sense but in the middle of things, doing what they do every day; they know

the drill. Occurrences beyond their immediate line of action is seen, made sense of, and understood against this background.

The confusion which notions like 'passive awareness' are meant to dispel arises from dichotomies such as 'explicit' *versus* 'implicit', 'deliberate' *versus* 'automatic', 'conscious' *versus* 'unconscious', 'focused' *versus* 'unfocused', or 'obtrusive' *versus* 'unobtrusive'. These dichotomies are false.

At another level, the source of the conceptual troubles that has been pestering this line of research is perhaps to be found in the very formulation of the problem. The fact that actors take heed of occurrences beyond their immediate task was and is seen as something of a paradox. The paradox reflects an underlying assumption, namely that focus or attention is by definition exclusive, like some kind of mental tunnel vision.

From a cognitivist point of view, the very notion that an actor is able to pick up and relate to occurrences beyond the scope of his or her line of action and without interrupting that line of action, is difficult if not outright impossible to fathom. For example, in his 'closing plenary talk' at CSCW 2000 Warren Thorngate claimed that 'It is impossible to get information in or out of our head without paying attention. Yet attention, as Herbert Simon has noted, is a limited resource' (Thorngate, 2000). Actors' seemingly effortless taking heed of the work of others runs counter to the cognitivist presumption that the mind is single-channel information processor, perennially struggling with 'mental overload'.

On closer inspection, then, in order to understand the phenomenon of 'awareness' in cooperative work we have to address the fact that *the world in which cooperating workers act and interact is given to them as a meaningful world.*

In addressing the problem of meaning, we are of course up against the Cartesian presumptions underlying cognitivism, in so far as cognitivism tries to account for human cognition in terms that not only ignore but *deliberately dismiss the problem of meaning*. The Cartesian trick is a simple but effective one. It consists in adopting a scepticist stance that, by conceiving of the mind as an internal realm, mystifies cognition beyond recognition, so to speak. In his *Philosophical Meditations* Descartes describes how he is sitting by the window overlooking a square somewhere in Northern Holland around 1640:

> 'if I look out of the window and see men crossing the square, which I just happen to have done, I normally say that I see the men themselves [. . .]. Yet do I see more than hats and coats which could conceal automatons? I judge that they are men. And so something which I thought I was seeing with my eyes is in fact grasped solely by the faculty of judgment which is in my mind.' (Descartes, 1641, p. 21)

One might object that what Descartes saw through that window in Holland was not really 'hats and coats' either. What he saw, one might suggest, was merely colors and shapes. To which one might object, in turn, that he did not see colors and shapes either but merely different frequencies of light in different patterns. And so forth, *ad absurdum*. What the trick boils down is a straightforward abuse

of the concept 'to see'. Whatever happens in the retina and the visual cortex, *the spectator* does not '*see*' mere colors and shapes, nor does he or she 'see' mere configurations of 'hats and coats' that are somehow propelled horizontally across a space. What the spectator '*sees*' is 'men crossing the square'. In the words of Gibson, 'Phenomenal objects are not built up by qualities; it is the other way around. [...] The meaning is observed before the substance and surface, the color and form, are seen as such.' (Gibson, 1979, p. 134).

In their 'natural attitude' actors are not ignorant or disinterested spectators, they are actively engaged in and with the world. As such they have interests, things to do, things to achieve. Things are meaningful to them. When an actor perceives a colleague doing something in the shared setting, he or she observes something that (typically) is immediately meaningful to him or her. To a competent member, making sense is thus (typically) effortless.

To competent members relevant occurrences stand out, impose themselves. An event 'leaps to the eye' because it is expected or is a deviation from that which one would expect. It does not require special attention.

There is nothing paradoxical in being engrossed in one line of action and simultaneously making sense of and taking heed of what goes on beyond one's immediate line of action in what appears as other lines of action.

These very brief methodological remarks do not constitute anything like a solution to the problem of 'awareness', of course. But they do indicate an approach that makes it a researchable problem.

Liberated from the scepticist mystification of intersubjectivity, we no longer have to marvel at the apparent miracle that actors effortlessly make sense of the actions of coworkers. Nor are we caught in a dichotomy between attention and peripheral awareness, active and passive, explicit and tacit etc. Instead we can form and pursue researchable questions such as:

(i) Upon which evidence does an actor rely when heeding the activities of others? What data (signals, cues) are available to the actor? What is the actor able to perceive of the actions of others? At which point does the actor seem to change course of action? Which specific situations or constellations of events seem to make actors change their course of action?

(ii) By virtue of which competencies are cooperating actors able to make sense of what others are doing? Which 'taken-for-granted knowledge' is invoked by the actor in making sense of the evidence available to him or her? Which 'indicators' or 'typifications' do actors primarily rely on? What do they monitor for and what is ignored? What is displayed and what is not? Which events make a difference and which are of no consequence?

(iii) How do actors exploit the material and conventional environment in monitoring unfolding events? Which indicators play a key role in determining the state of affairs? What is the relationship between the materiality of arti-

facts and their representational role as vehicles of signs? How is this duality exploited in monitoring and displaying?

(iv) How does the actor determine what is relevant to his or her own effort? How does the actor manage to sort out and pick up what is relevant? How does an actor, in modulating his or her activities so as to make relevant aspects thereof accessible to colleagues, determine what is relevant for the others? On the basis of which insight? How does an actor know when and how to 'attune' the 'obtrusiveness' of his or her monitoring or displaying?

Based on such insights we may be able to move the research on computation environments to support awareness in cooperative work significantly forward.

Notes

1. According to Webster, the noun 'awareness' generally has two broad meanings: (1) *consciousness, cognizance, knowingness: having knowledge of*: 'he had no awareness of his mistakes'; 'his sudden consciousness of the problem he faced'; 'their intelligence and general knowingness was impressive' and (2) *sentience*: state of elementary or undifferentiated consciousness; 'the crash intruded on his awareness'. (There is no direct counterpart in German, French, or the Scandinavian languages.)

2. This phrase is, of course, a play on the term 'appropriate ambiguity' aptly suggested by Bowker and Star (1991) in their analysis of fundamental characteristics of coordinative artifacts such as classification schemes.

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