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Moving with the Times: IT Research and the Boundaries of CSCW

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Abstract. The field of CSCW research emerged with the development of distributed computing systems *and* attempts to understand the socially organized ('collaborative' or 'cooperative') nature of work in order to embed such systems in the workplace. As a field of interdisciplinary inquiry CSCW was motivated by technological developments and the need to understand the particular contexts within which those developments were intended to resonate. In other words, it is no mere accident that CSCW took work as its topic and resource – the historical nature of IT research from which the field emerged meant that for all practical purposes it could not be otherwise. Yet times change. IT research moves on. Today mobile, ambient, pervasive, ubiquitous, mixed reality and wearable computing, et cetera, are of fundamental concern to the contemporary computing research community. Furthermore, these developments are accompanied by a movement away from the workplace to focus on diverse settings in everyday life: homes, games, museums, photography, tourism, performances, indeed diverse bodies of people and pursuits that generally fall under the conceptual rubric of the 'ludic'. Accompanying this shift away from work is a call for new approaches and concepts that will enable researchers to better understand the ludic and inform design appropriately. In this paper we seek to address the boundaries of CSCW and the ability of CSCW to respond to contemporary research agendas. We present an ethnomethodological study of a location-based mixed reality game to *demonstrate* the continued relevance of CSCW approaches and concepts to contemporary agendas in IT research.

Key words: CSCW, ethnomethodology, IT research, ludic pursuits, mixed reality game

1. Introduction

The field of Computer Supported Cooperative Work (CSCW) emerged from an invited workshop organized in 1984 by Irene Greif and Paul Cashman that was intended to elaborate ''an identifiable research field focused on the role of the computer in group work'' (Greif, 1988). While arguments ensued over the following years as to the adequacy of 'group work' conceptions following the involvement of social scientists (see Bannon and Hughes, 1993; Schmidt and Bannon, 1992, for example), the possibility of supporting

multiple parties working together 'collaboratively' or 'cooperatively' was motivated and underpinned by *advances in distributed computing* and aligned with a number of technological research trajectories. Technological developments and research played a central role in establishing a nascent field of interdisciplinary inquiry at the centre of which was a concerted effort to develop systems from these emerging technologies that would resonate with the social character of work and organization.

We recognize that when we say 'concerted effort' we gloss some of the historical tensions that existed between technologists and social scientists but that is not an issue we wish to explore here. Instead, we wish to draw attention to the *historical context* of interdisciplinary research, which underpinned the emergence and development of CSCW. That context was one motivated by the needs of IT researchers to understand the socially organized ('collaborative' or 'cooperative') situations and settings in which developing systems would be deployed and used (Suchman, 1989). This need for partnership between technologically motivated researchers and social science researchers underpinned the emergence of CSCW as a distinctive area. CSCW has provided a point of convergence where the research interests of both communities overlap and where the understandings from each tradition provide support for and further advance interdisciplinary inquiry. (Indeed, when the connection between these previously disparate communities has not been evident or where an area of investigation seems overly skewed to one particular tradition tensions have emerged).

While it might be argued that CSCW is today a distinct field of inquiry with its own research agenda that revolves around work and organization and is independent of the various constituent disciplines making up the CSCW community, we would strongly argue that decoupling CSCW from new technological and social science research agendas runs the risk of reducing the vitality and relevance of CSCW research. From its inception, interdisciplinary work within CSCW *tied the understandings of the social sciences to the articulation of future technological possibilities*, and was not simply or exclusively focused on the study of work and organization for the purposes of social science research (Shapiro, 1993, Plowman et al., 1995). Recognizing the fundamental nature of interdisciplinary inquiry in CSCW – the intertwining of social science with computer science to explore, inform, and propel technological research – is, we suggest, of crucial importance to the continued development of CSCW.

As IT research continues to uncover new technological possibilities and even diversifies in its domains of application, we think it important to remember the origins of the field and consider how CSCW might respond to the changing technological landscape. Contemporary IT research agendas are concerned with the development of such technologies as mobile, mixed reality, ambient, pervasive, ubiquitous, and wearable computing systems,

devices, applications, and architectures. Visions of these technologies often hinge on notions of ubiquitous or pervasive computing where technology is interleaved with our everyday activities, located in the places where we live, work and play. The need for these technologies to be *situated* in our everyday lives suggests that many of the lessons learned in CSCW about the *sociality* of work are salient to ongoing developments in these and other emerging areas of IT research. To explore the salience of CSCW in such contexts will require the field to extend its boundaries and broaden its horizons beyond the bounds of the workplace, however.

It might be argued from within CSCW, as it has been argued from without, that CSCW is ill suited to the needs of research agendas such as ubiquitous or pervasive computing. That the development of future and emerging technologies in new and divergent contexts (e.g. in the home, museums, tourism, gaming, etc.) calls for new approaches and concepts beyond those 'at work' within CSCW. Indeed, it has been suggested that these new contexts lack unifying themes, such as the delivery of a service or product for example, and have different organizational properties to those exhibited in the workplace. As Bell et al. (2003) put it, for example,

> ''In the workplace, applications tend to focus on productivity and efficiency and involve relatively well-understood requirements and methodologies, but beyond this we are faced with the need to support new classes of activities ... ... Current understanding of user needs analysis, derived from the world of work is not adequate to this new design challenge.''

These 'new classes of activities' may loosely and generally be related under the rubric of 'ludic pursuits'. As Gaver (2001 – who borrowed the notion from the original work of Johan Huizinga (1949) and then popularized it in a design context – describes the notion,

> ''People do not just pursue tasks and solve problems, they also explore, wonder, love, worship, and waste time. These activities, captured by the notion of 'Homo Ludens,' or people defined as playful creatures, are meaningful and valuable, but difficult to handle from traditional perspectives''

Difficult to handle, yes. Impossible, no. Indeed we suggest that CSCW has much to offer 'design for ludic pursuits', particularly existing approaches and concepts that are closely allied to the study of work but may be readily exploited to respond to the difficulties of handling Homo Ludens.[1]

The basis of our assertion is quite simply this: that the diverse activities people engage in, *rely on, exploit, and exhibit their sociality* as a condition of their intelligibility, meaningfulness and value (Garfinkel, 1967). In short, while ludic pursuits may be essentially 'playful' in character they are nonetheless socially organized and it is this that makes them available to CSCW

research. Furthermore, the need for new technologies to be situated within these diverse activities strongly aligns this research with the underpinning motivation of CSCW to develop technologies that are situated within real world activities and informed by our understanding of the socially organized nature of those activities.

In the rest of this paper we present an ethnomethodological study of a location-based mixed reality game to demonstrate the relevance of CSCW to contemporary research agendas. Ethnomethodology (or 'ethnography' as it is sometimes misleadingly referred to in a design context) is an approach closely associated with CSCW and the study of work (see, for example, Crabtree, 2003). We employ it here to show that ludic pursuits such as games may be studied as collaborative or cooperative activities that rely on, exploit, and exhibit some familiar social organizational characteristics, and that those characteristics may be drawn upon to inform the design of technologies supporting ludic pursuits as they have been used to inform the design of technologies supporting what Gaver (2001) describes as 'rational' pursuits in the workplace. The study is used as a concrete example then and followed by further discussion of the boundaries of CSCW, and the salience of existing CSCW approaches and concepts to new and emerging agendas of IT research.

2. A new class of ludic lursuit: Location-based mixed reality gaming

Location-based games are a new form of entertainment played out on the city streets. Players equipped with handheld or wearable interfaces move through the city streets. Sensors capture information about their current context, including their location, and this is used to deliver a gaming experience that changes according to where they are and what they are doing. In collaborative games this information is also transmitted to other players who may also be on the streets or may be online. The net result is to deliver a gaming experience that is interwoven with everyday experience of the city.

Location-based games are an exciting commercial prospect. They build directly on current wireless (but usually disconnected and location independent) games for mobile phones. This market is predicted to reach billions of dollars in the new few years and represents a potentially significant income stream for 3G mobile telephony. Early examples of location-based wireless games include *Bot Fighters*! from Its Alive! (http://www.itsalive.com) and *Battlemachine* from UnwiredFactory (http://www.unwiredfactory.com). Such games also provide an interesting focus for research, offering an open space in which it is possible to create a wide variety of experiences – both collaborative and competitive – that are relatively easy and safe to deploy in public. There have been several examples of research projects that *mix* online and mobile players to different extents. These include *Border Guards* from the

Mixed Reality Systems Laboratory in Japan (Starner et al., 2000), *Pirates*! from the Interactive Institute in Sweden (Bjork et al., 2001), and the *AR Quake* project (Thomas et al., 2002).

The focus of this study, *Can You See Me Now*? (Crabtree et al., 2004; Flintham et al., 2003), involves participants in a game of chase in both real and virtual space. Up to 15 online 'players', members of the public logged in on the Internet, are chased through a virtual model of a circumscribed area of a city by four 'runners', professional performance artists from Blast Theory (http://www.blasttheory.co.uk), who are located on the actual city streets and are equipped with handheld computers.[2] Players move through the virtual model at a fixed maximum speed. The model provides an abstract view of the streets where the runners are physically located.[3] It allows them to see the positions of the runners and other players, and players communicate with one another by sending text messages. The runners share the same abstract view on handheld computers. As they move through the real city streets, runners can see the positions of players and other runners, can read players text messages, and can communicate with one another using walkie-talkies with earpieces and head-mounted microphones.

The runners' talk is streamed to control room staff and players, providing them with ongoing commentary on the runners' actions, tactics and experience of the city streets, including reports of traffic conditions, descriptions of the local scenery, the physical sounds of the streets and the personal effort and exertion involved in catching a player. Runners can also communicate with control room staff and one another via a dedicated technical channel on the walkie-talkies. The runners carry digital cameras to record the physical location where each player is caught and the pictures appear on an archive web site after the event. Specifically, if a runner gets to within five virtual metres of an online player, the player is 'seen' and is out of the game. Their score is the time elapsed since joining the game.

Players interact with runners via two perspectives on the virtual world. One, a local perspective, centres on a player's current position and allows the player to see him or herself as an avatar and to see other players and runners similarly represented in the immediate vicinity. Avatars are labelled with players' names and the runners are further highlighted with a red sphere (Figure 1).

The other perspective, a global perspective, allows players to see the positions of more distant players and runners in terms of text labels. Other text labels highlight key locations in the virtual world and provide a shared frame of reference for players and runners alike to concert their actions (Crabtree, 2004). Players can view and enter text messages and hear the runners' audio from either perspective.

The runners' interface was delivered on an HP Jornada from a server located in a building on the actual city streets over a WiFi (802.11b) wireless

Figure 1. Players' local perspective on virtual world.

local area network. A GPS receiver plugged into the serial port registered a runner's position as he or she moved through the streets and this was sent back to the server over the wireless network. The runners interacted with the players via two virtual points of view. One, a local perspective, centred on their current position that allowed them to see others in the immediate vicinity. Seen from this perspective, runners were represented by blue arrows and text labels, and players by red arrows and text labels. The other perspective, a global perspective, provided an overview of the virtual space and represented others in terms of red and blue arrows only (Figure 2).

Runners can see the most recent text messages sent by players from either perspective in the area at the bottom of the screen. Similarly, three pieces of information at the top of the interface show the current estimated GPS error as provided by the GPS receiver (left), the strength of the network connection (middle), and the number of online players currently in the game (right).

Deploying *Can You See Me Now*? required the support of a three man, behind-the-scenes, technical crew who were housed in one of the central buildings in the physical game zone (which was approximately 500 by 1000 m). Control room staff were responsible for running and managing the online server and supporting the runners. Control staff made use of a variety of monitoring and control interfaces including an overview of the game space, an interface for managing the game queue, an interface for monitoring the state of the wireless network, an interface displaying the status of the runners including current connection status and GPS status, and an interface for playing the game. Below we focus on the runners' 'work' in particular,

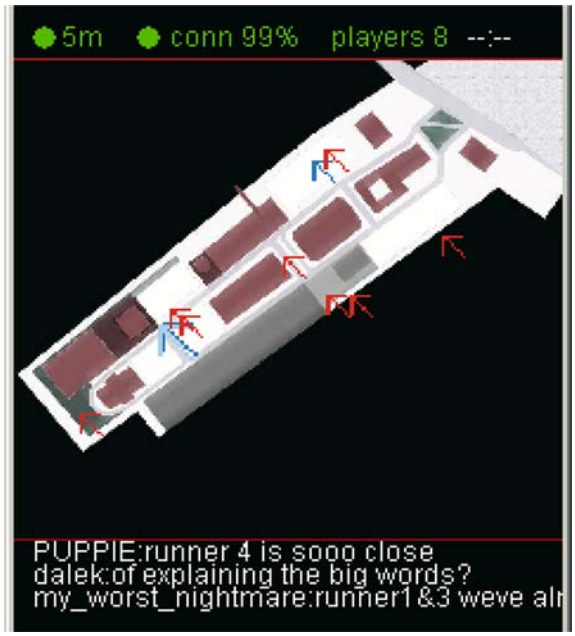

Figure 2. Runners' global perspective.

which is 'work' with players, with control staff, and with one another, in order to explicate the sociality of gameplay.

3. The social character of runners' 'work'

Players only have a virtual presence for runners and are, as such, only available in terms of an avatar's movements. This raises the practical problem of how the runners, who are situated in the real world, are to 'see' and catch players? In order to uncover the how of the matter we examine sequences of the runners' 'work' gathered from observations of different runners at different times to explicate the range of competences involved in coming to 'see' players.

3.1. MAP READING AND ORIENTEERING

We first join Runner 2 just after he has caught a player, which consists of taking a digital photograph of the location at which a player is 'seen', and he is now reorienting to the game:

Sequence #1

Runner 2 on walkie-talkie: This is runner 2. I'm back in the game and I'm looking to chase Jules.

Figure 3. Aligning the virtual with the real.

Runner 2 looks at his Jornada, turns his whole body as he does so, moving the Jornada around with him, to face his left (Figure 3).

Runner 2 then sets off inland across the car park in front of him towards a road (Wilamena), frequently glancing at and consulting the Jornada as he moves towards Jules.

Runner 2 on walkie-talkie: This is runner 2. I'm on Wilamena looking for Ceewood.

The runner taps on the Jornada interface to zoom into the map. He looks at the map and around the immediate vicinity in which he his located, moving the Jornada into alignment with the real workplace. He then taps the interface again to zoom out, turns to his left and runs off down a side street.

Runner 2 on walkie-talkie: This is runner 2. I'm proceeding south through Startun out onto Otto. There's a player out on Vern, I'm going that way.

Runner 2 on walkie-talkie: This is runner 2. I'm into Vern now. I can see Jules and Mike heading into Edam. I'm going to leave them. I'm looking for Tommy.

A routine but nonetheless crucial feature of the runners' 'work' is that they embed the virtual model in the city streets so that they can make sense of players actions – i.e., so that they can see their *coordinate relationship to players*, see which direction players are heading in, see where their movements might lead them, and project points at which they might be intercepted. The above sequence instructs us that runners embed the virtual in the real through the exercise of ordinary map reading and orienteering competences.

Those competences consist of *aligning* the virtual model with the real city streets through bodily movement so that, like an ordinary street map, the abstract representation of the city streets corresponds for all practical purposes with the actual city streets. This alignment of the virtual and the real, physically *orients* a runner to the coordinate relationship between him or

herself and the players and enables a runner to *plot a trajectory* towards a player. 'Plotting a trajectory' is not an inner mental event but observably consists of the physical alignment and coordination of the virtual model of the city streets with the real city streets, which in turn *points* the runner in the direction he needs to travel to intercept a player.

Having plotted an intercept trajectory, Runner 2 sets off inland across the car park in front of him, frequently consulting the Jornada as he moves towards Jules. 'Consulting' the Jornada is done as the runner's target location or destination is not static but a movable and indeed moving object: a player. The runner needs to *maintain a fix* on the target, then, and to *see changes in trajectory* that affect his current course of action (as the sequence shows us, runners often change target if another player comes into closer proximity). The following sequences elaborate the 'work' involved in 'closing in on a target'.

3.2. SWEEPING THE STREETS

'Closing in on a target' means that runners must track players down to a specific area and then locate them in a specific position within that area, give or take 5 m. That 'work' consists of various forms of 'sweeping the streets'.

Sequence #2

Runner 1 on walkie-talkie: Runner 1. There are currently a lot of players in Los Palmas car park.

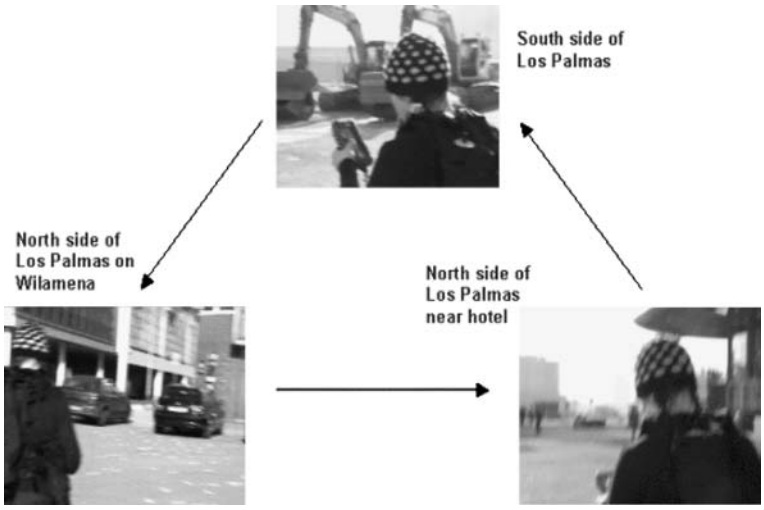

Figure 4. Triangular sweep pattern.

Figure 5. Sweeping through 'dancing' around.

Figure 6. Concerted sweeping.

Runner 1 sets off in pursuit of the players. She runs across Los Palmas car park consulting the Jornada as she goes, stopping occasionally, consulting the Jornada again, aligning the virtual with the real and moving off in a new direction accordingly. Runner 1's movements are not random, however, but make a triangular pattern with which she 'sweeps' the area (Figure 4).

Runner 1 suddenly breaks from the sweep and heads off across the road towards the Simulation car park. She makes her way towards the seafront and then stops.

Runner 1 on walkie-talkie: Runner 1 in Simulation car park. Just waiting for GPS to update my location.

Runner 1 stands waiting for an update. Runner four is nearby and heading towards Los Palmas car park.

Sequence #3

Runner 4 on walkie-talkie: This is runner 4 heading towards Los Palmas in pursuit of Dave.

Runner 4 reaches the road at the front of Simulation car park. He stops, looks at the Jornada and turns around. He moves around, going back on his tracks in a small semi-circular arc, zooming in and out of the map, aligning the virtual with the real through his movements, trying to establish the sense and direction of Dave's movements. He then sets off towards the seafront.

Runner 4 on walkie-talkie: This is runner 4 in Simulation car park, dancing between cars trying to catch Dave (Figure 5).

The runner stops and repeats the arcing movement, then moves forwards towards the seafront again.

Runner 4 on walkie-talkie: Runner 4 in the car park, onto the cobbles, heading for the seafront.

He stops at the water's edge and repeats the arcing movement.

Runner 4 on walkie-talkie: This is runner 4. Lost Dave. GPS down to 4 m. Connectivity 99%.

Dave has eluded Runner 4 and he plots a new trajectory to another player. Elsewhere, Runner 1 is in pursuit of a player.

Sequence #4

Runner 1 on walkie-talkie: This is Runner 1. I have GPS and 100% connectivity. I am currently in Los Palmas car park.

She consults the Jornada and then turns right onto Wilamena. Halfway down the street she meets Runner 3 coming in the opposite direction. The runners consult their Jornadas, moving in small arcing movements in adjacent positions to one another. Runner 1 then starts running down the street in pursuit of the player who has just eluded them and turns right towards the seafront, looking at the Jornada as she goes. She walks up to the seafront and then turns to her left facing the terminal, consulting the Jornada again.

Runner 1 on walkie-talkie: This Runner 1, heading after Justin.

Runner 1 starts running along the seafront when Runner 2 appears on her right, running down the other side of the street.

Runner 2: Let's sweep him.

Runner 1: Right.

Runner 2 on walkie-talkie: Runner 1 and 2 sweeping along north side of the terminal (Figure 6).

Both run along the terminal and stop at adjacent positions, consulting their Jornadas. Runner 1 moves forwards again, walking slowly.

Runner 2: I think he's doubled back.

Both runners turn around and run back along the terminal. Runner 2 turns to his right in front of Runner 1, covering the ground in front of her.

Runner 2: Get him. Get him.
Runner 1 starts running around in arcing and circular movements to locate the player precisely, then breaks to her left. She then stops and crouches down, removing the digital camera from her pocket.
Runner 2 on walkie-talkie: Nice going Runner 1.

These sequences show that ordinary map reading and orienteering competences are combined with game-specific competences developed to track down and capture players. Players are tracked down to specific areas through *broad sweep patterns*, whether triangular or concerted in character, and once within a specific area players are located through *finer sweep patterns* where runners 'dance' around in small arcs and circles to get within 5 m of and so come to 'see' a player.

These sweep patterns are devised by runners to handle the inherent ambiguity of the search and capture situation they find themselves in. As noted above, players are only present to runners as virtual representations. To capture a player the runners must establish a correlation between real and virtual coordinates to within 5 m then. The practical problem here is that the establishment of such coordinates is subject to the vicissitudes of a 'virtual gap', which is in part produced by a player's movements to avoid capture and in part produced by an inevitable degree of 'time lag' in updating the runner's ever changing position. This produces a situation of *uncertainty*, such that the runner does not know *just where* the player is.

The uncertainty is further compounded by inevitable GPS inaccuracies. This means that not only do the runners not know just where the players are, but that they also do not know just where they are in relation to the players, regardless of time lags. While the technology might tell runners that a player is 7 m away, not only might that location be changing due to position updates, it might also be wrong due to GPS error. And it's no good consulting the virtual representation to find the coordinates because it only reflects the virtual gap. So runners sweep the areas they have tracked players to, moving in ever decreasing circles as it were to locate the exact position of players.

3.3. 'WORKING' WITH CONSTANT INTERRUPTION

'Working' with constant interruption is an irremediable feature of using the technology. In sequence #2 it is clear, for example, that Runner 1's pursuit is interrupted by slow GPS updates. Interruptions are a product of the contingencies of the technology: GPS is subject to the contingencies of satellite availability, and WiFi coverage to the contingencies of the local built environment (see Flintham et al., 2003 for further detail). Managing interruptions is an essential feature of embedding the virtual in the real then, insofar as they

must be handled and repaired if interaction is to proceed. The following sequences elaborate the 'work' involved in 'managing interruptions'.

Sequence #5

Runner 2 on walkie-talkie. Runner 2. I've just lost all players; I've lost all players!

Runner 2: Looking at Jornada. I've got disconnection here.

The runner can do no other than abandon the chase, and he informs his colleagues and players alike that he has a specific problem and just where that problem is located.

Runner 2 on walkie-talkie: Runner 2. Heading seawards on Otto. I am currently disconnected (Figure 7).

He turns around and starts walking back down the street to the last known point at which he had connectivity. He arrives at the car park where he last checked the Jornada.

Runner 2 on walkie-talkie: Runner 2. I've connectivity again. I'm in Vern.

Sequences of runners' 'work' show not only *what* sort of technical interruptions impact upon interaction – in this case 'disconnections' – and *how* such interruptions impact upon interaction – causing runners to abandon the chase – but also, and importantly, they instruct us as to the competences involved in *managing* interruptions. We can see, for example, how in experiencing a disconnection the runner makes the kind of interruption he is experiencing public knowledge. Encountering an interruption is announced to the other runners over the walkie-talkie, to distribute and make others aware of the nature of the interruption and the location at which it occurs.

The runner repairs the interruption by retracing his steps and moving to a location where he last had connectivity. This strategy trades on and exploits

Figure 7. Seeing a disconnection: losing players.

local knowledge, both of the of the environment in which the technology is situated (of knowing where in the environment is a 'better location' to move to) and of the how the technology to-hand works (of knowing that disconnections are transient technical phenomena that may be resolved by moving to a better location, for example). Furthermore, the instance instructs us how local knowledge is developed: through hands on experience of using the technology *in situ* and through making others aware of and distributing knowledge of the interruptions encountered as they occur. Local knowledge is built up over the course of gameplay and is dynamic, reflecting both the history of gameplay and current contingencies (such as current GPS and WiFi 'blackspots'). In turn, this knowledge is exploited by runners to manage and repair interruptions to interaction.

Sequence #6

Runner 2 on walkie-talkie: Runner 2. I'm in pursuit of Dave.

He runs along a side street, consulting the Jornada as he goes, turning left at the end of the street and going down Wilamena before slowing to a walk.

Runner 2 on walkie-talkie: Runner 2. I'm heading seawards on Wilamena, waiting for a server update.

He continues walking down the street, looking at the Jornada and his place on the street, seeing the incongruity between his virtual and real positions (Figure 8).

Runner 2 on walkie-talkie: My GPS is currently 35 m. My server position is about 50 m out.

Runner on walkie-talkie: This is Runner 2. Can Runner 1 and Runner 4 hear me, or Runner 3 please? Come in.

Runner 2 switches to the technical channel.

Runner 2 on walkie-talkie: This is runner 2 on 4 Zero. I can't get any response from anyone else on 238 (gameplay channel). Can you please confirm that the other runners are on 238?

Runner 2 on walkie-talkie: And who else is on 4 Zero please?

Figure 8. A visible incongruence between virtual and real.

Runner 2: Runners 1 and 3 are having technical trouble. 4's in.
Runner 2 notices Runner 3 on the other side of the street and goes over to him.
Runner 3: Are you on 238?
Runner 2: I'm on 238, yeah.
Runner 3: OK.
Runner 2: I just switched back.
Runner 2: (Looking at Runner 3's Jornada, whose case is open). What's the problem?
Runner 3: Just not moving.
Runner 2: Yeah, I'm having the same. Looks like we have a bit of a server screw up.
Runner 3: All right.
Runner 2 starts walking away from Runner 3.
Runner 2 on walkie-talkie: This is runner 2. I've had no GPS update in 2 or 3 min.
Runner walks towards the seafront, where he knows there is usually good GPS coverage when it's available.

This sequence instructs us that 'working' with constant interruption not only consists of developing local knowledge of the physical gameplay environment and how the technology works therein, but also that *that* knowledge is intertwined with *diagnostic* '*work*'. While the nature of an interruption might be readily apparent – that the runner is 'stuck' as can be seen in the visible incongruity between the runner's virtual and real positions – the source and/or the extent of such interruptions is not always clear. Runners do not know whether being 'stuck' is a result of server problems, poor satellite availability or some other technical matter such as the disconnection of their GPS armband antenna or receiver from the rest of their equipment.

Similarly, they do not know if it is an interruption only they themselves are experiencing or that others are experiencing too. And knowing such things is important because it informs the runners' decision-making – i.e., it helps them establish a sense of what it might be appropriate to do next in order to manage the interruption that is currently to-hand: should the runner exploit local knowledge of the environment and the technology and move to a better location for an update or is something more serious in progress that requires a full restart, for example? So runners need to diagnose interruptions in order to handle them. Diagnosis is a collaborative achievement and the sequence instructs us as to some of the ways in which that achievement is collaborative.

On experiencing an interruption that is not quickly repaired runners consult one another via the walkie-talkies to establish which channel they are on (gameplay or technical) and to determine the gameplay *status* of others (whether others are playing the game or experiencing some interruption). The

absence of a response from other runners suggests that the interruption may be *widespread* and the runner consults control room staff via the walkie-talkie to establish whether or not that is the case. Runners may also collaborate with one another directly (face-to-face) as they meet through happenstance on the streets. Although serendipitous in nature, this form of collaboration is nonetheless important. It allows runners not only to see for themselves the interruptions others are experiencing but also, as with indirect collaboration with control room staff, to establish the *generality* of the interruptions.

And therein lies the nub of the matter: diagnostic work is concerned to establish the generality of interruptions, which in turn informs the runners' decision-making. Diagnostic 'work' enables runners to determine whether or not the interruptions they are encountering are theirs alone, and related to their *personal kit*, or being experienced by others as well and related to the *game's technical infrastructure*. This, in turn, suggests the next move in managing the interruption: moving off to a better location and waiting for a GPS update as more satellites become available, for example, or restarting the Jornada, or even restarting the game if needs be. The following sequence elaborates some more important features of the runners' diagnostic 'work'.

Sequence #7

Runner 1 is walking around the Los Palmas car park looking at her Jornada. She crosses the road on Wilamena, going towards the seafront. She walks across Simulation car park and then stops suddenly, holding the Jornada up in front of her.

Runner 1 on walkie-talkie: Runner 1. I've got locations on players but I seem to be stuck in New York.

Runner 1 turns around and starts to walk back towards Los Palmas car park. She stops at the roadside, looking closely at the Jornada. She turns around again and walks back towards the seafront (Figure 9).

Figure 9. Diagnostic work: moving from place-to-place.

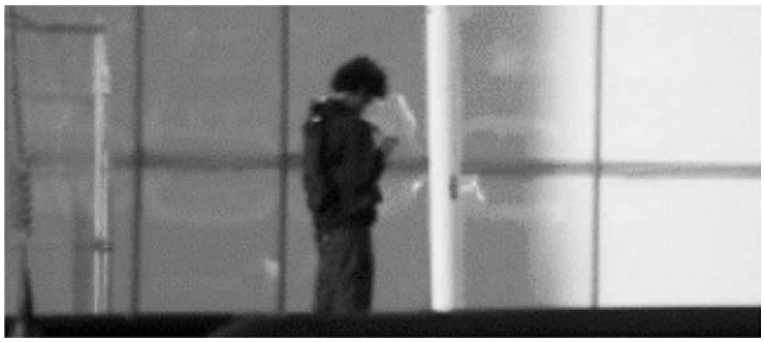

Figure 10. Seeing that others are interrupted too.

Runner 1 then heads back towards the road. She turns left and walks up Wilamena, crosses the road, turns down the first alley she comes to on her right and then turns right again at the end of that, heading towards Los Palmas. Halfway down the street she comes across John, one of the control room staff who also monitors the status of work on the streets as when technical troubles arise.

Runner 1: John, my position's gone really bizarre as in its not saying where I am. And I know that it takes a while but I seem to be getting stuck in really bizarre places. Like, I am not in Simulation car park at the moment.

John: (Looking at Jornada). No. The best thing to do is to stand out in the middle of the car park and just do a reset.

They both go to Los Palmas car park and John resets the Jornada.

Runner 1: Brilliant, are we in the right place?

John: We've not got GPS yet. But, I think there's only about three satellites or something.

Runner 1: I think runner 4's just dropped out of GPS.

They look up from the Jornada and see Runner 4 across the road, standing beneath a waveLAN baystation (where there should be good connectivity).

John: (Looking across road). Runner 4 seems to be waiting (Figure 10).

Runner 1: (Looking at Jornada). Yeah he is. He's just disappeared off here.

Runner 1 on walkie-talkie: Runner 1. Runner 4 can you here me?

John: Are any runners running?

Runner 1: No.

John: Everybody's down?

Runner 1: I think so.

Runner 1 on walkie-talkie: Runner 2 what is your current situation?

Runner 1: He's got GPS.

Runner 1: Hup, I've got GPS.

This sequence extends our understanding of diagnostic 'work'. It first draws our attention to a strategy for recognizing the *seriousness* of an interruption: moving from place-to-place. The strategy establishes that the interruption is more than a matter of a slow update in that it provides for its repair and, in failing to effect a repair, brings to light a technical gremlin that results in the runner 'getting stuck in really bizarre places'. The situation is repaired through serendipitous collaboration with a member of the control room staff (who has been out onto the streets to check on a piece of WiFi equipment) and who resets the Jornada to eliminate one possible source of trouble. The sequence also makes it visible that runners also consult one another when encountering serious interruptions, not only collaborating indirectly via the walkie-talkies, but also through surreptitious monitoring of the streets to see what other runners are doing and to establish whether or not the interruptions to-hand are local (i.e., of this kit) or general (of the technological infrastructure). The interruption in this case transpires not be local but general, a product of poor satellite availability which affects all the runners.

3.4. SUMMARY

Ethnographic study of runners' 'work' has elaborated the routine ways in which interaction is orchestrated or coordinated by runners on the streets. Those routines include:

- Tracking and intercepting players by embedding the virtual model in the real city streets. This is achieved through the exercise of ordinary map reading and orienteering competences.
- Locating and capturing players by sweeping the streets. A combination of broad, fine and collaborative sweep patterns enable runners to handle the vicissitudes of a variable virtual gap and establish the exact location of players.
- Managing and repairing constant interruptions brought about by technological contingencies. Runners manage and repair interruptions by exploiting local knowledge of the built environment and the technology, and exploit this knowledge to conduct diagnostic 'work'.

These routine achievements are collaborative through and through and consist of situated arrangements of interaction between runners and players, runners and runners, and runners and control room staff. Through map reading and orienteering, sweeping the streets, and managing interruptions, runners concert and orchestrate interaction, methodically so, time and time again. We believe the 'method' of the matter – i.e., the practices runners have together devised to do and orchestrate the 'work' as a matter of routine – has some important implications for the continued development

of this new class of ludic applications. We consider these in the broader context of the salience of established CSCW approaches and concepts to new research agendas.

4. Informing design for ludic pursuits

Throughout our analysis of mixed reality gaming we have placed emphasis on runners' 'work'. That is to say, we have treated what the runners do, not as leisure or entertainment, or in Blast Theory's terms as performance art, but as a *work*. There is no contradiction in describing *Can You See Me Now*? as a game, a piece of performance art, and a site of work at one and the same time. Multiple levels of description and account are entirely possible without contradiction, indeed it might be argued that a 'multiple thickening' of accounts is important to understanding the intelligibility, meaning and value of human activity (Ryle 1973), especially in novel contexts of action. While it is easy to focus on the game at the expense of these other issues, and to speak of ludic pursuits at work's expense, it needs to be remembered that for the members of Blast Theory, *playing the game is their work*: the 'runners' are members of a professional company who generate income and make their living from the work of creating and staging artistically recognized performances. We can quite legitimately talk then of the 'work of the performance', of the game in this case, reflexively recognizing that *work and the ludic are not mutually exclusive* but thoroughly intertwined[4]

With the work of the performance in mind, we find Hughes et al.'s (1994) remarks on the initial development of CSCW as pertinent in today's changing circumstances of design as they were when first made:

> '' ... one of the major problems of requirements elicitation, especially as far as the development of CSCW systems is concerned, is the *variety of work domains*; a variety *which is too often obscured by the use of the large-grained characterisation of work* and work domains which tend to predominate within the social sciences and, from a different direction, by the abstracted decomposition of work in terms of tasks which is characteristic of many software engineering requirements methods. Accordingly, and if this diagnosis is correct, studies of the social organization of work will need to proceed in a manner which *recognises this heterogeneity of domains and develops analytic tools which are capable of exhibiting the relevant scope of this variety ... this involves giving detailed attention to the subtleties and the situatedness of the work activities as day-to-day phenomena* ... Bound up with the above considerations are problems involved in identifying cooperative activities ... the relevant properties of the social organization of work do not appear as 'readily packaged' within work domains but need to be brought out by an analysis'' (our emphasis).

Hughes et al. developed a number of sensitizing or 'alerting' concepts (Hughes et al., 1992) from their 'ethnographic' studies of work to help analysts unpack the social organization of cooperative activities. We think that both the approach adopted by Hughes et al. and the concepts they and others working in a similar vein developed are as relevant to the study of ludic pursuits as they are to the study of 'rational' pursuits in more traditional workplaces. Of particular relevance to our analysis of *Can You See Me Now*? are the concepts of 'routines', 'distributed coordination', 'working with constant interruption', 'distributed awareness', 'local knowledge', and from the early work of Heath and Luff (1992), 'surreptitious monitoring'.

4.1. ROUTINES

Routine activities are often construed of as things done 'without thinking' and as consisting of mere repetitive actions. As the sociologist Herbert Blumer (1969) pointed out, however,

> "In dealing with collectivities and with joint action [or cooperative work] one can easily be trapped in an erroneous position by failing to recognise that the joint action of the collectivity is an interlinkage of the separate acts of the participants. This failure leads one to overlook the fact that a joint action always has to undergo a process of formation; even though it may be a well-established and repetitive [or routine] form of social action, each instance of it has to be formed anew."

Working in a similar vein, or on a similar premise if you prefer, CSCW researchers have shown that the notion of the routine may gloss over the very skills and competences that work relies on for its concerted accomplishment (Blomberg et al., 1994). The routine is often 'seen but unnoticed' to use a phrase due to its very familiarity and often passed by without so much as a second thought by workers and analysts alike. Yet it is indispensable to work's accomplishment and its explication provides rich insights into the subtleties of the social organization of work, as it is deeply rooted in that organization (Hughes et al., 1994).[5]

Routines invite us to examine in detail what people take for granted, namely *just how* they get the work done time and time again and *just what* that recurrent achievement consists of and relies on. In turn, paying close attention to the routine brings a host of organizational matters to the fore. Thus, and for example, we can see that in order to collaborate with players, runners must embed the virtual model in the city streets and exploit ordinary map reading and orienteering competences to track players down. Or again, how ordinary map reading and orienteering competences are tied to game-specific competences where runners exploit various sweeping strategies to

locate and capture players, not to mention the artful ways in which runners handle constant interruptions to their work. Examining the routine provides an invaluable starting point for analysis then, whether we are studying 'rational' pursuits or ludic ones. It puts us onto 'endogenous' topics (such as map reading and orienteering, sweeping the streets, and managing interruptions) and makes the orderliness and artfulness of work available to analysis from within the work, as it is carried out and accomplished by participants.

4.2. DISTRIBUTED COORDINATION

Having identified the routine activities that populate the work of a setting, the analyst might begin to unpack their organizational features in detail. The concept of distributed coordination is relevant to understanding the sociality of human activities wherever people are engaged in joint action, whether synchronous or asynchronous in character, 'rational' or ludic. As Hughes et al. (1994) remind us,

> " ... coordination does not consist in any one feature of the work ... coordination is not simply, say, the task of a manager or a supervisor although this, indeed, may well be a major part of their duties – but it is also integrated in various ways in the details of work activities ... coordination is a part of the generally fluid nature of cooperative work. Much of this coordination is implicit in the course of the work as people monitor the activities of others, through the public character of many of activities and the artefacts [used]."

The concept of distributed coordination provides us with an orientation to the details of collaborative activities and focuses on the ways in which participants concert their actions *in situ*. We can see, for example, that collaboration between players and runners relies on embedding the virtual in the real by exploiting map reading and orienteering competences. This enables the runners to coordinate their actions with those of players. Coordination is done by aligning the virtual model with the real city streets through bodily movement, which physically orients a runner to the coordinate relationship between herself and the players and enables her to plot a trajectory towards a player as the act of alignment points the runner in the direction she needs to travel to intercept a player.

In the various details of work – from maintaining a fix on a player by frequently consulting the Jornada, to closing in on a target by sweeping the streets in various ways depending on the immediate coordinate relationship of runners and players, we can see just what coordination consists of as cooperative work activities and just how coordination 'gets done' in distributed details of those activities. Distributed coordination does not, to

reiterate, consist of any one thing but is part of the fluid nature of cooperative work and integrated into the details of work activities. In detail, coordination (and thus an important element of the social organization of joint activities) is made available here through the range of competences runners' use and the practices they have devised to make the technology work *in situ*.

4.3. WORKING WITH CONSTANT INTERRUPTION

Making the technology work is a crucial matter. Obviously it does not work itself, nor (and more importantly) does it work to plan (Suchman, 1987). The 'real world, real time' character of technology use is fraught with contingencies and when we examine how runners coordinate their work it is apparent that it is done in the face of technological contingencies that cause constant interruptions to gameplay. As Rouncefield et al. (1994) point out,

> ''Work is carried through and reproduced by the collaborative activities of the staff. However, it is not done as an 'idealised version', but as a process done in spite of unavoidable 'interruptions' that occur as part and parcel of a normal day ... Interruptions, because of their very 'unpredictability' – that is, the fact of interruptions may be predictable but the precise nature of the interruption is unlikely to be – are difficult, if not impossible to incorporate into an idealised model of the work process ... [Nevertheless] understanding the subtleties ... of 'real world' work ...is an important part of understanding the sociality of work.''

An idealised version of the work might suggest that the occurrence of interruptions due to technological contingencies is the result of 'bugs' that will be ironed out over time through the development of more robust technologies. However, the vicissitudes of satellite availability and WiFi coverage *coupled with the uncontrollable effects of the physical environment* (including the location of users on the Earth's surface, time of day, proximity to buildings, and weather) produce a range of interruptions (including slow updates, getting stuck, disconnections, server errors, and even crash the system on occasion) that do not necessarily repudiate the idealised version but certainly draw it into serious question. If, as we suspect, working with technological interruptions is likely to be a persistent feature of location-based games and applications more generally, then understanding the subtle, socially organized ways in which interruptions are managed is important to identifying requirements for continued development. Furthermore, as interruptions are a common feature of diverse human activities, 'rational' or ludic, there is much to be gained from unpacking the ways in which people handle the interruptions that effect

their joint activities. Central to this achievement is an understanding of distributed awareness.

4.4. DISTRIBUTED AWARENESS

Distributed awareness is a key feature of the runners' work as they set about managing interruptions. As Hughes et al. (1994) describe the notion,

> ''What we have in mind here is the way in which work tasks are made available to others and the important role that this plays in the 'real world real time' social organization of work. Once again, this is a theme which involves interactional subtleties and, once again, is not any single element within work organization. Nonetheless, it is a theme which is relevant to CSCW design in a number of ways including, in particular, the means through which coordination of work tasks is achieved as a practical matter ...The aim is to bring to the fore some of the manifold ways in which work is made public and available to others as an essential ingredient in 'doing the work' as part of a socially distributed division of labour ... information which, in subtle ways, is available so that others can update themselves on the state of the work, how it is going, whether 'we are behind', 'on top of it', etc. Many of these affordances of making features of the work visible and available to others 'naturally' arise out of characteristics of the physical setting and out of the experience and knowledge which is accumulated through participation in the work setting and the activities which go on there.''

Distributed awareness is not restricted to the management of interruptions to gameplay but permeates interaction, particularly the continuous course of updates that runners provide as to their current locations and the players they are chasing (see Sequence #1, for example), and when coordinating collaborative sweeps on players (see Sequence #4, for example). However, in terms of managing interruptions to the game, distributed awareness is directed towards announcing interruptions, particularly in such detail as to what sort of interruption is being encountered, where it is occurring, what the runner is doing about it, when the interruption has been resolved, and where it has been resolved (see Sequence #5, for example). Announcing or broadcasting these details over the walkie-talkies serves to make other runners aware of what is happening in the game 'here and now', where WiFi blackspots are, where there's poor satellite availability or slow updates, where disconnections keep occurring, or more generally and vernacularly, where 'good' and 'bad' places are in the gameplay environment. Through distributing awareness of places where interruptions occur players build up local knowledge of the gameplay environment, which is subsequently exploited to manage and repair interruptions to the game.

4.5. LOCAL KNOWLEDGE

As Hughes et al. note above, distributed awareness 'naturally' arises out of the experience and knowledge which is accumulated through participation in the work setting and the activities which go on there. Distributed awareness is intertwined with local knowledge, which 'making the technology work' in the real world inevitably relies upon. As Hughes et al. (1994) describe it,

> "Working in and through the system depends upon 'local knowledge' which is not simply an adjunct to the pattern of work activities, but essential to them. Such 'local knowledge' is knowledge of the particularities of the work as exhibited in its day-to-day routines ... [in] all the multifarious ways in which experienced workers display their 'know how' and the 'real world' organization of the work's activities. It is knowing how to use the system as an ordinary, taken-for-granted, commonplace organization of work activities."

Local knowledge developed over the course of gameplay, and was dynamically updated as interruptions unfolded. This knowledge not only provided runners with a resource with which to manage, make sense of, and repair interruptions but also informed the development of capture strategies. Over the course of gameplay (which is usually 5 or 6 days at a time at various arts festivals), the runners come to recognize 'good' and 'bad' places to attempt to catch players. These consist of such places as open spaces (e.g. car parks, wide streets, park land) where slow updates rarely occur and, conversely, heavily built up areas where blackspots often occur, or hills and other topographical features (walls, fences, heavy traffic, etc.) which slow the runners' progress, making tracking and capture work tiring and difficult (see Flintham et al., 2003; Crabtree, 2004 for further details). In developing local knowledge of the gameplay environment the runners come to develop certain chase and capture strategies then, luring players into open spaces and ignoring those that are difficult to navigate wherever possible (not that it is always possible as players often hide in 'bad' places, partly due to the 'high score' being tied to how long a player remains 'unseen').

As these remarks suggest, an important feature of local knowledge consists of knowing how to 'make do with the technology-to-hand', which Hughes et al. (ibid.) describes as follows:

> " ... the way in which [people are] able to 'make do' with less than adequate technology ... [relies on] skilful strategies to get round some of the deficiencies of the technology ... [it is] a matter of developing a 'working sense' of the limitations of the technology, a sense of 'what to trust' and 'what to be careful about', and so on, but within a very practical understanding of the interweave of the technology and the work ... by and large ways are found to get round the problems, to solve them 'with whatever is at hand'."

Gameplay strategies are very much tied to the runners' working knowledge of the technology; to the runners understanding of what kinds of things can go wrong, what usually does go wrong, and of what can be do about it. Thus, and for example, the runners come to know over the course of gameplay that poor satellite coverage is factor to be reckoned with, that WiFi blackspots often occur in built up areas, that slow updates and disconnections will be produced by these technical events, and that there are ways to 'work around' them and otherwise repair them.

At the same time, the runners' also come to know that there are occasions when it is not clear just what the problem to-hand is and of just what needs to be done to work around or resolve it. These occasions give rise to collaboration with other runners and control room staff, which replaces a concern to distribute awareness with diagnosis of the interruption to-hand. Diagnosis is concerned to determine the generality of the interruption to-hand, which suggests appropriate next actions to be taken to repair them, and may be coordinated in one of two basic ways: either indirectly (via walkie-talkie) or directly (face-to-face) through serendipitous meetings with other runners or technical staff on the streets and through surreptitious monitoring of other runners.

4.6. SURREPTITIOUS MONITORING

'Surreptitious monitoring' (Heath and Luff, 1992) is in some respects a vague concept as general definitions of it were not formulated and it emerged from a particular study of work (of collaboration in London Underground control rooms). Nevertheless, like distributed coordination and distributed awareness, surreptitious monitoring is a part of the fluid nature of cooperative work and gains its generic purchase from the various ways in which it is integrated into the details of work activities. Generally speaking, the notion refers to the myriad ways in which people keep an eye on each others activities, remain peripherally aware of what's going on around them, discriminate the local environment of activity and assess the implications of others actions for their own conduct. Through surreptitiously monitoring each other's conduct people distribute information concerning both changes to, and the current status of, joint activities.

In this case, surreptitious monitoring is an important feature of diagnostic work. On occasions where the generality of interruptions is in question, the runner's make explicit reference to their colleagues. That is to say, that they look out for them, look to see what they are doing. In turn this helps runner's determine whether or not the interruptions to-hand are local (of their personal kit) or general (of the game's infrastructure and affecting others too) and thus establish an appropriate sense of what to do next in order to repair interruptions to gameplay.

4.7. THE GENERALITY OF SENSITIZING CONCEPTS

In Sections 4.1–4.6 above we have attempted to make explicit the salience of some existing CSCW concepts to the analysis of activities occurring in non-traditional workplaces, activities that might more generally be labelled 'ludic pursuits'. If our argument for the continued relevance of existing CSCW concepts to the study of 'Homo Ludens' is accepted in the case of *Can You See Me Now*? the question of generality still raises its head and it might be asked 'what of other games and ludic pursuits more generally?' Obviously a great many ludic pursuits – such as those explored by Gaver et al. (2002) in their 'workbooks' – consist of activities that are nobody's job of work, that no one makes a living from, or develops a career through.

Such activities still have *social characteristics* however, their very intelligibility or meaningfulness relies on them, and the concepts we have revisited provide a way of unpacking the sociality of action. These concepts sensitise the analyst to the sociality of human activities. They are not prescriptions for analysis but tools that provide an orientation to some fundamental social features of action. In this respect sensitizing concepts furnish analytic 'coat hangers' for unpacking the social organization of a setting and its activities. Thus, in exploiting the concepts of routines, distributed coordination, working with constant interruption, distributed awareness, local knowledge, and surreptitious monitoring, we start to see the social organization of *Can You See Me Now*? We can see that gameplay is organized in terms of map reading and orienteering, sweeping the streets, managing and repairing technological interruptions, and conducting diagnostic work. Furthermore, we can see what these activities consist of, and what 'making the technology work' relies upon, in observable and reportable details of the 'work' –i.e., the practical action and practical reasoning – of the setting and its activities (Sacks, 1992).[6]

We are not suggesting that this ensemble of sensitizing concepts will always be relevant, however, as relevance will depend on the particular or situated character of ludic pursuit under 'ethnographic' study. Certain concepts may transpire to be relevant on occasion, whereas others may not and the analyst might find other core CSCW concepts useful instead.[7] But our argument or insistence on the continued salience of CSCW concepts to the study of ludic pursuits does not rely on the generality of a single sensitizing concept or a specific ensemble – i.e., on whether or not we can generalize a particular concept or ensemble to all cases.[8] Rather, it relies on the *general usefulness of CSCW concepts for unpacking the sociality of ludic pursuits and informing design*, and that is matter that will be settled not by argument but through empirical work carried out by members of the research community.[9]

5. Informing the continued development of location-based games

We have presented a study of a location-based mixed reality game to demonstrate the continued salience of existing CSCW approaches and concepts that were developed in the study of work to the study of ludic pursuits. In particular, we have focused on the use of 'ethnography' or ethnomethodologically informed ethnography to give the approach its full but wordy title, and some core CSCW concepts that emerged from such research. Below we seek to complement this demonstration, indeed to bring it to a close, by *showing* that the implications to emerge from our analysis of a ludic pursuit may be used to inform the continued development of location-based games and such interactive applications more generally. Accordingly, we have seen how playful activities exploiting location-based technologies rely on the runners' ability to manage, diagnose, and repair interruptions, as failure to do so will inevitably result in the terminal breakdown of runner-player interaction. Managing, diagnosing, and repairing interruptions are crucial matters, which rely on the production of local knowledge and distributed awareness. Below we wish to briefly consider how these might be supported through design.

5.1. AUGMENTING LOCAL KNOWLEDGE

As noted above, distributed awareness is directed towards announcing interruptions, particularly in such detail as to what sort of interruption is being encountered, where it is occurring, what the runner is doing about it, when the interruption has been resolved, and where it has been resolved. Distributed awareness articulates and further develops the runners' local knowledge of the gameplay situation and is cumulative and dynamic – cumulative in the sense that it is developed over the course of gameplay and dynamic in the sense that it is ongoingly developed in response to the technological contingencies that effect interaction 'here and now'. Local knowledge only becomes available as a shared resource through the runners' awareness talk and, occasionally, in the talk between runners and control staff. As that talk is predicated on and/or made in response to technical events, the possibility exists of augmenting local knowledge by distributing awareness of the cumulative and dynamic or 'real time' spatial nature of GPS variability and WiFi blackspots on the runners' view of the virtual model.

Our first design prototype visualizes the history of GPS availability and error as reported by GPS receivers in order to build up a picture of 'good' and 'bad' locations. Figure 11 shows a visualization of GPS error over a 2-hour game session that has been manually overlaid on a simple map of the game zone. The solid black areas are buildings and the surrounding area is water. Coloured points are locations where a GPS reading was successfully

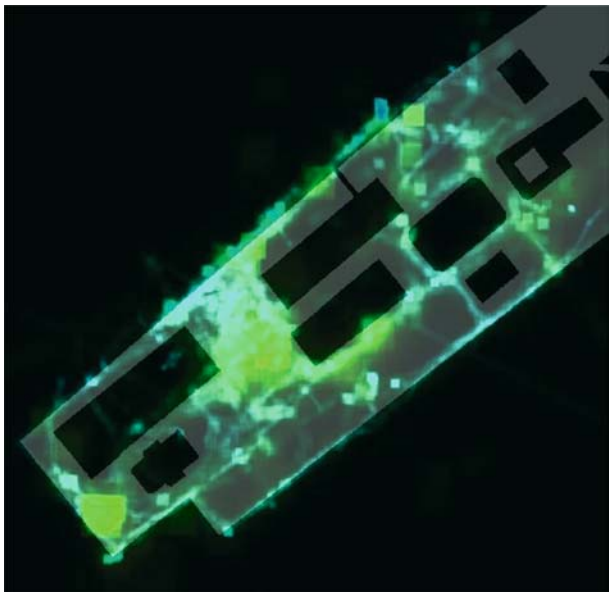

Figure 11. Distributing awareness and augmenting local knowledge cumulatively.

transmitted to the game server over WiFi and logged. Green blooms signify readings with larger errors (5 m or above) and blue blooms signify readings with smaller errors (approaching 1 m). Larger errors also produce larger blooms due to the uncertainty in the reported position. Grey areas with no colour show locations where no readings were obtained, either because there was no GPS or WiFi coverage, because they were inaccessible to runners (some were fenced off), or because runners simply never ventured there. This visualization serves a dual purpose of giving historical clues to the generally quality of GPS accuracy that might be anticipated in different places and of revealing areas of expected WiFi connectivity, which might not only be exploited by the runners as a resource to make sense of interruptions but also to inform their search and capture strategies.

We know that GPS exhibits considerable variation over time as GPS satellites move across the sky overhead and that these variations bring about interruptions to gameplay. Our second design prototype predicts the likely availability of GPS at different locations on the streets 'here and now'. This visualisation takes the 3D model of the game zone and information about the positions of GPS satellites at any given moment in time, and for each location on the ground, calculates how many satellites are in its direct line of sight. The output is a map of expected 'good' and 'bad' areas of GPS availability, as shown in Figure 12 below. In this example, which is an area of central London, buildings are shaded black, areas of likely 'good' GPS (with

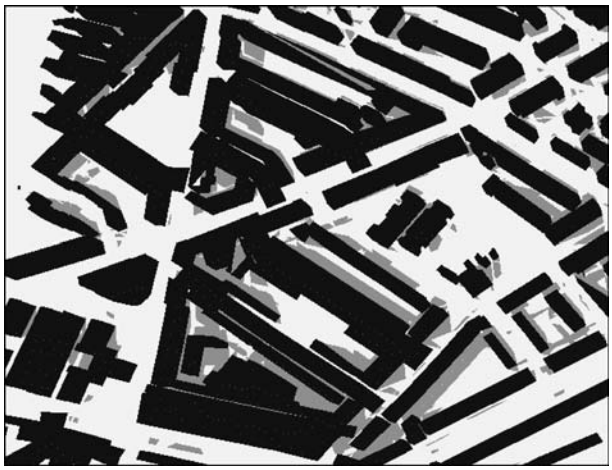

Figure 12. Distributing awareness and augmenting local knowledge in 'real time'.

line of sight to three or more satellites) are shaded white, and areas of likely 'poor' GPS (line of sight to less than three satellites) are shaded grey.

This visualization augments the runners' awareness work and provides support for the situated management and repair of routine interruptions. As Pettersson et al. (2002) put it,

> " ...'awareness' work ... is not a default way of doing work, but is engendered by quite specific and commonplace 'routine troubles' ... [it] is not a generalized phenomenon but is in fact specifically occasioned by a situation, which becomes recognizable as problematic as the interaction develops."

Recognizing 'problematic' situations is a key feature of managing interruptions and combined with existing technical information (as seen in Figure 2), this visualization enables runners to see *at-a-glance* whether or not the interruption to-hand is a result of poor satellite availability and/or connectivity or is a result of some other technical event that requires further diagnosis. Ongoing development work is exploring how both these visualizations can be combined and integrated with the runner's handheld interface to provide effective support for their work on the streets.

5.2. AUGMENTING DIAGNOSTIC WORK

Diagnostic work is concerned to establish the generality of interruptions and exploits information about the gameplay status of other runners to do so. This information derives from two distinct sources – from the runners themselves or from control room staff – and is gathered in two basic ways: indirectly (via walkie-talkie) or directly (face-to-face) through serendipitously

meeting other runners on the streets and more importantly, by surreptitiously monitoring their conduct.

The possibility exists to augment diagnostic work by furnishing information that not only makes runners aware of the walkie-talkie channels other runners are operating on, but also of conveying their GPS and connectivity status. GPS and connection status are generally available to the system and each runner already sees their own information on their Jornada. The extension simply makes this information available to other runners. It is more difficult to capture information about the current walkie-talkie channel runners are on, however, and an initial solution relies on control room staff manually updating this data in the audio management interface prior to distributing it to the runners Jornadas. Difficulties also arise with respect to GPS when there is a failure in the wireless network, in which case no status information can be sent to or from a runner even if their GPS is working. Dealing with this situation in particular has led us to consider a number of complementary design ideas.

The first of these is to provide information about the last known status of runners during disconnection. For example, when a runner suffers disconnection, their Jornada interface may continue to display the last known positions and statuses of other runners and similarly, the other runners may continue to see the last known status of this runner. However, it will be important to clearly distinguish between last-known state and live state, and also convey a sense of how stale this information is, for example, by displaying how much time has elapsed since the last update from a given runner, or even having the information fade from view over time. One problem with 'last known state' is that it only shows the point at which things went wrong. In order to support backtracking into areas of good coverage, it may be useful to display a trail of states leading up to the point of failure.

Secondly, and more interestingly from the point of view of IT research rather design, we can provide alternative technical modes of communication to supplement the centralised (Access Point-based) WiFi approach used in *Can You See Me Now*? For example, we would normally expect GPRS (GSM) coverage to be more complete than WiFi in any given area, and to be less affected by buildings (because of the different radio frequencies that it operates on). So the runner's device could be engineered to fall back to GPRS after it has been out of WiFi range for some critical period of time.

Our third and final proposal deals with the situation where a runner loses GPS but remains connected to the game. In this case, we recommend falling back to alternative positioning systems. These might include approaches based on WiFi or GPRS/GSM signal strength, radio beacons, or even – perhaps the most robust – a manual positioning system where the runner explicitly shows their current position to others (Benford et al., 2004).

Interesting technical challenges aside, it is already possible to provide channel data, GPS, and connectivity status to runners. This information provides runners with the information they need to surreptitiously monitor others *remotely* and to make some determination of the local or general scope of interruptions, thus aiding diagnostic work. Again, ongoing development work is exploring how these information channels can be combined and integrated with the runner's handheld interface to provide effective support for their work on the streets.

6. Moving with the times

CSCW is currently a field of interdisciplinary research that has primarily focused on work and organization. Yet IT research is changing and rapidly diversifying into new areas of human activity. With this move researchers have argued that approaches and concepts developed to support workplace design are inadequate for purposes of understanding and developing systems to support what are often characterized as 'ludic pursuits'. Furthermore, CSCW has shown some hesitancy in embracing these more 'playful' activities, being slow to incorporate them into its repertoire and treat them as relevant to its core research agenda.

We would stress, however, that CSCW needs to remember its historical origins, its genesis, and recognize that its emergence was thoroughly intertwined with IT research. If it is not to become divorced from the very thing that gave the field its impetus and purchase there is a need for CSCW to extend its boundaries and move beyond its current and almost exclusive focus on the traditional workplace. This is not to suggest that CSCW should dispense with its focus on work and organization but that the horizon should be broadened to take in new developments in computing as well. As research moves out from the workplace to consider how IT may be situated in a broader range of social settings, then CSCW must also move with it to consider how best to inform technological development within these contexts, unless it is to run the risk of becoming a historical curiosity rather than a vibrant living research community.

This is not to say that CSCW needs to radically reshape itself in order to tackle these new areas of interest. Indeed within this paper we have demonstrated that the argument that approaches and concepts developed within CSCW for the study of work and organization are inadequate for other domains *does not necessarily hold true*. The demonstration is underpinned by the recognition that the diverse activities people engage in, *rely on, exploit, and exhibit their sociality* as a condition of their intelligibility, meaningfulness and value. In short, while ludic pursuits may be essentially 'playful' in character they are nonetheless socially organized and it is this that makes them available to CSCW research.

The demonstration was done through ethnographic study of a ludic pursuit – a mixed reality game. As a feature of that demonstration we have shown that the social characteristics of ludic pursuits may be unpacked using existing CSCW concepts without casting them in 'rationalistic' terms of production and efficiency (etc.). Furthermore, we have suggested that ludic pursuits may be the work of some group and that is entirely defensible on occasion to treat ludic pursuits as settings of work. Where professional work is absent, then it is still possible to study the 'work' of the ludic – i.e., the practical action and practical reasoning whereby such activities are constituted and accomplished as 'real world' activities – and to unpack their sociality with CSCW concepts.

Our demonstration exploits but one approach and concepts associated with it to show the continued salience of CSCW to contemporary agendas in IT research. We know that other researchers are exploiting participatory design approaches to address contemporary challenges in domestic settings, for example, and can see no *a priori* reason as to why other approaches and concepts that have informed the development of collaborative systems should not have currency in the effort to understand and develop systems supporting ludic pursuits. Homo Ludens is, after all, a very social creature.

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Notes

1. This should not, of course, be read as a criticism of Gaver's work or reasoning. Our 'problem' as it were is not with Gaver, but with the potential irrelevance of new agendas of IT research to CSCW on the one hand, and with the perceived inadequacy of existing CSCW approaches and concepts to design for the ludic on the other.
2. Members of Blast Theory are not only participants in the game but co-designers of it and the game is as much an artistic exploration of new forms of digital gaming as it is a technical exploration of location-based applications.
3. The model is 'abstract' in the sense that while it accurately portrays the relation of streets and buildings it is devoid of street scenery – there are no people beyond participants in the game, for example, or traffic, etc.
4. In talking about the 'work of the performance' we set aside a concern with judging the success of the game as an exploration of new forms of interactive art. However, as an aside, we would note that *Can You See Me Now*? has been extremely successful in terms of critical review by members of the interactive arts community, which is perhaps the

most significant way in which judgements as to the artistic character of a work is reflected and shaped. For example, *Can You See Me Now*? was awarded the 2003 Prix Ars Electronica Golden Nica for Interactive Art, the leading international prize in the field. The success of the game can also be judged in terms of further bookings and commissions. At the time of writing, *Can You See Me Now*? has toured to Sheffield, Rotterdam, Oldenberg, Cologne, Brighton, and Barcelona and continues to tour with bookings in the USA and Japan in the pipeline; further evidence that this is indeed professional work for the artists involved.

5. It is notable that in more recent times routines have been shown to be indispensable to understanding the social organization of activities and technology use in the home, for example (Tolmie et al., 2002, Crabtree and Rodden, 2004).
6. What we are suggesting then is that it is generally possible to study the 'work' of ludic pursuits, as their intelligibility, meaningfulness and value is practically and reasonably constituted. The 'work' consists of the practical actions and practical reasoning implicated in the 'doing' of ludic pursuits and the social organization of that 'work' may be unpacked using CSCW concepts, not all of which (as we have hopefully demonstrated) necessarily rely on 'rational' presumptions of productivity and efficiency.
7. See, for example, the Equator technical report detailing *The Social Life of Uncle Roy*. http://www.mrl.nott.ac.uk/~axc/documents/The_Social_Life_of_Uncle_Roy_Field_Report.pdf
8. That would be absurd, as it presupposes that we know in advance what 'all cases' consist of and we if we knew that there would be no work for IT research to do.
9. It is notable that using existing CSCW concepts to unpack the sociality of novel settings and activities may also lead to the development of new concepts for analyzing the ludic (see Crabtree and Rodden, 2004, for example).

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