

RESEARCH ARTICLE



Back to the Control Room: Managing Artistic Work

Stuart Reeves*¹ , Christian Greiffenhagen² & Mark Perry³

**¹School of Computer Science, University of Nottingham, Jubilee Campus, Wollaton Road, Nottingham NG8 1BB, UK (E-mail: stuart.reeves@nottingham.ac.uk); ²Department of Sociology, The Chinese University of Hong Kong, Shatin, NT, Hong Kong, SAR, The People's Republic of China (E-mail: c.greiffenhagen@cuhk.edu.hk); ³Department of Computer Science, Brunel University London, Uxbridge UB8 3PH, Middlesex, UK (E-mail: mark.perry@brunel.ac.uk)*

Accepted: 18 May 2022

Abstract. Control rooms have long been a key domain of investigation in HCI and CSCW as sites for understanding distributed work and fragmented settings, as well as the role and design of digital technologies in that work. Although research has tended to focus mainly on ‘command and control’ configurations, such as rail transport, ambulance dispatch, air traffic and CCTV rooms, centres of coordination shaped by artistic and performative concerns have much to contribute. Our study examines how a professional team of artists and volunteers stage manage and direct the performance of a mixed reality game from a central control room, with remote runners performing live video streaming from the streets nearby to online players. We focus on the work undertaken by team members to bring this about, exploring three key elements that enable it. First, we detail how team members oriented to the work as an artistic performance produced for an audience, how they produced compelling, varied content for online players, and how the quality of the work was ongoingly assessed. Second, we unpack the organisational hierarchy in the control room’s division of labour, and how this was designed to manage the challenges of restricted informational visibility there. Third, we explore the interactional accomplishment of the performance by looking at the role of radio announcements from the event’s director to orchestrate how the performance developed over time. Announcements were used to resolve trouble and provide instructions for avoiding future performative problems; but more centrally, to give artistic direction to runners in order to shape the performance itself. To close we discuss how this study of a performance impacts CSCW’s understandings of control room work, how the problem of ‘diffuse’ tasks like artistic work is co-ordinated, and how orientations towards quality as an artistic concern is manifest in / as control room practices. We also reflect on hierarchical and horizontal control room arrangements, and the role of video as both collaborative resource and product.

Keywords: Control rooms, Ethnography, Ethnomethodology, Organisational work, Performance, Video analysis

1 Introduction

For HCI and CSCW, control rooms have long been a key domain of investigation to develop our understanding about the role and design of digital technologies in the workplace. They have become something of a canonical site, particularly for formative CSCW studies of the 1990s (e.g., Heath and Luff, 1992; Harper and Hughes, 1993; Goodwin and Goodwin, 1996; Suchman, 1997). They have enabled CSCW researchers to study complex distributed working spaces in which the interactional management of both remote and local communication systems and information technologies becomes key to the social organisation of work. Studies of control rooms have provided many formative cases for CSCW while simultaneously establishing a particular approach—a strong focus on *practices* (Kuutti and Bannon, 2014)—as a bedrock for CSCW.¹ Prior control room research has developed key sets of insights and concepts about what it might mean to do collaborative work with and around digital technologies. This has led to notions of mutual awareness, articulation work, and joint action, all of which have been adopted into the language of CSCW, and beyond this, to HCI.

This prior work has tended to explore ‘command and control’ type settings, centring on particular types of workplace, whether that be rail transport, ambulance dispatch, air traffic, security CCTV rooms (Heath et al., 2002), or more modern “multicentre” traffic control rooms (Luff et al., 2018). Such settings have become synonymous with the concepts they generated, such as mutual monitoring or awareness. Although these remain widely applicable and part of the historical fabric of the field, activities in mainstream CSCW seem to have now largely ‘left behind’ the control room. In CSCW—more so for the kind of CSCW practiced in North America—focal interest has tended to move *away* from richly collocated work settings like control rooms, towards distributed work and non-work practices (e.g., crowdwork, games, etc. as per Fischer et al., 2018). Indeed, the control room may no longer be seen as a suitable setting for examining coordination in a world where people have ready access to mobile and wearable devices for communication, computation and navigation, and in which their relations are continuously mediated by social network formations, rather than more ‘traditional’, preconfigured—perhaps even tending towards the stubbornly hierarchical—social organisational forms.

But, for a variety of reasons, we feel it is time to *revisit* the control room. These settings still have useful—and novel—things to tell us about collaborative work. One function this serves is to reflect on prior control room research, the durability of CSCW concepts it wrought, and build new concepts and distinctions upon them. A second reason is that the artistic work done by our particular

¹ We make a distinction here between historical European and North American CSCW traditions, where the former has tended to emphasise a practice-oriented approach, see Kuutti and Bannon (2014).

control room can help us make sense of a much more general phenomenon. Specifically, we look at a control room dealing with artistic work, and the production of a live streaming performance. This speaks to the spread of live streaming performances whereby production studios are no longer limited to complex, fixed-format, professional setups (e.g., from Broth, 2004; to Li et al., 2019). We note that examinations of control rooms as spaces for the production of artistic work are sparse. Where we do find them, they understandably tend to focus more on the technical practices of control rooms in the style set by prior CSCW studies, and perhaps less on the ways in which creative vision and artistic direction are themselves topicalised in and as control room work (to whit, Broth, 2004; Crabtree et al., 2004; Crabtree et al., 2007). We posit that artistic control rooms enrich and broaden existing understandings in CSCW about the nature of control room work, and indeed the potential relevance of the control room as a vehicle to explore novel issues around contemporary artistic performances, the construction of directorial action, and the role of digital, networked, collaborative technologies that are employed to mediate and stage performances. In addition, control rooms can tell us how contemporary media technologies enable new kinds of (live) *interactional forms* to emerge between performers, audiences, and directors, and help us reflect on the continued importance of the control room as a form of contemporary work practice. In doing this, we suggest that the contemporary control room, as a site of collaborative action, might also articulate crucial new collaborative forms that reflect an emerging contemporary milieu where live video streaming to large audiences is a prevalent and thoroughly routine activity (Fraser et al., 2020). Our study teases out taken-for-granted facets in this canonical control room work. In this paper we simultaneously engage with such present social and technological developments, and reinvestigate one of the formative settings of HCI and CSCW.

To this end we examine a control room managing a *performance*, namely the mixed reality game/performance² called *I'd Hide You* (IHY). Briefly put, IHY is a touring performance created by the artists' group Blast Theory. IHY takes its cues from various precedents, such as live vlogging (Juhlin et al., 2010; Lu et al., 2018) or game streaming (Sjöblom et al., 2019). Substantively, IHY unfolds as a simple game of 'tag' or 'hide and seek' played out on city streets between performers using live streaming video cameras, while online players view their activities and communicate with them. IHY furnishes us with a control room that aims to deliver a cinema verité influenced interactive game and a compelling live experience for online players. It also can offer us insight into a general development in control rooms with their increased emphasis on cameras and other hand

² We will use both terms—game and performance—interchangeably within this paper to discuss I'd Hide You. This is an attempt to respect both Blast Theory's own description of IHY (as a "game") as well as to point to its significance as a *performance* work, developed by a group of artists with a particular artistic vision.

held devices (Fischer et al., 2015; Luff et al., 2018), as well as the growing popularity of live streaming services provided by Twitch or YouTube being deployed by streamers in public spaces as part of ongoing engagement with their online audiences (Lu et al., 2018; Faklaris et al., 2020). The following sections introduce IHY in detail to ground our subsequent analysis of three important facets of the organisation of IHY's performances: 1) the creative 'task' itself and what the ultimate output of the performance is (and who it is for); 2) IHY's division of labour, including the importance of hierarchies of organisation and what is perceptible in that division of labour; and 3) how directorial announcements were used to shape the performance, going beyond existing understandings of how control rooms remotely manage 'trouble'.

However, we first want to remind the reader of some of the extensive and rich history of control room literature in CSCW, and how this relates to our understanding of IHY. At the same time, we emphasise a number of points that distinguish our present study. We also introduce some pointers towards understandings of artistic direction, performance and rehearsal that emerge from this past work and that we use to inform our own analysis.

2 Studying collaborative work in and around control rooms

Control rooms have long been a major topic of interest within HCI and CSCW, as well as in the cognitive systems engineering and broader human factors literature. There is a rich body of studies established since the early 1980s that describe them and consider how they might be reconfigured for more efficient or effective operation using a wide range of digital and non-digital interventions. The range and disciplinary spread of this precludes our presentation of a comprehensive review here, so instead we offer a tour through this literature to remind ourselves of some formative concepts that will then ground our examination of IHY.

While the earliest literature on control rooms focused on efficiency concerns as joint cognitive systems such as operator functioning (e.g., Rasmussen, 1980) or information display (e.g., Fitts, 1951), the main body of classic literature around interpersonal communication in control room systems largely stems from the start of the 1990s in HCI and CSCW. This has focussed on three key sites: rail line control rooms, ground control in airports, and air traffic control. Suchman (1996) frames the problem that this literature addressed as a problem faced by members of operations rooms, in which they work towards.

[...] the assembly of the various resources at hand into an ad hoc system dedicated to the trouble's resolution. For this assembly to happen there are three requirements. First, that the trouble be noticed, formulated and brought to the attention of relevant others; second, that whatever human and technological resources might contribute to its resolution be mobilized; and third, that the

consequences of those mobilizations be monitored and assessed for the resolution that could occur at any time, rendering further mobilization and coordination unnecessary (p. 37)

This statement sets the scene for us conceptually, where the control room is a *sociotechnical site*, enabled by a range of technologies that support its various core characteristics and associated practices. In doing so, its members are conducting a variety of activities all of which have been heavily conceptualised in subsequent CSCW research: piecing together an operational view, monitoring and intervention/control, division of labour/parallel working, and distributed working. IHY's control room is no different, representing these facets intrinsically.

Collaborative work in control rooms is characterised by their operation as “centers of coordination” (Suchman, 1993, 1997), bringing together the basic concerns of how members deal with distributed cooperation in a timely way, and how they manage an indeterminate horizon of ongoing troubles across space and time. Suchman draws from Heath and Luff's (1992) work, describing how control room members *render tasks visible*—or more generally perceptible as our analysis of IHY unpacks—by deploying practices that structure their own attention and direct the attention of others, both through talk (e.g., active overhearing, making out-loud comments, mutual monitoring, the recipient design of announcements) and other forms of activity (e.g., configuring visually noticeable task representations, glance, expressive gesture). This set of practices support both shared and differentiated work across individuals, with a demarcated *division of labour*, as participants work on their own activities. But, because of the configuration of the working space and the ways they conduct themselves, members are able to share their ongoing work in flexibly organised forms that are contingent to the developing needs of the rest of their team. Such centres of coordination have included studies across wide and varied settings from the domains of military (Hutchins, 1995), air traffic (Goodwin and Goodwin, 1996; Harper and Hughes, 1993) and rail (Heath and Luff, 1992) control systems, to also include city dealing rooms (Heath et al., 1994), call centres (Whalen et al. 2002), NASA mission control, ambulance dispatch (Martin et al., 1997), rally race management (Wahlström et al., 2011), disaster response (Fischer et al., 2015), and TV production (Broth, 2004, 2008), amongst others. A key to their operation is that these centres should not be seen as locales for examining the work of connecting individual operators, but at their core as inherently *social* activities that are interactionally managed—and therefore understood as sociological, rather than psychological, phenomena.

Heath and Luff (1992) present what is probably *the* classic CSCW study of control rooms in their work on London underground line control; in this they document the emergent and flexible division of labour between personnel. While it is a complex system with a degree of operational flexibility, there is a strong

centralised aspect to this work, led by a “Controller”. This Controller acts in a directorial role as guardian of the timetable to ensure that trains run on time across the network, and even if they are unable to shape the specific details of the service, they attempt to achieve regular arrival and departure of trains with relatively brief intervening gaps between them. At the heart of their analysis, Heath and Luff discuss how the local ‘design’ of public audio *announcements* achieves its performative force through being tuned to the passengers’ activities, and so making these announcements timely and relevant. To do this effectively, control room operators have to simultaneously work with (remote) train drivers as the different strands of their work (timetable management and public announcements) are highly co-dependent. We will see how such announcements come to be repurposed for *artistic* direction of performers by members of IHY’s control room.

Other control room papers extend Heath and Luff’s orientation to such work. Theureau and Filippi (2000) look at urban traffic control rooms but focus their analysis on control activities following automated traffic computer systems failure. They show how control is collectively distributed across operating staff; collaboration allows controllers to drop their broad focus and concentrate on small problems, but when larger problems occur, the team refocusses together. The affordances of the technologies used in combination with the organisation of spatial resources is also a topic for Martin et al. (1997) in their study of ambulance dispatch: as with Heath and Luff’s work, they show how team members maintained mutual awareness through extensive peripheral and focal mutual monitoring (Heath and Luff, 1992). However, due to the nature of their work environment, this differed from the London underground studies in that it required more visible negotiation rather than seamless uninterrupted coordination. Notably, Martin et al. show how interaction with computer systems is a *public phenomenon*, and that systems which afford occasions for social interactions between co-workers, or that allow different kinds of ‘seeing’, were likely to be more successful.

As we will see in IHY’s control room, physical layout enables and enframes co-present co-ordination of remote activities. Anderson et al. (1989), for example, show how the physical layout in the room “recapitulates the division of labour” where “a glance around the office suffices as reconstitution of the organisational plan” (ibid, p. 164). Suchman (1996) reiterates this, noting that spatial arrangements are not static, but are a collaborative achievement, as personal and joint spaces (and the boundaries between them) are continuously produced and transformed by their members. Indeed, the physical arrangements of control rooms themselves need not be custom-designed, but may take on an ad hoc format to meet local circumstances (e.g., Wahlström et al., 2011). Closely linked to the physical configuration of control rooms, over-seeing (e.g., Harper and Hughes, 1993) and over-hearing (e.g., Watts et al., 1996) play an important role in allowing co-present team members to become aware of activities that may impinge on their own work. This allows work disturbances or team workloads to

be rendered perceptible, enabling synchronisation and mutual coordinated action by members. Thus, talking to remote others can do ‘double duty’, with out-loud comments (e.g., Heath et al., 1994; Wahlström et al., 2011) being a commonly deployed practice that helps build intersubjective awareness of remote interactions. We will see similar practices in IHY’s control room but turned towards matters of artistic judgement.

Like the primary medium for IHY, a number of studies have looked at the role of video for co-ordination work. For instance, London underground CCTV and surveillance deployments in control centres (Luff et al., 2000; Heath et al., 2002) offer a clear case in which video is employed extensively. Here, operators have access to a ‘visual panorama’ that they use in concert with broadcast audio to manage remote passenger conduct in underground stations. In a sense, such studies—particularly by Heath and Luff—have valorised the minute details of control room work, thereby setting the scene for many other analyses. However, to some extent what they examine are phenomena tied to that *particular kind* of control room work where timings and gearings-in are vital to the minute-by-minute and even second-by-second aspect of e.g., rail travel timetabling (Heath and Luff, 1992). Live TV sports production is another case in which multiple video streams are monitored, analysed, cut, and selected for broadcast (Perry et al., 2014); in this, the deeply hierarchical structure of the control room—something we will see in IHY—is also mapped into both the media of communication (asymmetrical audio channels) and the means of video segment selection as the video production teams work to align visual content and talk under highly constrained time pressure. Video thus can act as a collaborative resource, but also the primary ‘outcome’ of control room work.

Of course, we are not the first to examine control room work for artistic or ludic purposes. A focus on these forms has tracked CSCW’s expanding interests (Brown and Juhlin, 2015), and naturally this has influenced control room studies too, moving away from a more narrow emphasis on organised work management. Frequently, these settings pull on more flexible working arrangements in which participants use mobile phones, smartphone apps, or deploy ad hoc socio-technical assemblies in the ways that they configure their operational activities. Such developments also in turn reflect changes in work-oriented control rooms too—thus we see more recent returns to the control room absorbing mobile alongside traditional desktop monitoring (Luff et al., 2018). Multiplayer, mixed reality games have provided an opportunity to examine large-scale control room activities, although mostly these have focused more on the interactions between central control operators and remote operatives than interactions within control room itself. Nevertheless, it is often possible to catch glimpses of such interactions. Crabtree et al.’s (2004) study of an earlier Blast Theory work, *Can You See Me Now?* (CYSMN), presents an interesting point about remote game runners doing ‘diagnostic’ work when ‘failures’ occur in gameplay; this touches on our study of IHY’s control room since it represents similar forms of collaborative sensemaking

around the problems of technology disconnection (e.g., interruptions) with, and across media, and between media representation and reality. Like IHY, in CYSMN this collaborative effort occurs on walkie-talkies, but also via team members' surreptitious monitoring of other 'runners' in the streets. The use of multiple communications equipment (wifi for connectivity and walkie-talkie) means that there are multiple, independent opportunities for coordination in the event of failure. However, control room staff are often left unaware of location or status of disconnected runners in CYSMN. Crabtree et al. thus suggest a design shift from supporting orchestration from 'backstage' to 'frontstage', not to remove the control room, but to decentralise orchestration and broaden support across the division of labour that will enable remote workers to locally orchestrate interactions themselves. Their ultimate suggestion is that decentralising control rooms is not about supplying remote workers with control room information but embedding it in "representations that are relevant and responsive to the situated and methodological ways in which interaction is ordinarily orchestrated 'on the ground'" (*ibid*, p. 398). This is an interesting and emerging trend in the *decentralisation* of some control room activities (see again Luff et al., 2018), and it offers opportunities that allow more rapid, scalable, failure-resistant, and situation-specific responses. However, where there is a need for co-ordinated directorial control as the artistic vision of IHY demands, a central operational hub still has a key role, even if the implementation of location action around this may be decentralised.

In sum, there are a number of matters our study of IHY's control room tells us about that are similar to those described in the existing body of work sketched above. But our study also advances descriptions of practices that are geared to support artistry and directorial work. IHY's control room has a distinct *hierarchical* organisation tailored towards the stage management and artistic direction of *performance*. Although prior work examines how performances are brought off as accomplishments of orchestration work coordinated from a control room, our study inspects this control room work in new detail: building up from descriptions of divisions of labour to address how *creative, artistic concerns* drive the specifics of that organisation right down to the particularities of performance direction as-it-happens. In that sense, we are trying to broaden what Suchman characterises as the dedicated focus of control rooms on "trouble's resolution" (Suchman, 1996). Underpinning all of this is the primacy of *crafting an experience for a third party*—the online player—coupled with the delivery of IHY via autonomous intermediaries, i.e., a crew of performers on the streets.

3 The setting

At the heart of this paper sits the control room of I'd Hide You (IHY), a work by the artist group Blast Theory. IHY operates like the children's game 'tag' or 'hide and seek'—but with a mixed reality element. The core game mechanic is that

remote online players take the perspective of one of three ‘runners’ in the game and then try to ‘snap’ one another by capturing rival runners within their runner’s camera’s viewfinder (at which point, online players score points). However, IHY is also a performance, combining cinema vérité with documentary filmmaking. Online players are thus not *just* playing a computer game, but are watching a performance put on by artists (runners, control room crew, etc.) on the streets of a real city (e.g., Manchester or Sheffield). In this respect, the runners on the street are also not just playing a game of tag with each other, but are interacting with people on the street, producing interesting shots of environments they pass through, and so on. Online players are thus also an ‘online audience’ (of the performance).

To date, IHY has run three times at different festivals: at *FutureEverything* in Manchester, UK in 2012, and at *Doc/Fest* in Sheffield, UK in 2013 and 2014. Each performance consisted of three 1 h long live broadcast game sessions, running at each evening for 2 days.

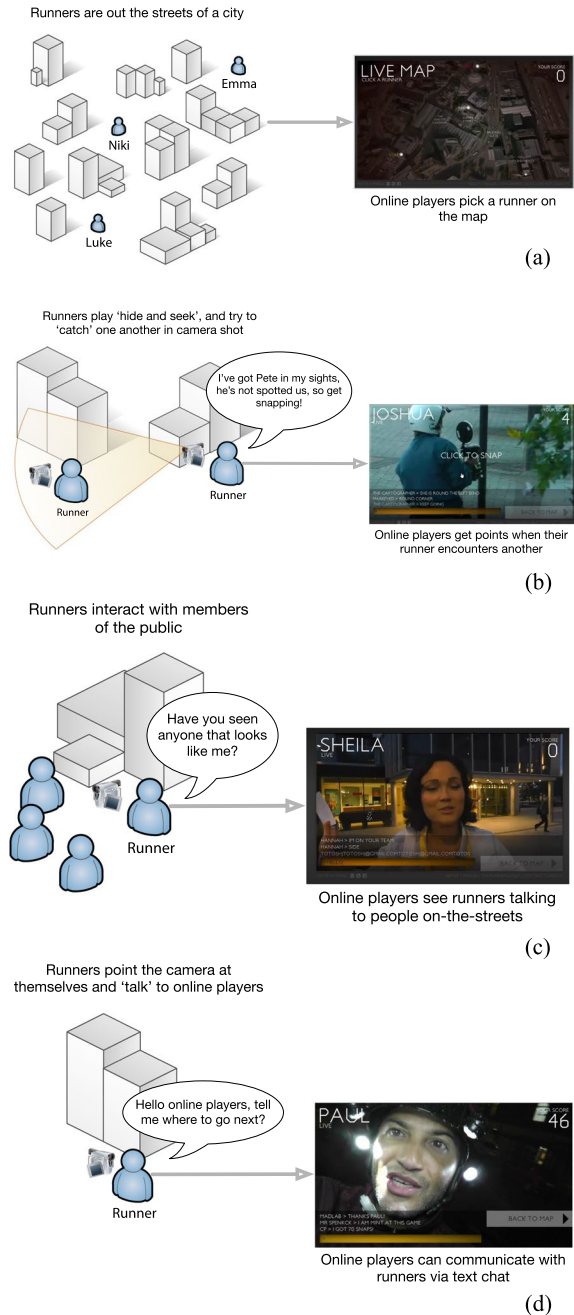
In the following section, we present a description of IHY from two perspectives: that of the online player participating in and watching the game, and that of the control room co-ordinating it.

3.1 Playing and watching “I’d Hide You”

Online players join the game via a web browser, entering a username of their choosing which is visible to the other players and runners. To take part, online players view a brief introduction video and then are shown a map of the game area with the location of the three runners for each game session positioned on it (via GPS). They then select to follow one of the three current live video streams broadcast by runners on a live map (Figure 1a) to begin the chasing and ‘catching’ phase of the game (Figure 1b). During this time, online players see a live video stream from their selected runner’s video camera (see Figure 1b–c for examples), along with chat messages from other co-watching online players at the bottom of the screen. Once a runner’s viewfinder shows a rival runner, any online players watching that particular stream can take a ‘snap’ of the rival runner, and score points (see Figure 1b). On the other hand, if the runner that an online player is watching themselves gets snapped (i.e., another runner gets *them* in their viewfinder), the player loses points.

During the game, online players can also engage in text chat with others watching the same video stream as them. Players may also message runners on the street, sending them encouragements, requests, or instructions. This communication between the runner and players is established by the runner periodically checking their camera rig, which features a smartphone displaying the text chat (Figure 2), which they regularly monitor to perform other game functions (such as manually operating the ‘snapping’ mechanism, seeing system status, and so on).

Figure 1. The Game/Performance (image credits: Blast Theory) **(a)** map view (depicting all three runners on the street); **(b)** video stream of runner ‘snapping’ another runner; **(c)** video stream of runner interacting with a member of the public; **(d)** video stream of runner performing ‘facetime’.



As already mentioned, runners were not just the avatars for online players playing a street game with each other. Runners were also tasked with delivering a performance for online players watching them. To this end, runners engaged in

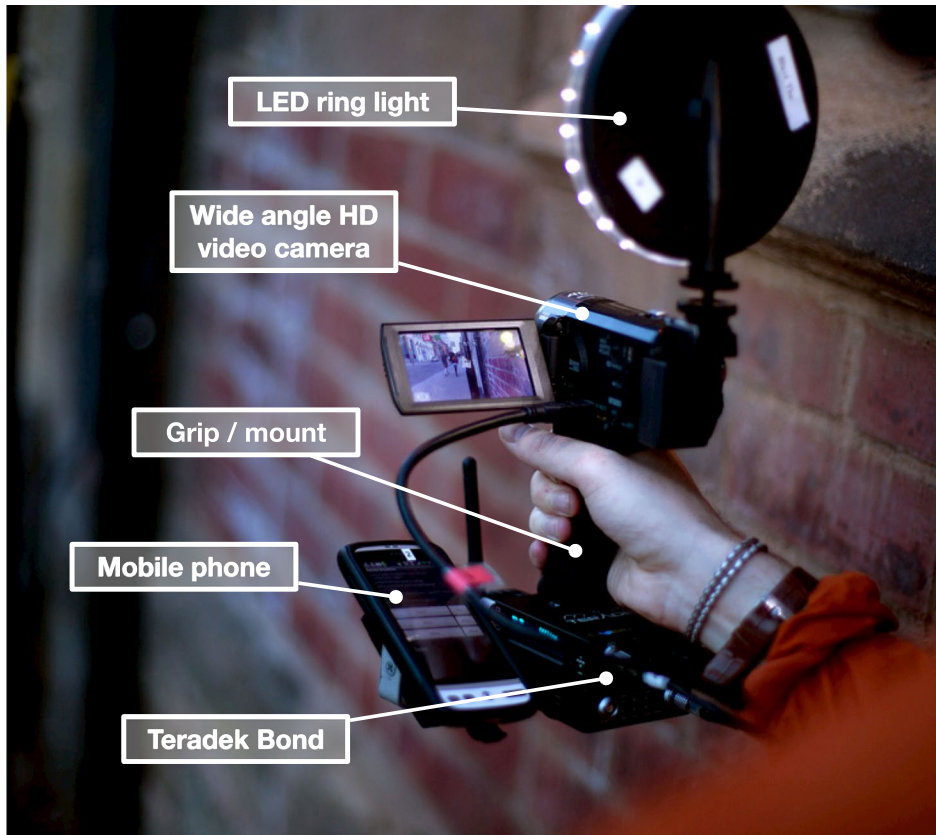


Figure 2. Runner camera rig (image credit: Blast Theory).

spontaneous interactions with members of the public (see Figure 1c, where runner Sheila is talking to someone on camera). This ranged from doing things like asking them about good places to hide, or whether the member of the public had seen other runners, through to adopting such people as ‘human shields’ to protect them from other runners, getting into a taxi for a short journey, or fulfilling a ‘secret mission’ such as getting a free drink in a pub. This sense of street performance thus infused what online players saw and influenced via text chat. Even more importantly, runners would find the time to turn the camera on themselves (doing ‘facetime’ as it was labelled by the artists), directly addressing the online players as an audience (see Figure 1d, where runner Paul is directly addressing online players). During performances, online players frequently wrote messages to help direct runners to others, asked them questions, and responded in text chat to questions from runners themselves.

The experience for such audiences, thus, was that of having a live connection with runners they were watching, whom they could both see the performed actions of and have the ability to influence. For instance, in Figure 1b, you can

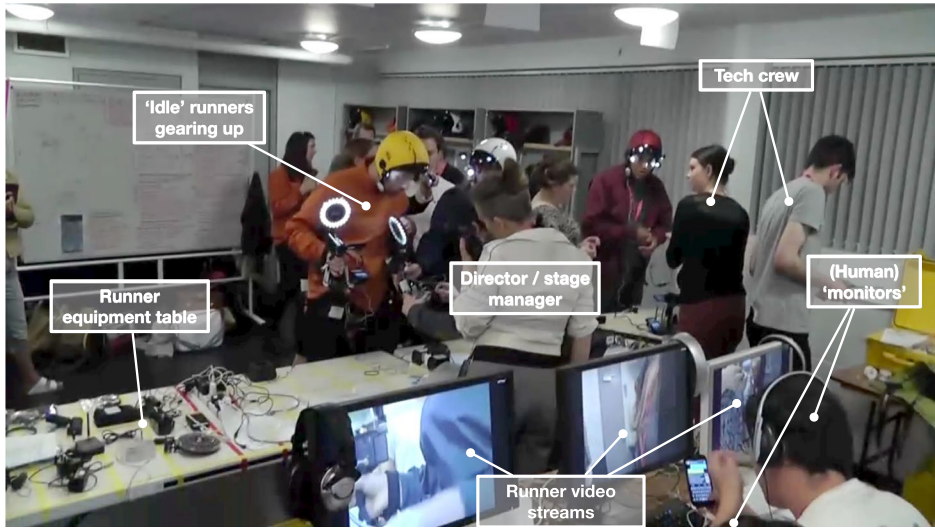


Figure 3. The control room of I'd Hide You.

see online players telling the runner (Joshua) that another runner “is round the left bend” and “round corner”. This kind of unfolding, live interaction was a powerful experience for online players, and formed a core attraction for them to play IHY. In post-game feedback, players mentioned things like the “sense of connectedness”, “getting to know the runner I was following” as enjoyable features of the game, as well as “dialogue[s] I had with other online players” and the fact they could “share intelligence with the runner I was following”.

3.2 Running IHY

IHY is managed via a complex technical setup within the control room located nearby the performance area. We briefly outline how the control room itself is organised—both as a division of labour and a set of systems and equipment—as this will become relevant in our later analysis.

Figure 3 shows the main control room, which consists of an arrangement of runner gearing-up tables (for equipping runners prior to game sessions) and video stream monitoring tables where human ‘monitors’ sit watching the three streams broadcast live by runners on the streets. Behind this at the rear of the control room (not pictured in Figure 3) was a table for the technical director.

Our focus will be on the monitors watching the runner video streams and the director/stage manager, with occasional references to the technical director. A simplified diagram of the setup is provided in Figure 4, which shows the lines of communication and roles taken on by team members.

At any one time, there are three **runners** on the city streets. Each runner has a camera rig (Figure 2) and a radio for communication back to the control room.

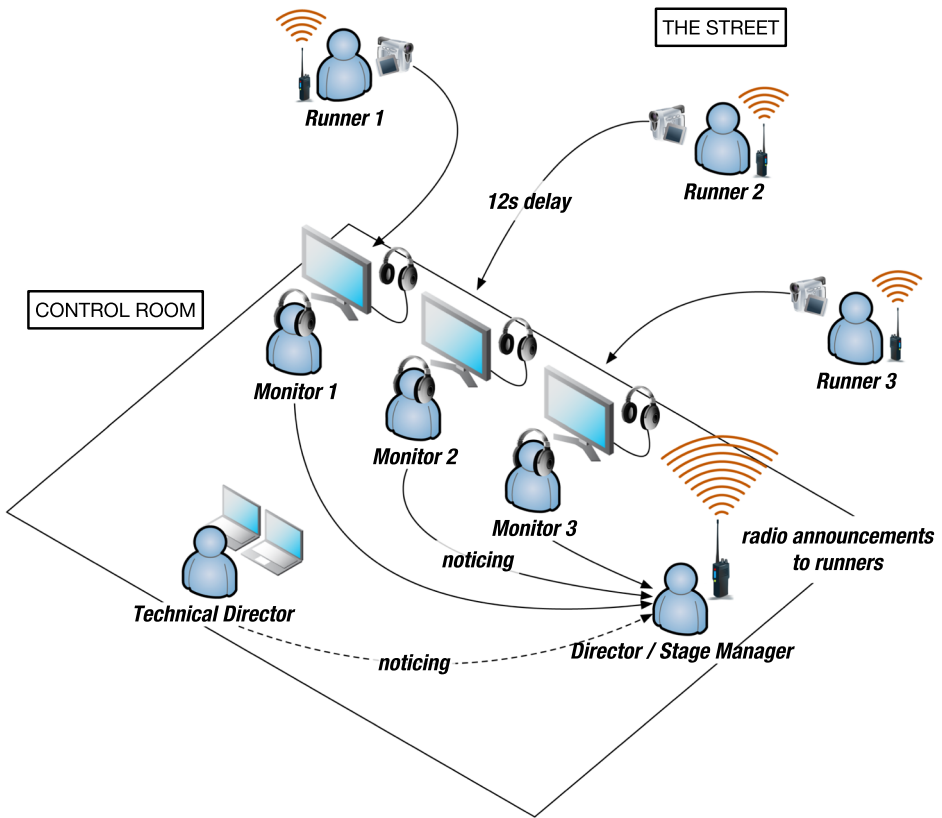


Figure 4. The control room and its relation to the street.

The runner radio channel is shared between themselves and the director/stage manager. There is a 12 s latency between the runner's audio/video stream and it appearing (simultaneously) in the control room and online for current players.

Each of the three runners' streams is watched by a designated **monitor** who performs multiple duties. Primarily they are tasked with noticing problems ('troubles') occurring, such as technical and performance issues, and alerting the director/stage manager where appropriate. However, monitors also note down suitable moments for later compilation into a showreel video documenting the performance. They wear headphones most of the time (each runner video screen has two headphones so that other people in the control room may listen in at the same time as a monitor).

The main point of radio contact for the runners is the **director/stage manager (D/SM)**. Primarily this person does something akin to 'stage management', in dealing with the smooth running of the overall performance and resolving troubles; secondly, this person also implements what we describe as

‘artistic direction’, i.e., the accomplishment of an artistic vision (see Hodge (2010, p. 2) on the emergence of the role of ‘director’ in contrast to a ‘stage manager’). The D/SM is alerted to any technical or performance issues by monitors, which are then dealt with as appropriate by the D/SM (e.g., radioing runners with instructions, asking tech crew to resolve a technical failure). The D/SM also proactively asks monitors in the control room for feedback on the activities of each of the runners. The D/SM generally stood behind the monitors, so as to be ready to respond to trouble, but also so that they could watch streams themselves to get an ‘overview’ of the game. There was generally one D/SM for most of the performances we examined (Ju), however at times a secondary D/SM (Hannah) stepped in to take over.

Finally, the **technical director** performs various critical game tasks such as opening and closing the game sessions, ensuring game systems are running correctly, fixing technical problems (e.g., monitors noticing that their runner stream has gone down), and also more occasionally noticing troubles that need to be dealt with by the D/SM.

3.3 Studying IHY

Our prior studies of IHY have focussed on the phenomenology of runners’ performances, examining the challenges they faced in broadcasting live from city streets whilst balancing the demands of interacting with online players, members of the public and, of course, the control room (Reeves et al., 2015). Like this prior work, our approach here is ethnomethodological (Garfinkel 1967, 2002), by which we mean we are interested in how IHY was *practically accomplished* as a performance.

Our ethnographic study involved the first and second author of this paper capturing video across all three performance runs of IHY. For IHY in 2012 (Manchester), we focused on establishing an initial broad orientation to IHY as an experience, identifying the key practices involved and issues arising. Following on from this, we studied a subsequent performance in 2013 (Sheffield). This offered the opportunity of a deeper ethnography, covering four days, including the initial setup (training processes and rehearsals) as well as the public performance. Finally, for its 2014 run (Sheffield again), we focussed on capturing online player experiences.

During our fieldwork for the first Sheffield performance, we collected four days of video and audio recordings mostly based in the control room, but also capturing moments of training as well as team meetings, and the occasional interview with artists and performers. From these recordings we present two main classes of data fragment: 1) control room fragments which present sequences of activity between control room staff, and between the D/SM and remote runners; these form the bulk of the data presented in this paper (transcribed here using basic orthographic form); and 2) meeting fragments which are transcriptions of

segments of team meetings, and are largely monologues by specific team members on a particular topic.

4 A control room of artistic work

Our study focuses on three features of the control room. First, we look at the activity managed by the control room, and show how team members orient to the fact that this artistic performance was produced for an audience. Second, we examine divisions of labour in bringing off this artistic work and show how—oriented by the output of this control room as artistic content—the organisation of the control was highly hierarchical. Finally, we look at announcements—radio communications employed by the D/SM to address runners—and how they were used to stage manage and direct IHY as a performance. Apart from more typical ‘command and control’ announcements, we also find ‘reminders’ and ‘directions’, which—particularly the latter—we find distinctive of the artistic character of work being conducted via IHY’s control room.

4.1 Managing an artistic performance

4.1.1 Artistic output

The ‘output’ of the managed activity here was notably ‘artistic’: the ultimate aim was not to perform specific tasks (e.g., landing planes, running trains, or handling baggage) but to create ‘compelling content’ (although of course one *could* frame this itself as a kind of ‘task’, just a different one to the aforementioned). This preoccupation with ‘content’ was often modulated with explicit notions like the importance of what the artists themselves described as “variety” in the performance, or the provision of distinct kinds of content. Such ideas were regularly referenced in training episodes with runners. In these sessions, artists talked about runners developing a “repertoire” of things to do while out on the streets, drawing from a “rich palette” constituted by various elements of the performance, coupled with the notion of different and distinct “flavours” with which to create an interesting and rich experience for online players. This “repertoire” spanned elements like chasing other players, interaction with members of the public on the street and online players, performing interesting monologues on camera, and capturing interesting camera shots of the game and the environment of the city. IHY’s training focussed on developing and preparing ways to *reliably* generate such moments and find their overall balance within the performance itself, whilst retaining elements of improvisation and unpredictability.

During the training sessions, runners were given guidelines about what they should be doing during the performance (Figure 5). These broad aims seem quite different from those that one might expect for activities managed by control rooms, although they could be compared to a set of operational ‘conventions’ perhaps. These conventions are not directly ‘functional’, however, nor do they

Figure 5. Excerpt from performance notes document issued to IHY team (1).

Talking To The Public On The Street

Overall mood

- stealthy, mysterious, hiding, secretive, less high octane
- chatty, fun, upbeat

have to do with efficiency of a particular task. In that sense they are qualitatively different.

This was echoed in a debrief session by the D/SM:

“I think the thing that everyone should try and focus on is: you’re trying to build conversations with people. You have a licence to talk to people in the street and especially to talk to people online about anything that you want. And to think between now and eight o’clock tomorrow night, about things that you would want to ask total strangers in the street.”

Fragment 1: D/SM debriefing runners after a game rehearsal

Here, the aim is to *create* a performance (performed via, but *not* subordinate to, various functional tasks).

4.1.2 Output produced for an audience

For control rooms, the aim of the managed activity is to accomplish specific material things like getting planes to an airport, getting trains from station to station, or getting luggage to the specific place. IHY’s control room was no different in that it too had an activity to be managed—i.e., playing a hide and seek style game. But, notably, that activity itself was also meant to be *seen*. Thus game activity managed by the control room produced content designed primarily for its (online) *audience* (as seen in Fragment 1). This was frequently remarked upon in the debrief session after training or even the performance, for example (key points underlined) in Fragment 2:

“Yeah, I guess it’s just remembering that, hm, your main audience is the people online... you know, as much as you’re interacting with people [on the street], you’ve got to be checking [the mobile phone] at the same time, I guess, isn’t it, I mean interacting with... you’re bringing them out there into the game”

Fragment 2: D/SM debriefing runners after a game rehearsal

Here, the D/SM remarks that it is the responsibility of the runners to bring this online audience ‘into the game’.

This recognition of the importance of connecting with their audience can be seen in other ways. In Fragment 3, the D/SM relays to the whole control room a message she has received from a team member present in the public part of the venue (in the Crucible theatre in Sheffield, a backstage room of which was also where the control room was sited). This public part of the venue is where festival-goers are milling around and three public machines are available to play IHY by festival attendees (and any other members of the public entering the building).

D/SM: People here are lovey-doving it, I just got a text from Kirsty

Team member: Really? In the Crucible?

D/SM: Yeah

Team member: Has anybody been in the Crucible to film?

D/SM: No

Fragment 3: Reporting back player experiences from the Crucible

At the start of the above fragment, the D/SM receives a text message from another team member (Kirsty) who is currently away from the control room, but is nearby the public machines. The venue itself is one of the buildings that runners may enter during a game session, which a team member introduces as a possibility (“has anybody been in the Crucible to film?”). The D/SM’s initial comment illustrates that the production underway is getting the kind of audience reception she wants to achieve, but this is extended into a longer interaction and given a positive reception by others in the room. What is especially interesting here is the reference to the Crucible as this is where a possible public *co-located* audience may gather to watch the live feed from the game. As we see, this novel turn is appreciated both by physically co-located online players in the Crucible who are characterised as “lovey-doving it”, as well as being generally positively received by control room team members.

There was thus a concern for how the activities managed by the control room will ‘look’ to an audience, and what the impact of performers’ work on the streets being in full view might be. For instance, during the team meetings, the D/SM and artists frequently talked about how online players might be experiencing this or that element of the performance. Hence they emphasised that the overall aim of the performance was “about the online player’s perspective” and aimed to “keep the online audience entertained”. In this way, control room activities became framed in terms of managing the projected experiences of the online player.

For instance, runners were encouraged by the D/SM to do frequent facetime (pointing the camera at themselves), a practice taken from cinema where the protagonist ‘breaks the fourth wall’ by addressing the audience directly. As the D/SM put it during a team meeting: “you’re trying to build conversations with people. You have a licence to talk to people in the street and *especially* to talk to people online about anything that you want.” Furthermore, when discussing whether runners should or should not do something as part of their performance,

Figure 6. Excerpt from performance notes document issued to IHY team (2).

Talking To Online Players – respond honestly, set your own limits

- Ask "where are the other runners?"
- Ask "where should I go next?"
- Ask " what should I do next?"

this was assessed in relation to whether it would be of interest to online players. During one such discussion the D/SM commented: "It is a possibility. But if you are doing that, you're doing that not for your pleasure but for the people online's pleasure." Some runners described envisioning themselves as embodying the online audience. One runner commented during a team meeting (emphasis ours): "I think that's because we tend to embody the game *ourselves* and it's about trying to allow the online player to be embodied in it. So as that *conduit*, as you [the D/SM] were saying earlier, we have to slow down."

IHY was not just 'any' performance, but an explicitly interactive one. As a result, the control room adopted methods to help generate more possibilities for interaction and therefore assessment for IHY in terms of its quality as an artistic performance. Hence, runners were explicitly instructed to *ask* the online audience questions (see Figure 6).

Runners were frequently reminded to mention the *names* of the online audience (who—we remind the reader—communicated continuously with runners through text messages on the runners' mobile phone). As the director put it: "it can be really delightful for people online to hear their names". During a team meeting the main D/SM (at this point Ju) described it in the following way:

Engage those people. Say their names. People love to hear their names. It's really, really good. And when you call out to somebody and go "Hi", don't forget to say: "Hi, Ju" or "Hi, Henry" or whoever it is. Because then it's like a direct line straight to that person. And it's just like lovely. It's like live radio. It's beautiful.

Fragment 4: D/SM describing how to engage with the online audience

This concern, clearly co-oriented to by both audience and performers, underpins the sense of "connectedness" reported by online players mentioned earlier.

4.1.3 Evaluations of the managed activity

The orientation to producing 'compelling content' meant to be seen by an audience, was also reflected in the kinds of assessments that were produced within the control room by the D/SM and other team members to reference specific runner behaviours observed on the monitors. Assessments made by the control room were also shared with runners as part of directorial practice by the D/SM (announcements).

Perhaps the most striking feature of these assessments was the frequent use of “lovely”, “sweet”, or “nice”. Several examples drawn from our capture of the D/SM’s radio announcements to runners during the course of the performance illustrate this:

“That’s a lovely shot there Sarah. Very nice, very nice. Over.”

“Lovely shot there, Niki. Nice reflection in the water ball. Over.”

“This is Ju to Emma. That is a lovely shot of people walking along. Over.”

“This is Ju to James. That was a lovely shot, as the cyclist went past. Over.”

“That was very sweet Niki. Over.”

Such assessments clearly illustrate that the work being done was seen as *creative* and *artistic* through reference to its experiential qualities. Members of the team were open to engaging with a host of judgements and evaluations that connect with the categorical frame of ‘performance’. It would likely be hard to try to transplant this kind of assessment to other control rooms such as flight control, or urban traffic control rooms, where the focus of assessment tends to lie more in functional efficiencies and operational regulation.

Furthermore, what we see here is that the D/SM radioed qualitative assessments of runners’ ongoing performances back to them. These helped shape the runners’ understanding of the D/SM’s own expectations from them and the reception of their activities in the control room, as well as acting as encouragements, and possibly heard as requests of them to prolong their current activities.

4.1.4 *Managing artists*

This orientation to artistic performance for an audience becomes even more visible in the advice given to runners, much of which was delivered during team meetings. Here we draw attention to one such meeting conducted prior to a live broadcast, where the D/SM connects the character of individual runners’ performances with these ideas:

If you feel like you’re being a bit silent you probably are. Sort of, trust those instincts. And if you think you’re probably stuck talking about one thing you probably are. Sort of, trust your instincts to, kind of, just jump to another thing or jump... Do you know what I mean? I’d much rather that you, kind of, rambled on and were charming and weird and lovely than felt like, sort of, trapped. So, you know, there’s no perfect, there’s no, you know... And it’s about everyone’s personalities coming through, that’s why we work with a bunch of people that we don’t know. For us it’s a delight and, you know, what you have is something that we don’t have and collectively we have something else. And the people online and on the street they’re going to get this kind of rich palette. You know, we’re all kind of reading this story together so it’s yours as much as ours.

Fragment 5: Performance directions by the D/SM to runners during team meeting

Here the director treats the runners as artists and performers reacting creatively and reflexively to circumstances. The *differences* between performers are something that is seen as an advantage (“it’s about everyone’s personalities coming through”), rather than as problematic deviations from the norm.

4.2 Division of labour

Control rooms are set up to manage multiparty, fragmented and distributed work; this need is also reflected in the technologies that they use. Such work needs to be coordinated in a way that produces coherent activity. The notion of a ‘division of labour’ has therefore been a prevalent concern for studies of control rooms in CSCW, using this concept as a way of describing how work is broken down and reassembled: specifically, how a control room might accomplish a range of complex and interdependent activities, where work may be undertaken by multiple people. We want to draw out the details of the division of labour both *within* the control room as well as *outside* it. From within we want to examine how IHY team members managed various performance activities with an organisational hierarchy that then structured the delivery of creative work. From outside, our study must examine the way the control room coordinates activities with remote runners and handles challenges around access to the performance—which happens ‘out there’—by control room members.

4.2.1 A hierarchical division of labour for artistic work

The most important finding is that—as we just outlined in the previous section—although the output of this control room was creative or artistic work, the organisation of the control was nevertheless largely *hierarchical*; a form of control room work perhaps less well-represented and less well-characterised in the literature.

We get a sense of how this hierarchical organisation worked out in practically in the fragment below, which we have selected as representative of many interventions involving the D/SM. To set the context of this fragment, the team are running three ‘rehearsal’ games before the public opening of the game the following night. Because there is no public audience yet, there is more radio communication from runners than usual. As we join the action, the D/SM is doing what normally happens during game sessions, which is to stand either beside or behind the bank of screens showing runner streams that monitors are watching and listening to (Figure 4). At this point, a monitor (M2) alerts the D/SM about a particular runner’s performance with the camera (James).

M2: James could do with holding the camera up when he’s talking to it, and also he’s only talking when he’s talking to the camera, he’s not talking while he’s like walking

forward.

D/SM: Okay.

(13s pause)

((D/SM walks in front of monitoring table to stand behind screen, puts on headphones, moves around to view screen for a moment. D/SM looks at screen, removes headphones, raises radio))

D/SM: ((via radio)) This is Ju to James. When you are walking along with your camera facing away from you can you carry on talking? It's not just when the camera's facing towards you. Over.

(2s pause)

James: ((via radio)) Yeah sorry about that, I'll get on it now. Err, over.

Fragment 6: “yeah sorry about that”

Firstly, this fragment is indicative of a normative order that permeates the divisions of labour within the control room and from it to the outside. This is an order, not only in the way (radioed) interventions tended to unfold—which we examine as ‘announcements’ in more detail later—but also of *which* participants were involved in an intervention. Overwhelmingly, the divisions of labour spanning the control room and the outside environment included three parties—the D/SM, the monitors, and the runners. In Fragment 6, the D/SM manages coordination between these ‘inside’ and ‘outside’ divisions of labour, between herself and the monitors, and between herself and the runners (who, we should note, do not directly communicate between themselves).

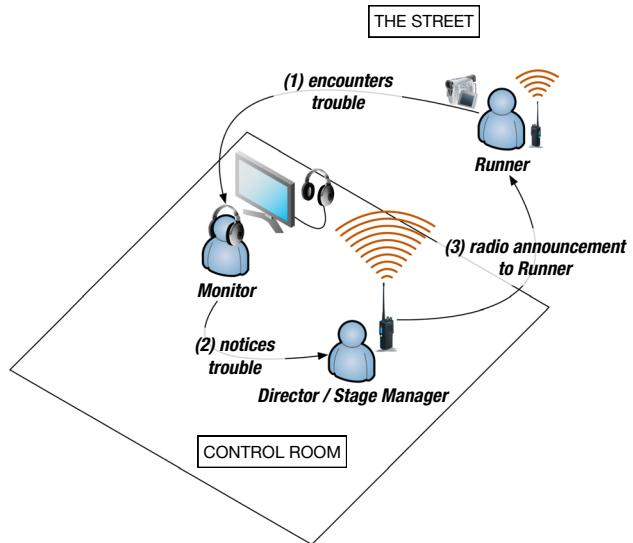
This hierarchical organisation sets IHY in modest contrast with some other studies which tend to focus more on parallel, albeit enmeshed, activities. For instance, we might point to the ways in which ‘noticing’ (e.g., emerging troubles) and ‘announcement’ (to drivers, passengers) were more evenly shared across participants within Heath and Luff’s well-known studies of London Underground line control rooms (1992).³ In contrast, for IHY, such noticing and announcement practices were strictly circumscribed jobs, coupled to a clear ‘chain of command’ structure, perhaps somewhat more akin to a military or space mission control centre (cf. Watts et al., 1996). We expand on this below.

Figure 7 sketches the sequence from Fragment 6, giving us something of a ‘canonical’ or ‘template’ form for typical interactions between members of the IHY team: runner (trouble) → monitor (notices) → director / stage manager (announces) → runner (resolves). Each stage of the process involved leverage of specific responsibilities and circumscriptions of action; team members were thus accountable to this general division of labour.

To begin with, there is a source trouble generated by a runner but typically not noticed by them (otherwise they would act independently to resolve it). Thus, monitors (M2) work up what they have seen as a *noticeable trouble* that can

³ This is similar to more recent work in which we see even more decentralisation and loose couplings of mutually relevant actions (e.g., see Luff et al. 2018).

Figure 7. The control room
sequence: Runner > monitor > D/
SM > runner.



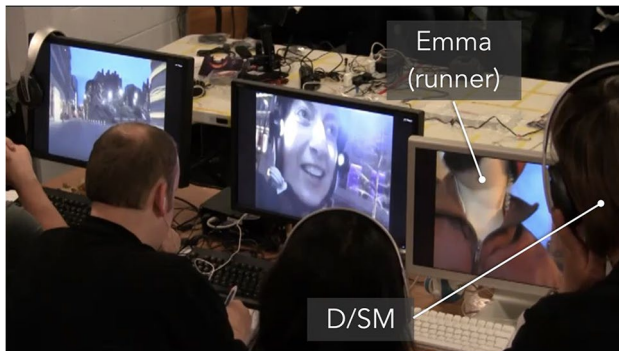
then be articulated to the D/SM. In Fragment 6, M2 identifies two problems: the way James is holding the camera while walking, and the camera angle when he delivers a monologue to it. Given the role of the monitors in identifying potential troubles but without the means of correcting it themselves, the monitor has to alert the D/SM to resolve these. In this case, M2 shifts his headphones to one ear (visibly emphasising a disconnection from his orientation to the remote action) and gazes towards the D/SM. Consequently, this action receives the attention of the D/SM. As it is not immediately obvious what the trouble is (the D/SM cannot view retrospective action from the runners), the monitor also must articulate his concern (“James could do with...”). Second, the D/SM then *checks* the specific runner to audit the potential problem. In this case, it means watching the screen and listening to the audio. Third, the D/SM radios the runner (R2) with an *instruction*, which in this case picks up on one of the troubles articulated by the monitor. Fourth, and finally, R2 (James) then acknowledges *receipt* of the message by way of an apology. This coordinative ‘format’ of a typical intervention sequence shapes how expectations, responsibilities, rights and an overall sensibility is to be adopted or carried out to achieve team members’ preferred courses of action, at the appropriate times, and effected through suitable means.

4.2.2 Differentiated perceptibilities as a result of the hierarchical division of labour

As a result of the hierarchical division of labour, not everything that happens ‘out there’ is perceptually available to everyone ‘in here’. So, many things simply

cannot be seen or heard by the D/SM, i.e., the only participant who is able to communicate with the runners ‘out there’.

In the previous fragment (Fragment 6, “yeah sorry about that”), trouble was noticed by the monitor, who then alerted the D/SM, who in turn then made an announcement to the runners. However, the D/SM could also make announcements directly, by assessing the visual appearance of the video stream from a runner and articulating the problem herself (Fragment 7). Here the D/SM can very literally see the problem, which she corrects via an announcement:



D/SM: ((watching screen on monitor)) this is Hannah to Emma (.) just lift your camera up a bit so we can see your face

Fragment 7: D/SM radioing directives to the runner about camera position during a live game session

First, we identify ‘*technical perceptibility*’ as limiting informational access: not everyone in the control room is able to assess technical matters as an emerging form of trouble. In Fragment 8 below, it is the technical director (TD) who locates a noticeable trouble with runner Pete’s performance and brings it to the attention of the D/SM:

TD: Uh, Pete is obviously not pressing his button on his phone

D/SM: Okay ((raises radio)) this is Ju to Pete, when you snap you need to press the button on the phone. Over.

Fragment 8: “not pressing his button on his phone”

Here, the runner is failing to press the button on his phone when he encounters other runners, meaning that online players therefore cannot score points by snapping (reminder: snapping is essentially an activity that must be managed by the runner during play). Only the TD can see this problem because it involves examining the debug output of the game engine’s inner workings, none of which is available to monitors. It is also not immediately available to the D/SM watching

the screen, although the discrepancy will very visible to the player. (It may be remarked upon by someone within the chat, and therefore *could* be rendered available for anyone following that chat, but this is something the D/SM rarely had time for.)

Technical perceptibility primarily occurs because of divisions between control room members based on their technical specialisation. One example of this is a split between being able to see the ‘underlying mechanics’ of the game compared with what the consequences of those mechanics are: the control room of IHY tended to divide these elements up, and this was most clearly evident in the work of the technical director. What is available to the TD and the D/SM differ substantially. This is illustrated in the Fragment 9 where the D/SM has been watching and listening to the runners delivering their closing game monologue to the camera. She then informs the TD of the runners having completed these closing speeches and asks him a question:

D/SM: Okay, they can come in, right, are you gonna switch it off?

TD: Mmm.

D/SM: Is it off?

TD: You’ve gotta wait thirty seconds.

D/SM: Okay wait.

Fragment 9: “is it off?”

Here the D/SM begins by asking the TD if the game is shut down (“are you gonna switch it off?”), at which point the TD notes that it takes thirty seconds to complete this procedure (which presumably is underway). Between them, the D/SM and the TD are managing the timing of the end of the game (i.e., precisely when the live feeds will cease streaming) alongside the need for runners to return to the control room to take off their equipment and pass this over to the next set. This is an activity that must be done as efficiently as possible due to the short period of stoppage between game sessions. What is available to the monitors and the D/SM is *not* the same as what is necessarily seen by online players—for instance, runners’ cameras may still be broadcasting on their return to the control room, but from the online players’ perspective, this will no longer be available since such streams are either shut down or made private. Instead, it is the TD who has the appropriate technical resources to ‘see’ these different perspectives and therefore the D/SM must refer to him during moments such as this to proceed with instructing the runners to return to the control room at a point where the live video streams are successfully hidden from online players. In this sense, as with Fragment 8 where the D/SM cannot ‘see’ whether online players are able to snap or not, here the D/SM also cannot (literally) see the video feed as it appears to online players. The control room *separates out* this online player view from that of monitoring the runners to offer a ‘front-stage’ / ‘back-stage’ type of arrangement (Reeves et al., 2015) as a matter of the division of labour. This purposeful splitting of perspectives is supported by the spatial arrangement;

the TD sits directly behind the three monitors and the space in which the D/SM tends to ‘hover’ around during the game (see Figure 4). In this way the TD is able to: get a visual overview of the play from where he sits, retain access to the technical running of the game via his own computer in front of him, and gain a different perspective by simultaneously playing as an online player, enabling him to simultaneously check the interface for any troubles.

Second, we identify ‘*temporal perceptibility*’ in limiting informational access: restricting or making work visible because of how activities play out sequentially, leading to differential access to activities by team members over the course of game sessions. We can draw a basic distinction between the availability to team members of performance troubles emerging ‘here and now’, versus those that emerge over a longer period of time.

This can be observed in the role of the monitors, whose job within the division of labour is a close and continuous inspection of an individual runner. In some sense, they act as ‘surrogate’ players, providing a bridge between outside and inside. Monitors therefore have access to a rendering of runner experiences over time, although as noted above, they can only see certain aspects of the online player experience. At the same time, monitors also orient differently to the video streams in their task as compared to others in the control room, in that they are spotting trouble, noting down showreel moments, and so on. Activities that are thus ‘invisible’ to the D/SM by virtue of their gestalt view instead become visible to the monitor through their sustained temporal focus. For instance, runners slipping into repetition or ‘boring’ kinds of activities are more apparent, and more available to the monitors as a product of this situation, and, furthermore, as a product of the chosen division of labour in IHY’s control room. One monitor raised this point during a team meeting when asked by the D/SM for feedback:

... one of the runners that I was monitoring was talking to one person in public like for quite a long time, like three or five minutes. I think that is not that interesting for the viewer to see, so probably just keep it a little... just one minute when talking or something like that, so not too long.

Fragment 10: Feedback from monitor during team meeting

Third, we identify ‘*aural perceptibility*’ in limiting informational access not just by seeing, but also by hearing. While it was easy to parallelise monitors to see what is going on, it was difficult to do the same for three streams of sound in IHY, i.e., to simultaneously attend to what all three runners are saying. Solutions present in control rooms like NASA mission control employ audio loops to deal with this problem, where those in charge in the hierarchy can enact broad aural oversight. However, in this case, individual runner performances do not need to mesh together so closely as different units must do in a rocket launch; indeed,

differences in their ‘textures’ as individual performances was considered desirable by the artists as we have previously outlined.

Within the IHY control room, sound, and its availability, created a differentiated set of perceptibilities in the division of labour. In discussing the test / rehearsal game sessions (which lasted 20 min), the D/SM observed the following during a team meeting:

I didn’t listen enough to each person [runner] if I’m honest because 20 minutes is like, I’m trying to listen to three people and obviously technically I was kind of doing this. So I will tonight listen to each of them really carefully for like five minutes each to make sure that I can hear anything.

Fragment 11: D/SM reflecting on test / rehearsal game session

So, while it is possible to parallelise vision to some extent in that the D/SM *could* attend to three video streams simultaneously (albeit in a limited way), it is far more difficult to listen to three corresponding audio streams in parallel at the same time whilst retaining a semblance of artistic judgement over the performances. Differential access means the D/SM needed to develop a strategy for maintaining her awareness of what the runners are saying (and therefore doing), which is a key part of what the above fragment shows the D/SM working out. While monitors can flag up troubles, the parameters of *what counts as a trouble* is the prime concern of the D/SM’s announcements to runners. So, some measure of monitoring by the D/SM herself, particularly of what runners are saying, becomes important to configure this. We can see this in the following fragment:

D/SM: Is, um, do you think he’s reading off the phone, is he making any-

M1: He is making comments.

D/SM: Er yeah okay.

Fragment 12: “is he making comments?”

Here, the D/SM checks with the monitor about the performance of the runner, asking whether the runner is “reading off the phone”, i.e., whether the runner is reading out the text messages sent by the online audience, an important way to achieve interactivity in the performance and “connectedness”. Critically for this fragment, the D/SM asks the monitor about something that is not observable ‘in the moment’. The D/SM doesn’t want to know whether the runner is “making comments” *at the moment*, but whether he *has been* “making comments” from time to time. In contrast to, say, holding the camera properly, which could be checked by simply looking at the current stream on the monitor, “reading off the phone” is *not* something that is currently observable.

Perceptibility is a persistent issue for control rooms in general. Thus, for example, we see solutions like large banks of video displays to enable continuous access to studio floor camera operators’ streams in TV broadcasting production rooms (e.g., Broth, 2004, 2008). In that case, a director and editor might sit

side-by-side making choices about which camera to select for broadcast as well as communicating to camera operators (and sometimes presenters) about various matters: who is about to go live on air, camera positions, shot framing, etc. But whilst video is parallelised in these environments, sound tends not to be, in essence avoiding the challenges presented to the IHY control room team. It is the need to retain parallel access to sound which leads to some aspects of internal division of labour in IHY, specifically the adoption of individual monitors watching and—crucially—listening to each audio-visual stream.

In sum, although division of labour is a well-worn topic for CSCW's explorations of control rooms, IHY lets us further reflect on this: on the uses of hierarchical organisation deployed within that context for artistic purposes, as well as the importance of different lines of 'perceptibilities', their meshing with the management and artistic assessment of the performance, and in co-producing the textures of these specific divisions of labour.

4.3 Announcements from the control room

We finish our analysis with a discussion of the announcements from the D/SM to remote runners, which lie at the heart of a control room. In prior studies we also find announcements, linked in particular with coordination and trouble-solving. These are typical for control room settings (Goodwin, 1996; Heath and Luff, 1992) and correspond to the functions in Suchman's (1993) definition of 'centres of coordination'. Whilst the method is old, the *form* of announcements in IHY offer a novel insight atop this prior work, in that they are about 'educating' the performers as well as 'directing' them. Before we turn to look at these, we briefly outline the conventional types of control room announcements present in IHY.

4.3.1 *Coordination and trouble-solving announcements*

Like many control rooms, IHY relied upon radio communications to manage distributed actions and, in this case, to coordinate with runners on the streets. Quite a few of IHY's radio announcements were related to the coordination of activities. They thereby connect to one of the three functions in Suchman's (1993) characterisation of control rooms in which they are "dedicated to the ongoing management of distributed activities in which one set of participants is charged with the timely provision of services to another" (p. 114). Announcements were employed by the D/SM to do things like managing key events in game sessions, or to give runners updates on the progress of the performance. They typically concerned timing, pacing, and were also employed in coordinating moments of collaboration between runners. As such, announcements tended to be clustered around the start and end of performance sessions, for example:

D/SM: ((into radio)) This is Ju to all runners, you can now give your opening text and start to back off from the other performers. Over. Enjoy. Have a good time! Over.

Fragment 13: Coordination announcement

In Fragment 13, the D/SM's announcement establishes a coordinated temporal event sequence for runner actions. Having assembled the runners together in a close cluster, the D/SM's announcement now directs runners to perform their "opening text" (an introduction to the game) to the camera and online players, and to begin dispersing into the city streets ("start to back off").

Other announcements dealt with trouble-solving, i.e., relating to Suchman's second function of control rooms: "The activities being managed are open and vulnerable to an indeterminable horizon of troublesome contingencies, some of which the work of the site is designed to address, some of which arise in the work's course" (*ibid*, p. 115). Furthermore, these kinds of troubles usually had to be dealt with quickly so as not to interrupt the performance; in this way they are also connected to Suchman's third point, a "rapid response to a time-critical situation" (*ibid*, p. 115).

Some of the troubles our participants had to deal with included players' microphones falling off, video streams failing, needing to deploy a rain cover, a rain cover blocking the lens, needing to restart the mobile app, speaking too quietly or quickly, not framing members of the public runners are talking to, runners not framing themselves during facetime, or swinging the camera too quickly. These were dealt with typically via quite compact announcements (e.g., D/SM radios the runner Jordanne thus: "this is Ju to Jordanne, your mike is fallen down, could you put it back up please? Over"). Indeed, the majority of troubles encountered by the control room related to technical failures that required rapid resolution.

4.3.2 *Directorial announcements in artistic performance*

Apart from coordination and trouble-solving announcements, other kinds of announcements were related to the needs of managing an artistic performance and group of artists, rather than workers. As artists, the runners did not necessarily need 'directives' of what to do, but benefited from support for what they should try out or not forget. As one runner articulated during a team meeting, radioed announcements by the D/SM often presented themselves as "nudges" or "reminders" to runners:

Occasionally Ju [the D/SM] will just nudge you in a particular direction if she feels that you're going down one route too much. Just a little reminder, a little bit of redirection or something.

Fragment 14: A runner describing in-game interaction with the director / stage manager, during a team meeting

Such announcements to runners were frequent: over course of the live performance we most closely examined (two nights plus the public part of the dress rehearsal), the D/SM delivered around 340 of them via radio. Yet there was also a sensitivity from the control room in getting announcements' frequency right, as revealed in an exchange between a runner and the D/SM during a post-rehearsal team meeting:

Runner: As I was shadowing I noticed that you were giving a lot more feedback and it just came in and I think-

D/SM: Too much?

Runner: No. Great. Just little reminders, about-

D/SM: Okay, because I don't want to be annoying.

Fragment 15: Checking the level of 'reminders' from the D/SM

This concern for avoiding being "annoying" but nevertheless ensuring runners got "little reminders" initially seems like a politeness. Certainly, it seems possible that something similar could emerge in other control room settings where announcements are being made. However, for IHY this tells us there is *more* to these announcements; specifically how they actually play a key role in running and directing a live performance. We examine this in detail in the following sections on reminders and directing performers.

4.3.3 Reminders

Not all announcements related to troubles that had to—or could be—dealt with there and then. Some could be used as prompts to remind runners to avoid such troubles in the future.

We have encountered one example of this above in Fragment 8, when the D/SM asked the runner: "when you snap you need to press the button on the phone". At this point the actual trouble (of not snapping during an encounter) could no longer be fixed. The experience for online players for *that* encounter had already been 'ruined', so the D/SM therefore made an announcement to that individual runner to avoid this mistake in the future. In another fragment below, M3 gets the attention of the D/SM to inform her that the particular runner being monitored failed to frame the camera correctly when she encountered and spoke to a member of the public:

M3:(looking towards D/SM) Eh, one thing I will say is that when she [the runner] was talking to that woman, she didn' focus the camera on 'er.

D/SM: Mm-kay.

M3: It were basically it was like, somewhere else.

D/SM: Okay ((into radio)) This is Ju to all runners, would you just make sure when you are talking to the public on the street that you pull the cameras up to see their faces nicely. Over.

Fragment 16: “she didn’ focus the camera on ‘er”

It is important to note that just as M3 begins to request the attention of the D/SM (i.e., looking towards her), the runner M3 is watching is finishing her encounter with the member of the public and starting to move on. This leads to M3 using the past tense to refer to the encounter (“when she was talking to that woman”). The trouble identified here—shot framing—lies with runners not pointing cameras at the faces of members of the public when they are encountered. ‘Good’ framing was often difficult for runners to achieve since they needed to both conduct a conversation with people on the streets, while at the same time film themselves doing so (and attend to matters of shot framing and so on)—no mean feat. Unlike the bare accounts of trouble as in Fragment 15, the monitor here articulates the trouble in some detail. There are two aspects of the announcement that we draw attention to here. First, and in contrast with the prior section, while the trouble raised by M3 relates to a specific runner, the D/SM *generalises* the trouble by transforming it in her announcement to address “all runners” (the radio channel was shared by all three runners). Second, the D/SM uses a rule-formulated *instruction* in her announcement, i.e., in this case the rule being ‘when X, do Y’.

Other examples of similar troubles that were expected to be dealt with ‘next time’ by runners included runners not pressing buttons to ‘snap’ other runners, not talking when pointing the camera ahead of them (i.e., only speaking during facetime), and not checking player chat messages after having requested help from them (e.g., asking online players where they should go next). These instances involved instructional announcements emanating from the control room, i.e., to handle troubles that can no longer be resolved ‘now’ and are instead tied to various situational contingencies. In that sense, the control room orients to trouble itself as temporary or fleeting in some way, for instance where the framing of a shot is being poorly executed, but ‘disappears’ just as the trouble is spotted. While fleeting, it is still significant, and thus members of the control room also display an orientation to the possibility of future recurrence *unless* some adjustments are made by the runner. Further to this, while troubles to be dealt with ‘now’ via radioed directives from the D/SM are treated as *isolated* instances with no relevance to one another, these types of trouble accumulate *sequential* significance: that is, noticing that such a problem has emerged ‘this time’ (such as not pressing the ‘snap’ button, or not framing a shot correctly when speaking to the public) then transforms any prospective actions the runner performs *into* a ‘next time’. Ultimately the instructional format turns on producing solutions to these troubles that, while being matters to be dealt by the runner(s) as and when they see fit, nevertheless have a more specific criteria for application that must

be applied by the runner. Accordingly, the language used also differs from the kind of bare directives produced in announcements as found in the previous section. The D/SM's reformulations of these troubles into instructional, rule-based arrangements ('if X, do Y' or 'do X when Y') underpins this organisation of action between D/SM and runner.

We have further evidence of a common organisational orientation to this kind of trouble: frustration was sometimes expressed by members of the control room (monitors, technical staff, idling runners playing the game, etc.), as if a perceived rule had been violated (such as failing to press the snapping button). Interestingly, in such instances the D/SM usually employed the address "all runners". These elements—addressing all runners instead of one, and formulating this as a rule to follow—mean that the remote team member's mistakes could be interpreted as a possible 'teachable moment', with the associated control room announcements constructed in such a way by the D/SM to avoid a possible element of 'blame' or 'singling out' that might come with the pointing out of possible rule violations.

4.3.4 *Directing performers*

In addition to announcements acting mainly in service of stage management, we found much radio communication was *directorial* in nature—a notion, we think, which enriches prior work on conceptualising control room announcements. Here we discuss the D/SM's work as the work of a director shaping IHY as both game and performance.

Advice for directors in theatre or film frequently emphasises that the director should not issue 'directives', i.e., should not just tell performers 'what to do'. Thus Clurman (1972, p. 95) notes: "Direction is not to be equated with giving orders." Similarly, Rabinger (2008, p. 4) underlines that the job of the director is to "get the best out of people without being directorial." In this view, actors need to 'own' their performance, i.e., inhabit the character, to ensure a successful performance. As Catron (1989, p. 221) notes: "Remember that actors must discover characterization qualities themselves. [...] Your job is to lead each performer by asking questions, not by supplying answers."

Servicing these principles in the control room—enabling artistic work to take place via its communication by the director—marks some announcements as being distinct from others we have explored, such as reminders. Directorial announcements are thus often formulated in what Weston (1996) calls the "language of permission" (and which he contrasts with the "language of enforcement"):

"Learn to give direction in the language of permission, rather than language of enforcement: 'It's okay to slow down,' rather than 'You're going too fast.' Good direction often comes indirectly, and offhandedly. If the director

gets too excited about an idea, the actors can feel pressured to do it right, frightened of failing to execute it properly.” (Weston 1996: 259)

During the performance, the D/SM commonly made announcements such as these over the radio:

“This is Ju to Niki, there are only you and one other player—one other runner in the game at the moment, so you might want to come out and try to stalk them down. Over.”

“Ju to all runners, it is very fine to rest sometimes. Over.”

“This is Ju to all runners. I think people are starting to come out of the Crucible now. It might be an interesting place to get people. Over.”

These announcements do not tell the performers what to do now or in the future; they are neither instructing nor reminding. Instead, they are suggesting things, using formulations like “you might” or “it is very fine.”

There is an implied temporal flexibility to such directions: they were always designed to be dealt with by a runner ‘at some point’ or ‘some time’ (not ‘now’ or ‘next time’). Like other announcements, though, what follows is the runner’s reaction. These responses by runners—to adjust their actions pertaining to performance matters—was naturally expected to gel with the control room ‘view’ of the given performance trouble (i.e., as a trouble located in the performative work of runner(s)). We also note that such direction announcements were *less* frequent than directives, reminders, and so on.

Such directions often did not address any specific troubles that needed to be fixed or avoided *per se*. Instead, they had to do with the overall *quality* of the performance. And, to reiterate, they were formulated *not* as orders or rules, but as *suggestions* or *encouragements* because the director wanted runners as performers to ‘own’ them as facets of their performances. Overwhelmingly, performative issues arose around the various challenging aspects of the game that IHY presents to the performer, such the need for runners to frequently point the camera at themselves, for them to talk with members of the public on the streets, for runners to show and do a variety of activities during the game, and for runners to maintain the ‘energy’ of the performance for the whole hour of the session. Runners—as performers—needed to ‘buy into’ these activities and adopt an approach that delivered a good mixture of these aspects into their overall performance. In essence, the sorts of trouble directorial announcements sought to remedy were about the *quality* of the performance and as such did not turn on more ‘straight-forward’ solutions of doing this or that action now or at the next instance, but instead on doing ‘more’ or ‘less’ of something. The most frequently encountered issue was to encourage performers to do more ‘facetime’.

The following fragment offers just one example to provide the reader with a broad sense of how directions were geared into the organisation of control room work. In this fragment, the D/SM is watching a runner (James), and radios to him

to do more facetime; M2 (who is wearing headphones) then catches the attention of the D/SM.

D/SM: ((into radio)) Ju to James, it would be lovely to see you talk to the camera? Over.

M2: ((turning to D/SM)) Yeah, I think same with James he doesn't-

D/SM: Yeah that's what I was jus- yeah I just said it to James, he hasn't turned on himself?

M2: Um, he's a couple of times in the whole thing

D/SM: Yeah yeah.

M2: And a lot of the- it would be great to see his reaction I think.

D/SM: Yeah yeah

M2: And he's saying his reaction but it would be great to see his face.

D/SM: Yeah ((into radio)) it's always nice to see everyone's reaction on their face and not just in their voices too. Over?

Fragment 17: “great to see his face”

First we will step through what happens here. While this fragment is slightly more complex than previous ones, it nevertheless illustrates various key points about directions by the D/SM and their use in handling troubles that specifically can be *improved upon* by runners as the game unfolds. At the start of the fragment the D/SM has been watching the runner James for a while and, noticing some trouble herself, radios James to urge him to perform facetime (“it would be lovely to see you talk to the camera?”). This announcement has a distinctly different character to previous ones we have examined—it is not a directive to solve a trouble now, and neither is it a rule-formulated instruction for how to deal with a potentially troublesome moment next time around. Instead, the D/SM uses a questioning intonation coupled with a more persuasive “it would be lovely to X” formulation, rather than request-formatted “could you X” or similar. At this point M2 clearly has part-overheard the D/SM’s announcement because he highlights that the runner he is monitoring (the very same James) is not doing facetime. M2 then elaborates on the trouble by noting that James has only performed facetime “a couple of times” in the game session. Unlike previous fragments, M2 also offers a solution here that “it would be great to see his reaction” (nuancing this with “he’s saying his reaction”) in addition to articulating the trouble. The D/SM then transforms what M2 says, by constructing her direction to address “all runners”, noting that it’s “always nice” to *see* reactions as well as hear them.

Other examples of performative troubles resolved with direction announcements included the following: not speaking to the camera enough (i.e., performing facetime), the need for improvements in physical performance including ways of moving on the streets (e.g., ‘creeping’), improvements in the street performance by talking to more members of the public, managing the frequency of encounters occurred with other runners, or reading chat messages from online players to enhance performer-audience connection.

Like Fragment 17, such troubles cluster around aspects of the performance that concern matters not readily resolvable by fixes to be performed at specific

moments in time (whether immediate or specified by a rule). They were treated distinctly in a number of ways. First, we mentioned quality assessment as a feature of the monitor's noticing in Fragment 17 (i.e., that the runner James has only performed facetime "a couple of times in the whole thing"). As this makes clear, M2 orients to the frequency of noticeable moments (i.e., 'more' or 'less') of trouble rather than binary categories of 'broken' / 'fixed' or 'done' / 'not done' as was the case for directives and instructions. Further, these assessments consider, as M2 puts it, "the whole thing"—i.e., the full hour of performance—as a bar against which to make considerations as to whether to raise the trouble. Second, we begin to see the introduction of more hedged language from control room members in raising this kind of trouble—here M2 uses "I think" and "it would be great", for instance. A connected reason for this is to do with the increased judiciousness exhibited for troubles that related to performance matters. In these cases, we noticed that the D/SM would tend to subject such troubles to more frequent checking. The hedged language of M2 as a trouble-noticer also frames the 'type' of trouble for the D/SM—simultaneously as a *candidate* for consideration, *and* as something in need of a potential performance direction.

Third, the sense of temporality differs within the D/SM's announcements of performance directions. Resolving these types of trouble—and concomitant matters of determining whether they have been dealt with 'enough' by a runner—turn upon runner-led artistic judgements about just *when* to attempt moves towards said resolutions. In these cases, the language of directions does not specify when a runner might react to a direction, but rather highlights that *something* is in some way absent or lacking from their past, and ongoing, performance. Hence, in Fragment 17 we see the D/SM offering something akin to a desire: "it would be lovely to see you talk to the camera?". This is neither a clear directive—"please can you talk to the camera"—nor an instruction—"when X please talk to the camera." Instead it has a persuasive, urging quality. Concretely, the control room is directing James to perform more facetime, but ultimately this must be treated as a matter for him to at some point interleave within the range of simultaneous activities in which he is engaging, in and as his performative work. Thus the language of the D/SM in these cases also tends to build in a strong sense of non-immediate compliance, albeit the expectation of compliance 'at some time' nevertheless.

5 Discussion

I'd Hide You's control room is a site for carefully managing the multitude of activities involved in bringing off a performance, and every part of its setup and organisation is directed towards that end. The three parts of our study each in turn dissected what flexible production work *is* and how IHY represents a novel control room environment. At the same time, IHY builds upon CSCW's body of

knowledge about how artistic performances are brought off as practical activities with video mediated technologies.

To recap, we began by examining how the various tensions and frictions that are probably inherent in any creative endeavour became manifest in IHY's workings; IHY is an activity managed by the control room, where team members must orient to their joint work as an artistic performance, with an audience and a particular creative vision. We then expanded our focus by looking at how divisions of labour were organised and accounted for, both during team meetings and within control room activities. These divisions were fundamentally designed to support the performance of IHY and its qualities as a game built strongly on the improvisatory, contingent encounters set up to occur between runners, the public, and online players. In this, the control room's hierarchical nature was emphasised—the organisation of which helped drive the joint work of performance. Finally, we looked at the material organisation of in-game performance: how its work is brought off as an organised activity via close monitoring work of live video streams, and game state. Radio announcements—a standard method for management in control rooms—here functioned as an engine for artistic production, supporting stage management of the game to deal with troubles and support 'next time' learning to 'keep the show on the road'. Such matters, we think, are a going concern for most types of control room environments. However, we also saw how performance direction jointly produced by the D/SM and other team members became central to managing the performance; both in terms of its execution as an artistic product, and as a collaborative matter of control room work.

Studying the control room lets us pick apart salient features that IHY surfaces, refreshing and building upon more well-studied forms of control room. At the same time we note that features like IHY's hierarchical distribution of labour, team members' orientation to task, and nature of language use in stage management and direction, may be brought about in some way by IHY's employment of a *temporary* or 'pop up' control room form where practices are developed differently to, say, a more permanent control room. Nevertheless we think our exploration of IHY's control room—perhaps by virtue of being unusual in some sense⁴—can give us some useful ways to think about the makeup of control rooms in general. In sum, our study contributes new perspectives on old topics (like divisions of labour) as well as introducing wholly new distinctions around the use of video materials to both act as 'product' as well as control media. Further, and particularly for the growing liminal space between professional and non-professional live broadcasting via contemporary practices of live-streaming, IHY strongly anticipates new practices around this. To this end our study also aims to promote a reinvigoration of interest in control rooms, whether that is in identifying new aspects, or in assessing prior perspectives on control rooms in

⁴ To remind the reader: IHY's control room was routine work, and a familiar feature of their artistic practice for Blast Theory, and as such *not* unusual from the perspective of the artists.

HCI and CSCW. This is what we discuss next in further detail, spelling out a program of future work for CSCW's return to the control room.

5.1 Control rooms performing diffuse tasks

The nature of IHY lets us explore how control rooms may serve 'singular' outcomes or 'diffuse' ones (or both, of course). For this study, our data shows that what monitors, technical crew, the D/SM, and runners are doing is notable in that their collective work is *not* directed uniformly towards any shared, specific singular evaluatory feature that then may be employed as an ongoing indicator of 'success', or one which denotes success after a given game session is over. To put this another way, the creative work of IHY does not turn on a particular metric of success or failure at all. So, what makes a successful performance of IHY? Our study showed how there are a complex set of components of the artistic vision and its execution which must come together in a balanced way; monitors and the D/SM display a continuous orientation to assessing 'how things are going', judged in terms of the broad shape of the collectivity of runner actions. In this way team members are much like an orchestra to the D/SM's role as 'conductor'—the quality of a performer's execution of a particular note or even musical phrase is, individually, not specifically what constitutes a 'good performance'—rather, it is a gestalt assessment of the ongoing achievement of the conductor's artistic vision that counts.

As a diffuse 'task' IHY's control room does *not* have a specific set of (quantitative) conditions to assess, nor a predetermined optimal 'pathway' to that success. Of course, some control room tasks may well require very much the opposite, where singular activities revolve around standardised sequences of action and metrics of success / failure. For example, this could be the goal of a successful launch sequence (Watts et al., 1996), ensuring a train gets from A to B on time (Heath and Luff, 1992), or that a plane arrives at a particular gate (Goodwin and Goodwin, 1996). (We note that in a limited way IHY's control room did have a singular task focus in some senses, being concerned with this on a technical level, e.g., ensuring the software infrastructure was running.) Overall, then, IHY helps us reflect on how control room design meshes with 'singular' versus 'diffuse' tasks. If control rooms are oriented primarily to 'singular' tasks, then other activities within them ultimately derive their meaning from the accomplishment of that particular task e.g., the launch of a rocket, the smooth running of a rail network or air traffic. Finally we note that singular tasks may also be directed towards an *absence* of a thing—for something to *not* happen—such as avoiding unsafe incidents via monitoring CCTV, and issuing announcements to stop such incidents from occurring (i.e., ensuring safety as in Luff et al., 2000). Other control rooms might well combine all of these modes, however this is a question for further research.

5.2 Managing safety vs. evaluating quality

Our study helps shed light on the different ways members of control rooms can *orient* to their getting their task(s) done—i.e., how do they *treat* their activities? For instance, we might expect those staffing a ‘typical’ control room to go about accomplishing their tasks with a primary orientation towards *managing safety*. Well-known control room studies we have cited extensively already display this: for example, managing airspace in air traffic control rooms to ensure not only that planes are scheduled correctly but also do not occupy parts of the airspace simultaneously in an unsafe manner, or the monitoring of CCTV to spot breakdowns in safety protocols. We can then compare this safety orientation to control rooms primarily geared towards evaluating *quality* instead. Such a preoccupation with quality is a key feature of performances and games, and so it is perhaps no surprise that IHY’s work would necessarily be focussed on this, just as those of TV production can tend to be (Broth, 2004, 2008).

5.3 Hierarchical divisions of labour vs. horizontal

Now we turn to divisions of labour, a topic well-mined by research on control rooms and prominent conceptually within CSCW work in general. The very idea of a working division of labour perhaps is most purely, canonically, and simply expressed by the visual impact of control room arrangements—imagine a classic mission control room for space programmes—so it is of little wonder that CSCW would find inspiration from this specific kind of site to inform the design of technologies for collaborative action. Yet as it stands, the concept of the division of labour in CSCW often is left underexplored—we tend to only get as far as an observation that *there exists* working divisions of labour. So what does IHY teach us about distinguishing *different* kinds of divisions of labour and how they are shaped by task, in this case the performance element?

Specifically, we suggest IHY lets us reflect on contrasts between *horizontal* and *hierarchical* divisions of labour that arise in the organisation of control rooms and their deep connection to task characteristics. These two tendencies align with the different examples we have already discussed. More horizontal divisions of labour are reflective of rail line control rooms where various interlocking but simultaneously parallel tasks are present (Heath and Luff, 1992). Whereas, more hierarchical divisions of labour are perhaps best signified by the NASA flight controller as a key overall decision-maker (Watts et al., 1996); the job title ‘controller’ reflects this distinction. We also might imagine this differentiation in terms of our ability to draw chain of command diagrams and the differential strength of ties present therein.

We have already said IHY offers a more hierarchical division of labour; however, unlike the flight controller example, this arrangement is designed for artistic and creative purposes, but is also coupled with a need to let individual

performances (e.g., of runners) form the basis of the overall delivery on the artistic vision—something of an anathema to mission control. So, although we might say the D/SM is the ultimate decision-maker, this nevertheless brushes over devolved power, and ignores the levels of autonomy built into the performance. This was most clearly found in the tension between the need for top-down artistic direction and necessity for runners to ‘bring themselves’ to the performance. In this way, performers in IHY had to navigate the hierarchical division of labour, and skirt the boundaries of what was ‘theirs’ to do. Further, the use of multiple audiovisual streams and their management seems to reinforce the necessity for this specific hierarchical division of labour. Empirically we have shown how IHY’s announcements demonstrate an orientation to this hierarchical order, whereby the degree of hierarchical ‘force’ in place softens as we move from strong directives for fixing trouble (e.g., technical issues) through to reminders (rule-formulated instructions for dealing with trouble ‘next time’) and onwards to performance directions (which are the most frequently ‘hedged’). The stage was set for this orientation through team meetings and rehearsals that members attended, which—although primarily about establishing team competencies—also co-produced the division of labour’s ordering.

Our final observation about divisions of labour and their various differences regards how hierarchical or horizontal orderings impact a termination point, which may be a specific person or people ‘at the sharp end’. That point is difficult to discern in air traffic control or rail line control rooms where responsibilities and latitudes of action are diffuse or distributed. However once again we can turn back to IHY with its D/SM, or to other hierarchically organised control rooms like those of NASA missions where a flight controller acts in a similar role as this termination point.

5.4 Control room materials as collaborative resources and products

To close our final points we now turn to the *materials* of the control room; or, to put it another way, what ‘stuff’ the control room staff are working with. In many ways IHY crew members are dealing with resources that are quite similar to other control rooms, specifically (but not limited to) live video streams broadcast from runners and half-duplex radio communications between the D/SM and runners (as well as other behind-the-scenes crew). More broadly we see in control rooms that radio could be formed as a series of open communication loops in the most complex of cases (Watts et al., 1996), and in more typical scenarios, acts in a similar way to that implemented in IHY as a smaller set of channels and participants of those channels, but nevertheless is used to provide command and control facilities in a range of scenarios (e.g., Harper and Hughes, 1993; Goodwin, 1996). Of course, extant work on control rooms reflects upon various different styles of communication, including commands but also “informings” (Goodwin, 1996). Other work includes public address systems within the voice

communications systems as resources for enacting ‘control’, although this may be coupled with some other manner of observation to check on the effects of PA announcements, e.g., via video (Luff et al., 2000), or perhaps local spotters on the ground as a way of coping with the unidirectional nature of PA systems. In this regard, IHY’s use of outgoing radio communications fits with prior work, although it is clear that a deeper unpacking of the different potential accomplishments of radio communications is often left unexplored (with Goodwin’s picking apart of “informings” being an exception).

The other key material—video streams—is present in many other control room settings. However, its use in IHY, coupled with radio communications, lets us reflect on a distinction between use of video as a *resource for methods of control* and use of *video as a product* (and perhaps both). Video streams acting as a ‘seeing resource’ feature regularly in control room studies (e.g., Goodwin and Goodwin, 1996; Fischer et al., 2015). As we have seen, IHY is no different in that video is indeed treated a resource for monitoring ongoing runner activities and gameplay, so as to help construct a visual field of oversight that enables the control room to be alerted to potential troubles. However, in IHY video also forms the object or outcome of control room work, in that video materials *are* the performance itself, i.e., a live, interactive broadcast for online players. This use of video crosses into spaces like production control rooms where camera operators’ streams are intercut by a director and editor team (Broth, 2004, 2008). The challenge for the D/SM and other members of the team is in navigating the video’s dual control and product qualities. This led to the development of interesting strategies; for example, runners sometimes produced responses to radio announcements, but were ‘hidden in plain sight’, embedded in the video stream but crafted as an innocuous component of the end product for online players. For instance, at one point a runner responded to control room direction for him to “take a breather” by then building this into a subsequent address to online players; during this moment of facetime he spoke to the audience about the necessity of him slowing down, thus his talk to the camera was designed for double duty—to account for his reduced movement to the online players at the same time as acknowledging control room announcements directed at him.

6 Conclusion

In summary, our study focussed on three salient features of I’d Hide You’s control room: 1) the nature of performance as a managed activity; 2) the role of hierarchical divisions of labour in this artistic work; and 3) how radio announcements were used to stage manage and, most importantly, artistically direct the game / performance. These three features are also reflective of the increasingly mobile and flexible forms of production work that are enabled by more recent developments in

e.g., live video streaming, and internet and mobile infrastructures. IHY thus occupies an emerging space between established live broadcast delivered via traditional media networks, and the (somewhat) new infrastructural capacities that let people engage in relatively high quality live video streaming from anywhere at any time. Our study thus provides some new ways of conceptualising live broadcasts as they become increasingly accessible to ‘anyone’. In unpacking this, we lay claim to two key contributions using I’d Hide You as an exemplar: 1) IHY enriches our understandings of existing concepts from control rooms in CSCW and HCI; and 2) IHY highlights new forms of interactions and relations in artistic work practices.

Acknowledgements

We are immensely grateful to Blast Theory—particularly Ju Row Farr, Matt Adams, and Nick Tandavanitj, as well as all the other crew members and performers involved in I’d Hide You—for supporting us in collecting data and examining the workings of IHY as a game and performance. This work was supported by the Engineering and Physical Sciences Research Council [grant numbers EP/G065802/1, EP/K025848/1, EP/M02315X/1, EP/T022493/1]. We also thank the anonymous reviewers for their valuable feedback and suggestions. The data used for this study is made available via the transcripts within the paper, and is not available to owing to consent approval.

Declarations

Conflicts of interests The authors have no competing interests relevant to this paper.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article’s Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article’s Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

Anderson, Robert; John Hughes; and Wes Sharrock (1989). Working within a division of labour. In *Working for Profit: Social Organization of Calculation in an Entrepreneurial Firm*. Aldershot: Avebury, pp. 159–171.

- Benford, Steve; Andy Crabtree; Stuart Reeves; Jennifer Sheridan; Alan Dix; Martin Flintham; and Adam Drozd (2006). The frame of the game: Blurring the boundary between fiction and reality in mobile experiences. In *CHI '06: Proceedings of the SIGCHI conference on Human Factors in Computing Systems. Montréal, Québec, Canada, 22–27 April 2006*. New York, NY: ACM, pp. 427–436. <https://doi.org/10.1145/1124772.1124836>
- Broth, Mathias (2004). The production of a live TV-interview through mediated interaction. In Cor van Dijkum; Jorg Blasiu; Claire Durand (Eds.), *Recent Developments and Applications in Social Research Methodology*. Barbara Budrich Publishers.
- Broth, Mathias (2008). Seeing through screens, hearing through speakers: Managing distant studio space in television control room interaction. *Journal of Pragmatics*, vol. 41, no. 10, pp. 1998–2016. <https://doi.org/10.1016/j.pragma.2008.09.023>
- Brown, Barry; and Oskar Juhlin (2015). *Enjoying Machines*. Cambridge, MA: MIT Press.
- Catron, Louis E. (1989). *The Director's Vision: Play Direction from Analysis to Production*. Mountain View, CA: Mayfield.
- Clurman, Harold. (1972). *On Directing*. New York: Collier.
- Coulter, Jeff; and E. D. Parsons (1990). The praxiology of perception: Visual orientations and practical action. *Inquiry*, vol. 33, no. 3, pp. 251–272. <https://doi.org/10.1080/00201749008602223>
- Crabtree, Andy; Steve Benford; Tom Rodden; Chris Greenhalgh; Martin Flintham; Rob Anastasi; Adam Drozd; Matt Adams; Ju Row-Farr; Nick Tandavanitj; and Anthony Steed (2004). Orchestrating a mixed reality game ‘on the ground’. In *CHI '04: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. Vienna, Austria, 24–29 April 2004*. New York, NY: ACM pp. 391–398. <https://doi.org/10.1145/985692.985742>
- Crabtree, Andy; Steve Benford; Mauricio Capra; Martin Flintham; Adam Drozd; Nick Tandavanitj; Matt Adams; and Ju Row Farr (2007). The cooperative work of gaming: Orchestrating a mobile SMS game. *Computer Supported Cooperative Work (CSCW)*, vol. 16, no. 1-2, pp. 167–198. <https://doi.org/10.1007/s10606-007-9048-1>
- Curl, Traci S.; and Paul Drew (2008). Contingency and action: A comparison of two forms of requesting. *Research on Language and Social Interaction*, vol. 41, no. 2, pp. 129–153. <https://doi.org/10.1080/08351810802028613>
- Faklaris, Cori; Francesco Cafaro; Asa Blevins; Matthew A. O’Haver; and Neha Singhal (2020). A Snapshot of Bystander Attitudes about Mobile Live-Streaming Video in Public Settings. *Informatics*. 2020, vol. 7, no. 2, p. 10. <https://doi.org/10.3390/informatics7020010>
- Fischer, Joel E.; Stuart Reeves; Tom Rodden; Steve Reece; Sarvapali D. Ramchurn; and David Jones (2015). Building a birds eye view: Collaborative work in disaster response. In *CHI '15: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. Seoul, Republic of Korea, 18–23 April 2015*. New York, NY: ACM, pp. 4103–4112. <https://doi.org/10.1145/2702123.2702313>
- Fischer, Joel. E.; Stuart Reeves; Barry Brown; and Andrés Lucero (2018) Beyond “Same Time, Same Place”: Introduction to the Special Issue on Collocated Interaction, *Human–Computer Interaction*, vol. 33, no. 5–6, pp. 305–310. <https://doi.org/10.1080/07370024.2018.1440556>
- Fitts, Paul M. (Ed.) (1951). *Human Engineering for an Effective Air-Navigation and Traffic-Control System*. Washington, DC: National Research Council.
- Flintham, Martin (2009). *Supporting Mobile Mixed-Reality Experiences*. PhD thesis, University of Nottingham.
- Fraser, C. Ailie; Mira Dontcheva; Joy O. Kim; and Scott Klemmer. (2020). How live streaming does (and doesn’t) change creative practices. *interactions* vol. 27, no. 1 (January - February 2020), pp. 46–51. <https://doi.org/10.1145/3372040>
- Garfinkel, Harold (1967). *Studies in Ethnomethodology*. Englewood Cliffs, NJ, USA: Prentice-Hall.
- Garfinkel, Harold (2002). *Ethnomethodology's Program: Working Out Durkheim's Aphorism*. Lanham, MD: Rowman and Littlefield.

- Goodwin, Charles (1994). Professional vision. *American Anthropologist*, vol. 96, no. 3, pp. 606–633. <https://doi.org/10.1525/aa.1994.96.3.02a00100>
- Goodwin, Charles; and Marjorie H. Goodwin (1996). Seeing as situated activity: Formulating planes. In Yrjö Engeström; and Middleton, David (Eds.), *Cognition and Communication at Work*. Cambridge: Cambridge University Press, pp. 61–95. <https://doi.org/10.1017/CBO9781139174077.004>
- Goodwin, Marjorie H. (1995). Assembling a response: Setting and collaboratively constructed work talk. In Paul ten Have; and George Psathas (Eds.), *Situated Order: Studies in the Social Organization of Talk and Embodied Activities*. Washington, DC: University Press of America, pp. 173–186.
- Goodwin, Marjorie H. (1996). Informings and announcements in their environment: Prosody within a multi- activity work setting. In Elizabeth Couper-Kuhlen; and Margret Selting (Eds.), *Prosody in Conversation: Interactional Studies*. Cambridge: Cambridge University Press, pp. 436–461. <https://doi.org/10.1017/CBO9780511597862.013>
- Harper, Richard; and John A. Hughes (1993). ‘What a f-ing System! Send’em all to the same place and then expect us to stop’em hitting’. In Graham Button (Ed.), *Technology in Working Order: Studies of Work, Interaction, and Technology*. London: Routledge, pp. 127–144.
- Heath, Christian; Marina Jirotko; Paul Luff; and Jon Hindmarsh (1994). Unpacking collaboration: the interactional organisation of trading in a city dealing room. *Computer Supported Cooperative Work (CSCW)*, vol. 3, no. 2, pp. 147–165. <https://doi.org/10.1007/BF00773445>
- Heath, Christian; and Paul Luff (1992). Collaboration and control: Crisis management and multimedia technology in London Underground Line Control Rooms. *Computer Supported Cooperative Work (CSCW)*, vol. 1, no. 1–2, pp. 69–94. <https://doi.org/10.1007/BF00752451>
- Heath, Christian; Paul Luff; and Marcus Sanchez Svensson. (2002). Overseeing organizations: Configuring action and its environment. *The British Journal of Sociology*, vol. 53, no. 2, pp 181–201. <https://doi.org/10.1080/00071310220133296>
- Hodge, Francis (2010). *Play Directing: Analysis, Communication, and Style* (Fifth ed.). Boston, MA: Allyn and Bacon.
- Hughes, John; Val King; Tom Rodden; and Hans Andersen (1994). Moving out from the control room: Ethnography in system design. In *CSCW '94: Proceedings of the ACM Conference on Computer Supported Cooperative Work. Chapel Hill, North Carolina, USA, 22–26 October 1994*. New York, NY: ACM, pp. 429–439. <https://doi.org/10.1145/192844.193065>
- Hutchins, Edwin (1995). *Cognition in the Wild*. Cambridge, MA: MIT Press.
- Juhlin, Oskar; Arvid Engström; and Erika Reponen (2010). Mobile broadcasting: The whats and hows of live video as a social medium. In *MobileHCI '10: Proceedings of the 12th International Conference on Human Computer Interaction with Mobile Devices and Services. Lisbon, Portugal, 7–10 September 2010*. New York: ACM, pp. 35–44. <https://doi.org/10.1145/1851600.1851610>
- Kuutti, Kari; and Liam Bannon (2014). The turn to practice in HCI: towards a research agenda. In *CHI '14: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. Toronto, Ontario, Canada, 26 April – 1 May 2014*. New York, NY: ACM, pp. 3543–3552. <https://doi.org/10.1145/2556288.2557111>
- Li, Jie; Xinning Gui; Yubo Kou; Yukun Li. (2019). Live Streaming as Co-Performance: Dynamics between Center and Periphery in Theatrical Engagement. *Proceedings of the ACM on Human-Computer Interaction*, vol. 3, issue CSCW, Article 64 (November 2019). <https://doi.org/10.1145/3359166>
- Lu, Zhicong; Haijun Xia; Seongkook Heo; and Daniel Wigdor (2018). You watch, you give, and you engage: A study of live streaming practices in China. In *CHI '18: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. Montreal, QC Canada, 21–26 April 2018*. New York, NY: ACM, pp. 1–13. <https://doi.org/10.1145/3173574.3174040>

- Luff, Paul; Christian Heath; and Marina Jirotko (2000). Surveying the scene: Technologies for everyday awareness and monitoring in control rooms. *Interacting with Computers*, vol. 13, no. 2, pp. 193-228. [https://doi.org/10.1016/S0953-5438\(00\)00038-2](https://doi.org/10.1016/S0953-5438(00)00038-2)
- Luff, Paul; and Christian Heath (2002). Broadcast talk: Initiating calls through a computer-mediated technology. *Research on Language and Social Interaction*, vol. 35, no. 3, pp. 337-366. https://doi.org/10.1207/S15327973RLSI3503_4
- Luff, Paul; Christian Heath; Menisha Patel; Dirk Vom Lehn; and Andrew Highfield (2018). Creating interdependencies: Managing incidents in large organizational environments. *Human-Computer Interaction*, vol. 33, no. 5-6, pp. 544-584. <https://doi.org/10.1080/07370024.2017.1412830>
- Martin, David; John Bowers; and David Wastell (1997). The interactional affordances of technology: An ethnography of human-computer interaction in an ambulance control centre. In Harold Thimbleby; Brid O'Conaill; and Peter J. Thomas (Eds.), *People and Computers XII: Proceedings of HCI '97*. London: Springer, pp. 263-281. https://doi.org/10.1007/978-1-4471-3601-9_16
- Perry, Mark; Oskar Juhlin; and Arvid Engström (2014). Dealing with time, just in time: Sense-making and clip allocation in multi-person, multi-stream, live replay TV production. In Mathias Broth; Eric Laurier; and Lorenza Mondada (Eds.), *Studies of Video Practices: Video at Work*. London: Routledge, pp. 262-286.
- Rabiger, Michael, (2008). *Directing: Film Techniques and Aesthetics* (Fourth ed.). Amsterdam: Focal Press.
- Rasmussen, Jens (1980). The Human Operator as a System Component. In H.T. Smith and T.R.G. Green (eds.), *Human Interaction with Computers*, pp. 67-96. London: Academic Press.
- Reeves, Stuart; Christian Greiffenhagen; Martin Flintham; Steve Benford; Matt Adams; Ju Row Farr; and Nicholas Tandavantij (2015). 'I'd Hide You': Performing live broadcasting in public. In *CHI '15: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. Seoul, Republic of Korea, 18-23 April 2015*. New York, NY: ACM, pp. 2573-2582. <https://doi.org/10.1145/2702123.2702257>
- Sjöblom, Max; Maria Törhönen; Juho Hamari; and Joseph Macey (2019). The ingredients of Twitch streaming: Affordances of game streams. *Computers in Human Behavior*, vol. 92, pp. 20-28. <https://doi.org/10.1016/j.chb.2018.10.012>
- Suchman, Lucy (1993). Technologies of accountability: Of lizards and airplanes. In Graham Button (Ed.), *Technology in Working Order: Studies of Work, Interaction, and Technology*. London: Routledge, pp. 113-126.
- Suchman, Lucy (1996). Constituting shared workspaces. In Yrjö Engeström; and Middleton, David (Eds.), *Cognition and Communication at Work*. Cambridge: Cambridge University Press, pp. 35-60. <https://doi.org/10.1017/CBO9781139174077.003>
- Suchman, Lucy (1997). Centers of coordination: A case and some themes. In Lauren B. Resnick; Clotilde Pontecorvo; and Roger Säljö (Eds.), *Discourse, Tools, and Reasoning: Essays on Situated Cognition*. Berlin: Springer, pp. 41-62. https://doi.org/10.1007/978-3-662-03362-3_3
- Theureau, Jacques; and Genevieve Filippi (2000). Analysing cooperative work in an urban traffic control room for the design of a coordination support system. In Paul Luff; Jon Hindmarsh; and Christian Heath (Eds.), *Workplace Studies: Recovering Work Practice and Informing System Design*. Cambridge: Cambridge University Press, pp. 68-91. <https://doi.org/10.1017/CBO9780511628122.005>
- Wahlström, Mikael; Antti Salovaara; Leena Salo; and Antti Oulasvirta (2011). Resolving safety-critical incidents in a rally control center. *Human-Computer Interaction*, vol. 26, no. 1-2, pp. 9-37. <https://doi.org/10.1080/07370024.2011.556541>
- Watts, Jennifer C.; David D. Woods; James M. Corban; Emily S. Patterson; Ronald L. Kerr; and LaDessa C. Hicks (1996). Voice loops as cooperative aids in space shuttle mission control. In *CSCW '96: Proceedings of the ACM Conference on Computer Supported Cooperative Work*.

- Boston, Massachusetts, USA, 16–20 November 1996*. New York, NY: ACM, pp. 48–56. <https://doi.org/10.1145/240080.240188>
- Weston, Judith (1996). *Directing Actors: Creating Memorable Performances for Film and Television*. Studio City, CA: Michael Wiese.
- Whalen, Jack; Marilyn Whalen; and Kathryn Henderson (2002). Improvisational choreography in teleservice work. *The British Journal of Sociology*, vol. 53, no. 2, pp. 239–258. <https://doi.org/10.1080/00071310220133322>

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.