

I'd Hide You: Performing Live Broadcasting in Public

Stuart Reeves, Christian Greiffenhagen*, Martin Flintham, Steve Benford,
Matt Adams⁺, Ju Row-Farr⁺, Nick Tandavanitj⁺

School of Computer Science
University of Nottingham, UK
{str,mdf,sdb}@cs.nott.ac.uk

*Department of Social Sciences
Loughborough University, UK
c.greiffenhagen@lboro.ac.uk

⁺Blast Theory
Brighton, UK
{matt,ju,nick}@blasttheory.co.uk

ABSTRACT

We present a study of a mixed reality game called ‘I’d Hide You’ that involves live video streaming from the city streets. We chart the significant challenges facing performers on the streets who must simultaneously engage in the game, stream compelling video footage featuring themselves, and interact with a remote online audience. We reveal how these street performers manage four key tensions: between their body and camera; between the demands of online audiences and what takes place on-the-street; between what appears ‘frontstage’ on camera versus what happens ‘backstage’; and balancing being a player of the game with being a performer. By reflecting on how they achieve this, we are able to draw out wider lessons for future interfaces aimed at supporting people broadcasting video of themselves to online audiences while engaged in games, sports and other demanding real-world activities.

Author Keywords

Video; live broadcasting; camerawork; public settings.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

The ubiquity of high quality cameras on mobile devices, combined with the emergence of a new generation of wearable cameras, is driving the emergence of live video streaming. In turn, this is being supported by a growing number of live streaming services such as Bambuser, Ustream and YouTube Live. This combination of new cameras and platforms brings the potential for radical new kinds of interactive experience in which people film their real-world activities for a remote online audience: from new TV formats, to pervasive games, sports and citizen journalism.

Beyond such future applications, the emergence of mobile video streaming is also relevant to several ongoing threads

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from Permissions@acm.org.

CHI 2015, April 18 - 23 2015, Seoul, Republic of Korea
Copyright 2015 ACM 978-1-4503-3145-6/15/04...\$15.00
<http://dx.doi.org/10.1145/2702123.2702257>

of research in both in HCI and the social sciences [10, 8]. Previous studies have examined the content and practices surrounding the use and manipulation of video material, ranging from amateur recordings [17] and live broadcasts [16] through to professional production settings [23, 7, 10]. Research systems have also been developed to offer automatic editing of video in a post-hoc way [25, 4, 2, 1]. Mostly these approaches have been algorithmic, although some summarisation techniques leverage crowdsourced (i.e., human) judgements [5]. Coordination between camera operators has also been explored via the development of systems that support collaborative action during capture from multiple devices [24]. Sometimes these systems also support a vision mixer or directorial role [11, 20, 26].

Our aim is to extend our knowledge of the possibilities and challenges of streaming live video from the streets to online viewers, particularly in situations where the cameraperson is also a primary participant in the action. This situation, in which a person must simultaneously perform in public while filming themselves for remote viewers, is likely to be increasingly commonplace in future video streaming experiences and therefore warrants attention within HCI.

We present the results of a research engagement that explores an extreme version of such situations. This followed an approach of ‘performance-led research in the wild’ [6] in which we collaborated with professional artists to create, tour and study an interactive game with mobile video streaming at its core. This paper briefly introduces the game, called ‘I’d Hide You’ (IHY), before presenting a detailed account of how the game’s street performers—which we call ‘runners’—balanced the challenges of performing, filming themselves and engaging with remote online players. We articulate the growing craft knowledge of these runners as they learned to operate the video technology and identify how they went about managing the various tensions that surfaced. This enables us to contribute to the design of future mobile video experiences and enabling technologies.

PLAYING THE GAME: INTRODUCING ‘I’D HIDE YOU’

IHY is a web-based game, designed and run by the artist group Blast Theory, in which several trained runners, situated on the streets, broadcast live video streams from handheld cameras to online players (see Figure 1 for the online player web interface). To some extent the game builds on Blast Theory’s prior work (e.g., ‘Can You See Me Now?’ [12]). During a game session, online players can log

into the game using an email address and a name of their choosing (which was visible to other online players and runners). Players can follow each runner's location (via GPS) on a map of the game area. They then select to follow one of the three current live video streams broadcast by them. The core game mechanic involves the runners chasing and 'catching' one another inside their camera's viewfinder, at which point any online players who are viewing their stream can take a 'snap' of the captured runner to score points. If the runner themselves gets snapped (i.e., another runner gets *them* in their viewfinder), the online players watching the snapped runner at the time lose points. During the game, online players can also engage in text chat with other players that are watching the same video stream as them and can also message the runners on the street, sending them requests and instructions (Figure 1).

Besides hunting down others, runners are also required to produce an entertaining video feed, one that highlights interaction with online players and features monologues to the camera and interactions with members of the public on the streets. The resulting effect could be said to create a *vérité style* of video broadcast (i.e., a staged documentary, aimed to unveil reality), but one that is also *interactive* for the audience. IHY has run publicly for two-day performances each year between 2012-2014. For each day of performance, the game ran for three one-hour evening sessions, with three runners continually streaming from the streets during this time (albeit different permutations of runners for each game session).

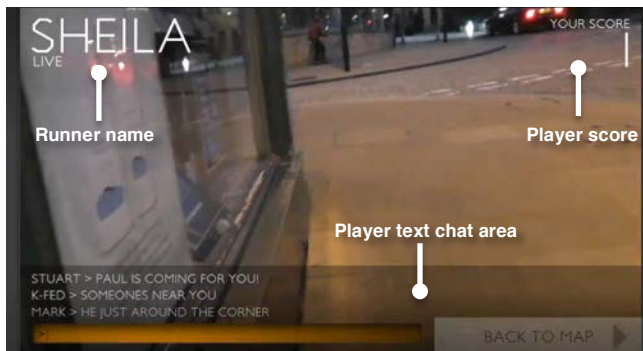


Figure 1: I'd Hide You online player interface (annotated)

METHODOLOGY: STUDYING 'I'D HIDE YOU'

Our approach to studying IHY was broadly ethnomethodological; that is, we were interested in understanding how IHY was *practically achieved* and brought off as a matter of team-working, and how the production of the live broadcasts from runners was organised as part of broader interactional phenomena [18]. To this end we opted for ethnographic techniques to understand and describe the methods involved delivering IHY as a public event.

Two investigators performed ethnographic work, including video capture, for three instances of IHY. For IHY in Manchester 2012, we focused on establishing an initial broad orientation to IHY as an experience so as to identify the key

practices involved and issues arising. Following on from this, we studied a subsequent performance in Sheffield 2013, from which we derive the majority of the data presented in this paper. Here, our ethnography was deeper, covering four days, including the initial setup (including training processes and rehearsals) as well as the public performance (we also gained access to runners' video footage). Finally, for its 2014 run, a return visit to Sheffield, we focussed more on capturing online player experiences.

Like any touring professional experience, IHY is a complex affair involving multiple participants and roles, spaces, practices and also technologies that connect these, as well as extensive preparations in advance of any actual performance. We therefore must describe its organisation alongside how we captured the various aspects of this for our study. Key personnel involved were as follows:

- A *stage manager* (one of the artists) and an assistant who 'call the show', i.e., coordinate much of the training and running of the game;
- Nine *runners* of which three were experienced (e.g., had participated in Manchester 2012 and had worked with the artists on prior projects) and six who were not;
- Three *monitors* observing runner video streams during the game, under the stage manager's direction;
- Between four and five *technical crew*.



Figure 2: Runners gearing up for the next session

We captured extensive video recordings of the IHY team's activities across the four days. We were primarily based in the game's control room (Figure 2) which provided a gearing-up point for runners before and after the game sessions, housed three live video feed displays for the monitors and stage manager, and space for technical crew to prepare and monitor equipment, including cameras (see below), walkie talkies and mobile phones.

Our corpus broadly captured the following activities across the four days. IHY firstly involved two days of training for the runners and monitors. Day one involved experimenting with cameras during a 'hide and seek' exercise participated in by all runners and monitors. In this exercise, any available video-recording device was used (primarily phone cameras); footage was later reviewed by groups and discussed in meetings. Day one also included a performance briefing by the artists and finally a game test followed by a post-test debrief. Day two involved various collective team meetings, including separate monitor briefings, runner

strategy meetings and walks of the game area (0.077km²). The three more experienced runners and the artists also met for a creative discussion. Day two culminated in a full game rehearsal. After this, IHY involved two days of publicly performing the game, with associated pre- and post-game team meetings. Overall there were 884 unique online players (based on email address entered) during this period, although the number of ‘plays’ was greater. More than 35000+ snaps were performed during these plays, with the average duration of a single play being around 6 minutes per game session.

THE EQUIPMENT

The runners used a bespoke camera setup developed specifically for IHY which proved to be central to their practices. We therefore take some time to introduce this before presenting our findings. While we have previously described the equipment as ‘a camera’, in reality this combined quite a complex array of digital technologies.

The most central element is the **camera rig** that is held by the runners (see Figure 3). This consists of three elements: (1) a wide-angle HD handheld camera with (2) a viewfinder, attached to a grip and mount; (3) a Teradek Bond attached to the bottom of the grip’s mount which enables the video from the camera to be demultiplexed for streaming over multiple mobile data network connections (e.g., 3G) and subsequently multiplexed on a server; (4) a mobile phone mounted to the side, permits control of the snapping mechanism (i.e., choosing to make it available to online players) and displays online player text messaging; (5) a light on top of the camera is used both to improve the video but also to enhance the camera rig’s ‘performativity’.



Figure 3: The camera rig; in use (left)

The camera rig is of central importance for the runner’s work in delivering a narrative to the online players. The runner’s activities with the camera are thus the primary means by which the runner is able to *construct* IHY as a phenomenon. The camera rig is used to build and deliver a narrative to the online players through a range of practical manipulations that the runner carries out during their session (as we shall see below). During training, runners therefore had to move away from the practices of camera-work they had learned / inherited from mobile phone cameras and seek to establish a “natural” relationship with

the camera rig (to use their terminology; note that we use double quotation marks to refer to direct quotations from our data). This relationship turned on the performative features of the camera (e.g., as we have noted, attention to its design aesthetic, its increased visibility to members of the public, etc.) and the fact that it both impacted and had to be built into runners’ performances. Thus to say the camera rig is ‘performative’ draws out a contrast with cameras used as purely ‘functional objects’: for instance, this might include uses of cameras on studio floors.

Supporting their use of the camera rig, runners also carried radio communications (walkie-talkies) with an attached ear-piece. This technology, while the most established, was also the most problematic (e.g., insufficient coverage, batteries draining rapidly, etc.).

THE RUNNER’S PERSPECTIVE

The focus of this paper is the work of, and challenges for, the runner, who operates in various ‘roles’, including camera operator, game player, and performer. Thus it is the runner’s work that, through examination, lets us consider possible future forms of live video broadcasting that we will come to discuss later. We gained key insights from the training of runners prior to the performance, since it was here that the less experienced runners moved beyond “existing visual practices” and developed “shared ways of seeing the visual landscape as a team” [11]. Moreover, these “shared ways” were often made explicit in debriefing sessions after trial runs of the game.

We present the runner’s work under seven headings: (1) the overall aims and objectives of the game; (2) the orientation of the runner to the online players to whom they are broadcasting; (3) key attributes of the wider environment of the city streets within which runners are situated; (4) interactions with other runners; (5) the phenomenological aspects of the runner’s experience of play; (6) the work involved in practically using the camera rig; and, finally, (7) the runner’s relationship with the control room.

(1) The overall aims and objectives of the game

As already mentioned, the artist group had a clear vision for IHY, one which they tried to communicate to runners as part of their training. For example, runners were provided with written ‘guidelines’ in which the “overall mood” for IHY was described as “stealthy, mysterious, hiding, secretive, less high octane” while at the same time being “chatty, fun, upbeat”. During team meetings reflecting on training exercises and trial games, the artists emphasised two aims and objectives for the performance of runners.

The most important was for runners to be “**building conversations**” with online players and members of the public on the streets. So, while runners had to ‘play the game’, what was most important was to *interact* with the online audience. As one of the artists 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.”

Secondly, artists emphasised that runners should be providing the online players with a “**rich palette**”, i.e. a combination of a variety of activities (chasing other players, interaction with people on the street and online, interesting monologues with the camera on their face). The artists recruited both locals (e.g., media and performance students) and experienced artists (with whom an established relationship existed) to act as runners and monitors in the hope that “what you [runners] have is something that we [just the artists alone] don’t have, and collectively we have something else”. In other words, a ‘successful’ IHY performance was seen as one in which all different elements came together—and runners therefore had to perform various functions simultaneously or at least sequentially (for example: creating interesting shots as a camera operator; performing exciting game play as a runner; being a witty conversationalist with online players).

(2) The orientation to online players

Runners were reminded that they were constructing their broadcast for online players, who were their “main audience”. The artists characterised the core role for the runner as acting as a ‘**conduit**’ for online players who may at any point be viewing this particular runner’s video stream, or sending messages to the runner via the text chat feature.

Runners were conceptualised as supporting **immersion** for online players: “you’re bringing them, out there, into the game”. In other words, runners were encouraged to act as a kind of ‘proxy’ for online players. This immersion was about communicating the **embodied experience** of the runner back to the online player, as one runner reflected: “we tend to embody the game ourselves and it’s about trying to allow the online player to be embodied in it”. In sum, runners were reminded that they were not playing a game ‘for themselves’ but ‘for others’, i.e., to take an **empathetic perspective**: “it’s not just my world, it’s not just my game”, “you’re doing that not for your pleasure but for the people online’s pleasure”.

But in what practical ways could runners achieve these aims? Various verbal, bodily and camerawork strategies were adopted to achieve **intimacy** with online players.

Firstly, runners were encouraged to speak online player’s names out loud to connect with them. The stage manager emphasised that “it can be really delightful for people online to hear their names”, characterising the effect of this as being “like a direct line straight to that person [...] it’s like live radio, it’s beautiful”. Saying the names of online players was a key feature of the **interactivity** of IHY.

Secondly, physically showing one’s face to the camera—characterised as “*facetime*”—was seen as another powerful way to practically ‘do’ this conversation-building. Again, the stage manager highlighted how “everyone kind of gets a little ripple of excitement when you see your face, it’s just

gorgeous”. “*Facetime*” is a practice taken from movies, where the protagonist ‘breaks the fourth wall’ by addressing the audience. These kinds of shots can be used to convey a sense of **sincerity**, but in IHY they also were considered powerful in creating direct interaction with online players.

Finally, runners in their role as camera operators had to make sure that their camerawork, including matters (which we will return to) such as framing, shot composition, verbal inflection and bodily performance on-camera, were oriented towards online players.

During the training sessions, runners were encouraged to review their own and others’ footage to see how their stream might be experienced. A notable example occurred when one runner reviewed her footage after a game session, and started to notice her lack of *facetime*, commenting to an ethnographer, “I think I need to look at the camera if I’m making like a personal, um, message because it looks like I don’t really care. I’m a bit like [miming a camera pointed to the side of her face] ‘oh tell me about John’, I need to be like [rotates imagined camera towards face] ‘hey John! How are you doing? What are you up to?’”. Here, the runner was speaking to an online player ‘John’ while shooting events on the street, which she thought could come across as her ‘not caring’. Instead, when she is addressing an online player, she should look at her or him (we note consonance here to the language strategies of participants in [26], orienting to an “imagined audience”).

(3) The street environment

Although runners’ primary orientation is towards the online audience, their work is physically conducted on city streets, being amidst and sometimes participating in its goings-on. As such they must constantly engage with the street environment, i.e., perform what we term here as ‘streetwork’. Broadly speaking, this consisted of various encounters (typically talking) with members of the public, aided by a range of prepared topics and questions (which we discuss later). The runner’s ongoing need to do streetwork is a major feature of *what* is broadcast to online players.

(4) Other runners

Besides members of the public, the street environment is—of course—also populated with two other runners at any given time. **Encounters between runners** form a core aspect of the game since this is a source of constructing situations for snapping and thus generating opportunities for online players to gain points. Runners had to work towards physical encounters between themselves and other runners so as to carefully construct these moments. This was articulated by both runners and artists as a ‘creeping’ approach to bodily movement which enabled them to locate other runners at-a-distance and thus offer up snapping opportunities to online players. During these moments runners would often ‘narrate’ the situation for the online players (partly as a method for managing the optical acuity differential between runners’ eyesight and the—‘lower quality’—video stream). At the same time, runners also took ad-

vantage of the opportunity for ‘surprise’ and ‘spontaneous’ encounters that emerged from, say, turning a corner and suddenly confronting another runner.

Encounters between runners also had to be managed in terms of duration. A key issue was the importance of avoiding “face-offs”—moments where two or even three runners are in visible close proximity (and therefore enabling snapping). The stage manager’s direction during a briefing to runners was: “We don’t want face-offs [...] they’re fun, and they’re nice. But like don’t get locked in that loop of just doing that. [...] if you do get snapped then [...] back off out of there.” Limiting the encounters was also described by the stage manager as showing “humility”.

Overall, the interaction with other runners was a combination of competition and cooperation. While there certainly was a competitive ‘game’ element at play, runners appreciated that they had to cooperate in order produce an interesting experience for online players.

(5) ‘Yourself’

Runners did not just have to orient to the online players, manage the street, and interact with other runners, they also had to ‘manage themselves’. We catalogue four different elements of this: conspicuousness, bodily movements, fatigue, and performance demeanour.

The runner’s equipment—not only the visibility of the camera rig with its light but also their clothes, helmet, communications equipment and general behaviour on the streets—is **conspicuous**. The stage manager stated to runners (debriefing after a training session) “you’ll feel more self conscious when you’ve got all that clobber on [...] you will feel like [...] a weird sci-fi ‘Robocop’ person”.

Runners’ use of the camera rig means that “movement is just blown out of context”, as described by a runner during another debriefing in reference to a conversation about the problem of keeping the camera still while running, i.e., avoiding “360 [degree] pans”. As such, **bodily movements** must also be performed with this as a continual concern; to draw on the debriefing discussion, this meant either running or panning but not both together. Reviewing the footage was a key method for managing this, e.g., the stage manager encouraged runners to “watch the screens to kind of stand behind there for a while, see what [the broadcast stream] looks like, imagine that you’re watching it online and sort of give it some thought”.

During game sessions, runners spend a significant amount of their time being physically active which results in **fatigue**. In addition, the weight of the entire camera rig is also a concern for the runners as it is physically demanding to hold for the game. Thus, the stage manager might instruct a runner to “take a breather” (both in a literal sense but also in a narrative sense of switching activities away from encounters with other runners momentarily). Runners also had ‘refuges’—pre-arranged ‘hidden’ places in the game area—that they employed for this purpose at times.

Performing the game was also psychologically demanding. Interacting with strangers on the street is not “natural” (again, their term) and some runners found this difficult. During a game session the stage manager would advise a particular runner via radio: “you might want to be brave and talk to a member of the public”. One way to deal with these psychological aspects was for runners to develop what might be termed ‘**performance demeanour**’. This included being ‘psychologically prepared’ for the game’s start.

(6) Camerawork

‘Camerawork’ is our shorthand for the range of bodily practices involved in controlling the camera rig so as to produce a suitable broadcast for the online players. We have already noted various ways in which camerawork was an important and ongoing concern for the runners across all aspects of their work. We now consider some further aspects in depth.

The framing of shots produced by the camera rig, their composition and consideration of their aesthetics are key orienting matters for the runner. We have outlined the technical capabilities of the camera rig earlier. Beyond these, the physicality of the rig is also important. The rig has a range of interfaces and displays that must be managed by runners. Firstly the position of the viewfinder (Figure 3, 2) vis-à-vis the lens of the camera that is—as with most consumer-grade video cameras—located to one side of the camera’s body (see [19]). The runner must attend to the viewfinder at the same time as attending to their activities on the street (such as talking to members of the public), in the process assuming certain unnatural physical positions so as achieve a good shot. Compounding this is the position of the mobile phone screen, also to one side.

The training sessions raised two issues. First was the need to avoid footage that is considered to be poor for the online player. Secondly, was delivering a variety of shots to fit in with the stage manager’s directions. In this sense runners attempted to build themselves a “video literacy” for IHY [26]. Runners were reminded by the stage manager that their bodily movements affect the video stream. For example, during a debrief they were warned: “running is challenging, so you shouldn’t run too often”. Similarly, moving the camera too quickly would create a bad experience for online viewers: “just be careful when you swing the camera from your face to the view in front, go a little bit slower”. Finally, the external lighting conditions could affect the quality of the stream. The most extreme example of this is found in night-time shooting where the video may become ‘blocky’. For similar reasons, zooming with the camera was occasionally used, but kept to a minimum.

Camerawork also consists of producing both a ‘variety’ of and ‘interesting’ shots. Runners were encouraged to think about capturing interesting street scenes, objects and angles (e.g., the stage manager suggested runners make use of different heights when framing shots). Runners also tried to find beautiful ‘backdrops’ when they were talking to members of the public. During the performance, the stage

manager would occasionally remark on particularly ‘noteworthy’ shots by radio to the runners, e.g., “that was a lovely shot, as the cyclist went past”.

(7) The control room

The final feature of the runner’s work involves the control room, which, from the runner’s perspective, is able to see their video feed (albeit delayed) and contact them via their walkie-talkie. The control room’s interaction with the runner tended to manifest itself—what we have termed here—as ‘concrete instructions’ (in relation to technical problems), ‘stage directions’, and ‘reminders’. Runners would also occasionally be singled out for praise, such as compliments on their camerawork, or encounters with other runners or members of the public.

There were various occasions where a monitor noticed a problem and brought this to the stage manager’s attention, who then (sometimes) radioed ‘**concrete instructions**’ to a particular runner or to all runners. For example, the microphone of the runner may have become loose or a runner might be standing next to a generator, making her or him difficult to hear. The stage manager also issued some general ‘**stage directions**’ to runners. Direction here could include countdown to live broadcast or to tell runners when and where they were in the game.

The dominant form of communication from the control room however comprised ‘**reminders**’, in relation to aspects of the performance that runners should do more or less of. These could pertain to snapping (e.g., alerting runners to a lack of accurate use of the snapping mechanism), not to forget reading messages from online players. Perhaps the most frequent reminder was that of engaging in facetime (a practice often described as “unnatural”). For example, the stage manager radioed: “to all runners; you’re doing really well; it would just be nice to see your face a bit more”. Or to a particular runner: “if you just turn the camera on your face, that would be lovely; we haven’t seen that, yet; over”. Such reminders were often experienced as helpful by runners, presumably because they helped them to maintain their performance demeanour and game variety. As one runner said: “what is really nice [is that] occasionally [the stage manager] will just nudge you in a particular direction if she feels that you’re going down one route too much”.

TENSIONS

What stands out from our findings so far is the sheer complexity of being a runner in IHY, having to meet the needs of multiple ‘audiences’ (online players, the public, other runners and the control room) while learning to use a complex camera rig in sometimes unnatural ways in order to provide interesting and appropriate quality footage. Remembering and balancing these multiple concerns was no mean feat, as evidenced by the need for (and appreciation of) constant reminders from the control room. In this sense there are multiple frameworks of participation [14] that the runner must continually ‘juggle’ as part of their work. Runners, as operators of their cameras, are also clearly held

accountable [13] on a moment-by-moment basis for the video they produce [18, 23]. Unsurprisingly, this introduces significant ‘tensions’ that in turn, reveal various ‘interactional problems’ that must be overcome or managed by the runner as we now discuss. Building on our description from the previous section and drawing on further exhibits from our data, we articulate four key ‘tensions’: (1) body versus camera; (2) online versus on-the-streets; (3) frontstage versus backstage; and (4) game versus performance.

Tension 1: Body versus camera

The primary job of the runner is to produce a video broadcast that—as we have described earlier—offers ‘intimacy’ and ‘immersion’ for the online player. This was exhibited in the way the stage manager (during team meetings) directed runners towards the need to “translat[e] the fun and the stuff that you’re doing through [the camera] into the viewer’s mind in some ways”. Herein arises the first tension: runners were both ‘performers / players’ of the game *and* ‘camera operators’. They had to simultaneously ‘do’ things on the street (i.e., streetwork) while capturing them for the online players. Accordingly, they needed to perform particular kinds of camerawork so as to produce an appropriate video stream for online players.

Problems such as “pointing [the camera] up the nose when you’re talking [i.e., doing facetime]” had to be avoided. Pointing the camera rig when around members of the public had to be performed sensitively. For instance, they may be involved in other things (e.g., sitting outside a café or restaurant) and not want a camera pointed at them or its light shone towards them. For quiescent members of the public, talking to them at the same time as performing camerawork produced further challenges. As one runner described the practical difficulties of such encounters during a team meeting: “you stand just generally quite close to someone which means you have to tilt the camera, which means you then can’t see the screen”. At times runners were so engaged in this bodily and verbal job of streetwork that they momentarily forgot to ensure their camera was capturing faces, thus the stage manager often radioed reminders during the game for runners to “pull the camera up”.

The tension can be characterised thus. Bodily actions had to be produced sensitively to do ‘double duty’: to be ‘interesting’ (e.g., ‘interesting’ interactions with the public, ‘interesting’ shots, etc.), and yet also be appropriate and ‘interesting’ in terms of camerawork. Runners adopted various tactics to manage this tension. For example, they tended to reduce the amount of running they did to avoid the video stream developing into blurry, blocky visuals (as described previously). They also performed bodily ‘creeping’ so as to produce camera positions closer to the ground, which could then be employed to imply (to the online player) faster movement than was actually being performed.

The tension between doing ‘exciting’ things on the street, but being able to translate this into appropriate camerawork can perhaps best be illustrated through the issue of how to

turn around. While quick glances and turns are part of an engaging game-performance, quick changes in camera-movement do *not* result in a suitable video broadcast. Consequently, in running with, turning and pointing the camera, each bodily activity must be transformed to suit the kind of video broadcast produced by the camera rig as it is held and manipulated by the runner. Or in other words, the runner-qua-performer can glance, but the runner-qua-camera-operator cannot (see [19]).

During the training sessions, the runners were therefore instructed to, in a sense, separate the movement of their body from the movement of the camera. In other words, the runners were asked (by the stage manager) to *first* turn their head, announce what they were seeing, and only *then* turn their camera: “you need to sort of slow it [turning] down, even if the tendency is—there’s someone behind you—you might actually say, ‘there’s someone behind me’ and *then* start to turn”. One of the runners encapsulated the matter of managing the camera rig with the description that “it’s a whole new [...] *body*” which is being experienced by them as a matter of their work as runners. This ‘**camera-body**’—that is, the bodily ‘totality’ of the runner *and* their equipment—requires a transformation in bodily practices.

Tension 2: Online versus on-the-street

The second tension that the runner is faced with is the importance of delivering the online player experience (including interacting with them), yet at the same time engaging *with* that street environment itself. A potential for such dissonance in public places has been noted previously, such as in the mismatch between the physical space of a mobile phone user and virtual space that the phone implicates (i.e., connection to others remotely) [22]. Collaborative video capture systems have also noted tensions between focus on ‘the event’ and interaction with remote others [9]. The runners experienced tensions similar to these; during a team meeting, one noted “you’ve got two audiences [...] the live ones and these [online] players”. However, the demands of these two audiences is not equal. For the runners this emerged as a tension between **immediacy** and **priority**.

For the runners it was “natural” to focus on what was immediately happening on the street. They also had to rely on encounters with members of the public for their role in the game. Nevertheless, getting too engaged with ‘the street’ was seen as a potential problem, with the stage manager warning the runners that “the public on the street can really occupy you in a way that’s as consuming as the other runners can occupy you”.

Thus, while the street environment has a higher *immediacy* for the runner (i.e., it ‘demands’ attention), online has a higher *priority* from the point of view of the game, since runner’s work in IHY is entirely focussed towards delivering the online player experience. As one monitor expressed it: “it’s just remembering that your main audience is the people online [...] as much as you are interacting with peo-

ple [on the street], [...] you’re bringing *them*, out there, into the game”.

The role of the runner in both these competing environments also contributes to this: the runner acts as a kind of ‘performer’ (from the perspective of members of the public and online players), but *also* as camera operator (significantly only for online players). An example of this is found in the challenge of runners making monologues to camera while walking around the street environment and performing this concerted activity in a way that appears “natural” for the online player (we might draw a comparison here with Baker’s study of how “natural” documentary interviewing is achieved [3]).

Apart from the immediacy / priority expression of this tension, there was also further conflict between ‘first time’ encounters with people on the street with the possibility of ‘continued’ watching by online players. In other words, using the same kind of introductory text was not a problem for interacting with people on the street (since for them this would be the first time they hear it), but *could* be a problem for an online player for whom this might be the third or fourth time hearing the introduction text. Runners were instructed *not* to say “we’re doing this online game”, since: “for on online players, once you’ve heard that once, [...] your heart sinks when the second time someone says: ‘oh yeah, we’re doing this online game’; because you’re like: ‘yeah, *I know that*. I’m playing”.

Broadly, then, there is an asymmetry between the interactional resources available to the runner in the street environment compared with that of the online environment they must simultaneously engage in. To use a metaphor of ‘information channels’, there is a sense that the street environment is ‘thick’ (the richness of ‘being there’) while the online environment is ‘thin’ (delivered through the mobile device on the camera rig only).

Tension 3: Frontstage versus backstage

The runner ‘performs’ their role in the game in a highly public environment. While the live video broadcasting starts and ends on the streets from the perspective of the online player, for the runner there are various elements which are kept ‘backstage’, meaning they must be hidden from the online player. Managing what is ‘frontstage’ and ‘backstage’ is a key tension encountered by the runner. This management can be divided into **preparatory work** that takes place prior to the game, and the ‘behind-the-scenes’ activities orchestration work employed **during** the game.

While IHY is, in many ways, a spontaneous, improvised performance, considerable preparatory work is necessary for the *possibility* of spontaneity and improvisation. For example, in preparation for the game, runners must develop a range of ‘talkables’, i.e., topics which they can readily deploy in their interactions with members of the public and online players. For instance, the stage manager described a “sheaf” of useful questions: “Where are you guys going

tonight?', 'Oh, can I walk with you?', You know: 'What are you doing?', 'What are your names?', 'Where are you from?'. Similarly, runners also prepared 'good places' in the urban environment, such as buildings they would like to enter. This involved gaining permission from those in charge of those places beforehand (e.g., pubs, shops, etc.).

During the game, the matter of 'going live' was articulated by the stage manager in terms of a performance demeanour as mentioned earlier: "we've got to kind of get into a sort of mental state of: in here [control room] we're *off*, out there we're *on*". For the runners this is "a slightly different sort of mind-set. Snap *on* at the door downstairs [...] you're no longer sort of pedestrian and casual". Thus, going 'frontstage' involves a 'mental and physical' change.

Also during the game, runners must manage what is on-camera and off-camera. For example, there may be various members of the orchestration team out on the streets fixing technical issues, yet should be kept off-camera. This management around 'liveness' mirrors how camera operators on studio floors coordinate with production teams [7].

Finally, during the game there are a number of mechanisms—such as snapping—and communications matters—such as radio contact with the control room—which are either intended to be entirely hidden from the online player (how snapping works), or at the very least minimised (radio contact was reduced where possible and language employed was controlled, e.g., no names were spoken by runners over the radio). A variation on hiding communications was the development of 'code words' which could be used in text chat but produced by control room orchestrators for runners (e.g., a message of "go to Tudor Square" but produced by an online player that "we [the runners] would recognise").

Tension 4: Game versus performance

Our final tension arises from the nature of the game-performance itself. IHY has a clear game mechanic: it is explicitly described as a game and runners make considerable attempts to help their online players score the most points. Yet at the same time IHY is a performance, intended to deliver a "rich palette" to online 'audience'. Runners had to be *both* players *and* performers.

We saw earlier how this tension became manifest in training sessions when runners were instructed to "avoid face-offs", something that had happened at a previous incarnation of IHY at Manchester. "Face-offs" occurred when IHY turned into a pure 'shooting game', neglecting other aspects of the performance. In short, Manchester involved "too much snapping".

This tension also became evident during one post-game team meeting, where the artists, runners, monitors and technical crew collectively reflected on things that could be improved the next day. Into a relatively calm and concentrated situation, the head of the technical crew (himself an artist) announced about the game just finished: "we have about just over [...] 2,000 snaps taken in the game. But

unfortunately it looks like the red team are in the lead again". At this point several of the runners from the red team noisily congratulated each other, to which other artists responded "you've torn it now", quickly reminding them: "remember what we said, it's not all competitive".

The game mechanic is also of concern to the online players who often indicated in text chat that they wanted 'more snapping' opportunities. Yet runners had to balance this against the more 'performative' aspects of their work. As the stage manager said: "the game is in there, but it's not necessarily the first and foremost thing, you might say". For example, 'facetime' was seen as a critical part of the work of the runner, yet it does not directly impact snapping or the scoring of points. As we have mentioned, runners were issued many reminders from the control room to maintain this performance-oriented aspect of IHY; the stage manager outlined the priorities during a team meeting: "in a way it would be nice to have the reverse problem of too many face shots rather than too many street shots, I think".

There is thus a tension between runner-as-performer versus runner-as-player. It is perhaps "natural" to be player first and performer second, as one runner reflected: "sometimes it felt like you just got trapped in just trying to find people [other runners]". Hence the constant 'battle' for the stage manager to reign in the runners-as-players role.

IMPLICATIONS FOR FUTURE VIDEO EXPERIENCES

IHY demonstrates various ways in which live video streaming might enable future media experiences that connect 'online with on-the-streets'. It also reveals how a new role of 'performer / player / camera-operator', equipped with extended camera rigs, can combine various roles in order to deliver compelling live and interactive broadcasts. And yet IHY also reveals that this is highly demanding as runners struggle to balance four key tensions, and need to learn and deploy an extensive body of craft knowledge.

Drawing on craft knowledge

Perhaps the most immediate lesson we can find from our study is to draw on this body of craft knowledge as a source of practical strategies and tactics. Those wishing to deliver future live streaming experiences around television, games, sports or journalism, as we discuss below, might adapt a variety of strategies from IHY including:

- Devising and rehearsing embodied camera movements such as creeping and turning;
- Addressing online audiences through frequent facetime, yet avoiding repetitious engagements with those on the streets or being overly drawn into gameplay;
- Carefully preparing by scouting physical environments for good locations for action (with permission) and rest;
- Establishing orchestration strategies and agreeing how to communicate them backstage rather than frontstage.

Some of these strategies may seem obvious with hindsight, but they were hard-earned in IHY involving frequent debriefing, reviewing footage and dedicated training days.

Redesigning camera-rigs (and other interfaces)

The novel camera rig in IHY was central to these various practices and combined features normally absent from both traditional handheld video cameras and device-embedded cameras (i.e., attached to tablets or phones). Its user interface provided a viewfinder, connectivity indicators (i.e., lights on the Teradek), an ergonomic grip design for balance and manipulability, and methods for interaction with watching online audiences (text messaging and enabling snapping). In creating this camera rig, smartphones offered a useful platform for integrating various features not currently available on consumer handheld camera technologies. Yet the rig could be improved, especially given its critical role in connecting online audience, public on the streets and control room. We offer four directions.

1. **Camera movement.** One clear possibility is to change the manner in which the camera moves in relation to the runner's body and arm, slowing down and smoothing out its movement whenever they turn rapidly. This might be achieved through the design of enhanced physical rigs (steadycams), or through software manipulation of video captured from panoramic cameras, or even completely decoupling the camera from the body (e.g., using unmanned aerial vehicles [15]). Whatever the underlying technology, this will require a degree of semi-autonomy in the camera.
2. **Thickening online connections.** A second possibility is to 'thicken' connections to the online audience. This might range from making their messages more prominent, perhaps overlaying them on the viewfinder rather than placing them on a separate display, to the use of other modalities such as sound or tactile feedback. We might also redesign online interfaces to extend audiences' abilities to give instructions.
3. **Entry and exit.** Previous research has argued for greater technical support for the management of starting and ending moments of capture [16], an observation that we echo in terms of providing more explicit support for performers putting on and taking off their 'game faces'. This might involve rituals of preparation, possibly by further emphasising the costume aspects of donning equipment.
4. **Orchestration.** We might also enhance the connection to the control room through better orchestration support. This could include more timely reminders possibly with scope for a degree of automation (e.g., alerts about face-offs when runners become proximate), to greater control over separating frontstage from backstage by selectively muting or hiding information from the online audience.

Implications for future video experiences

While these proposals are specific to IHY, we suggest that they have wider significance in two ways.

- Firstly, our study exhibits emerging 'compressions' of **performer and camera operator**, where the person holding the camera is *also* the subject of the footage,

pointing the camera at themselves and speaking 'to' it [17, 16]. In live situations, this also involves interacting with the audience.

- The second implication is the blending of **audience and director**. While this has only been indirectly implied by our study (we did not focus on the online audience), it remains key for future research. This represents a broad emerging move towards increased interactivity for audiences where viewers not only watch video but also direct the action (e.g., the remote vision mixer of [11]).

Thus, our findings speak to a variety of future streaming experiences spanning (and perhaps converging) television, games, sports and even journalism. For television, they suggest ways of enriching existing entertainment formats such as gameshows in which viewers tune in to protagonists' activities in unusual physical environments. For sports and games, they suggest richer ways of relaying action from the pitch or streets, supporting the emergence of eSports from computer games, or perhaps enabling future exertion games that combine the two [21]. For journalism, they imply the rapid transformation of a spectator, present at the scene of an event with a commodity camera, into a temporary reporter who is able to broadcast footage.

We suggest that all of these scenarios will involve similar tensions to the ones revealed by our study and may therefore be open to similar interventions. This is not to say that they are identical, however. We anticipate that these tensions will be balanced in different ways according to each situation and especially to where the primary focus of the performer / player / camera-operator lies. For television, as with IHY, the primary focus may be the remote viewer, whereas for games and eSports it is more likely to remain the local physical activity. Journalism raises the further challenge of training. Our findings revealed the importance of systematic training, but this is unlikely to be available to a general spectator who suddenly finds themselves in the position of broadcasting an unfolding event. In such cases, significant aspects of training may need to be delivered *through* the device, moving beyond purely technical support, such as shot stabilisation, shot variety [16] (e.g., mixing wide shots and close-up shots) or face detection (e.g., warnings if a face is not framed correctly) to providing rich guidance for how to stream appropriate video.

CONCLUSION

By developing and studying an unusual touring performance, we have shed light on the challenges that will be faced by people who live-stream video of their activities to online audiences. We suggest that design for the emerging compressions of performer / player / camera-operator will need to carefully manage four tensions between: the 'naturalness' of bodily action and the often 'unnatural' actions that must be made with the camera; the priority of the online audience versus the immediacy of the street environment; the separation of backstage orchestration from the visible frontstage of the activity; and between playing and

the performance of playing. Beyond revealing these, we have highlighted future technical innovations that might better support them as live video broadcasting becomes ever more technically feasible and commonly-practiced.

ACKNOWLEDGMENTS

We are grateful for EPSRC support from grants EP/M000877/1, EP/G065802/1 and EP/K025848/1.

REFERENCES

1. Adams B., Venkatesh, S., & Jain, R. 2005. IMCE: Integrated media creation environment. *ACM Trans. Multimedia Comput. Commun. Appl.*, 1(3):211-247, 2005 (August).
2. Arev, I., Park, H. S., Sheikh, Y., Hodgins, J., & Shamir, A. Automatic Editing of Footage from Multiple Social Cameras. *ACM Transactions on Graphics* (SIGGRAPH), ACM, New York, 2014.
3. Baker, C. D. Knowing things and saying things: How a natural world in discursively fabricated on a documentary film set. *Journal of Pragmatics*, Volume 13, Issue 3, June 1989, pp. 381-393.
4. Bao, X. & Choudhury, R. R. MoVi: mobile phone based video highlights via collaborative sensing. In *Proc. MobiSys '10*, pp. 357-370, 2010.
5. Bernstein, M. S., Brandt, J., Miller, R. C., & Karger, D. R. Crowds in two seconds: enabling realtime crowd-powered interfaces. In *Proc. UIST '11*, pp. 33-42, 2011.
6. Benford, S., Greenhalgh, C., Crabtree, A., Flintham, M., Walker, B., Marshall, J., Koleva, B., Egglestone, S. R., Giannachi, G., Adams, M., Tandavanitj, N. et al, Performance-led research in the wild. *ACM Trans. Comput.-Hum. Interact.* 20(3), Article 14, July 2013.
7. Broth, M. The Production of a Live TV-interview through Mediated Interaction. In: C. van Dijkum, J. Blasius, H. Kleijer & B. van Hilten (eds.), *Recent Developments and Applications in Social Research Methodology*, *Proc. of the Sixth International Conference on Logic and Methodology*, 2004.
8. Broth, M., Laurier, E. & Mondada, L. (eds.) *Studies of Video Practices: Video at Work*, Routledge, 2014.
9. Dezfuli, N., Huber, J., Olberding, S., & Mühlhäuser, M. CoStream: in-situ co-construction of shared experiences through mobile video sharing during live events. In *Ex. Abs. of CHI '12*, pp. 2477-2482, 2012.
10. Engström, A., Juhlin, O., Perry, M. & Broth, M. Temporal hybridity: Mixing live video footage with instant replay in real time. In *Proc. CHI '10*, pp. 1495-1504, 2010.
11. Engström, A., Perry, M., & Juhlin, O. Amateur vision and recreational orientation: Creating live video together. In *Proc. CSCW '12*, pp. 651-660, 2012.
12. Flintham, M., Benford, S., Anastasi, R., Hemmings, T., Crabtree, A., Greenhalgh, C., Tandavanitj, N., Adams, M., and Row-Farr, J. Where on-line meets on the streets: experiences with mobile mixed reality games. In *Proc CHI '03*, pp. 569-576, 2003.
13. Garfinkel, H. *Studies in Ethnomethodology*. Prentice Hall, 1967.
14. Goffman, E. *Forms of Talk*, Philadelphia: University of Pennsylvania Press, 1981.
15. Higuchi K., Rekimoto, J. Flying head: a head motion synchronization mechanism for unmanned aerial vehicle control. *CHI '13 EA*, pp. 2029-2038, 2013.
16. Juhlin, O., Engström, A., & Reponen, E. Mobile broadcasting: The whats and hows of live video as a social medium. In *Proc. MobileHCI '10*, pp. 35-44, 2010.
17. Kirk, D. S., Sellen, A., Harper, R. & Wood, K. Understanding Videowork. In *Proc. CHI '07*, pp. 61-70, 2007.
18. Licoppe, C. & Morel, J. Mundane Video Directors in Interaction: Showing One's Environment in Skype and Mobile Video Calls. In Broth, M., Laurier, E. and Mondada, L. (eds.), *Studies of Video Practices: Video at Work*, Routledge, 2014.
19. Macbeth, D. H. Glances, trances and their relevance for a visual sociology. In Jalbert, P. L. (ed.), *Media Studies: Ethnomethodological Approaches*, pp. 135-170, University Press of America, 1999.
20. Mughal, M. A., & Juhlin, O. Context-dependent software solutions to handle video synchronization and delay in collaborative live mobile video production. *Personal and Ubiquitous Computing*, 18(3):709-721, Springer, 2014.
21. Mueller, F., Edge, D., Vetere, F., Gibbs, M., Agamanolis, S., Bongers, B. & Sheridan, J. Designing sports: a framework for exertion games. In *Proc. CHI '11*, pp. 2651-2660, 2011.
22. Palen, L., Salzman, M. & Youngs, E. Going Wireless: Behavior and Practice of New Mobile Phone Users. In *Proc. CSCW '00*, pp. 201-210, 2000.
23. Perry, M., Juhlin, O., Esbjörnsson, M., & Engström, A. Lean collaboration through video gestures: coordinating the production of live televised sport. In *Proc. CHI '09*, pp. 2279-2288.
24. de Sá, M., Shamma, D. A., & Churchill, E. F. Live mobile collaboration for video production: design, guidelines, and requirements. *Personal and Ubiquitous Computing*, 18(3):693-707, Springer, 2014.
25. Vihavainen, S., Mate, S., Seppälä, L., Cricri, F., & Curcio, I. We want more: human-computer collaboration in mobile social video remixing of music concerts. In *Proc. CHI '11*, pp. 287-296, 2011.
26. Weilenmann, A., Säljö, R., & Engström, A. Mobile video literacy: Negotiating the use of a new visual technology. *Personal and Ubiquitous Computing*, 18(3):737-752, Springer 2014.