

Designing for crowds

Stuart Reeves

Dept. of Computing Science
University of Glasgow, UK
stuartr@dcs.gla.ac.uk

Scott Sherwood

Dept. of Computing Science
University of Glasgow, UK
sherwood@dcs.gla.ac.uk

Barry Brown

Department of Communication
University of California, San
Diego, USA. barry@ucsd.edu

ABSTRACT

Designing for spectators and audiences presents new challenges to the design of technology. In this paper we focus our attention on understanding and designing for *crowds* as a distinct design topic. We present a study of one particular instance of crowd activity—football fans on match day. Close video analysis of interactions within the crowd reveals how crowds seek to maintain membership through synchronisation of activity, but also how crowd support interaction between its members through co-ordination around shared objects and the ‘snowballing’ of songs and gestures. Drawing on this data we develop salient topics for HCI design for crowds, such as: reconceptualising interaction design to treat crowds *as* crowds rather than as groups of individual audience members; understanding intra-crowd interactions, via the use of shared objects and synchronising crowd interactions; and understanding the nature of peripheral participation in crowd activities, and interactions between distinct crowds. We also reflect on conceptual challenges that crowds pose for HCI as it increasingly develops its interests in public settings.

Author Keywords

Crowds, design, spectatorship, sports fans.

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

One key theme in HCI has been the exploration of new interactional situations that use technology. One recent area of interest has been settings in which users form part of an audience or crowd, spectating upon performer activity, and perhaps interacting with a system themselves [23]. Interest has also extended to situations involving the implication of passers-by in interactions with technology [4]. Studies of interaction in the performance arts [28], museums and galleries [18], city streets [9], funfairs [26] and clubs [10] have all expanded our understanding of these settings. With

some exceptions, this work tends to address ‘audience-like’ formations (even where it deals with ‘crowds’, e.g., “crowd-and-DJ interactions” [10]) and is typically concerned with performance scenarios in which interaction between professional performer and audience is key. Issues such as the maintenance of awareness between collaborators, the ways in which they coordinate and design their conduct with an orientation to peripheral visibility and legibility, and conduct mutual monitoring of one another [16] have been applied to these new settings. For example, the availability and legibility of participants’ manipulations of an interface to surrounding audience has a clear importance for design within these public settings [23].

In this paper we develop this work further by focusing not on performance and performance-like situations, but instead convivial *crowd-based* settings. Crowds are distinct in that they offer a setting where large-scale participation is a key characteristic. Furthermore, this participation is not necessarily mediated by some singular ‘spectacle’ as with audience-performer scenarios, and any performance-like activities are more distributed, fluid and shared amongst members of the crowd. The relationships (and interaction) between members is much more varied than that between performer and audience, where (on the whole) there is a maintenance of shared attention. In crowds, individuals and the group maintain a shifting focus for participants.

This distinctness suggests the need to enhance existing models of audience-performer settings. Crowds also present distinct design challenges in how we can support interaction between a system and potentially thousands of users simultaneously. To explore these issues this paper offers an empirical study of one crowd-based setting (a sports crowd). Using detailed video analysis of crowd interaction we develop observations concerning how individuals within crowds interact with each other, how they produce their status as members of a crowd, and how crowds manage their interactions with those on the periphery or outside the crowd.

RELATED WORK

Technical demonstrations of ‘crowd computer interaction’ [6] with systems to support spectators or audience (e.g., sports fans [31]) have been of interest to researchers for some time. One of the earliest audience-driven interaction systems was the ‘Cinematrix’, a large screen interactive [7], in which audience members (divided into two ‘teams’) held up coloured paddles in order to control interaction with a

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simple game projected on a large screen. Thus, devices or controllers held by participants [31], or vision techniques to detect movement (e.g., [29]), coupled with large displays, have become the dominant paradigm for enabling multiscale crowd interactions. Interestingly, as noted by others, little of this work presents analyses of the material practices of users in these settings [21], and, although guidelines do exist [20], they are high-level [21].

So, in spite of emerging indications of interest in crowd interactions (e.g., [6, 24]), they can present something of a challenge for HCI, and there is little published work that analyses crowd interactions. Crowds can seem to be unlikely users of technology or alternatively present a difficult setting in which technology design may be deployed. We contradict this, however: crowds are already heavy users of technology, and making sense of the different social forms that crowds take is fundamental to understanding the diversity of modern technology use.

We might imagine that the considerable research focus outside of HCI upon the activities of ‘crowds’ would assist us in developing such understandings within HCI. However, often this research has been developed in terms of theoretical and abstract accounts (e.g., [22]) of the presumed hidden motivations of sports crowds (e.g., [27]), or theories of the sports crowd experience in terms of stadiums design (e.g., [1]), whilst ignoring what practical actions actually make up the recognisability of the crowd. With a few exceptions (e.g., [32, 11]), often endemic within crowd studies in general, and within many football studies in particular, is the focus upon problematic and exceptional crowds, such as crowds of unrest (e.g., hooliganism [19, 14] and outside of football). Thus, as noted by others [13], it often appears that the everyday sociality of fans, and their ‘mundane’ and routine formations have often escaped the majority of analytic attention. So, rather than develop abstract accounts and generic typifications of crowd behaviour or fan types (e.g., [12]), we wanted instead to understand more about the everyday, practical and mundane interactional ways in which crowds of fans constitute themselves at and around sporting events.

UNDERSTANDING CROWDS OF FANS

Fundamental to designing for crowds is understanding what makes a crowd a crowd in the first place, how this is formed interactionally. We turn directly to a selection of video-based vignettes drawn from our corpus of data collected over the course of several football matches. These will be used to explore in detail the material practices of football fans here as they interact and participate with each other, and practically constitute what becomes see-able as a ‘crowd’.

Our approach has been broadly ethnographic; part of our corpus consists of observation work (and video recordings where possible) derived from attending various football matches. While not wishing to exoticise very ordinary competences, we also draw extensively upon our personal

experience as a group who have supported but also worked in football grounds. The authors are a mixture of non-fans and football fans and we found that this pairing of competent members of this particular culture, with those for whom the culture was alien provided useful alternate perspectives in triangulating the sense of what practical activities take place at and around football matches. We also draw upon our own experiences in and around matches, both as part of a more formal data collection mentioned above, and our own histories as fans, in order to make sense of our data, enabling us better understand, say, competence in starting songs in the crowd. Additionally, we note background use of informants and interviews with fans discussing the role of football in their everyday life.

Thus, we employ video data presented here less as part of a systematic video corpus, but rather (using an interaction analytic, ethnomethodologically-informed approach) in order to exhibit certain phenomena found within our larger data set. From our experiences observational and otherwise, such activities as exhibited in our analysis are typical of crowds congregating around football events. In exhibiting these events we will take a practical orientation to this crowd, and pay close attention to the small details of collective football fan conduct and coordination. Just as when studying a language, one may only need individual examples of talk to elucidate our understanding as competent speakers (rather than statistical correspondences); thus our focus was on using this data to examine what we ‘already know’ from fieldwork and participation in these settings [25].

We noted that attending football matches often involves a great deal of time spent travelling to and from the stadium, as well as moments of extended ‘downtime’ like half-time, queuing, and drinking before and after a match. Although this time does not constitute the ‘main event’ it is nevertheless a fundamental component of the experience for many fans. So, in order to examine this significant aspect of ‘the football trip’ we were drawn to observing and capturing some of these moments. As such we attended and recorded part of the build-up to an international football match taking place in the UK.

There are numerous challenges one faces when attempting naturalistic audiovisual capture in public and semi-public spaces, however we found these challenges are often magnified for spectator sports environments, particularly so for football (e.g., achieving unobtrusive footage with good sound quality).

Sequence 1: The crowd in the pub

It is match day for supporters of a national football team. We join these home fans as they converge in a local pub. There are many ‘gathering places’ in which fans will locate themselves on the day of a match, and this particular pub is no exception, in that fans will frequently meet here before home games.

Many of the home fans in the pub are wearing blue shirts trimmed with white (the colours of the national team), along with other clothes associated with support of their team—hats, scarves, etc. It is notable that the extent of dress varies—whilst some supporters are wearing an extensive number of items relevant (i.e., seen by supporters as representative) of their support of the national football team, often involving quite extensive customisation of clothing (e.g., with badges), other supporters are only wearing a national team shirt with casual clothes, whereas others still are displaying no particular visible signs of their support other than appearing to be in visiting groups that contain fans wearing such items. Also present in the very same pub is a much smaller group of opposition supporters, made more visible by virtue of their red shirts displaying the colours of the opposing side's national football team.

In this excerpt from the data there appear to be various relatively distinct and separate groups of home fans, from a particularly physically and vocally active group towards the centre of the pub's main area in front of the bar (see Figure 2, top), to more visibly subdued fans, such as those seen talking together at the edges of the crowd near a wall (see Figure 1). The environment of the pub itself is loud, with continuous talking and singing. Many present are at the moment we join them singing together a particular song that is associated with the home fans' national team. The nature of the song is that it rises tonally through a scale for each line of the song, and then repeats. This provides natural climactic points as those singing reach the end of a verse.

Many fans in the pub are singing this song together. As the song then approaches the end of a verse, the group towards the centre in particular, as well as others elsewhere in the crowd, begin jumping up and down, and raising arms. Their jumping up and down in concert, and in 'time' with the song is not strictly 'in time' but rather retains a 'looseness' that still is coordinated with each other around key moments. The song progresses and they, and others, cease jumping together but continue to gesture, raising arms and 'pumping fists', once again in approximate time to the rhythm of the song (see Figure 2, top).

Those performing these actions (particularly noticeable are those gesturing and jumping) appear to be located in observably different groups distributed spatially amongst the rest of the crowd. There are three apparently distinct groups



Figure 1: A segment of more 'subdued' supporters

that are visible within the centre alone (due to their physical orientations). We can also see other members of the crowd performing similar actions around the same time, as well as people holding up cameras and beer glasses.

Interaction within the crowd

Something that is greatly apparent initially is that we can see and hear different, and seemingly unlinked groups of supporters doing a number of things—timing their strikes of a plastic deer, coordinating their gestures at particular points in the flow of the song, organising their singing to be the right words and lines at the right time—in concert with each other. So, despite the distinct nature of these groups, they are all engaging in these activities of jumping, gesturing and so on, *together*. Similarly, many more fans across the crowd than just those displaying more observable bodily conduct are 'joining in' singing the song *together*. The paradox, however, is that most of these people that make up the crowd of fans will not know one another. How they are seen as being in a 'crowd of fans' and what are the observable and visible ways in which they do this? What are the competencies required to understand and take part in the activities constitutive of this observability?

In one sense the crowd here in our data consists of many different and distinct groups of individuals (e.g., friends, family) who have gathered in this particular place in order to attend the event together. In this understanding, the crowd here is potentially just clusters of these separate and unrelated groups. However, members of these separate groups orient themselves to the crowd at large beyond these immediate local groups. A common orientation to something (e.g., a match and a team), as well as an observable accountability to this, perhaps through wearing particular colours, forms one part of identifiability of the crowd of fans. That is to say, one key element of dress and behaviour is the production, for anyone observing, of being members of a larger crowd.

Distinct groups embedded within the crowd of fans at large interact together in subtle and not-so-subtle ways. The observable and accountable crowd emerges via the practical conduct of these smaller groups. The various distinct groups and individuals within those groups conduct themselves with an *orientation towards the possibility of collective participation* across these groups.

Thus, it is characteristic that the kinds of interactions fans engage in here are visible and audible not just within the immediate vicinity of known fellow supporters, but also at a



Figure 2: Supporters collectively 'pumping fists'.

distance. Returning to our data, and as we can see in Figure 2, arms are thrust high in the air, making the fans clearly visible within the sea of heads. Similarly, jumping inherently involves making oneself prominently visible to others via such a noticeable movement. Singing is, as we have described, ‘performed’ and designed by crowd members (perhaps mostly by those starting a song) to be clearly hearable for others within the crowd, as well as simultaneously forming an offer to others for the possibility of joining in. This orientation towards shareability is also a feature of jumping and other gestures, which furnish similar possibilities for others joining in.

We can also ask what other ‘work’ arm waving does here besides being visible for others (note that we use ‘work’ in the sense of an analytic device). We can interpret this in a number of different ways. It may be ‘about’ directing or punctuating speech or singing, perhaps for indicating some kind of defiance, or instead embodying and physically sharing emotional feelings (e.g., anger, excitement, joy) with others. There is also something inherently powerful and enjoyable about doing such actions with others at the same time. However, we must retain a perspective on what is reasonably observable here; and primarily this is the simple ways in which bodily and verbal conduct may be ‘augmented’ and thus made more public, shareable, and collaborative (in that it is possible to join in by virtue of the orientation towards hearability and visibility).

Actions that are produced synchronously with others, such as doing singing ‘in time’, doing jumping around the right moment, or gesturing at the same time, require a sensitivity in the production of fans’ own bodily and verbal conduct to those both immediately around them as well as those further away. Producing verbal and bodily actions that are part of collaborative conduct with others also involves ongoing mutual monitoring of one another’s actions, something that is perhaps most apparent in coordinating synchronous action. It is this basic interactional work of monitoring and producing one’s actions with an orientation towards others’ own monitoring that forms a fundamental part of the ways in which the crowd constitutes its ‘crowd-ness’, and its apparent collectivity and becomes observable.

The importance of place

A final observation we can make about episodes like these is that the fans produce such actions in the context of the match day, and gain their relevance also from the location in which those actions are conducted. In understanding this, we can consider how the very same set of people could be present in this pub on a non-match day, however would have an entirely different character to what we see now. The sense of ‘place’ [15, 32] is constituted from a historical development of this pub as being one of many supporters’ ‘centres of gravity’ within the city that fans will congregate in before a prospective national match. It is thus appropriate and fitting for fan conduct to be played out here, just as it is the material actions of fans that also help construct the sense of place.

This issue of appropriateness, and the sense that conduct is seemingly quite ‘performative,’ helps us relate to what has been suggested by some as the ‘carnival’ atmosphere of certain football crowds [11], in which the everyday definitions of the boundaries of appropriate behaviour are changed. Props, flamboyant attire and actions that would not be considered appropriate in the very same place with the very same people at a different point in time highlight the utility of this metaphor.

Sequence 2: Deer and flags

Returning to the video recordings we can now begin to explore another important aspect of interaction we can see in the pub: the part that various objects play in collaborative action amongst fans.

A short time later during another song, we recorded and observed an inflatable deer being bounced around between members of the crowd (see Figure 3, left). The relevance of this is related to the lyrics of the song being sung (which features a deer). The deer is bounced back and forth several times between various parts of the crowd before coming to rest. During this time various members of the crowd in different locations can also be seen jumping once again, and gesturing with arms.

Later still, we observed a number of the crowd members holding up a large national flag for the opposing team (see Figure 3, right). Several opposition supporters are holding up this large flag above their heads, and moving its edges up and down. It appears that other fans, supporters of the home team, are also visible in taking part in this activity.

Coordination around shared objects

A crucial feature of our discussion of the bodily and verbal conduct of crowd members has been the availability of this conduct to other members of the crowd at a distance. The episodes described previously involving the inflatable deer and the flag also builds upon this point.

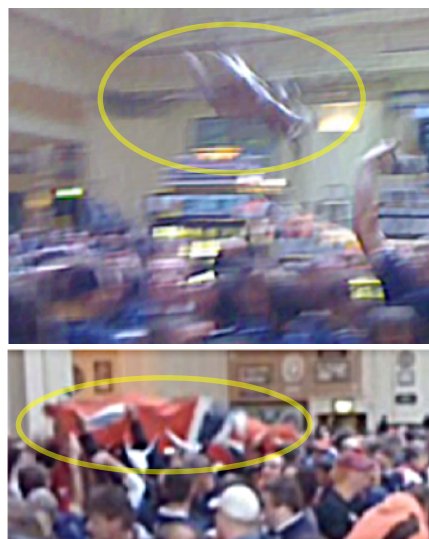


Figure 3: A plastic deer (circled, top) being bounced between members of the crowd (note: image has been sharpened); a flag being held by home and opposition fans (circled, bottom).

Taking part in a strike of the deer involves participation between members of the crowd in distinctly different spatial places. In fact, the deer may be seen as a kind of ‘shared object’ for members of the crowd to coordinate with and around. The object itself (the deer) here does the work of enabling individuals in the crowd to interact with one another at a distance in some basic, lightweight fashion.

The flag also provides similar opportunities for those fans close to its location in amongst the crowd. It may also be thought of as a kind of ‘shared object’ that a number of fans may take part in holding together at the same time. We also have seen in the vignette how home fans located close by the flag could demonstrate their friendliness towards the opposition fans through joining in with this activity. This point regarding such ‘bridging’ interactions between groups of opposed supporters is relevant to the characteristics and expectations of being a ‘good fan’ supporting the home national team. This will be explored more fully in a later section where we will see a more fine-grained description of how interactions between such opposing groups of fans play out.

We noticed other, less obviously shareable items also being passed around between fans; for instance, a pair of flashing glasses were exchanged between a number of fans within the same visiting group. This helps illustrate the diversity of forms of participation and interaction with and around objects—ranging from synchronous collaborative activities designed for a locally-situated group (waving a flag), to activities involving objects that are passed on between adjacent crowd members (the glasses), to objects that involve carefully timed responses between widely separated sections of the crowd (the deer).

Snowballing interactions

Fans’ orientation to collaborative observability is more clear when we begin to pick apart the practical work of singing a song together, not only with ones’ immediate group of friends but also with a crowd of fans in general.

As part of our observations at and around matches we noted the ways that songs are sung in football crowds. When a fan wishes to begin a song, we observed that it is typically begun with deliberate loudness and slowness. So, at first it will often involve one fan in particular prominently and slowly singing the very first line of the song. Like the concern for visibility of gestures, in this situation involves a concern for hearability; i.e., that the first line becomes hearable as something that other crowd members can join in with. Thus, fans initiating a song craft it noticeably into ‘beginning a song’ such that it is an ‘offering’ to other members of the crowd. This offering also requires a sensitivity in terms of when it is produced; fans must be sensitive regarding the opportunities for when to start a song and when they should not.

Mostly a fan’s song ‘offering’ is conducted in such a way so as to attract the attention of a local group of friends, however it also is produced for any unassociated others

within earshot. As local known and unknown others join in, the volume of noise obviously increases, thus further increasing the song’s reach to the crowd at large. For successful song initiations, subsequently this ripple of others joining in begins to ‘snowball’, with larger and larger sections of the crowd joining in.

Similar observations can be made about ‘Mexican waves’. The activities that make up a Mexican wave, such as holding up one’s arms, are designed to be visible in order for other members to participate, and at the same time forms the core activity of a Mexican wave (i.e., reflexivity). Participation in a Mexican wave also requires abilities of prospection for appropriate timing and synchronicity with others (i.e., seeing and projecting when the ‘right time’ is to be part of the moving body of the wave).

At this point we can also consider the observations of Clark and Pinch in their ethnography of the work practices of market traders [8]. In their study, the authors describe the ways in which groups of onlookers come to gather around market stalls through the strategies and techniques involved in traders’ performance of sales talk. As part of constructing an “edge” (i.e., a crowd of prospective buyers), traders rely on passers-by becoming increasingly likely to join the crowd when an existing group are already present. Thus, it becomes crucial for the trader to attempt to make at first one passer-by stop, as this then encourages others to stop, and so on.

Crowd uniformity

Having detailed the ways that members of the crowd attend to particular prominently visible and hearable activities, and join in with their own, we must also consider those not conducting themselves in such a way. In fact we may note that large portions of the crowd are not jumping, not raising arms and perhaps not singing. Alternatively, some fans are just singing, and others are talking. This leads to the rather obvious caveat in our analysis so far that crowds are not uniform or homogenous and should not analytically be treated as such.

As evidenced by the data, we can see that instead, the conduct of crowds of fans such as this have a sets of features directed both towards notional uniformity of presentation and non-uniformity of presentation. So, for example, we have seen how activities are performed and designed with an orientation towards and sensitivity to collective action that others can easily join in with. This may be, for instance, as simple as wearing specific colours (e.g., the wearing of national team strips), or items of relevance like team scarves and other significant clothes (e.g., national dress). It also may be bodily and verbal conduct, perhaps involving singing the same songs, gesturing in particular, commonly performed ways (e.g., arm raising). However, at the same time as we have seen there are many clearly distinct groups within the crowd, they may be entirely ‘disengaged’ in most of the other activities others are engaged in or in some cases be opposed to certain activities fellow

supporters engage in (see [11]). Further to this, configurations of apparel and particular customisations can be employed by fans, such as badges, hats and other props, in order to ‘stand out’ rather than as a presentation of uniformity. So, the supporters still retain an orientation towards uniformity of action and self-presentation, but the crowd’s members can choose their own level of observable adherence to this.

Thus we can begin to see collaborative crowd interactions such as singing, gesturing and playing with ‘shared objects’ such as the deer or the flag, as being *flexible* activities. Members of the crowd can choose their own level of involvement in such collective activities; they can engage in, say, jumping in time to a song when they wish to and disengage from that when they wish to. Doing so does not make them ‘less of a fan’. This also is a feature of fan conduct at matches, as not all fans necessarily sing, jump, gesture, shout, stand up, and so on, and their level of engagement in such activities does not necessarily conflict with the notion of legitimately and actively ‘supporting’.

However, we must temper this observation with our understandings of how the level of participation by fans is seen by others. For instance, in our observational data we found that not joining in may sometimes be seen as a technique of presenting oneself to others as having ‘been there and done it before’, i.e., that, coupled with age, reserved behaviour may be employed as a method for exhibiting experience as a fan.

Crossing boundaries

Next we can look at how boundaries between very different groups within the crowds can be permeable. Here we examine a group of opposition supporters who are ‘embedded’ in amongst the larger crowd of home supporters. The group here are standing in a marked circle within this larger crowd (see Figure 4). Previously we very briefly saw how a flag featured as a shared object around which both home and opposition fans could both interact with one another around. Here we see some more detailed interaction between these opposing supporting groups.

As we join the action, a home supporter from the surrounding crowd approaches the opposition group, placing his right hand on the back of a member of the opposition supporters (see Figure 4), moving his arm further around the fan’s shoulder and turning to face him. Shortly after appearing to exchange a few words, the home supporter attempts to shake hands with the opposition fan. However, this particular opposition fan has a bottle in his right hand, is unable to reciprocate. Thus he raises his right hand to highlight the problem to the home fan. The home supporter, appearing to identify this problem then converts his gesture into a pat on the head of the opposition fan. Subsequent to this exchange, he then moves further into the circle of opposition fans. Following this, the opposition group is approached by two further home supporters who also begin talking with them (see Figure 4).

This sequence shows us the ways in which distinct sections of crowds of fans may interact. Although some actions may be designed to promote crowd homogeneity, e.g., gesturing together at the same time, as well as wearing, say, clothes of a particular colour, the form of ‘crowd’ we conceived of earlier in this paper, i.e., one that engages in varying amounts of collaborative action, may be internally divided in quite considerable ways.

Here the opposition fans are faced with a ‘problem’ of sorts regarding the ways in which other fans act. The ‘problem’ is that because of their status (i.e., as supporters of the opposing team), the opposition fans are unable join in with the kind of collaborative crowd activities we have seen previously, i.e., jumping and ‘pumping fists’ in time with others’ songs associated with the home fans’ national team.

The opposition are highly recognisable as opposing supporters by virtue of their different strips, their physical positions and so on. In the vignette several home supporters create a ‘bridge’ between the two crowds.

In order to understand interactions such as these between groups within the crowd of fans here, we must take into account the particularities, context, history, ‘spirit’ and character of different groups of supporters. Interactions such as those seen between home and opposition fans are coloured most strongly by the home fans’ position as supporters of their national team and the normative character that support takes on: here, what is appropriate, expected, and normal behaviour is friendliness towards the opposing side and the breaking barriers (see [11] for more detail on this characteristic of this group of supporters). Committed home fans may demonstrate their own commitment through approaching the opposition in a manner of friendly rivalry. Thus, interestingly, such ‘bridging’ activities are part of what makes one a ‘good fan’ in this particular context.

Summary

In the sequences of interaction detailed in this paper, we have seen some of the various forms of collaborative action



Figure 4: A home supporter (H) approaching an opposition fan (O) (top left and right, marked); offering a hand (bottom, left); the head pat (bottom right).

engaged in by large numbers of individuals and groups, enabling them to interact with one another in simple, elegant and often powerful ways. This was seen particularly through coordinated bodily and verbal conduct, such as the ways in which songs may be started, and bodily conduct may be timed with such songs, and thus with others. The interactions we have seen also hint at something of what it is to be a competent fan, particularly when considering how fans start songs (i.e., knowing when and how to conduct oneself).

We have also seen the introduction of shared objects to crowd groupings, and that such objects may come to establish (fleeting and ‘lightweight’) connections between unrelated members of the crowd. In this way, shared objects offer the potential for fans to interact with one another in a very simple way.

It was noted in our analysis that the crowd here is also not a homogenous, uniform entity, although it is often oriented to and designed as such by participants in their shared actions and attire. We also saw how engagement in these kinds of activities may also be highly flexible in terms of participation. The vignettes further illustrated the textured makeup of the crowd of fans, through seeing how opposing crowds may meet as in our example of interaction across crowd boundaries with fans’ ‘bridging’ interactions.

DISCUSSION

It is clear that crowded settings are a challenging environment in which to support interaction—the analysis here is beginning to uncover some ways in which technology could be threaded with interaction within crowds without disturbing or conflicting with crowds’ ordinary interactions and behaviour. We note that in many ways this paper is a continuation from existing HCI work on audiences (e.g., [23]), and bears a relation to CSCW topics such as the maintenance of mutual awareness and monitoring between people in workplaces (e.g., [16]).

We will focus on four points here. Firstly, we discuss how technology can support ‘crowds being crowds’. That is, how technology can interact with users without causing them to no longer be seen as part of the crowd, or disturb the very behaviours which produce crowd membership in the first place. Secondly, we discuss ‘intra-crowd communication’—how technology can support interaction between members of crowd. Thirdly, we discuss how technologies can support interaction between crowds and those on the periphery or outside the crowd. This can be one important part of differentiating an ‘angry’ crowd from a friendly one. Lastly, we discuss broadly the potential for understanding crowds as the unit of design for interaction. This involves a break with seeing interaction in terms of a user, or an individual *as part of* a group, and instead interaction with *the group itself* as a meaningful unit.

Supporting crowds being crowds

One of the first key findings is that membership in a crowd is not necessarily something that we can taken for granted

in our analysis, but instead is produced by members’ conduct. For an audience this might be mutual orientation to a common subject (e.g., a performer), whereas for the crowds here there were a range of actual devices used—common dress or carrying or wearing particular objects (hats, flags). The synchronisation of behaviour is also important—jumping at the same time, walking in the same direction (marching) or common movements (waves, hand movements). Lastly there is a range of aural devices used to present membership in the crowd, such as singing, shouting, yelling, etc. The importance and centrality of synchronising activities—bodily or verbal—with one another cannot be underestimated. We have seen, for instance, disparate crowd members who are otherwise unassociated jumping and gesturing and singing in synchrony. This synchronicity and sensitivity towards timing conduct that is relevant for the moment is constitutive of the character of the crowd as it is presented to its own members as well as bystanders.

One key problem with designing technology to interact with crowds is how to not disturb this engagement. Most forms of technology are focused on interaction between a single user or a small group and a system. Even those systems that involve large displays usually rely on interaction with a small group (e.g. [21]). Yet this interaction scheme may tend to differentiate individuals from the crowd as a whole. Indeed, a crowd as a unit can come to be cast very quickly as audience or spectators [23]. This can create a ‘barrier’ within the crowd.

What we find promising is ways of interacting with crowds that allow them to still be crowds, and produce that status simultaneously with any technological interactions. For these reasons technologies that focus on common behaviour are promising in contrast to systems where a small group or an individual is differentiated. One simple example is crowd cheering meters [2] which allow a crowd to synchronise and orient to a group activity together. Systems that involve a collective interacting together—perhaps on their own phones—and make this visible (say holding a phone up) are another simple example (see the [7] for an early example of this).

This said, we do not wish to overplay the importance of supporting the homogeneity of crowd behaviour. Fans do wear similar colours and similar clothes, they sing the same songs together, and they make the same gestures together. However, as we have noted, crowds are not homogenous or uniform (since they are experienced as a multilayered complex of distinct groups that fans attend to), and participants may use complex configurations of dress and indeed their own participation as a method for ‘standing out’ from the potential uniformity of a crowd of fans. A fundamental aspect of this is the varying and flexible levels of engagement that fans as participants may involve themselves in.

This raises the challenge of designing for flexible engagement for members of the crowd, who may have very different perspectives upon the amount they wish to ‘stand out’

or ‘blend in’. If we designed a system for members of crowds to interact with one another—i.e., acting as a shared object, we must consider the issues of crowds-within-crowds and the possibilities for ‘bridging’ between these groupings within crowds. This implies some support for multiple overlapping concerns, such as the ability to attend to one group at one time, and another group at a another time. Applications for crowd interactions should not rely on simplistic models of homogeneity or uniformity or aggregation (which is obviously an easier model to design infrastructure for, [7] being a well-known example). Instead we suggest systems designers give crowd members a choice or flexibility as to the scale of crowd they consider themselves part of, and offer them tools to manage the way they present themselves to the complex ecology of the crowd. We should consider the various sub- and super-crowds that people attend to at different points (e.g., at one point as a fan of the national team, at another attending to a group of friends).

However, we must also potentially be wary of divides in crowds. As we have noted, there is a sense in which gestures, for example, are not produced as performative acts for an audience, but rather as both being about sharing with others in some synchronous activity as well as at the same time forming *offers of participation* for the crowd at large. Members of the crowd are typically more concerned with enabling participation than performing to one another, although we would not deny that elements of performance-like behaviour are indeed crucial to the conviviality of the crowd setting.

Intra-crowd interaction

Following from these observations one promising route is to seek to support *intra*-crowd interaction. As we saw from the fieldwork there are a range of different ways in which a crowd interacts with each other, and while the interactions between strangers may be on the whole very lightweight and almost trivial, they are key in helping the crowd gain a sense of common purpose, but also in preventing ‘trouble’ both interactional and more broadly.

In our analysis shared objects like the plastic deer and the flag offered forms of interaction between members of the crowd—the deer enabled lightweight interactions between crowd members who were spatially distant as well as close by, whereas the flag enabled only those close by to take part in holding it. We also examined other objects that had to be passed around from individual to individual (such as the glasses).

Supporting such a variety of ‘shared objects’ seems an interesting research direction. It may be that these could be data objects inspired by this form of ‘moving’ interaction are not tied to any individually-held device, such as software components that ‘bounce’ between mobile phones belonging to spatially (and socially) distant members of the crowd. Such shared objects would not necessarily be ‘owned’ by anyone, but instead support extremely light-

weight and fleeting interactions. Another variety of digitally-shared data objects could rely instead on spatial proximity, as found in the flag example; digital objects in this example would rely on coordination between proximal fans. In particular peer-to-peer sharing could support the sharing of digital objects that serve a more individual form of passing on (one-to-one), as seen in our example of the flashing glasses.

Another interactional form that exists in crowds is visible in our discussion of how songs or chants start. We witnessed the ‘snowball’ of different songs with one individual starting the interaction and it spreading to others. Many crowd songs are actually designed to support this—with a distinctive short first section which might be sung solo, followed by the participation of others. This sort of interaction in a crowd takes place with gradual accumulation; participation of each individual is optional, but routinely grows as a group synchronises themselves. Another example is how an audience might start to clap [17].

Supporting this sort of growth of action is difficult as it moves away from both a homogenous view of crowd state, but also of individual commands. Technically, voting interfaces go some way here, but without perhaps the simple dynamism of a group cheer or song.

Interaction between crowds and peripheral participation

As we discussed above participation in a crowd has a certain fluidity and this is particularly so for those on the fringes of a crowd who either may act as spectators, partial participants or who may move between these roles. The relationship between non-crowd members and members can be key to the positioning of a crowd as ‘friendly’ or not—e.g., the particular efforts of the football fans in our paper to engage and if not incorporate, at least interact in a light-hearted manner with fringe crowd groups. These interactions might fail, of course, and interactions in even the most friendly crowds (carnivals, political marches, parades) can be fraught. Crowds are frequently policed when in contrast many crowded spaces (shopping streets) are usually not. One concern for technology then is in supporting interactions between the crowd and others, perhaps simply through explaining what a given crowd is and why it is together, or allowing communication across the boundary.

It can be important to consider ways in which crowds might bring others on the periphery into the crowd itself. More broadly, these sort of transitions take place both within and across the crowd. A crowd may well consist of large numbers of participants engaging in collective activities designed for crowd participation, and yet at another moment engaging in very localised activities within their immediate group of fellow fans. Thus the address of any system [3] might at one moment be concentrated locally and at another to the crowd at large, and, perhaps also to distributed locations linked by digital communications technology. Further, the way in which interaction is done in these settings offers some purchase to ‘viral’ metaphors—and therefore suggests

that technologically mediated interaction may be supported by existing epidemic distribution techniques (e.g., [30]).

A related issue concerns the possibility of supporting crowd interaction at a distance, in our observation and interview work, we have also noted the importance of considering the synchronicity and ‘quality’ of messages between groups of fans in distributed locations. For instance, in the common situation whereby some fans are unable to attend a match with their fellow supporters, updates about scores and other incidents on-pitch from those that are actually present (e.g., via SMS on a mobile device) obtain an important quality even though the information can be obtained from various forms of media (e.g., websites, newspapers, TV). With this in mind, we can also ask how this ‘quality’ of any synchronised but distributed group action will be affected by delay due to transport latencies (e.g., seconds, minutes, etc.)? Further, is the synchronisation method used, and its mitigation of the latency levels ‘good enough’? This obviously becomes a real challenge when considering network latencies and other issues associated with mobile systems, particularly when attempting to support shared expression across sites where this issue of quality of interaction may take on some relationship to the communications infrastructure it is conveyed across.

Conceptual contributions

In contrast with earlier work on participation frameworks, in this work we have attempted to more radically move away from the individual as the unit of analysis the user. This necessitates for HCI a serious challenge. Despite the focus on groups, or technology as a more broad aspect of our environment, often our interaction designs are still focused on a single user at a time, per interface, or at the very most a small set of users. Moving to considering how a system would interact with a crowd as a crowd is a challenging one that we have only started at in this paper.

Taking inspiration from our data, interaction between crowds and systems could perhaps not take the form of the deterministic single issue of commands. We take the model of the singing of songs as a surprisingly useful one. A single interactant collects others through their singing to produce synchronised group activity with individuals choosing freely to participate.

It may be that interfaces need to engage with user action more probabilistically than in terms of definite distinct commands. So, for example, a system might allow multiple choices to be made, with screen space dictated by the proportion of those who have chosen different options. Or we might consider majority rule as a guiding principle although supporting participation is a challenge. Going beyond the individual in this way is in some ways a more radical step than has been attempted in CSCW.

A related point is the nature of time in crowd interaction and the importance of behaviour that is tightly coupled to what is happening at that point in time. For example, consider the detail of the feedback involved in taking part in a

Mexican wave—participants carefully watch other crowd members’ actions, and use them to time their own participation, yet at the same time those selfsame actions that participants engage in also provide a resource for further others conducting their actions, much as with collective singing of songs.

It is with this sort of real time behaviour in public settings that we can begin to see how the roles of participant and audience ‘snowball’ and diminish, fluidly and rapidly changing. Designing to exploit these sort of exchanges is a challenge in that any processing would have to be sensitive to both the ever changing crowd interactional space, but also that delays can radically change the meaning of an interaction.

CONCLUSION

This paper has presented an empirical analysis of the material practices of crowds of fans attending a football event. Through exploring the observable ways in which they conduct themselves we have uncovered a number of *potential* sensitivities that designers could take into account when deploying technology in these new and exciting situations. Every crowd environment is different, however, and designers must carefully select the concepts they draw from this paper when applying it to their own design. Future work will seek to compare these sensitivities with other crowd types (e.g., music fans). Furthermore, although this paper has attempted to give balance to a discussion that is often concerned with extreme crowd behaviour, we emphasise the importance of considering the ethics of *any* design for crowds.

Our main contribution is broadening recent interest in spectator experience, audience and performance-like situations to expand beyond audience-performer relationships to more radically participatory settings such as the football crowd, offering designers new insights into how practical action by fans may both direct how design can be done in these spaces as well as offer new possibilities.

In concluding, we have identified and highlighted a number of key design issues: supporting the flexible participation status of crowd members that is sensitive to local and global groupings; supporting self-presentation and the subtleties of ‘standing out’, perhaps using customisation, and ‘blending in’ as part of a larger uniform whole; supporting synchronous, spatially distributed activity that provides offers of participation but not necessarily explicit ‘performative’ features; supporting interactions between subgroups within crowds but noting the sensitivity of address—i.e., some interactions may be appropriate at particular times and between particular groups; and finally, supporting shared objects and artefacts that may be offer the possibility for rapid and improvised collaboration between different spatial arrangements of fans (e.g., only those close by, or only those separated in space).

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