MarathOn Multiscreen: Group Television Watching and Interaction in a Viewing Ecology

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ABSTRACT

This paper reports and discusses the findings of an exploratory study into collaborative user practice with a multiscreen television application. MarathOn Multiscreen allows users to view, share and curate amateur and professional video footage of a community marathon event. Our investigations focused on collaborative sharing practices across different viewing activities and devices, the roles taken by different devices in a viewing ecology, and observations on how users consume professional and amateur content. Our Work uncovers significant differences in user behaviour and collaboration when engaged in more participatory viewing activities, such as sorting and ranking footage, which has implications for awareness of other users' interactions while viewing together and alone. In addition, user appreciation and use of amateur video content is dependent not only on quality and activity but their personal involvement in the contents.

Author Keywords

Video; Multiscreen; Television; Groupware

ACM Classification Keywords

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

INTRODUCTION

Television watching is an evolving landscape of technology and practice. Our viewing is becoming a progressively connected and interactive experience through the use of innovations such as; video on demand services, enhanced programme guides and mobility [4]. In addition, viewing is being distributed to multiple display devices operating in concert with the traditional big screen. Increasingly, users are bringing mobile computing devices into the living room whilst watching television, using them as a second screen. Multiscreen applications, bespoke second screen experiences that augment and enhance programming with additional content, are one mechanism by which viewers consume synchronously between TV set and mobile computing device [5]. At the same time, the rise of user-generated video is bringing "traditional notions of the 'amateur' and 'professional' into question" as amateur content is an increasingly important part of media production and consumption [21]. In this paper we present an exploratory study of the confluence of these two trends to better understand collocated collaborative interaction and highlight implications for existing groupware research.

Television watching is a social experience that often takes place with friends and family. With the increasing presence of multiple devices across this activity, it is likely that future viewing experiences will entail complex and evolving configurations of devices, users, television programming and group practice. Such experiences are currently ad-hoc, and the collaborative context is poorly understood. As designers and curators of these experiences, our role is to create useable and enticing opportunities for incorporating multiple displays in ways that are both novel and reflective of collaborative social practice. To this end, CSCW techniques and practices surrounding groupware in other collaborative contexts may offer the opportunity to extend a richer understanding. However, a key tension remains; television watching is embedded in the domestic context and is often about entertaining and relaxing experiences rather than productivity and performance [14]. Therefore, if we are to transfer known practice and techniques from other contexts, any incorporation will also need to be sensitive to the specific nuances of television watching. It is our intention that this research begins the work of drawing together these two perspectives.

Our study responds to two emerging trends in the consumption of television and video content; (1) second or multiscreen viewing, and (2) the integration of professional and user generated content. Recent years have seen an explosion in the creation of crowd-sourced amateur video footage. Everyone is now capable of being a videographer, and most people will carry a video camera with them, allowing them to document their lives at any time. The inclusion of user-generated content in our investigations requires users to act as curator as well as viewer,

transitioning between passively viewing and actively engaging with a corpus of content; making decisions on personal interest, quality and preference, before activities such as 'viewing', 'sharing' or 'mashing'. Our discussions centre on the evaluation of a prototype multiscreen application that allows users to watch and organise video from a community marathon. Using 'MarathOn Multiscreen', an interacting group of collocated users were able to watch a combination of professional and amateur footage across an ecology of display devices, playback videos of a specific runner and find unidentified videos of them, and generate organised playlist of videos. We conducted a qualitative user trial of the application, which sought to collect observations of user strategies for coordinating viewing, and explore the efficacy of the application in supporting the sharing and navigation of amateur video.

We begin with an overview of relevant literature that guided our objective and design direction, before describing the MarathOn Multiscreen application and study method. Subsequently we report on the user trial results and conclude with a discussion of implications for groupware literature and design practice. We uncover the importance and challenges of user awareness in multiscreen television applications across different modes of viewing, and the implications of sharing content where users have a personal investment.

RELATED WORK

Over the last decade CSCW research has dramatically extended the scope of investigation into group practices, looking beyond the workplace and investigating other environments including the home [27]. Television watching, while social, is also a relaxing and entertaining pursuit that often takes place in the domestic context, where metrics such as efficiency and performance are not the primary or sole considerations. Instead, systems may be evaluated on the basis of user engagement, associated social practice or entertainment value. Since interactive and multiscreen television serves diverse populations who are principally engaged in entertainment and leisure pursuits [14], this social context is further complicated. To date there has been little reported work on group viewing behaviour and television watching. Existing practices and approaches have developed without consideration of how they might be reconfigured to work effectively with emerging interactive television applications and systems, and the associated social practices.

Groupware is a key tenet of CSCW and HCI literature, describing interactions by multiple users working in a collocated environment with a single display [45, 9, 29, 43], multiple displays [35, 10, 33, 22], and interactions which are geographically distributed [30, 25]. Much of this research centres on the issues of user collaboration practices and promoting group awareness of the interactions of others across shared space and data [28, 20].

In terms of collaborative action, Prior CSCW studies have investigated the process of television production [26], the social practices of viewing [39, 46] and collaboration and sharing of media collections at home [42]. However, given the traditionally passive nature of television watching, limited research has considered group interaction *with both* the television *and* other devices. Within the field of HCI, early examples of interaction between the television and a mobile computing device include Robertson *et al.'s* prototype of a real estate information service [40] that facilitated user interaction with a television from a PDA. Over recent years there has been increased interest from the HCI communities in second screen television and media experiences that span multiple devices, extending the interaction proposed by Robertson to involve broadcast television content. Viewing that merges multiple screen and content streams has become part of everyday viewing practice [15]. In a unifying review of existing studies, Cesar *et al.*, [13] describe the possibilities for multiscreen television as to 'control enrich and share' the television experience.

Designing for Television Watching

The television is a cornerstone of everyday life. This ubiquitous medium and appliance mediates and guides contemporary political and social discourse, weaving itself "profoundly and intimately into the fabric of our daily lives" [44]. Traditional television watching has been considered a 'lean back' activity [38], in which viewers are passive actors, contrasted with 'lean forward' activities, where users are actively interacting with the content, such as the familiar desktop and mobile paradigms. However, the television landscape is evolving and greater levels of interactivity are being introduced. For example, the rise of personal video recorders and Internet streaming offer new means of storing programmes and organising viewing [4]. Recent innovations in television research and usage include the distribution of programmes broadcast to mobile devices [12], improvements to electronic programme guides, such as search and recommendation [31], and the integration of companion applications to extend programme content to a second screen device [13]. Each of these innovations has allowed viewers increasing agency in their viewing habits, changing the way programming is scheduled, shared and otherwise consumed, enabling interactions and experiences not possible with conventional linear broadcasting alone. Vinyagamoorthy *et al*. [48] posit that, as some content displayed on the television becomes increasing interactive, so the traditional view of television as a 'lean back' activity needs to be revised.

Existing literature on multiscreen television has explored a variety of the potential application areas and user experiences of real-world broadcasting and augmentation. The interaction of television and social media has received much attention through their ad-hoc combination. This has allowed researchers to explore how users experience

television and share it with friends, family, the wider community [19], and programme-specific forums [6].

Other studies have also focused on means of enhancing the viewer experience through bespoke applications. For example, through offering extended EPG (electronic programme guide) and control mechanisms on a second screen, [16] or providing extended content that enhances the linear broadcast programme over the course of a season [37].

Sport is a natural sphere of study for multiscreen research, as viewers of the genre tend to integrate other sources of information into the viewing experience such as prior knowledge of statistics and historical performance [24]. Sporting events are regularly mediated through multiple channels and interfaces, allowing users greater agency as to when and how they receive information and balance their viewing experience. Anstead *et al*. [1] explored the augmentation of sports broadcast across a 'many-screens' ecology of interacting users and devices. Additionally, some grounding exists in the experience of sports spectatorship and the simultaneous documenting with mobile video. For example, Jacucci *et al.* [34] discuss the co-experience of groups of spectators videoing a motorsport rally, and Bentley & Groble [8] detail a system for the near-live delivery of multimedia artefacts, including user generated video for spectators watching in the stadium. Dezfuli *et al.* [18], describes the implementation of a multiscreen television application that integrates both broadcast video footage from sports events, and mobile phone footage taken in the stadium.

Our study sits at the intersection of these strands of literature, offering a novel understanding of the features and tensions that are surfaced through merging user-generated video content and its consumption via the television. We find that second screen viewing is uniquely positioned to offer complex interactive forms that have the potential to enhance viewing experiences for users, while presenting new challenges for usable design of aware and consistent interfaces.

STUDY DESIGN

We conducted a qualitative lab-based study of the MarathOn Multiscreen application, which permitted the close observation of user collaborations and allowed for the study to be constrained to the precise behaviours of interest. The study was designed to collate participant opinions and record observations of their interactions across multiple tablet devices. Our study was led by the following questions:

- *How is viewing shared across activities and devices?*
- *What roles do devices take in supporting group collaboration across a viewing ecology?*
- *And how do users consume and curate professional and amateur video footage?*

For example, do coordinating strategies evolve that help users to consume and share the video across the ecology of devices, between the two types of content, and across the viewing activities users engaged with. The inherent sociality of television watching is enhanced by the possibilities of companion applications to enable sharing of programming across supplementary devices. This sociality is reflected in the social nature of spectating sports events [36] that the MarathOn Multiscreen application was designed to support through the review and selection of marathon videos. The usage and coordination of multiple devices is characterised by the task that users are engaged with, their aptitude and experience; prior research has referred to these configurations as display ecologies [32]. The focus of our study was narrower however, describing interaction with television content across multiple devices, viewing and video selection. Herein we refer to the interaction between participants, television and companion devices as a viewing ecology.

The MarathOn Multiscreen application was built to support a collection of video recorded during the Nottingham 'Robin Hood Marathon', which takes place each September in the UK. We derived the amateur video corpus from a prior project investigating the capture of video footage at marathon events by spectators, RunSpotRun [23]. The RunSpotRun app allows users to video record their experiences of spectating a marathon using a mobile phone camera. While videoing, users 'tag' runners by recording their bib number as they pass using an onscreen keypad. These user-generated tags along with the time, duration and geolocation of the video were associated with the video as metadata. This allowed for the organisation and selection of footage, i.e. all videos of a particular runner, or all videos from a region of the course. The RunSpotRun application was evaluated at the 2013 event and 17 spectators took part in the trial, generating over 11 hours of footage.

During the MarathOn Multiscreen evaluation participants had access to both the amateur corpus of footage, taken as part of the RunSpotRun trial, and a professionally shot video that had been uploaded to social media sites shortly after the race. The two video sets allowed for user reflection on the characteristics of both types of footage. Several of the participants in this study had taken part in the RunSpotRun evaluation meaning that they also considered the impact of footage that they had shot themselves. Other participants had taken part in the marathon and so had the opportunity to review footage that had been taken of them competing.

Based upon this substantial video dataset, our work here is concerned with how users interact, across multiple display devices, when presented with both this spectator footage and a professional video. Within our study, the MarathOn Multiscreen application makes use of this metadata to enable both organising interfaces and the tagging of runners.

STUDY PROCEDURE AND APPLICATION DESIGN

A prototype multiscreen viewing application was developed which allowed a group of viewers to watch, organise and sort professional and amateur video of a community marathon event. Using the application, participants completed two periods of viewing, engaging in different levels of

interactivity. The first viewing activity was a passive 'lean-back' interaction where users selected footage to watch on both the television and tablet, or they read supplementary companion content on the tablet. In the second viewing activity additional application functionality was unlocked, allowing users to watch videos and find unidentified footage of a specific runner, Jason. In addition, users were asked to build a playlist of the best videos of him for inclusion in a video souvenir. While this second viewing activity is akin to more traditional groupware practices, it also represents a necessary step in the development of video souvenirs from the marathon, a desired output of the corpus discussed in [23]. However, our implementation of the activity was designed to reflect a more familiar televisual experience, for example, incorporating simple interactions and full screen video playback on the television. The two-part structure of the trial highlighted differences between viewing activities, aiding our analysis and simplifying the briefing of application functionality to participants. The following subsections describe the available functionality for each task and the study procedure.

Passive Viewing Task

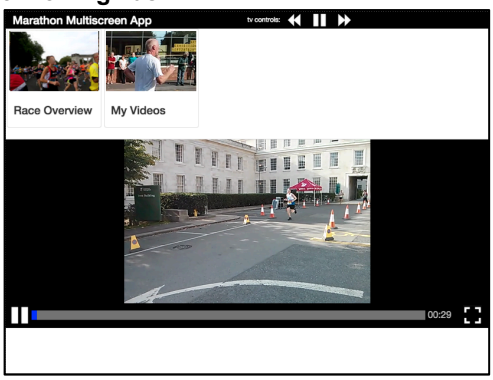

Figure 1. Video playback on the application

During the passive viewing task users were asked to watch the footage using both the television and the tablet application. In addition, users could review auxiliary information about the professional content, synchronised with the video. There was no remote control available to users and all interaction with the television was conducted from the tablet application. In the first mode, the application had the following functionality:

Playback of video content on the tablet: Professional and amateur videos were available to select and watch back on the tablet. Users had the option to play video from the beginning or to resume from a previous playback location. Figure 1 is a screen grab of amateur video playback on the tablet.

Control and Playback on the television: Users could select videos on the tablet for playback on the television. Additionally, users could pause, rewind and fast forward content playing on the television from the tablet application.

Facts and figures information pages: A collection of information pages about the professional video content was made available to users, in sync with playback. These pages included, race history, course, results and marathon facts.

Upon completing the briefing users had approximately 25 minutes to watch the professional and amateur footage. This was followed by a short semi-structured interview. During the interview participants were asked to discuss their preference for either amateur or professional content, focusing on the values that each type of content brought to the experience of watching back the marathon. They were also asked to reflect upon how they shared content between themselves, how the devices were divided between them, and which content was best shown on the different devices.

Sorting and Organising Viewing Task

In the second half of the study, users had access to the sorting, organising and playlist features offered by the application, allowing them to review a runner's video, find untagged footage and create a shared playlist. In the evaluation the application was configured to show both general footage and possible footage of Jason. When the application was operating in the second mode, the following functionality was available in addition to the features from the first viewing activity:

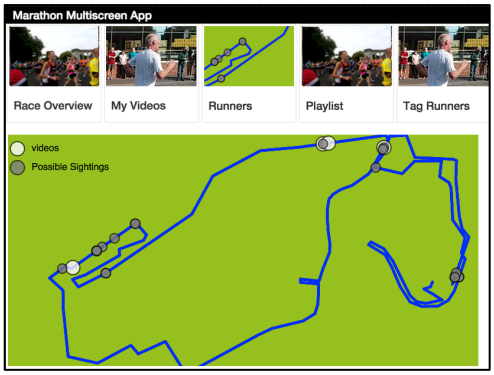

Figure 2. The map interface

Watch a runner clip: The application allowed users to watch clips of footage where a runner had been tagged. The application included two interfaces to help users navigate the amateur corpus for footage of Jason, a map (figure 2) and a list. The map interface that organised tags of a runner, and highlighted points in the video where that runner might be, was based on their running speed and video timestamp. The list interface displayed the same videos vertically. When users selected one of the videos to watch, they had the option to view these on either the tablet or the television.

Runner tagging: The application allowed users to add tags to the RunSpotRun dataset. When users selected one of the videos showing a location where the runner might, they had the option to view these on either the tablet or the television. Whichever they chose, a tagging button was displayed on the tablet. When a user clicked the tag button, a new tag of the runner was added to the videos metadata. New tags were updated on both tablets interfaces immediately.

Playlist: Users could build a playlist of short video clips that contained tags of runners. Videos on the playlist could be reorganised, removed, or played back on either the television or the tablet. A single playlist was common to all tablets in the viewing ecology, therefore additions and changes were shared and displayed across the devices.

Once this new functionality was explained to users, they had a further 25 minutes to use the application. During this second phase of interaction, users were asked to look for new video footage of the runner Jason using their choice of either the map or list interface, and to tag any times they spotted him in the footage where he had not been previously tagged. In addition, users were asked to build a playlist of videos of Jason during this time, and to order their choices by preference. Users were told to think of the playlist as a selection of videos to be included in a video souvenir of Jason's race. Upon completion of the interactive part of the study, a second 10 minute semi-structured interview was conducted. Questioning in this interview centred on the practice of how users found and organised videos of Jason from the race, and elicited revised opinions based on the experiences of the second part of the trial. Finally, users were asked to reflect on the videos they had selected to be included in a souvenir, why these were chosen, and the rationale behind their playlist order.

PARTICIPANTS, LAYOUT AND DATA CAPTURE

Participants took part in the study in groups of three, but only two tablets were made available to them during the trial. This allocation was chosen to maximise the possibilities for sharing behaviour, generating more potential configurations than a single tablet and ensuring user didn't simply interact with one device each.

Thirty participants, in ten groups of three, completed the study. Five of the groups had an active interest and investment in the video content; each of these groups was composed from a combination of runners, spectators who had shot video using the RunSpotRun application and those who had not, and friends of Jason. Any videos contributed by members of the study group remained unanonymised for their evaluation session. The other five, non-invested groups, were made up of participants who did not take part in the RunSpotRun study, but had expressed an interest in watching back footage of the marathon as a community event.

For the purposes of anonymity, each participant and group has been assigned a user code. Each participant is either labelled as (a) *spectator;* a spectator who watched the marathon, (b) *spectator (app);* a spectator who watched the marathon and used the RunSpotRun application, (c) *friend of Jason*; a participant who wasn't present at the marathon but knows the runner Jason, (d) *community*; a participant who is not invested in the race but lives and works in the local area and has an interest in the community event, or (e) runner; a competitor in the marathon event. Table 1 summarises the participant user codes and their investment in the race. Participants were recruited in existing friendship groups, to ensure comfortable social interaction during the study. To some extent this dictated the spread of users' connection to the race, however an even split between invested and uninvested groups was maintained.

The laboratory layout was designed to minimise the unnatural effects of the setting and data capture. Comfortable seating was arranged around a medium sized flat panel television and participants were invited to sit where they wanted. Tablets were placed neutrally on a coffee table in front of users so as not to imply ownership of a particular user.

Data Capture and Coding

During the evaluation, user behaviour was video recorded. The purpose of this was to capture deep observations on sharing of content and subtlety of communication between participants. The camera was positioned under the television, pointing at users. The video data was combined with interaction logs generated by the application while in use. Post trial, the logs were synchronised with the video, to allow interpretation of social and system interaction. The user interview that completed each part of the study was also video recorded. Both observational and interview data was coded thematically on the basis of both recurrent practice and aspects considered to be of substantive significance. The initial study objectives were utilised as 'analytic foci' [41], providing a framing for the analysis. Initial nodes were generated by identifying key interactions from the participant videos. These nodes were then grouped into organising themes and then further distilled into global themes. These global themes have been used to organise our findings section below.

Group	Participant 1	Participant 2	Participant 3
I1	I11: Community	I12: Community	I13: Community
I2	I21: spectator	I22: spectator (app)	I23: runner
I3	I31: spectator (app)	I32: spectator (app)	I33: spectator (app)
I4	I41: Community	I42: Community	I43: Community
I5	I51: Community	I52: Community	I53: Community
I6	I61: friend of Jason	I62: friend of Jason	I63: friend of Jason
I7	I71: Community	I72: Community	I73: Community
I8	I81: Community	I82: Community	I83: Community
I9	I91: spectator	I92: spectator (app)	I93: Spectator (app)
I10	I101: runner	I102: runner	I103: runner

Table 1. Participants and their investment in the marathon

FINDINGS

This section begins by describing the strategies and sharing practices users exhibited, and interactions with the available content. Overall, the application was well received; 21 participants responded favourably, finding it broadly usable.

Coordination of viewing

During the first part of the study, users watched the professional and amateur video content freely, without a focused task. As one might expect with passive television watching, participants were not observed to formulate explicit strategies that coordinated or structured their viewing across the television and tablets. The only exception to this was the initial decision point where participants decided which type of content to screen on the television. Seven of the groups actively discussed which content to play on the television first, six of these groups opted for the professional video.

Groups organised themselves in an ad-hoc manner, applying social norms of politeness and sharing to ensure that everyone got a fair chance at using the tablets when they wanted. The following quote from group I9 exemplified the feelings of many participants about managing the limited resource of the tablet amongst the groups in the first part of the study.

I91: "The British polite way, I guess. I waited for those social cues that felt it was alright for me to take it. I would have just grabbed it off her otherwise. [Laughs]"
I93: "I think [I92] took the first tablet, so I waited a little bit and it seemed like you two were going to share, Then I picked up the other one"

Users did however share out information about what they were reading on the facts and figures display, accessible through the tablets, by verbalising what they were reading. Participants shared race statistics and information with others, clearly relating it with what was being watched on the television. Eight of the study groups were observed to use the facts and figures display, with seven of these groups actively sharing around what they were reading with others in the group; enhancing and extending the experience of watching the professional video footage. For example, the following exchange by group I6 where I61 was able to inform his fellow viewers of the race route, and they were able to reflect on the surrounding areas of Nottingham.

I63: [talking about the race route to I62] "I guess it goes up through the Victoria Embankment then it goes."
I61: "Here it is, it starts down here" [I61 holds out the tablet, I62 and I63 lean in to look and explore the race route]

Impromptu coordination of the TV watching was contrasted against the more strategic and organised approaches adopted by users in the tagging and ranking part of the trial. In five groups users tried to ensure that, with the tablets divided among several group participants, other members of the group did not review the same video for possible sightings of Jason. This strategy for the division of labour was guided by the interface that the group chose to use. When using the map interface, users divided the suggested videos geographically. When using the alternative list interface, one tablet user would select videos from the top of the list, while the other would start at the bottom of the list.

I21: "So is it worth just having a quick split are you starting at the top of Jason's list"
I23: "No"
I21: "You've just selected one at Random. That's really useful. [Sarcastically]"

I62: "So shall we focus on one area the same or shall we do it with two different areas. So do some greys on the left [points to I63] and some greys on the right [point to I61]"

Working Alone and Together

During the tagging and ranking section of the study, groups were divided evenly between those that worked together, and those that adopted a strategy in which 2 participants worked together and 1 worked alone. Users were not able to work individually given the limited resource of two tablets between three. The users who adopted the 'working alone' strategy were always those physically located at the periphery of the group rather than those sitting in the middle. When asked about why I93 adopted this behaviour, she and I92 reasoned about how design of the app had led to problems with their strategy. Their inability to see what was being done by others was seen as limiting the effectiveness of 'working alone'.

Researcher: "So, you saw what they were doing and went off and did your own thing a little bit just because it was easier?"
I93: "Maybe, I wasn't really sure what they were doing" [to I91 and I92].
I92: "It took a lot of mental energy to remember what you were doing in the app, so when two people were doing it, you're not just focusing on the app, your talking between you [...], so you forget what you were doing, as opposed to if it were a focused task for one individual,[...] it's a lot of work."

Figure 3 shows a configuration of users where 2 participants work together and 1 alone, and figure 4 the whole group collaborating together.

Figure 3. Participants working alone and together

Group I4, evolved a strategy that involved each of them working together collaboratively across the TV and the two

tablets. I43 described the strategy as having developed after the start of the task, when they had no structure to their selections; he described their lack of a strategy as leading to "complete chaos". In their approach I41 controlled which videos were watched by the group on the TV, while I42 was primed to press the pause button should any of them spot Jason on the other tablet. I41would then tap the tag button. Both group I4 and I9 were relatively successful, spotting and tagging Jason in 4 videos each, however the strategy adopted by group I9 led to two duplicated tags, whereas as all I4's tags were unique. In four out of the five groups that adopted a system of two participants working together and one working alone, duplicate tags of Jason were created.

Figure 4. Participants all working together

While the Jason tagging task led groups to employ a range of strategies and practices, the ranking task showed much more consistent behaviour amongst the groups. Seven out of the ten groups worked together as a three to rank the videos of Jason into order.

Television and Control

In the TV watching section of the trial all groups watched most or all of the professional video content on the Television. Group I6 said that this organised their viewing of the content during the first part of the study. This provided them with the "main focus" by which they could orientate their viewing on the tablet, investigate the facts and figures, and select spectator footage.

I62: "Main focus yeah, I think we all kind of thought we would could connect everything in and watch it […]. Watch the highlights of the race, look at the map, try and figure out some sort of connection to the snippets [amateur content] as well."

I63: "[…]I would have trouble changing it without people saying it's what they wanted. So there is a social aspect"

The television was clearly cast as the social hub of viewing, an evident focal point across all of the groups. Subsequently, users were also cautious about making sure it was appropriate to change the channel with the rest of the group and not to interfere with another participant's viewing. As one might expect, the size of the television played its part in ensuring that it was an important component of the viewing ecology. Additionally, users from group I4 responded positively to the enhanced methods of television control offered by the application, indicating that the features had added depth to their experience:

I43: "Larger screen, more real estate, picture quality."
I41: "I do like the fact that it's more interactive with your TV, its not just a stationary object any more, it's the fact you can throw stuff on there, you can control it many ways, you can't do that with a controller normally. So I think that that's an appealing fact that you can play around with your TV with a lot more depth."

Additional television preferences were stated after the tagging and ranking section of the trial. As discussed earlier, the characteristics of the television supported various strategies for tagging Jason, as a group. Group I2 said that the television's scale enabled them to collectively confirm the identity of the runner. Participants also responded that the process of spotting him together was not only made easier but also more enjoyable.

I33: "We didn't really watch any of it on the tablet just collaboratively stared at the screen to see if we could spot him, I guess as a backup if you missed him you could maybe rely on someone else to have spotted him. [...] I think it's just more enjoyable to do it together [...] it definitely made it more interesting than working on our own."

Inter-device Relationship

In some instances, users struggled with the relationship between the devices. In the TV watching part of the study, the tablets operated independently, meaning that either user was able to start and control playback on the television at any time. Moreover, the viewing history was unique to each tablet, so that resuming content on the TV would pick up from the last watched place on either the TV or that tablet. Subsequent progress on the other tablet was not taken into consideration. This model was intuitive to most users, however there was some confusion [group I5] in identifying that a video could be played on the tablet, whilst still being able to use the television controls.

The inter-device relationship was altered subtly during the tagging and ranking section of the trial, where the tablets shared a common playlist of videos and tag list of runners. This functionality facilitated users working together to find videos of Jason and to order them. In four of the groups, duplicate videos were added to the playlist from different tablets, making the ranking task more confusing and longer, as participants tried to sort the same video more than once. Several user groups expressed frustration at not having enough information about what fellow group members were doing on the other tablet, and what was playing on the television while they were tagging.

I52: "[The] problem is, if another user selects a video on the TV, we don't know who did that"

Table 2 shows the number of tags each group generated of Jason and the number of duplicated tags. Group I7 was the only group to tag runners who were not Jason.

Group	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10
Tags	3	5	1	4	5	4	9	4	6	4
Duplicates	0	1	0	0	0	1	0	0	2	1

Table 2. Tags and duplicated tags by groups

Content Control

Users articulated several reasons for pushing content that was initially being watched on the tablet, to the television. Sharing amateur content was common. Users wanted to share video or facts and figures with the group because they saw interesting footage or information or, in the case of the invested groups, they wanted to share the content which they had produced

I23: "You definitely look like you were filming as I ran passed […]"
I21: [Watching I23's video on the tablet] "So where do you think you were"
I23: "you were on Castle Boulevard […]"
I22: [takes the tablet to see for himself]
I21: "Stick it on the TV [I22 puts the video on the TV]"

In the 'lean forward' part of the trial, users continued with this practice when searching for video footage that included Jason. They did however find this to be a difficult process, and not one that the application was optimised for. Finding the video that they wanted to share with the group was hard as the interfaces didn't differentiate the videos that they had already seen, or have a mechanism for switching the tablet video to the television and vice-versa; functionality akin to that of technologies such as Apple Airplay [3].

Amateur and Professional Video

At the conclusion of the first part of the trial all spectators were asked to indicate which type of footage, professional or amateur, offered better value for watching the marathon. 19 participants stated a preference for the professional video, favouring the cleaner and more polished view of the race; this was particularly true of the groups who had not run or spectated the marathon.

However, of the eight spectators that took part in the trial, six attributed more value to the amateur spectator footage, regarding it as a better reflection of the experience of being there. This preference was not shared by competitors in the race, with group I10 stating a preference for the professional video. As keen runners, they liked being able to see how the professional athletes performed at the head of the pack, offering a viewpoint unavailable during the race.

I101: "The nice thing about the video is seeing things you can't see. Especially with the professional one, those runners are twice as fast as I am, so I'm never going to see them."

Opinions towards the amateur footage were revised significantly during the second part of the trial, with many participants, including the runners from group I10, stating a preference for the crowd sourced videos in the tagging and selecting part of the trial:

I102: "definitely worked better for looking at the amateur footage compared to the first task, which was, here is a load of videos which vary from ok to rubbish and this was like here are some videos that might have something interesting in."

Appreciation of amateur footage involved a balance between recording quality and user interest in its content. Ranking practices were mostly based on content quality. The amateur footage was variable in quality and factors such as the shakiness, and the correctness of exposure and focus were paramount in informing decisions about video ranking. The quality of the footage of Jason was also a factor, with users preferring footage where he could be clearly identified.

I was clear that users made considered choices before watching this content on the television. As already stated, professional content was watched by all groups on the television. This practice was observed without the group reflecting on what it may contain or their interest in it. For uninvested groups, amateur video, and video not captured by group members, was selected from the list without much consideration. However sometimes users would make reference to the location of the video, or they would want to share something they had seen on the tablet with others. For the participants that had taken content, there were several reasons to watch and to share this content with the group. For example, participants from group I3 watched their videos on the tablets and did not share them with each other. During the interview they stated their reasons for watching and not sharing:

I33: "I had a quick look on the tablet but I already knew the footage I filmed was incredibly dull [laughs]."

I31: "so did I [...] was more a self-conscious thing I wanted to check was I say anything stupid."

Participant I93 took this approach even further by refusing to watch her video at all, avoiding any social embarrassment and stating that she "thought it might a bit rubbish". Participant I92 on the other hand was more ready to share and watch her videos with the group. As a prolific videographer at the marathon, she had generated over an hour of footage and was keen to see her work. Group I9 were unique in the study in that they started with a spectator video on the television rather than the professional video, playing I92's footage. However, I22's video, which group I2 believed contained footage of I23 running the marathon, was initially watched by I21 and I22 on the tablet. When they reached the part of the video where I23 was likely to have been captured, the group collectively switched to watching the video on the television so they could all easily see him on the big screen.

During the first part of the trial users in three groups commented on a preference for the map interface for amateur footage. They felt this aided the video selection during the first part of the trial, and while this was rectified in the second part of the study, users suggested it as a way to help organise

and navigate the spectator footage in the passive section of the evaluation. Conversely the group of runners [I10], found the spatial organisation of the race information not to be as important to them as the timing information. They already had a good understanding of the race route, having run it, and were more interested in working out how long after the start gun the video was taken. This information would allow them to see the professional and club runners taking part, and to aid in spotting themselves in the footage.

I102: "I think as a runner, it's a linear route, you know you've gone passed it at some point so it's just about the time"

DISCUSSION

We organise our discussions around emergent themes from the data in respect of (a) our research questions, and (b) the existing literature from groupware, television and content consumption. We conclude each subsection with design implications and strategies for other practitioners working with multiscreen viewing ecologies.

Leaning backward and forward

Tasks, such as the runner tagging and ranking activities we report on here, may seem contrary to the normally relaxing experience of television watching [44]. However, we believe that multiscreen applications which interact with large quantities of crowd sourced content, such as MarathOn Multiscreen, *require* users to act as curators to generate personal narrative experiences. Traditionally television has been a 'lean back' activity, however increased interactivity suggests this view may need revision [48]. Recent work in second screen viewing applications has pushed the boundary of television watching as a passive viewing experience, introducing new opportunities to interact with relevant additional content through secondary devices [37] or social media updates [19]. We map the two phases of the user trial to these modalities. The passive viewing activity, where users viewed the video content was a 'lean back' activity, whilst the tagging and ranking tasks were 'lean forward'.

During the first, lean back, section of the user trial, users were observed not employing strategies or coordination in their viewing, much as one would expect from traditional passive television watching. Content selection and control were ad-hoc and governed by users' polite willingness to share. This approach spread effectively to the sharing of facts and figures and distribution of devices. During the ranking activity, a lean forward task, users tended to orientate together and worked collaboratively with the single playlist. Groups had few difficulties using this interface to sort the videos. However during the tagging part of the trial, where participants were asked to search for additional footage of the marathon runner Jason, they struggled to coordinate and organise themselves. The observed lack of coordination resulted in user frustration and unnecessary doubling of effort across the group. Where users adopted a strategy of two participants working together with one tablet, and the other participant working alone, it was observed that this resulted in the generation of duplicate tags of Jason. Even though the application revised both list and map views instantly when a new tag was created, across all devices, this did not stop users from tagging a video that had already been selected. In contrast to those groups who tried to divide content between each other, Group I4's strategy of working together by dividing the tasks of selecting video and tagging between the tablets was more successful as they generated no duplicate tags.

Groupware literature highlights the importance of awareness and visibility of other users' interactions for good usability of collaborative applications [28, 9, 20]. MarathOn Multiscreen's awareness features were lacking in comparison with capabilities of these examples, and proved insufficient even for the relatively simple collaborative tasks users undertook with the application. This held true for the passive viewing task where users were comfortable coordinating their viewing between the television and the tablets. However, in the later part of the trial the need for awareness of others' actions was increased, and the mechanisms provided by the application were insufficient, affecting the applications effectiveness as a curation tool. In a real world setting, the transition between viewing activities would be fluid and interfaces would need to respond to this change, promoting awareness of the activities of others where needed. In situations where these features are less necessary, they may be seen as undesirable by users, potentially interfering with the relaxed sociality of viewing and with the privacy afforded by independent viewing. As currently designed, the viewing ecology promoted by the application supports a flexible sharing of devices between users who work together and alone; offering feedback on a per-user basis may not provide adequate awareness as devices are exchanged between users.

Users of the MarathOn Multiscreen application struggled with awareness of others' content-related actions. One approach worthy of further investigation may be the introduction of 'role restrictive' mechanisms suggested by Dourish & Bellotti [20], formalising the strategy adopted by group I4 by only allowing certain devices to perform particular functions of the application across the ecology. Whilst the authors are critical of this approach, stating that it limits the potential activities of a user and that it challenges these roles being renegotiated during the activity, it is our belief that in this context, the simple nature of these interactions would require little renegotiation. As an alternative, the system could report not on what a user is attending to, but what work has been completed, and suggesting an effective next video for users to view. In the case of MarathOn Multiscreen this information would include identification of the videos that have already been watched, tagged (by any user, with any device), and then suggest the next most likely video of Jason.

Device roles in the ecology

The television was the centre of the application's ecology and the social hub of viewing for users. The big screen allowed users to share and review video footage between the group as a whole, in ways not possible with the intrinsically individual display of the tablets. The subtleties of usage and coordination of the devices in the ecology however, were characterised by the tasks and modality that users were engaged with [32]. Usage of the television and interaction differed between the two modalities of lean forward and lean backwards. While leaning backwards and watching the breadth of content, professional video dominated the television. The editorial polish and high quality camera work marked it out as fitting better with the communal display. Decisions around whether to share spectator content during this modality were more involved and often entailed viewing the content first on the tablet to decide what was interesting and worth sharing with the group. During the lean forward part of the trial the large scale and communal aspects of the television were utilised to support tagging Jason, where the TV allowed users to view together. In this context, being able to swiftly move content between the devices became important to users.

The relationship between the tablets necessarily evolved with the changing characteristics of the activities users engaged with. The introduction of a shared playlist and video list caused some users issues with understanding the reach and implications of their interactions.

In addition, the application included interfaces with both shared (runner views and playlist) and device specific data models (tablet playhead progress). Users understanding of the reach of their actions was compromised by the transition between these models, posing the question; when is it appropriate, and understandable to users, to include interfaces that share a dataset between devices? Additionally, how can these interfaces' functionality be best articulated to users in order to avoid confusion and wasted effort?

Professional and Amateur Content

The quality of professional video footage was starkly contrasted for users against the variability of the amateur footage, which at times was shaky, poorly framed and badly exposed. These factors had a negative effect on many users' enjoyment of the video and the value that they attached to it. However user investment in the footage and the task at hand had a positive effect on how the amateur video was perceived.

Organisation of this content, both for invested and uninvested groups, provided important structuring for viewing or tagging tasks. Several of the users suggested, prior to seeing the map for the tagging task, that a locative interface would help them to identify the amateur video footage they wanted to see. Additionally group I10, which was made up of three race runners, preferred an organisation scheme that would show the run times of runners in the video. This would allow them to select footage based on the quality of a runner or to look out for footage of themselves. In the lean forward part of the study, where some of these features were available to users, the content was better received and users were more effectively able to navigate it. Future iterations of the application could use the map interface in both lean forward and backward modalities to enhance content navigation. This interface could additionally contain mechanisms by which users might filter the footage by runner time.

Our user-suggested enhancements for a locative interface in the lean back application mode could be a useful addition to functionality. However, this design direction would be highly context specific and would not transpose to other similar applications operating in different domains with different design constraints; for example stadium based sport spectating [18] or reconstructing amateur footage from music concerts [47]. Therefore, we recommend that presentation and organisation of crowd-sourced video should be a foremost consideration when consulting users during design process.

Public, private and Avoiding Embarrassment

Avoiding embarrassment arising from crowd-generated content was a concern for several participants. While the communal display of the television was the preferred location for viewing professional content and searching for Jason, users had a more complex relationship with video that they had either shot or where they were the subject. For some, the opportunity to share the video they had shot was seized upon and they wanted to share this on the television. Likewise, if a group member who had run the marathon was featured, or believed that they might be in some of the footage, this was presented publicly for the whole group to see on the television. This behaviour was not universal to all participants however, with others wanting to vet their video before it was cleared for public viewing. In one instance, a participant completely refused to watch any of the footage she took at the marathon, believing it to be of poor quality and limited length. The opportunity to privately watch footage before sharing with the group was enabled by the feature that allowed video footage to be viewed on the tablet as well as on the television.

Public display literature has explored embarrassment with interacting in a public space [7, 17]. Additional work from cultural studies, such as [11], has explored the embarrassment of watching television content containing adult themes within the family. In HCI however, less has been written about how embarrassment is dealt with in respect of user-generated content. Anstead, et al., [2] compare the impact of embarrassing photos between family and friendship groups in a theme park, concluding that the inclusion of embarrassing footage in souvenirs can negatively impact an individual's public image. In this study we observed participants being equally cautious toward footage in which they were invested.

Successful designs for software that include personal footage should ensure that there are opportunities for users to watch footage back privately before sharing it with the group on a communal display. A future system, with more rigorous protection for user privacy, could potentially offer interactive mechanisms for users to be able to pull content from either being viewed publicly or being used in lean forward tasks such as tagging and ranking.

LIMITATIONS

The evaluation we report here was designed to generate results on the difference between lean forward and backward tasks, and our findings show a distinction in collaboration practices and organisation. However, the lean forward tasks and the tagging and sorting of video clips of Jason exhibit interactions common to traditional groupware activities presented in a style suitable to television viewing. As such our study is limited to reflecting two very polarised forms of interaction rather than fully exploring the full range of collaborative lean forward applications that are possible. For example, applications including alternative lean forward interactions, such as playing along with a quiz show, may not exhibit the distinctions shown here, whilst demonstrating more recognisable and entertaining television experiences. In addition, the two-part structure of our study did not show a natural transition between the tasks, as one might see in the home, where users organically migrate from passively viewing to being active curators.

For the evaluation of MarathOn Multiscreen we choose a tightly controlled setting to conduct our study. This decision was motivated by a desire to manage specific variables such as the number of users in each group, the number and type of device, and the replication of the study conditions, for example, room layout and initial placement of devices. In addition, MarathOn Multiscreen is a relatively novel prototype not compatible with current broadcasting technologies, therefore, setup in the home would require additional researcher intervention that would reduce the natural behaviours such a study would intend to capture. By taking this approach we also allow for potential replication and extension to a larger sample size than would be tractable within a naturalistic setting. Whilst our approach may limit the generalizability of our findings and guidelines, we see controlled studies as an important step in the evolution of multiscreen applications and believe this approach will help to inform applications and studies that take place in the wild.

Within the confines of our controlled study we investigated a viewing ecology comprised of three users, two tablets and a single television. While these limitations allowed for consistent results, we do not seek to draw conclusions on different configurations of viewers and devices. Furthermore, as the devices used in the study were provided, their use was not contextualised by ownership. The balance between tablet ownership and access is a complex and nuanced set of questions that can be shaped by collaborative interactions and user relationships [49]. In a future study conducted in the domestic context, device coordination may well be guided by who within the interacting group owned the devices used.

CONCLUSION

We have presented the evaluation of a collaborative multiscreen television application. MarathOn Multiscreen explored the consumption of amateur and professional television content of a community marathon across a viewing ecology of display devices. During the study users were asked to engage with passive and active viewing activities and observations were made about sharing and collaborative practice between users' devices and content. In addition, our investigations sought findings on use and curation of a corpus of user generated footage. Our discussions lead to implications and guidance for designers of future collaborative multiscreen systems, and avenues for further study and research. We observed issues of awareness of other users' actions while actively engaged with the sorting organising viewing task, which were less present during passive viewing. The fluidity of the viewing ecology that promotes ad-hoc sharing of information, devices, and transitions between activity requires a dynamic approach to user feedback, articulating other users' interaction where needed and maintaining a lightweight interaction where not.

In our study, the presentation and sharing of amateur content was shown to be user and context specific. Where users had an active investment in video footage, they were often more accepting of poor quality camera work and a lack of editing. However, some users regarded the sharing of their own amateur footage as potentially embarrassing in the social context of friends and peers. To this end, allowing for users to pre-screen their videos before sharing, encodes the level of user control required in order to allow users to manage the boundary between the public and private screening of their content within the television viewing ecology.

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