Fixed in Time and "Time in Motion": Mobility of Vision through a SenseCam Lens

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ABSTRACT
SenseCam is an automatic wearable camera, often seen as a tool for the creation of digital memories. In this paper, we report findings from a field trial in which SenseCams were worn by household members over the course of a week. In interviews with these users, it became apparent that the way in which SenseCam images were played back, the manner of which might be described as a stilted movie, affected the values that were realised within them. The time-lapse nature of the image stream led participants to romanticise the mundane and find sentimentality in unexpected places, and was particularly effective at portraying personality and play. In so doing, SenseCam images enlivened the visual recording of everyday scenes. These values influenced what the participants sought to capture and view, and have implications for technologies that might support lifelogging or the development of user-generated content.

Categories and Subject Descriptors
H.5.m [**Information Systems**]: Information Interfaces and Presentation – *miscellaneous.*

General Terms
Design, Human Factors.

Keywords
Photography, time-lapse, mobile, wearable, passive, automatic, camera, user-generated content (UGC), lifelogging, looking, gaze, experience, value, strange, mundane, sentiment, play, creativity.

1. INTRODUCTION
"What the camera does, however, and what the eye in itself can never do, is to fix *the appearance of that event. It removes its appearance from the flow of appearances and it preserves it."* [2, p.54]

In our daily lives, the way that we look at, and consequently view, the world is mitigated by a number of factors. Many of these are social, with gaze being intrinsically linked to the dynamics of human interaction. Psychologists such as Kendon [14] and Argyle and Cook [1] have shown how the roles of speaker and listener are mediated by shifts in gaze. For example, listeners are understood to request, and speakers to offer, the conversational floor through gaze-related behaviours. Further, sociologists like Sudnow [31] have shown how gaze is used to create a sense of mutual engagement in conversation and in other social activities that entail nearness between persons. But what happens when the gaze is between a person and an object? In exploring gaze outside of social interaction, sociologists have conceptualised looking as a behaviour that is determined by broader qualities, ones in which the concept of role is elevated above transient states such as speaker or listener. In the early Nineties, for example, Urry [34], inspired by Foucault's concept of the medical gaze, examined the social role of the tourist, and suggested that the manner of gazing is altered when individuals adopt this role.

These alterations reflect what Urry calls the underlying social organisation of gazing behaviour. In his view, places are chosen to be gazed upon in anticipation of socially constructed ideas of pleasure, as in 'this is a scenic view' or 'this is a famous view'. This form of looking removes the-thing-looked-at from everyday experience, and further, the manner in which the thing is actually looked at is different:

"People linger over such a gaze which is then normally visually objectified or captured through photographs […] These enable the gaze to be endlessly reproduced and recaptured." [34, p. 3]

The tourist gaze is characterised by the eye roving (so to speak) over a landscape that is itself full of moving objects and persons. Photographs then allow this gaze to be mimicked, but with the transformation of one key property. With photographs, the thing-looked-at is fixed. As noted by various theorists, this property of photography has certain consequences for the ways in which the subject is actually perceived. For example, Sontag suggests that the camera makes "familiar things small, abstract, strange, much further away" [30, p. 167], and notes further that "photographs do more than redefine the stuff of ordinary experience [… they] add vast amounts of material that we never see at all. Reality as such is redefined [..] a record for scrutiny" [30, p. 156].

Ten years later, Berger [2] saw this as somewhat more sinister, as a mechanism whereby fixity of meaning was created, a fixity that was, in his view, for those in power. People who took photographs (and this was not everyone, but an elite) were in a position to impose interpretations: looking was ideological, Berger claimed. Since then, and indeed especially in the years since Urry's book *The Tourist Gaze*, the ascendance of snapshot

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photography has shifted the quality of the relationship between the taker of images and the nature of the gaze thus enabled. This is particularly so with the emergence of digitisation and the widespread use of cameraphones and image sharing networks, such as Flickr and Facebook. Rubinstein and Sluis [26] have said that traditional photography valorised the thing captured, allowing a reverie for the gazing photographer. Now, snapshot photography and, more latterly, 'networked photography', is shifting that relationship, almost transforming it altogether.

For one thing, Rubinstein and Sluis note that the idea of the image taker as 'author', whereby author is meant as someone with a special ability (as in the ability to take a 'good photo' or to select 'appropriate images' and thus act ideologically), is becoming replaced simply by the importance of 'place'. They illustrate this with the case of the London bombings, in which the quality of snapped images was less important than what was shown, and what was shown was not defined by the taste, competence, or status of the photographer, but by the social event in question. Who or what the author is is no longer salient, where they were (or are) is. Another change, also related to the diminishing importance of authorship, is that there are no longer certain measures of good and bad. When pictures were expensive to take and ponderous to show, such measures were important. When taking and showing is almost cost free, the production of infinite numbers of images and the displaying of them to vast audiences (or users as the nomenclature now has it) obviates that need.

This change in volume has also meant a change in the experience of gaze: if, before, there were few pictures to gaze at, and hence the thing gazed at got valorised in the gazing, now there are so many images that the fixity of gaze is transforming into a gaze at multiple images. What had hitherto been the 'decisive moment', captured by a single photographer, has now dissolved into a flux [26, p. 22]. One paradoxical consequence of this is not that Berger's tyranny of image has been undermined by a plurality of content; rather, the use of tagging in sites such as Flickr has meant that different events in different times and places come to be assembled and socially treated as the same. Thus instead of a unique view being valorised by the viewer's gaze, millions of similar views get treated as the same by equally large numbers of users. A private party in one part of the world is treated as much like another, elsewhere, at another time. Difference has been replaced by similarity; indexing has not produced richness but sameness; the social esteem given to uniqueness has been replaced by commonplaceness.

The bottom line for these changes ought to be, it seems to us, a recognition that what 'gaze' is or what the technologies that enable gaze are, are all subject to change. We view the above as showing that the relationship between camera user and picture viewer will continuously alter just as the technologies of image capture and sharing alter. To take snapshots is not to take a photograph; to share a set of images on a social networking site is not the same as displaying a photograph in a gallery. But new forms, salient now, will themselves alter in the future. And as they do so the role of the author, ideas about good and bad images, issues to do with differences in the number or identity of the viewer(s), the role of place or social status as key determinant in the value of an image, all these and other dimensions will keep jostling and altering as both the technologies and the social practices around them develop and shift.

It is this that provides the backdrop to, and insight for, the analysis we present here. We report on the experiences enabled by, and the emergent patterns of use delivered through, the deployment of a type of camera that was new to our participants. This camera is designed to be worn rather than carried, and automatically takes images rather than demands the user to 'author' them. Moreover, at this stage of development, the resulting images cannot be networked but can only be viewed and shared by those who wear and use the cameras themselves. Thus, the technology we want to report on does offer a kind of snapshot imaging, but does so without authorial control. Yet, although the images are not 'taken by anyone', this does not mean that the captured images are anonymous. The very placement of the devices (on a body for example) makes identity, perspective, gaze essential to the experience of using, looking at and interpreting the images. And finally, though the devices produce multiple images, the resulting corpora are not broadcast or tagged. These are taken by, shared within and interpreted by the 'users' themselves.

More particularly, in this paper we discuss how people experienced the world as captured by *SenseCams*. These are automatic wearable cameras, which take photographs every 30 seconds or so, to be later played back in rapid succession on an associated PC. SenseCam images cannot be networked or shared. While there have been an increasingly large number of papers reporting on SenseCams as memory aids of sorts, our interest in them is driven by the arguments above. We have undertaken a number of studies to see how their use can support or enable new experiences other than related to cognitive ideas of memory [see also 10, 11, 18, 19], and, further whether those new experiences themselves look like evolving in interesting directions, either through new forms of social behaviour or through iteration of the design of SenseCam itself.

More especially, with SenseCam, the number of images captured in a day may number in the thousands. Thus, questions of how to control or make manifest image capture (if at all), and how best to represent these photographs back to the users after capture, offer challenges. Here we hope to demonstrate how the decisions to hide the actual act of image capture on the device, and to support quick, sequential playback thereafter on a PC, have significant implications. We shall show, in particular, that instead of casting a lingering gaze over images, the experience for the viewer of SenseCam images is almost more akin to blinking; the term 'a mobility of vision' [28, cited in 32] seems particularly apt. But a sense of the richness of lived life is exuded too, despite the evident incongruence of these images from real 'felt life'. Finally the production, sharing and viewing of SenseCam images within a closed field, namely that of family and loved ones, also has implications for a sense of authorship, authenticity and related notions of intimacy.

We shall elaborate on the design and user experience implications of these findings for the development of all sorts of image capture technologies, including those that seek to support lifelogging, the production of private visual experiences and narratives, the creation of user-generated content (UGC) for networked sharing and much else besides. Before presenting our results, we will briefly review analyses of traditional photography and more recent innovations, including digital photography and cameraphones.

2. RELATED WORK

There has been a good deal of research on domestic and recreational photography, exploring topics that range from subjects that motivate image capture [3] to the way that photographs are organised and edited [16], shared with others [4, 9, 17] and displayed within the home [5, 32]. In this paper we are concerned with automatic photography, which tends to result in so many photographs that some of the above become irrelevant. Images are not selected for capture, the activity of editing is unlikely to be tackled, and image playback can fundamentally change the nature of viewing photographs with others.

As noted above, changes in photographic practices have altered the notion of authoring images. Traditionally, certain events have promoted image capture, while others are neglected. Sontag [30] has proposed that the act of taking a photograph imports a sense of occasion on the incident that is unfolding and in a sense, serves to honour it. Similarly, studies of domestic photograph collections have shown that happy events, such as weddings, are over-represented, while more sombre occasions, such as funerals, are overlooked [5]. The move to digital photography, combined with the increasing proliferation of cameras and cameraphones, has led to changes in what is photographed and to the capture of many more images. This represents something of a shift from the traditional approach of only photographing the special; for example Kindberg et al. [15] have shown that cameraphones are used to take images that might support ongoing tasks, with photographs becoming a resource for oneself rather than a subject for sharing with others. Similarly, Van House et al. [35] have argued that the convenience and spontaneity of cameraphones has shifted the definition of what can be considered 'photoworthy'.

This capture of numerous images, and the emergence of image sharing sites, has meant that collections of photographs are no longer restricted to albums or shoeboxes, to individuals or to families, but can span across strangers. These collections, grouped according to various metadata, depict views that are somehow similar, despite being taken at different times, by different people, in different places. Research in this area has investigated how we might organise these collections of images, for example, through the use of metadata [13], and further, how tags might be used to support blogging and its variants, such as photoblogging and geoblogging [e.g. 25]. Another angle has been to explore the emergence of new social practices, for example, those developing within image networking sites [22], or those that involve photographs as a form of communication [21, 27, 36].

In the case of studies that have focused on photography as captured through automatic wearable cameras, social practices are rarely examined, with research often examining lone usage. These devices tend to be linked to concepts of lifelogging and memory; indeed, evidence has shown that SenseCams can be used to support memory for, or at least knowledge about, the past [29]. Other researchers have considered how such vast collections of 'digital memories' might be managed so as to allow the user to make sense of them. In the case of SenseCam, researchers are investigating how events within the image corpus might be automatically recognised so as to support organisation [7]. However, not all researchers have interpreted SenseCam as a lifelogging tool. It has also been explored as a potential aid for creativity [20] and as a means of supporting reflection [8, 10, 11].

In this latter study [10, 11], individuals were asked to use SenseCams for a week with the aim of selecting key photographs with which to tell a simple story. Their experiences showed that the quality of SenseCam photographs, which are taken through a fisheye lens and often from unusual angles, made the world appear strange, and as such, discontinuous from experience as remembered. This led the group to see the mundane in new ways, and to reflect upon neglected elements of their lives. In the present study there was some replication of these findings, but interesting differences also emerged. Most obviously, without the task of picking out favourite images, we noticed a different emphasis in our participants' experiences. Instead of focusing on single photographs, they took note of them as sequences. There are parallels with digital photography here: as already noted, it is increasingly common to view a multitude of images at once, either because they are grouped together on a networking site, or simply because the photographer has captured so many pictures. With SenseCam however, the multitude of images is taken to an extreme. Further, the means of playback also had an impact. Without the need to look for and caption single images, as in the previous study, participants tended to watch back their photographs as continuous, time-lapse streams. This shift in emphasis was enough to make staccato movement, or 'time in motion', as one participant described it, a fundamental element of the way in which the photographs were experienced:

"The frame rate, it gave you the effect of a movie, a stilted movie; that was quite interesting to see in little sequences".

In this paper we will explore how the watching of these 'stilted movies' altered the values that were found within the photographs, and even had an impact on the ways in which the SenseCams themselves were used. First, we will describe in more detail the field trial itself.

3. THE FIELD STUDY

The field study took place over the course of a week, during which time researchers interviewed the participants twice. As part of the first interview, two of the authors visited the participants at home so as to demonstrate SenseCam and its associated software. Each household was loaned a number of SenseCams along with a laptop to support the downloading and viewing of the images. It was made clear that participants could delete any images they wished to before the computers were returned. Further, we offered to copy the images that were captured onto DVD, so that they could be accessed after the field trial, and explained how the participants themselves could copy photographs of interest. We emphasised that we were not concerned with gathering data about the participants themselves through SenseCam; instead our motivation was described as being an interest in if and how the devices might cause them to think differently about their daily lives. After a week had passed, the researchers returned to discuss with the householders how they had used the devices.

3.1 SenseCam

SenseCam [12] is a wearable camera with a wide-angle lens (Figure 1). It takes photographs at regular intervals while turned on, and in its default mode will capture around 3000 images in a day. It also has a number of built-in sensors, including an accelerometer, a passive infrared sensor, a temperature sensor and a light sensor. Information recorded by these sensors is used to

trigger the taking of photographs. In addition to an on/off switch, SenseCam has two buttons. The first of these triggers the deliberate taking of a photograph, while the second causes the recording of images to be temporarily suspended.

Figure 1. The SenseCam device used in this study

SenseCam itself does not have any means of displaying images back to the user; these must instead be downloaded onto a computer. Images that are imported together are saved in a specially created folder, and can be opened directly or viewed using a dedicated piece of software. This allows photographs to be played back at varying speeds, and enables the viewer to bookmark and label sequences of interest.

3.2 Households

Seven households took part in the field study, five of which were families with young children. Three of these lived in a village in Cambridgeshire and were interviewed as a group in one of the family's homes. The fourth lived near to Manchester and the fifth was based in London. The composition of these families was as follows.

The first Cambridgeshire family, whose house formed a base for the interviews, consisted of a lesbian couple and their two children, a girl aged 7 and a 1 year old boy. The second family consisted of husband, wife and two girls aged 7 and 4, and the third comprised husband, wife, a 10 year old boy and an 8 year old girl. Due to the age of the youngest children in the first two families, they were provided with three SenseCams between them, whereas the final family were given four. These families were interviewed together following previous research in which group discussions of SenseCam proved a fruitful means of understanding how the device was used and experienced [10].

The family near Manchester consisted of a married couple and their two children aged 11 and 13, and the London-based family had a son aged 7. This latter family were visiting their grandparents, in their early 60s, during the field trial period. These families were provided with four and three SenseCams, respectively.

The final two households each comprised a couple in their early 30s. These two couples were friends with one another and lived near Blackburn in the north of England. Each of these households was given two SenseCams each. Again, these participants were interviewed as a group.

4. FINDINGS

The interviews with the households were transcribed and emergent themes identified. The original aim of this study was not to explore how the viewing of SenseCam images would be perceived, but was to understand how having access to multiple SenseCams might lead household members to reflect differently about themselves and each other [see also 18 and 19 for additional findings]. However, the theme of 'time in motion' reoccurred throughout the interviews, emerging as an important element of the context in which the participants experienced SenseCam. As such, this paper uses the notion of the 'stilted movie' as an overarching framework for the analysis presented. Findings related to this notion are organised into sub-themes, and supplemented with evidence from the SenseCam data. In particular, within the image corpus we focus on segments that were either highlighted at interview or that were bookmarked through the SenseCam viewer, as either of these indicates photographs that were memorable or considered worth returning to. Seven sub-themes will now be presented.

4.1 Romanticism and the Aesthetic

As already alluded to, the camera has a tendency to encourage the viewer of a photograph to see the world differently. Sontag has suggested that photography instils an "instant romanticism about the present" [30, p. 67], and further, that "seeing through photographs [..] nourishes aesthetic awareness and promotes emotional detachment" [30, p. 111]. Specific to SenseCam, Harper and colleagues have noted how the world is made appealingly strange through its fish-eye lens [10]. In the present study, the aesthetic qualities of SenseCam images once again emerged as a topic for discussion. Participants found a degree of charm in the candid nature of the images, and felt that SenseCam offered possibilities for photography that would be difficult to arrive at deliberately. One of the more creative participants had in the past tried lifting still shots from video with the desire to achieve a similar effect, saying, *"You just get half a person's face and then it blurs, and I prefer stuff like that, not posed, but not perfect either"*.

However, it was unusual for single images to be highlighted during our discussions with the participants. Furthermore, inspection of the bookmarks added to the SenseCam streams showed that it was rare for lone images to be tagged. Instead, the aesthetic quality of the images was bound up with changes that were subtly evident across transitions between photographs, changes that were somehow emphasised when playing the photographs back in rapid succession. These changes sometimes resulted from the movement of the SenseCam wearer. For example, the female half of one of the young couples remembered the photographs of shadows depicted in Figure 2 as being particularly striking:

"When you and I were walking over the dam on Friday, and [..] my shadow looked really long, they looked really really good on the stills".

Alternatively, changes within a space were made evident when SenseCams were left to capture unfolding scenes. Because of the physical affordances of the camera, it could as easily be placed in a corner as it could be worn around one's neck. This led to most of the participants positioning their SenseCams where they could record activities from a fixed vantage point for various intervals during the trial. Sometimes these SenseCams were forgotten, and left to capture an empty room (Figure 3). Sometimes they were set to face outwards, so as not to make work colleagues feel uncomfortable (Figure 4). Sometimes they were set to gain an insight into an occurrence happening while the user was elsewhere. What was surprising was that in many of these cases,

the participants took pleasure in the aesthetics of the images that were obtained. Moreover, even when they set out to record something in particular, they were often surprised to find appeal elsewhere, as the following extract from a discussion with the Cambridgeshire families shows:

- *"And just watching the light, in this room particularly, it was actually quite beautiful, just watching it on fast when the room was empty, just watching the clouds come over"*

- *"I set it up to watch the cats, but it was the light that was actually interesting".*

Figure 2. Shadows captured during a walk

Figure 3. Changes in light and shade in an empty room

Figure 4. View of rain falling on an office window overlooking Manchester

Apparent in these descriptions and others was how changes in light and shade were intrinsic to the ways in which participants romanticised scenes. It seems that the discontinuity of movement associated with the playback of SenseCam images emphasises these changes, lending appeal to photographs of empty rooms and falling rain. Indeed, a single photograph of raindrops on a windowsill has nothing of the character of a sequence of shots in which the raindrops are continuously shifting. This romanticism is not the same as that described by Sontag; here time is not frozen so as to allow for an exploration of the image. However, it seems that aesthetic awareness has in a sense been nourished; the staccato movement rendered through playback allows us to see the world anew, albeit not through a lingering inspection.

4.2 Sentimentality

We have already referred to the changing attitudes towards what is photoworthy in our review of related work. Researchers have shown that the ease and low costs associated with digital photography support experimentation with imagery, the capture of images for practical purposes, and the taking of many more pictures than was common with film cameras. Nevertheless, photographs of social relationships or ones which support shared experiences continue to be a major theme in personal photography. Unsurprisingly then, sentiment was to be found within the SenseCam image sequences. On rare occasion, these photographs stood alone, emerging from the stream as single pictures. However, within the whole image corpus, only two photographs had a single bookmark. One was the left-hand image in Figure 3 (bookmarked 'living room in the sun', although note that the image sequence that follows this, showing the changing light, was also bookmarked), the other is of a baby holding his mother's finger, presented below in Figure 5.

Figure 5. Single image bookmarked: '[a] and mummy' (left), and image taken immediately afterwards (right)

The fact that there is only one tagged image (in a corpus taken from 21 SenseCams) that stands alone as a representation of a social relationship offers a stark contrast to other forms of photography. It is likely that the candid and fortuitous nature of this image adds something to its value; the timing of capture and the angle from which the photograph was taken are both serendipitous. The photograph taken immediately afterwards, also shown in Figure 5, illustrates this clearly.

That participants did not bookmark single photographs underlines the fact that value was most commonly realised in image sequences. Like an appreciation of the aesthetic, sentimentality was expressed in relation to photograph streams, but topics were less conventional than those that might normally elicit this type of response in domestic photography. For example, the father of the family based in Manchester felt strangely sentimental about a series of photographs of his wife:

"You just fell asleep on the sofa next to me actually, and it was about two hours [..] and you were tossing, turning, and it was quite nice to sort of keep that sort of, I mean that not that you would take a photo of that normally".

Again, it was the movement of his sleeping wife, made evident through the discontinuity in the series of photographs, that was recounted in the description of these images. Through such sequences, behaviours are embodied that would not normally be visible in a photograph, and further, that would not usually be thought of as worth photographing.

4.3 Enlivening Static Objects

Thus far, we have described how the staccato motion rendered through viewing SenseCam images allows for an appreciation of the aesthetic and supports sentimentality. These themes have some parallels in traditional photography, but also offer points of

difference, for example in what is romanticised and in where sentiment is recognised. Both themes also find parallels in time-lapse photography, a technique (usually associated with cinematography) in which frames are captured at a slower rate than that at which they are played back. Typical subjects include cloudscapes, flowers opening, moving crowds and traffic. Through SenseCam, the participants often inadvertently created films that evoked the time-lapse genre; the examples already described are illustrative of this. Other examples were associated with the movement of objects around a scene, in a way that exemplified the activities of people. This was particularly relevant when the person doing the action was the SenseCam wearer (and therefore rarely in shot), or when children were involved. As one mother commented, *"they move around too quickly for anything to be captured"*, but their activities were often made evident by other changes in the visual scene.

Figure 5. *"The children's bedroom being tidied up."*

While changing light was romanticised, the movement of objects within a scene often aroused curiosity or incited humour instead. Participants spoke about *"my dinner disappearing off my plate"*, *"toys in the living room growing and disappearing"* (see also Figure 5), and the washing up; *"one minute there's loads of dishes and then… they're clean"*. These constant changes in the photographed scene enlivened objects that would normally be rather mundane, and reflected the somewhat chaotic nature of the households with young children. Such sequences were described as having *"more life to them"*, with one participant simply saying, *"It's characterful, it's living"*.

4.4 Embodying Personality

In addition to finding time-lapsed image sequences to be endearing and comedic, participants felt that SenseCam captured personality in a way that still shots could not. There was, for example, a sense that facial expressions and gestures were made more noticeable through SenseCam:

"I like watching how people interact with each other, you know their facial expressions, which I thought it picked up really well because of the stills again, I think a lot of that would be missed on video, you wouldn't notice".

As already mentioned, many of the participants used SenseCams to record scenes that they were in themselves by positioning the camera in a fixed location from which they could be viewed. Others saw photographs of themselves when viewing the results of SenseCams worn by family members or partners. This gave them an unusual insight into their own behaviour [see also 18]. Interestingly, it seems that these disclosures are not made as obvious through watching back video of oneself. Instead it seems that the small movements that comprise nonverbal behaviour are heightened by being rendered in time-lapse:

"You don't realise when you speak just your expression on your face and you know [..] you use your hands and, obviously when you're just taking a still photo you know you don't get any of that do you, you know there's no sense of that, and even when you've done camcorder at Christmas because it's rolling you don't notice it, actually you notice far more the expressions that your face makes and your hands and, cos it's much more accentuated isn't it".

In addition to offering a new perspective on one's own characteristics, participants also felt that SenseCam sequences conveyed a sense of the personalities of their loved ones. The candid nature of the photographs will certainly have contributed to this. However, the movement that the images communicate were key in embodying individuality, as demonstrated in the following extract from one of the mothers:

"We got some very funny footage, [.. my daughter] was sitting listening to a tape, a story tape, and every single image she was sitting in a different position [.. she] is doing something different in every picture, and that made us absolutely laugh, over that twenty minute period she did not stop [..] her in a little nutshell".

4.5 Capturing Play

The activities of children were commonly captured during the field trial. Often this was not because the children themselves were wearing SenseCams; in fact, this proved rather unpopular amongst the youngest members of our field trial, who described the device as "boring" [see also 19]. However, the parents of these children did take pleasure in capturing their activities, and this seemed particularly evident during play:

"The things that I liked was putting the camera somewhere in a room and just watching the life of the room, we've done it a few times, just put it outside on the window ledge outside when the kids were out playing, just watching all of that was quite entertaining".

Figure 6. Images of a child playing with a beanbag, bookmarked: '[J] does dive bombs!'

Figure 7. Images of a child swinging on a stool, bookmarked: '[C] STOOL DANCING'

This was also reflected in the image sequences that were bookmarked, with certain types of play being expressed

remarkably effectively through SenseCam. One such sequence was remembered by one of the participants as *"time in motion pictures of him sliding across on this beanbag"* (Figure 6), while a second set depicted a girl swinging around on a rotating stool (Figure 7).

4.6 Creativity

As already hinted at, while SenseCam was effective at capturing the play of children, it was not used as a resource for playfulness by them. However, this was not the case for some of the adults (in particular, the young couples), who did consider various ways of putting SenseCam to creative use. In previous work, creativity was suggested as being driven by the distorted images created by the fish-eye lens [10]. In contrast, the participants in this study specifically tried to create time-lapse movies, and furthermore, wished for more creative control over the camera, in order to do this more effectively:

"I think it would be good if you could set it yourself to take more often if you wanted to, you know when we did that thing where we were walking to the tree and it only took two pictures".

Figure 8. Time-lapse images of couple walking towards a tree

The couple quoted above were also fairly creative in the subjects that they chose to capture. For example, they used the device to record their cat while it was asleep (Figure 9), and bookmarked the resulting image sequence:

"We also filmed him asleep, you know when you leave your cat and you think they don't move, and it keeps twitching and everything, that was really interesting to watch."

Figure 9. Images of sleeping cat, bookmarked: '[i] sleeping lazy sod!'

4.7 Compressing the Everyday

A final aspect of the experience of viewing SenseCam image sequences was the way in which time was portrayed. Previous research has led to discussions of discontinuities between the way in which time is subjectively experienced and the way in which it actually unfolds [10]. When looking back on the day, we tend to weight most heavily activities of interest, filtering out the humdrum. The findings of this field trial replicated the previous one, with participants noting their surprise at the amount of time they spent, for example, driving, or shopping. However, this compression had effects other than simply revealing time tied up in the mundane. It bolstered the creativity discussed above, through the capture of subjects that would not normally be thought of as worth photographing or reviewing:

"You wouldn't sit through a video of the back garden, [but with SenseCam] you would have a really quick, you know two minute sequence of the day, or nightfall; that would be brilliant I think".

The low time overhead associated with capturing and viewing image sequences meant that participants were more willing to experiment with such ideas. Further, *"being able to compress an entire day into two or three minutes"* was seen as a unique means of recording an essence of the everyday, which when presented in time-lapse mode, was perceived as being somehow compelling:

"The family tea is just the best thing we filmed, I think [..] how long does [c] take to eat three pieces of cheese?"

As the above quotation illustrates, the portrayal of time was often an intrinsic feature of these distillations of everyday life. SenseCam offered a different view of the world, and our participants often delighted in its strangeness. However, they also took pleasure in recognising elements of themselves or their loved ones within it. The fact that the length of time a daughter takes to eat some cheese is represented, albeit somewhat differently, seemed strangely reaffirming. Thus, our householders found satisfaction in the mundane, bookmarking events such as breakfast (see Figure 11) and the school run.

Figure 11. Images bookmarked: 'BREAKFAST SUNDAY MORNING'

5. IMPLICATIONS

The findings presented above indicate that there are both parallels and points of contrast between the experience offered by SenseCam and that associated with traditional photography. Photography has been described as making the familiar strange, and as encouraging the viewer to focus on the aesthetic. Similarly, SenseCam led participants to romanticise about the mundane. Photography is often associated with sentiment; people take photographs of those things most important to them, and this is especially the case in the context of domestic life. SenseCam image streams were found to provoke similar emotions, albeit sometimes unexpectedly. Conversely, Sontag has described photography as encouraging a kind of emotional detachment [30], implying that the defamiliarisation associated with it facilitates an inspection of the forms depicted. Again, parallels can be found, with SenseCam image streams sometimes being bookmarked for their visual quality, and not because of the memories they trigger. Despite these similarities, there are obvious differences in the experience of using SenseCam. One of the clearest points of contrast is made most evident during image playback. Because of

the abundance of photographs, taken at short intervals, and because of the capacity to watch these images as if they were a stilted movie, time is not frozen but instead passes almost relentlessly. Moreover, this has the effect that certain subjects are rendered more successfully than others, leading to these subjects being particularly valued.

This aspect of the SenseCam experience is due partly to its automaticity and partly to the design of its associated software. With an automatic camera such as this, the photographer has little control over what is captured, and will find it difficult to construct events through the taking of photographs. The authorial role is thus weakened. However, events can be created after capture, through the bookmarking of certain sequences. Here, the design of the SenseCam viewer has an influence on what is bookmarked, with sequences that look good in time-lapse mode being highlighted over those that do not. In some ways, if the creation of events is influenced by what *looks* good, rather than what *was* good, parallels with photography remain. People do take photographs to celebrate the aesthetic (Sontag has argued that "What moves people to take photographs is finding something beautiful" [30, p. 85]). With SenseCam, beauty is sought out later, but still celebrated. Cameras can be forgotten, lost, abandoned, but still produce worthwhile sequences. Indeed, we have seen here that when SenseCam photographs are reviewed, sequences of empty rooms might be bookmarked in the same way as those representing family gatherings and days out. The viewing of these mundane scenes is enjoyed, but presumably the enjoyment derived purely from seeing one's living room cast in a pleasing light is different from that experienced when recognising the characteristics of one's own children portrayed photographically. Perhaps one of the most obvious implications to come from this research is that people need to be able to organise images in more flexible ways, so that they might express these different values more clearly.

Interestingly, none of the participants spoke of using SenseCam to support tasks or to aid memory, in contrast to more recent uses of digital photography and cameraphones. While Van House et al. [35] give an example of a photographed wine label that served as a reminder of a particularly good bottle, this type of usage was conspicuous in its absence here. This is perhaps not so surprising; the lack of control over the camera may have negated such usage. Moreover, the large number of images captured make such photographs difficult to find later. It is presumably easier to manage such usage with cameraphones, where the images can be captured, instantly reviewed, and retrieved at any time using a mobile device. In a more direct example of lifelogging, Millican [23] reports his experiences of wearing an always-on video camera. Little is said about review or playback of the captured film. Indeed, Millican suggests that the simple act of wearing the camera led to a heightened awareness of unfolding events, such that there was no need to later review what had been recorded. In the present study, it seems that the wearers of SenseCam saw the device neither as a way of capturing specific information, nor as a means for heightening unfolding experiences. Instead, it was seen as a way of recording perspicuous aspects of the everyday.

To elaborate further on this point, SenseCam was not thought of as a way of generating an exact record of one's own experiences. It was often deliberately turned off, and when left on it was not always set to record from one's own perspective, or even to record scenes where the user was present. As we have seen, it might instead be left on a windowsill, or turned outwards to record falling rain. This may reflect the frame of reference from which the participants approached SenseCam, i.e. they may have fallen back on their understanding of more traditional forms of photography while interpreting the device. These other forms do not support memory by showing things exactly as they were, but instead offer a record that is understood to be different. Photographs are known to be posed and selective; they depict scenes that have been chosen for a reason, and these scenes are rarely candid. Similarly, with SenseCam, while pictures were not posed, choices were made in terms of where the camera would be placed and what it might capture. Elements of performance were evident in the creative usage that emerged, especially in attempts to capture time-lapse sequences. The resulting images are not seen as an absolute record of what happened, but as something that offers a different perspective on the events of the day, with the potential to serve as a reminder of those events. Participants did not need to preserve every detail of every event, and accepted that there would be discontinuities between the photographs and their experience as remembered. Recording an essence of what had happened was sufficient for them.

This serves to illustrate two points. The first relates to lifelogging. In contrast to typical views of lifelogging, participants in this study did not wish to capture their lives as they were exactly. The second relates to UGC. This study has shown that the ways in which users seek to generate content will depend not only on the affordances of the recording device, but also on the means of playback available to them. While this may seem obvious, it is noteworthy that the participants in this field trial were influenced by different aspects of the camera to those studied by Harper et al. [10]. The subtle manipulation of task across the two studies altered the ways in which users approached the device. While in the previous field trial, participants were encouraged to look for single images to caption, in the current study, it was found that the obvious time-lapse nature of the resulting image stream led to the emergence of different values. Further, different creative uses emerged, with participants deliberately setting out to create time-lapse sequences, or speaking of being inspired to capture nightfall. This has implications for how devices such as SenseCam might be approached in the context of supporting UGC. For example, if an interface were developed to support the sharing of SenseCam images with others, simple design choices might have significant ramifications for what would be selected for presentation.

Moreover, current research is exploring how SenseCam images might better be managed. It seems that there are various potential outcomes here, with work investigating how the creation of folders might relate to different events, as recognised and automatically created through an analysis of picture properties [7]. Indeed, there is much to recommend some automatic editing; current sequences of SenseCam images often contain many blurry and indistinct photographs that are then intersected with interesting time-lapse sequences, as described here, and other segments that are meaningful to the user. Further, evocative single images might be found, fortuitously, at any point within the image stream. The analysis that we have presented suggests that the ways in which such automatically created events are displayed to the user will have ramifications for the experience that emerges. For example, in a folder-based scenario, single images might be more

prominent. In contrast, if the user is encouraged to watch back an unfolding sequence of images, compelling time-lapse streams will be more conspicuous.

Of course, these implications need to be put into context. These results are taken from a week-long field trial, in which SenseCam was essentially experienced as a novelty item, a device for which access would be limited and that users might wish to make the most out of. Indeed, it seems probable that the incentive to be creative would quickly diminish if SenseCam were ubiquitous. Further, there is a large possibility that image sequences of one's sleeping wife might be viewed less sentimentally if they were captured on a daily basis. But this is not to say that other aspects of life would not take on this quality. In a field trial reported by Oleksik et al. [24], participants recorded various elements of the domestic soundscape using digital recorders. Here participants particularly wanted to store things that might soon be lost, such as a child's snores, which only remain endearing for as long as the child remains young. With SenseCam, sentiment might be rediscovered, years later, when coming across an image stream of one's daughter swinging on a stool. Thus, despite the limitations of the field trial reported here, we suggest that the results are illustrative of where value might be found over a much longer period, provided that the means of presentation is held constant.

6. DISCUSSION

We began this paper by considering how we look upon the world in everyday life, and how this behaviour changes when we adopt different social roles, such as that of the tourist. We have suggested further that by gazing in different ways, different experiences emerge. We are not the first to do so. With relevance to the camera, writers have proposed that the experience of looking is transformed through the photograph. Even with reference to tourism, Alain de Botton recommends 'room travel', drawing on the notion that if we adopt a form of the tourist gaze when surrounded by the familiar, and thus "notice what we have already seen" [6, p. 254], we might holiday in our own bedrooms.

In contrast, the time-lapse experience offered by SenseCam is more akin to a 'mobility of vision' [cf. 28]. SenseCam images are not like the photograph, which "saves a set of appearances from the otherwise inevitable supercession of further appearances" [2, p. 55]. Instead, a SenseCam image stream inundates the viewer with those further appearances, emphasising the changes between stills and making them the focus of attention. One watches in anticipation of change rather than pausing to reflect upon a fixed moment. Because the time-lapse mode draws attention to particular behaviours and activities, the ways in which we experience such an image stream are altered. What we notice, what we remember, and how we cater for this in future use of the camera are all implicated. Here, our participants found enchantment in the banal, reciting to us how they were struck by the changing light in empty rooms. They found character in the everyday, being compelled by image sequences of the washing up diminishing. And they recognised personality in their loved ones, through the accentuation of their gestures and their frozen, but ever-changing, facial expressions.

This latter point is as much a feature of the context in which SenseCams were used as it is of the affordances of the device itself. The images were captured and viewed by family and loved ones, and as such differ from the multitude of images to be found on networking sites. Therefore, although a multiplicity of views was evident, it is not the same as that described by Rubinstein and Sluis [26], who consider the experience of viewing a number of anonymous images grouped together through common metadata. Instead, the assortment of images taken by SenseCam could be specifically related back to one's own life, and to that of one's family. Thus, they supported recognition of character and the expression of sentiment, and made the portrayal of mundane elements of one's own life somehow refreshing. Further, authorship became coupled with knowledge of who was wearing the camera and the bookmarking of images afterwards; the creation of the 'event' shifted from the point of capture (the 'decisive moment') to the point of review.

To conclude, in this paper we have explored the ways in which SenseCam image sequences encouraged a particular type of gazing, that which might be described as a mobility of vision. The consequences of this, such as the enlivening of everyday scenes, the manifestation of personality, and the rendering of play, affected the experience of using the cameras. Certain image sequences were brought to the foreground, with the result that some pictures were bookmarked simply because they looked good, regardless of the remembered experience. Such findings have implications for technologies that might support lifelogging or UGC; in both cases the means of playback, and the impact that this has on what is rendered most successfully, will influence what users will wish to keep, look back on, and share with others.

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