

Moments in the Home

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ABSTRACT

Photo and video capture is currently dominated by the use of digital cameras, often in the form of smartphones. Yet there is easily the chance that one can miss capturing a precious moment. We explored the idea of automated video recording in the home as a form of memory collection and display for families through the autobiographical design of Moments, an always-on video recording system. We iteratively designed Moments and it was used by one of the researchers and his family over a two year period. The family found unique potential for the system in capturing moments that would have otherwise been forgotten in time, where they especially valued seeing ‘big changes’ and minute details of their life. Yet Moments created tensions around the family’s inabilities to access specific points in time and commitment to keeping the system running. We use these benefits and concerns to suggest future research directions for always-on video recording in the home.

Author Keywords

Photos and video; families; surveillance; memories; slow technology.

ACM Classification Keywords

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

INTRODUCTION

Many people capture copious amounts of photos or videos of their family members and their activities [34]. This is particularly the case for families with young children [9]. Yet there is typically a requirement that someone is present and ready to capture a desired moment [23]. This is easily challenging to do amidst the everyday busyness of domestic life. As such, we were inspired to explore the idea of automated video capture of cherished family moments in the home. Past research efforts have looked at the automatic recording of family moments through the capturing of images based on ambient sound [23]. Life logging technologies similarly attempt to capture everyday moments throughout one’s day using wearable cameras [48]. We build on this work by exploring the idea of always-on video recording in the home. Studies have looked at people’s reactions to video recording in the home

as a data collection tool [44]; however, we have yet to see user reactions to always-on recording when it provides them with the benefits of family memory collection.

Naturally, the idea of always-on video recording in the home provokes many questions. While it offers the potential to capture and replay significant family moments, including developmental milestones of children, celebrations, and changes in people over time, there is certainly the risk of familial privacy concerns around video surveillance. There are also a range of design questions around what locations and angles are best suited for always-on recording, when and how recorded videos should be made accessible, whether video recording should indeed be *always-on*, what moments families value most when it comes to replaying their past experiences, and what privacy concerns are evoked through always-on video recording.

We recognized that answering these questions would be difficult. They would require a large corpus of family life to be captured and then replayed, in the order of months to years, and extensive buy-in would be needed from family members in order to keep a recording system active, with the willingness to have the family’s privacy at risk. This meant that traditional lab-based user studies would not suffice because they would not capture ‘real’ activities. Field deployments in participant homes would be ideal but problematic for such long durations of time and it would likely be difficult to get family commitment. Typically, deployments of home technologies last in the order of several weeks to one or two months because of their complexity, difficulty in running, and level of commitment from participant families [4,30]. Only in rare cases and for particular types of technology have field deployments been in the order of a year or more (e.g., [41,46]). As such, we realized we needed an alternative design and evaluation method outside of what is typically used in present-day HCI research if we were going to uncover the benefits and challenges of such a system during longitudinal usage.

Here we turned to autobiographical design, a design research method drawn from the field of computer science as a reflexive practice [1] and more commonly used in the early days of the field of CSCW as a means to deeply explore systems design research [37]. Autobiographical design involves extensive self-usage of a technology throughout its design process and is valuable for collecting longitudinal data on technology usage [37]. It has been shown to be particularly valuable in situations where it is difficult to deploy technologies in real situations given their

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frailty and incorporation of ubiquitous technologies [36,37]. It is also useful in situations where researchers want to “put themselves in harm’s way” first with a potentially risky system before knowing how it should be designed and presented to other users more broadly [36,37]. In this way, it is a test case to understand what is important in the design, what should be refined, and what should be left out. The goal of autobiographical design is certainly not to generalize usage behavior to broader populations; instead, it is meant as a means to deeply understand a design area to suggest research direction [36,37].

Our research involved designing an always-on video recording system called Moments and using it over a period of two years. Our design draws from slow technology design principles [20,41] as a means to create anticipation and reflection around the reveal of past family memories. At the 21-month mark of usage, we had a second researcher, independent from the family, conduct interviews and design activities with the family members to understand the effect of Moments on the family’s life. Our paper describes and reflects on this long-term usage to reveal key themes related to the value of media content, aspects of presence and commitment with long-term video recording systems, and notions of ‘lost’ moments within a large volume of media. We use these lessons to step back and explore the broader implications from our work for the design of always-on video recording systems in the home.

RELATED WORK

Photo and Video Capture and Sharing

Traditionally, families and friends shared photos with each other in a collocated setting using printed photographs [9,34]. This social act was highly desirable and people’s preferred mode of viewing [9,17] as it allowed family members and friends to reminisce and tell stories about their experiences [13,17]. As digital photos and videos became widespread, the amount of work needed to manage them became large [31]. Given the popularity of collocated photo sharing, a variety of prototype systems have been designed to support such practices around digital media. For example, these have focused on photo viewing and reminiscing around a digital table [24,49] and the design of domestic objects to support collective memory amongst family members [51], conversation, and reminiscing [5].

There have also been systems designed with an emphasis on automated or ubiquitous capture of video, similar to Moments. The Other Brother [23] captured unplanned or spontaneous photos in the home based on ambient sound. Studies found that family members appreciated the capture of surprising moments [23]. Initially family members had privacy concerns, but, over time, they noticed the recording device much less. TIMELINE provided the recording and rapid review of video from multiple workspaces [39]. Participants could watch each other work in real time, or see recorded footage from earlier. SenseCam was designed as a lifelogging camera to capture images throughout one’s

day [7,8] has been shown to allow people to connect to their past as well as aid memory during challenging health situations, e.g., Alzheimer’s disease [7,26,48].

Slow Technology

Researchers have recognized that technologies designed for settings outside of the workplace need to move beyond efficiency to other forms of meaning and connection where people might draw different understandings from their media or data and its consumption [20]. To this end, slow technologies aim to create a more meaningful connection between people and computational artifacts through designs that take time for users to learn how they work and why they work in a particular way [20,41]. For example, GoSlow was a slow technology for mobile devices that periodically prompts users to reflect on their mood [10]. Postlater was an asynchronous media sharing application that let users share photos or videos with family by sending them to a specific date and time in the future [21,22]. A field study showed that these features created valuable reflection [22]. The PhotoBox was a slow technology that randomly printed out Flickr photos for household members as a means to reconnect them to their past [41]. This created additional interest in their photo archives [41]. We build on these ideas to explore how principles from slow technology design might be used with always-on video recording to similarly create user reflection.

Always-On Communication Systems

Always-on video for communication and awareness purposes has been explored in domestic settings as a means to connect multiple homes together. The VideoProbe [12,27] shared still images between homes based on user movement. Users enjoyed capturing humorous moments and being playful, but sometimes had privacy concerns [12]. RoomLink focused on shared audio between two households; however, focus groups revealed privacy concerns over streamed audio between homes [25]. The Family Window connected two homes and provided ‘time shifted’ video that could be recorded and played back. Participants liked the idea of having the option of recording events since it meant they would not likely miss special moments [28]. Family Portals connected three households together with always-on video [29]. Users valued the sense of connection, however, there was increased privacy risk by having more people connected [29].

Surveillance and Video Recording

Ubiquitous surveillance involves the “unilateral collection of data on people with sensors embedded in their everyday environment” [44]. A day reconstruction study on video recording in environments such as offices, malls, and public spaces found that people were concerned with notification and consent to be recorded, improper access to video, and unauthorized use [38]. Using a similar method, Massimi et al. [33] found that people use visual cues in their environment to determine if they are being surveilled (e.g., the presence of cameras). O’Donnell et al. [40] found that surveillance is more accepted when performed by a group

with whom one identifies. A survey by Choe et al. [11] that asked people to speculate about their reactions to ubiquitous recording in their home found that they were concerned about being recorded when partially clothed or during intimate or socially awkward acts [11]. They were also concerned about audio being captured, including talking to oneself, child rearing, and arguments [11].

As can be seen, most studies of ubiquitous video recording focus on speculations of usage with few exploring actual usage and reactions to recording in the moment. A notable exception is the Helsinki Privacy Experiment, a study of ubiquitous surveillance *within* families' homes over a period of six months [44]. The idea was to explore a 'worst case scenario' where a large amount of data would be logged without any particular benefit to users. Some surveillees grew accustomed to having their lives logged, while others grew increasingly concerned or changed their behaviors to reflect the fact that their activities were being recorded and logged. The most disturbing sensors to participants were video and audio recording along with Internet activity logging. Our research builds on this study by more deeply exploring video recording in the home, in particular, when the family has potential to receive benefits from the recorded footage (e.g., family memory collection).

The Human Speechome Project (HSP) is also similar to our study of Moments. In the HSP, video cameras continuously capture a single home in an effort to understand and map children's speech development patterns [47,52]. While also focused on recording *one* family's activities, the HSP has not studied the family's reactions to continuous capture.

AUTOBIOGRAPHICAL DESIGN AS A METHOD

Our research draws from autobiographical design as a design research method. Autobiographical design is "design research drawn from extensive, genuine use by those creating or building the system" [37]. It draws its roots from practices in the 1980s by computer scientists who designed for themselves as a *reflexive user* where they would imagine themselves as future users [1]. This was seen as a valuable method for bootstrapping issues and reducing initial costs in exploring an idea [1]. In the early days of the field of CSCW, media space researchers used a similar self-usage approach to design and study their systems [3,15,32]. Since then, it has been periodically used and published as a design research technique (e.g., [16] in 1996, [18] in 2006, [28] in 2010, [14] in 2016). Yet what happens often is that researchers use the method but are hesitant to publish their results from it because of potentially negative reactions from peer reviewers [37].

Autobiographical design is similar to design requirements elicitation methods such as ethnography and technology probes, yet differs in that the observations and understanding of usage are tied with an initial period of design iteration [36]. Usage is then tracked long term over periods of months to years to provide detailed longitudinal data situated in aspects of 'real life' [36]. Interviews with

HCI and CSCW expert researchers who have used the method described it being a valuable design research method for early design when little is known about a design space and when it is difficult to deploy a technology to external users or where it may not make sense to do so [37]. However, they cautioned that autobiographical design needs to ensure its own sense of rigor as is the case with all research methods in the field of HCI [37]. Rigor for autobiographical design means careful and critical reflection on one's work including, "*an extensive period of genuine, intensive use, measured in months or years; surprises in usage that lead researchers to rethink or further develop initial design conceptions; improvements to design driven by specific, documented incidents of use; and careful articulation of the impact of design decisions on experiential qualities of the system in use.*" [37]

By following these tenets, autobiographical design supports fast tinkering with an idea, reveals 'big effects' from usage, and provides detailed and experiential understanding, not often available from other research methods [37]. Of course, autobiographical design does not produce generalizable results, and nor should this be expected [37]. In the subsequent sections, we describe how we employed an autobiographical design approach to create and study always-on video recording in the home.

THE DESIGN OF MOMENTS

Moments is an always-on video recording system for families, designed to be used within the home. A Kinect camera is placed in one location and connected to a computer that records video continuously (Figure 1). A web application runs on a tablet and has access to playback the recorded video (Figure 2, bottom right), with constraints that are described in subsequent sections. The goal is to help families collect and reflect on past moments and experiences that took place in certain areas of the home.

Design Need and Iteration

Moments was designed to fulfill a researcher's desire to capture the everyday spontaneous moments that occurred within his family home, containing himself, his wife, and his three young children (aged 1, 6, and 8 at the onset of the project). He wanted to be able to capture their growth and development as well as the 'special moments' that might occur in their home. These special moments might include, for example, a child's first steps or family celebrations. There was a particular interest in the changes that might occur within these moments over a long period of time, for example, seeing a pattern of who sits down to eat together at mealtimes and how this might change. Many of these moments were either missed or difficult to capture and so the researcher desired a more automated approach for such capture. Thus, as can be seen, there was a clear need and desire by the researcher to have such a system; this is an important facet of autobiographical design, such that one can learn deeply about a design situation [37].

Over a period of four months, an undergraduate research

designer iteratively created Moments through a series of brainstorming, sketching, and prototyping activities, in consultation with the researcher. During this time, Moments was placed in the researcher's home in a home office and recreation room to explore the design ideas as they were developing. This represented a period of 'fast tinkering' with the design, which is common in autobiographical design and one of the benefits of the method [37]. After four months, the design reached a stable point where the researcher and designer felt the system met the primary needs of the family. Development ceased and the family began using Moments more permanently in the main living space of their home, a kitchen/living room.



Figure 1: The Moments camera near the roof of the kitchen.



Figure 2: A Moments iPad on the kitchen counter.

Usage Constraints

As we designed and built Moments we recognized that we wanted to purposely include a number of usage constraints in an effort to make the system feel like it was focused more on family moments and less on surveillance. Our ideas were inspired by slow technology designs where notions of time and relevance can be brought to the surface by allowing a design to slowly reveal itself, its contents, and its value to the user [20,41]. For example, content from the past could be revealed to the user at particular moments in time in an effort to make a past moment more memorable or valuable than it might otherwise be if it was more easily accessible [22,41]. Existing systems such as the PhotoBox [41] and Postulator [21,22] used this technique to bring forward photographs from the past to the user in present day where the technique created valuable user anticipation and reflection; we extended this idea to video recording.

Location

First, in order to watch recorded video, the user must be located in close proximity to the capturing camera. For example, Figure 3 shows Moments displaying video on an iPad located on a kitchen counter. Directly above it is the recording camera. Clicking on a 'settings' icon on the Moments display causes a calendar to appear that family

members can use to select a date that they would like to review for that camera. When a date is picked, video plays for that day. Thus, family members can set the iPad on the counter (with the screen set to permanently stay on) and video will be shown of the selected day continuously. In this way, it can act as a glanceable display into the family's past. The idea of glanceable displays in the home builds on prior work on digital family calendars [35] and messaging systems [43] which shows that families find value in being able to walk by and glance at content on a display with ease. Previous research also suggests that playing the video back in the same location it was recorded in can help create an emotional connection to the video [45].



Figure 3: Moments showing video from one year earlier.

Timing

We also constrained the timing of the video that could be replayed. Video is only ever played from the selected day at the present time. Thus, when selecting video to play on a display, if one were to select yesterday as a date, and it was presently 1:00 pm, the device would play video from yesterday at 1:00 pm. Our hope was that by limiting the viewing experience to the corresponding *time* of day, video replay would be made more valuable since one may have to wait for a particular time in order to see an activity occur. For example, if a person wants to see video of children opening up presents on Christmas morning, she/he would need to think about what time of day that occurred at, and then wait until the next day to see it, if the time had already passed today. The intention was to use the time delay to generate anticipation much the same way that slow technologies have been successful in creating anticipation around the reveal of time-delayed photographs [21,22,41].

This type of viewing contrasts nearly every present day photo or video-sharing application where usage includes letting people easily access recorded videos and replay them at any point in time. This access has somewhat ironically meant that recorded videos/photos are not often viewed once they are placed in an archive [17]; thus, in some ways, we wanted to see the effect of an 'opposite' style of design. We also recognized that by limiting playback, family members would not be able to replay any moment at any point in time, as well as re-watch moments in short succession. This might be more akin to scrubbing

recorded video from surveillance systems, which was not our intended use of Moments. Of course, there are many ways to design a system such that it does not feel and act like a video surveillance system. We chose but one route that seemed promising and reflected the desire to create anticipation with the revealing of past moments.

Audio

Moments does not record audio. Previous research on always-on video media spaces in the home has found the transmission of audio to be more privacy-invasive than video [28,29]. Prior research has also shown large concerns over audio recording and streaming [11,25]. By capturing audio, we would be more likely to record family arguments or negative conversations about other people, which might be much less desirable. On the other hand, video of such events would appear somewhat mundane. We also did not want to alter conversations in the home, which was found by researchers who studied the recording of audio [44].

Implementation

Moments works with two applications. The first runs on a MacMini computer connected to a Microsoft Kinect camera and continuously polls the camera for images at a resolution of 640 x 480. Images are stored in a database running on a local server computer within the home. Thus, there is no concern over access to the images from outside of the home. We deliberately chose low-resolution images to reduce storage consumption. Video is also captured at a low rate of up to 10 frames per second (fps). Computer vision techniques are used to detect how many people are present in the room. If nobody is present, we captured video at a rate of 1 fps in order to capture changes in the ambiance of the room (e.g., lighting changes). The user interface to replay video is implemented as a web application that can run on any tablet, computer, or smartphone device when connected to the home's intranet. When a date is selected, images are retrieved from the database and concatenated together to playback video from the time period. Video continues to play as long as the web page is open.

EVALUATION METHOD

Moments has been used by the researcher and his family in their home for a period of 2 years and their usage is ongoing. Throughout this time, the researcher recorded periodic confessional videos of himself and his children that described their usage of Moments and any thoughts they had about the system. Of particular importance is the fact that the videos represented the thoughts and reflections from a trained researcher in human-computer interaction. This brings the added value of having a researcher as a participant where the researcher is trained to observe, critique, and reflect on the family's usage with extensive knowledge of the related literature and continuous access to observe the home environment and see nearly all of the effects of the technology. Such 'all day, everyday' observations are not normally possible in field studies.

We wanted to augment this data and understand the

family's usage from an external perspective as well as bring additional rigor to the analysis by having a second researcher, independent from the family, perform data collection and analysis. Our goal was to have an unbiased, third-party researcher understand the family's experience and the father's detailed reflections and be able to analyze, describe, and document them. This person was brought on to the project and she conducted semi-structured interviews with family members at the 20-month mark of usage. The confessional videos were used as an entry point to think about how the interviews should be structured and what focal points would be interesting to explore.

Interviews

Interviews with the two adult parents focused on topics such as usage patterns, views of the recorded video, the location of the camera, and privacy. For example, the researcher asked, "When do you most often look at Moments?", "What do you look for?", "What moments do you like to see the most in the system and why?", "Tell me about the most surprising usage you found for Moments". The two oldest children (aged 7 and 9 at the time) performed a design activity that involved drawing Moments, how they thought it worked, and what they would like to add to it, if anything. For example, the researcher asked, "Can you draw what you would like to add to the Moments system? Can you explain your drawing to me?" After the activity, the children were interviewed about their drawing and thoughts on Moments. The interview focused around their knowledge of the system, details of what they saw interesting in the system, and possible privacy concerns. For example, they were asked, "Can you tell me about a time you tried to look at the display very closely to see what was happening back then?" The third child (2-years old) was not interviewed.

Data Collection and Analysis

Interviews were audio-recorded and transcribed for data analysis purposes. The independent researcher performed open coding on the data to draw out the important findings and then axial coding to group them into categories. Selective coding was used to draw out and summarize the key findings into themes. These are discussed in the following sections and relate to aspects of commitment, screen attention, reflecting on moments, time constraints, and privacy. Throughout our results, we refer to the family members as the father (researcher), mother, oldest son (age 9), the daughter (age 7), and youngest son (age 2).

GENERAL USAGE

After the initial four months of Moments' design and development, it was setup within the family's home in two locations. The first location was in a rec room in the basement. A Kinect camera was placed on a stand facing towards a couch and play area. An iPad display was placed in a stand near the camera, such that it could easily display video if the family desired. The intention of the camera's location was to capture the children playing in the rec room.

The second location was in the family's kitchen on the main floor of their home. A Kinect camera was placed on top of the cupboard in the corner of the kitchen so that it could capture most of the kitchen as well as part of the adjoining living room. Figure 1 shows the camera's placement and Figure 3 shows the view from the camera. The father wanted to capture the family's everyday comings and goings, activities around the dining room table, and play that might occur in the living room. The placement on top of the cupboard was purposeful; the father wanted an overview of the living space with a view that would not change easily. In contrast, placement of the camera on a kitchen counter may cause it to be bumped or change viewpoints fairly frequently. On the counter below the camera, the father placed an iPad, which was meant to continuously show Moments on a selected day (Figure 2). The goal was to make the video viewable at-a-glance when they walked by, such that they might be drawn into looking at it more closely if something interesting appeared.

These two locations were used over several weeks, however, it became apparent that the camera and setup in the basement rec room was not being utilized; most of the time, family members were on the main floor of the home in either the kitchen or living room. For this reason, the basement location was removed to save computer storage space. Other locations were considered such as having a camera at a child's height in the living room, yet there were pragmatic concerns about the youngest child grabbing and damaging the setup. As such, the remainder of the family's usage involved using only a single camera and iPad situated in the corner of the kitchen. This location was never changed during the family's usage, which reflects the value of the location and its mapping to the family's needs. Family members described glancing at the Moments display when they were in the kitchen area getting dishes or food, or while on their way to the garage. The display was never moved to a common area such as the kitchen table for joint discussions of the family's video, akin to collocated photo sharing; it always stayed on the kitchen counter.

For the first year, Moments was set to show yesterday by default. This meant unless a family member selected another day, it was routinely showing what happened the prior day. Sometimes family members would change the date (described later), but this was infrequent. After the family had used Moments for a full year, the design was modified so that by default it showed video from exactly one year before. The father saw this point in time as a key milestone as it represented a significant amount of family moments being captured. It also created a straightforward way of knowing what Moments was displaying; it was always exactly one year ago. This display configuration continues to date and has been used for a total of seven months by the family at the time of writing. Throughout the remainder of the results, we describe the way in which the family used Moments and their reactions to the system. We also outline the benefits and pitfalls of the design.

SEEING BIG CHANGES (OR A LACK OF)

The family was most often drawn into looking at the Moments display when they would glance at it and see 'big' changes in the video compared to present day. For example, they noticed dramatic appearance changes such as someone having long hair vs. short hair, the changing ways in which a toddler sat at the kitchen table (in a high chair vs. a regular chair), as well as large changes in clothing styles, such as might occur on a special occasion.

"We notice when somebody has super long hair compared to super short hair." –Father

"There are times that I pass it and I'll be holding [my youngest son] and I yell for [my oldest son], or [my husband], or [my daughter] to come and see, 'Look how small he was!' He is the one you can tell the greatest difference in because he was a baby and he was in my arms and now he's a toddler running around." –Mother

Family members were also drawn in to looking more closely at Moments when there was a *lack* of big changes. For example, a family member might notice that someone was wearing the same shirt today as they did a year ago, recognizing that the shirt was now likely 'getting old.'

Family members repeatedly talked about times when they noticed guests in their home on the Moments display. Seeing only their immediate family members on the display was fairly typical, yet seeing an extended family member or friend on Moments was rare and so it tended to spark curiosity. This curiosity led one or more family members to congregate around the corner of the kitchen and look more closely at the display to inspect who was there and ponder over the reasoning. This was typically a conversation-starter amongst family members if multiple people were around.

"I think the most surprising would probably be when you see somebody on there that's not a part of the house. And you have to remember back to ... like I'll see my mom on there and I'll be like, 'Hey! My mom was visiting us last year at this time? What was she doing out here?'" –Mother

"Like we noticed Grandma was there, or we notice the other Grandma is there... But otherwise, the rest of the stuff is unremarkable. It's just normal. There's us in our kitchen eating." –Father

When nobody else was around to talk about the recorded video and guests shown within it, Moments often created a moment of self-reflection.

THE IMPORTANCE OF 'THE DETAILS'

The family was keen to be able to see past moments that were tied to birthdays and special seasonal celebrations, such as Christmas or Easter. For the first few months of usage (December through March), because the system had not been recording for a very long time, when the family purposely selected dates to look at, they often focused around the recent Christmas.

“Early on, yeah, because we didn't have a bunch to look at. I was definitely replaying the Christmas stuff. I'd started using it just before Christmas, and December 20 was the first kind of celebration. So then, for the few weeks after that, I always thought Christmas was a special time, so I often set it to just play that day again.” -Father

As time progressed, family members would notice the replay of birthdays, holidays, and other special celebrations that had occurred in the home. Yet what was surprising was *exactly what* they found interesting in those moments. Rather than enjoying the re-creation of the event per se, family members found it interesting to look at the details of what was going on. Thus, the value of the video was not in seeing a replay of the overall event. Instead, value was found in knowing the specific details of the day, regardless of how mundane they might seem. For example, the parents liked to see what item was prepared for a meal, what show was playing in the background on the television, what shirt each person was wearing, how the house was decorated, or what time of day people were awake and eating breakfast. In addition, family members said that the preparation for important celebrations was interesting to see. Normally this was not something they would capture on photo or video.

“Say it was Christmas and I looked back at last year's Christmas...What was cool is, each year we change our tree. Change where our tree is. The stockings are usually different. When we set the decorations you can see it on Moments, which is really cool.” -Oldest Son

The father distinguished such usage of Moments from the way that they routinely used photos and videos within the family. With Moments, memories were about a broader, more detailed view of life.

“It's more about a way to capture this higher level sense of our existence, whereas I think with a photo or a video, you're catching a very specific instance of your life. This is not that. It's about, what was life like for me at that point in time? What were certain people like at that point in time... it's all these mundane things that we do... If I had video clips of my parents when they were kids in their house, it would be so cool to see.” -Father

THE PURPOSEFUL CREATIONS OF MOMENTS

While much of the moments that the system captured were spontaneous and happened simply as a result of everyday life happening in the home, there were instances when family members would do certain actions for the sole purpose of Moments capturing them. For example, throughout the first few weeks of usage, while the novelty of the system was still in effect, the father and children would occasionally perform silly actions such as waving at the camera or performing dance moves. The hope was that they would see them again at some point in the future and be able to relive the humorous moment. The children, in particular, liked seeing themselves on the screen.

“Me and [my sister] would usually dance. We'd dance in

front of it and then go see what was happening when we'd hide behind the couch and just pop up.” -Oldest Son

While this behavior mostly happened during the design's early usage, the behavior periodically resurfaced when guests were over and Moments was explained to them.

On another occasion, Moments was used by the father to purposely capture information for his children, to be seen at a later point in time. The father was going out-of-town to a conference and so he created a scavenger hunt for his children to do while he was gone. The father recorded himself in front of the camera making a particular gesture with his arms. He recorded the date and time of this event on a piece of paper representing the clue. Then, when he was out-of-town and the children were doing the scavenger hunt, they had to view the associated video in order to see what their father had done as part of the clue. This required them to wait until the next day at just the right time to see the father's visual message.

LONG TERM PRESENCE AND COMMITMENT

Moments was designed to provide automated capture, in somewhat of an unobtrusive form. That is, it was expected that video would simply be recording without the requirement for intervention, or, perhaps, even knowing that the system was recording. Yet usage was far from this ideal. Instead, the system had somewhat of a continuous presence in the home. The father described this as a 'friend that was always around.' For example, the computer made a soft humming sound as it processed and recorded video, which meant that it was easy to notice it was running. The father also had somewhat of a continuous sense in his head that Moments was running and needed to be attended to in order to ensure it stayed running and there was enough storage space on the computer's hard drive. These thoughts came up often when he was in the kitchen near the system. For example, the father talked about always ensuring the cupboard door near Moments was closed because if it was left open, it would partially obscure the camera's view.

“If something is capturing you all the time, you develop this sense that you need to help it capture you and you're not going to block its view. So that's troubling. Now I'm its friend and I have to help it out and make sure it can see all the time.” -Father

The children liked to routinely use the Moments iPad to play video games. This occurred in the morning before school and during intermittent periods of time after school. The challenge was that every time the iPad was used to play games, it had to be returned to displaying Moments when the play was done. The children were initially told to do so by the father and then it eventually became a habit. Again, this represents an act of commitment to ensure the technology was running and visible.

Over time, the father grew accustomed to the presence of Moments. This helped entrench the feeling that it was 'part of' the family and a representation of their life together.

The father described his desire for the presence of the system and his commitment to it to persist longer term such that it could then act as a type of family heirloom that could be passed on from generation to generation. This was despite the work needed in order to ensure it was always running and recording the family.

“It is useful as a family heirloom, which is weird because I never expected it to be like that. Now, the family heirlooms that I might get from my mom will be a printed picture of my grandparents when they got married or something, and the paper's brittle and it's over 50 years old. [With Moments] it's just this comforting thing that you see on the counter and you know...it almost creates this sense of family. That's a representation of my family and what we've done over the last couple of years in our home...It's knowing that our family's existed and done fine for the last couple of years... You keep it around, and I can pass it on to my kids. To me, this is kind of the same thing.” –Father

TIME CONSTRAINTS AND THEIR EFFECTS

Although the time constraints of the system added a sentimental value to it, they also caused burdens in terms of its usage. Sometimes family members wanted to see a special moment but they did not know what day or time it happened at. Instead, they remembered details of the activity and their feelings associated with it. This led to less targeted usage with the system (e.g., looking at a specific moment of interest) than the father had anticipated.

“You have to know exactly what time the memory happened in order to go back and use it. And considering that I can't tell you what I did this morning at 9, I can't go back and search and say, ‘Oh yeah, I know that on this day, I know this happened at 9’. I just don't have that memory capability. So, that's why I think it's less useful for me because even on birthdays and stuff, unless I know what time we had the cake, I have to keep periodically checking it every couple hours in order to go back and get that memory.” –Mother

The difficulty in knowing when past events occurred meant that the humorous video clips that the children recorded rarely resurfaced because they did not carry a significant date with them that was easily remembered.

The father described how the idea of selecting times to watch did not match his longer term uses for the system because many days seemed unremarkable. Instead, he preferred that the system suggest days and times to view.

“The original intention in the way I thought it would be used is you can walk up, you can pick a day, and you can go and look at it. But what I've realized over time is that it's really hard to just pick a day. Like if you think, ‘Oh, I want to see this day.’ Well, no, that doesn't actually happen. There's no particular day that you really want to know about, and so I'd almost rather the system just say, ‘Here's a day that might be interesting to you, and now you can look at it.’” –Father

PRIVACY

Overall, the family did not feel that they had changed their behaviors despite being recorded by Moments. Moments had captured such a large amount of activity that they felt it was unlikely that privacy-sensitive activities would resurface and be noticed. The daughter (age 7) described Moments in a way that was similar to a surveillance system (e.g., cameras watching you) though she was not bothered by it and enjoyed that she could “*see people easier.*”

Both parents talked about how Moments caused them to create a mental representation of what was a ‘private zone’ in their home. By private zone, they referred to places in the living room and kitchen (or adjoining rooms) that could not be seen on-camera. They said that, because Moments’ had a fixed location, it was easy to create this mental model.

“I think because of the fixed viewpoint, I have a really good sense of what is on camera and what isn't. Because it never changes, I never have to worry about that, and so I guess I'm always in my head remembering what that zone of the house is. Maybe that's not a good thing that I have to mentally remember that, but it does mean that I don't really have many privacy concerns about it.” –Father

“I feel like our kitchen is the most spied-on part of the house...I know the privacy zones... And I know if I go further this way into the living room, then it's more blurry.” –Mother

That said, the mother told us that she was not really concerned about Moments recording at the present time because she tended to forget about it. At the beginning of the family’s usage, Moments was more of a concern for the mother because they had a small baby who would nurse (breastfeed) in various locations on camera. This could cause the mother to be partially exposed on camera. She was concerned that, at a later point, a guest might be at the house and a specific day and time might appear on the Moments display and reveal her partly clothed.

“I think the only thing is when I nurse [my youngest son]. Because it happens wherever, whenever. So there's no real time for it. I don't really care, but then I wonder if people are over at the house...What happens if there's something embarrassing on there? And I forgot about it because I don't know it's there anymore.” –Mother

Despite the concerns, this type of video recording never happened to appear when guests visited, yet the potential for such an instance to occur still existed.

Early on, family members were concerned about guests to the home and whether they would be comfortable with Moments. Guests included periodic visits from friends and stays of several days by grandparents. Both parents said that they routinely told the guests about the system as part of conversation and, initially, the guests appeared uncomfortable where the guests described the system in terms of surveillance. This is likely because they did not

receive any benefit from it. Guests also do not have the advantage of knowing what regions are visible on camera given their limited usage. Thus, unlike the family members, they are not able to develop a mental model of the system longer term. Despite these concerns, the parents said that, later in their visit, guests looked as though they had ‘eased’ into having Moments going or likely had forgotten about it.

Presently the family members do not typically comment on Moments to guests as the system has mostly become unremarkable and something they do not think about, though, when interviewed, the mother talked about possibly putting up a banner at the front door to inform guests. If guests were not told about Moments, they usually did not notice it since it was in the corner of the kitchen.

When each family member was asked whether there was a time that they wanted to delete footage, their answers were all negative. They said they usually forgot that Moments was recording so they would not know what was recorded. The low resolution of the video also helped in this regard.

“I honestly can't think of a moment that I would want deleted because I sometimes forget it's recording. So, I wouldn't know unless I went through every day, every hour, if there was something I would want deleted.” – Mother

“I don't think there's ever really been a time I wanted to delete something. I think because I know the fidelity is low enough, I don't really care.” –Father

The father elaborated that there were some recorded moments that he did not want his children to see at present time, but he did not want them to be deleted. For example, he noted that Moments had recorded him and his wife placing Christmas presents from Santa Claus under their tree on Christmas Eve and, if the kids saw this footage, it would ruin the idea that Santa Claus was real. Seeing the video at a later point in time once the children had learned about the true nature of Santa Claus would be fine.

DISCUSSION

Our paper has explored the autobiographical design of an always-on video recording system for the home. In many ways, we likely explored a ‘best case scenario’ for always-on video recording (e.g., in terms of privacy concerns) since the system was designed for the family specifically and one of its key designers was a family member. Thus, there was certainly buy-in from multiple family members. As such, like other autobiographical design studies [36], our goal is not to generalize the usage of the system to other families. Instead, we now focus on several key takeaways from the family’s usage that suggest further design investigations in this research space and raise important research questions.

First, we found that Moments challenged our assumptions of what might be considered valuable to record in the home. This raises design questions about what is important to capture in video recording systems. As expected, the family did indeed value seeing changes over time. Yet what was

surprising was the level of detail they valued seeing and how such details pertained to everyday mundane things. The family’s usage was much less about the moments themselves and the experiences family members had together and more about the details within those moments. This became especially valuable when the family used the system for a long time. This is because the details became forgotten and prompted the family, in a quizzical fashion, to think about and question their past. The challenge is that such moments and detail about them could certainly be difficult to know a priori, which speaks to the value of always-on video recording. By ‘capturing everything,’ one has the option and the ability to gather whatever sort of details they might find interesting to review after the fact. However, capturing everything may not always be an option, given the pragmatic realities of long-term capture with always-on video recording (e.g., disk storage). Thus, determining what is worthy of capture ahead of time would certainly be useful. The most interesting moments for the family tended to revolve around situations where more than one person was present, including everyday situations as well as holidays and celebrations, as well as points in time where a non-family member was present. These types of situations are relatively straightforward to detect with computer vision techniques (e.g., counting people). This suggests value in future design research that explores the automatic capture and replay of such situations.

Our study also revealed a desire to specifically tie together time periods through a form of asynchronous communication where family members would purposely do something in front of the camera for their future selves. This is intriguing as we have yet to see designs for families that purposely allow them to do this in the home. Research prototypes have supported the random reveal of past media content [41], but none that we know of have allowed one to specify a future point in time for content to ‘reveal’ itself. Designs have done this for mobile device usage [21,22]; however, our research suggests the expansion and exploration of these ideas for situated displays in the home.

Second, our study reveals new ideas around the design and long-term use of slow technologies. Past research on slow technologies shows that users can face a tension between a lack of control over the reveal of content and the enjoyment they receive from its slow and random reveal [41]. Yet in past research, users have had other options for accessing their media content (e.g., an existing communication system [20], a Flickr archive [41]) outside of the slow technology, if they wanted. In our case, users could *only* access their content through a slow technology. This created frustration because users had control over what was viewed, but they did not necessarily know where to look to see content they were interested in. They could also not look at other systems to see their content; they were forced to have Moments reveal it to them. This raises design questions around what amount of control a slow technology should provide users. Should a slow technology only ever provide

content in a way that reveals itself slowly over time? Or should there be hybrid approaches where content is also made more accessible to users? What is the appropriate level of control and access? Will additional levels of control take away from the benefits of slow reveal?

Given these questions, we see benefits in exploring always-on video recording systems that might remind people of when particular events of significance occurred (e.g., birthday parties or celebrations) to provide a greater sense of control, while still allowing the system to reveal content to family members. For example, systems could provide visual indicators in a calendar of how many people were present at particular moments in each day; a large number of people might mean it was a family gathering. Designers may also want to explore ways to allow family members to flag or highlight days of importance shortly after interesting moments occurred by, for example, interacting with a display to ‘tag’ days or times. In both of these situations, family members might still be able to gain the benefit of anticipation by waiting for a time of day to play, yet now they would have a stronger sense of what days to look at.

We also recognize that family members may want to purposely block the availability of certain moments and restrict access to them. This may be permanently or for shorter durations of time. For example, the parents wanted to hide videos of them acting as Santa Claus until a later point in time. This raises questions around how designers may want to allow users to include or exclude content from appearing where it may be available at different times (e.g., when children have reached a certain age) and not others.

Third, we recognize that there are important considerations to be made about the level of commitment that an always-on video recording system creates. Moments created an ongoing sense of presence in the home for itself and with this presence came the creation of work and commitment by family members. Even though the system was meant to be autonomous and passive in its recording of the family’s life, it still required work. This meant ensuring ‘good’ camera views of the family, adequate storage space, and network connectivity. Certainly some of the work came from the fact that the system was still a research prototype. Yet it is also likely the case that if always-on video recording systems are placed in homes more broadly, the users will not be as technically proficient as the family members who used Moments (e.g., the researcher) or perhaps as committed. Thus, even in a possible ‘best case,’ commitment is a major concern. Systems like Moments would likely create additional work for family members just like it did for the researcher’s family.

Such ideas need to be thought through if designers are to consider the broader exploration of always-on video recording. The fact that it is always-on in some ways means that it must be always thought about, or frequently attended to. Unlike past slow technology research where designs could be hidden or not worried about, if desired, [41],

technologies like always-on video recording may continue to require user attention. The pragmatic challenges of large amounts of data from always-on recording means that such systems can be difficult to forget about. Cloud-based servers may provide a storage solution, but they pose the risk of having one’s data stored outside of the home (Moments used a home-based storage system to alleviate privacy concerns). This raises design questions around how such systems could be created to relieve user commitment while still ensuring usage continues long term. How does one design for device placement such that ‘good’ views of family life are always available? How can pragmatic, technical issues be attended to by users in a manner that requires as little attention and commitment as possible?

Lastly, there are questions and challenges around privacy. Always-on video recording caused the parents to create a mental representation of what was on camera in their home where fixed camera locations made it easy to develop such mental models. Guests did not have this advantage and nor did they receive benefit from the system, unless it was valuable to them that they be recorded as part of a family moment. This raises questions around how guests can be easily told about recording devices or have recording zones presented to them in an understandable manner. The use of an always-on recording system can become unremarkable to family members over long periods of time, and, after prolonged use, they may not want the constant reminder that the system is recording, despite the value of the feature for guests. How can designs create a balance between warning people about always-on recording and not being obtrusive in the presentation of this information? Design suggestions from the media space literature across the years [6] presents some possibilities from workplace settings (e.g., feedback displays), however, this requires testing and exploration in home contexts. A limitation of our study is that we did not directly explore the reactions of guests to the system. Future work should certainly explore this broader set of stakeholders for always-on video recording.

CONCLUSION

We studied the design and use of an always-on video recording system called Moments. Through this process, we identified several themes of behaviours and routines around one family’s long-term usage of the system. On the positive side, the family was able to gain a valued perspective on their life and be reminded of their past experiences, sometimes in great detail. In some ways, Moments turned into a representation of the family’s life over time and how they lived and grew. However, the design of Moments raised important design questions around how past moments should be made accessible while still creating anticipation; and, how always-on video recording systems can be designed such that they do not create new commitments around their maintenance and ongoing care. This raises important design questions for future research to explore that build on our autobiographical design experiences.

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