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# You are Being Watched: Bystanders' Perspective on the Use of Camera Devices in Public Spaces

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**Abstract**

We are observing an increase in the use of smartphones and wearable devices in public places for streaming and recording video. Yet the use of cameras in these devices can infringe upon the privacy of the people in the surrounding environment by inadvertently capturing them. This paper presents findings from an in-situ exploratory study that investigates bystanders' reactions and feelings towards streaming and recording videos with smartphones and wearable glasses in public spaces. We use the interview results to guide an exploration of design directions for mobile video.

**Author Keywords**

Wearable glasses; privacy; streaming; recording.

**ACM Classification Keywords**

K.4.0 [Computers And Society]: General.

**Introduction**

Imagine you are in a park and playing soccer with your children when someone starts streaming video to a remote person using Skype. You notice that the camera sometimes points towards you and your children who are all now bystanders in the video. How would you react? How would you describe your feelings? How

comfortable would you be? This type of situation has the potential to grow increasingly common in society with the proliferation of mobile devices with embedded cameras. It could easily happen in a variety of public locations. We have also seen new forms of recording hardware that include wearable cameras like Google Glass [13]. Given the potential for privacy intrusion, technologies like Google Glass have received negative press coverage [2].

Previous research shows that mobile video users have a tendency to not think about the privacy of bystanders [10]. Yet past research has focused on the relationship between recording and privacy only and does not cover reactions to streaming videos. Moreover, there is a need for more research into how capturing modes (recording vs. streaming) can affect privacy and how wearable camera devices differ from smartphone camera devices.

In this paper, we present an in situ interview study focused on bystanders' reactions and feelings towards streaming and recording videos with smartphones and wearable glasses in public settings. Our analysis of interview data revealed that participants react differently to wearable cameras like Google Glass and perceive differences between recording and streaming in relation to privacy. This suggests design challenges for future mobile video capturing devices.

### **Related Work**

Researchers have studied how privacy can be preserved in the presence of ubiquitous devices. Early research suggests privacy issues arise from lack of feedback mechanisms [3]: a devices' inability to inform people when they are being captured and saved.

Massimi et al. [7] used the Day Reconstruction Model [6] to interview participants about the recording technologies that they witness in their daily lives and found out that the type of environment (private, public, shared) strongly influenced recording perceptions and expectations. A similar study of people's feelings towards CCTV recording found four dimensions of information privacy concerns: collection, improper access, unauthorized secondary use, and errors [8]. Another study was conducted with in-depth analysis of bystanders' interview data to a camera installation recording a public fountain area [5]. Participants expressed privacy concerns in public and surfaced considerations like physical harm, wellbeing, informed consent and gender. Past studies conducted by Steve Mann [1] and Thad Starner [11] have anecdotally reported their experiences of using wearable cameras in a public spaces and how people responded to them.

Nguyen et al. [9] conducted a study with many parallels to our own to investigate bystander reactions to a wearable camera used as an assistive device for memory or vision impaired users. They reported bystanders' eagerness to know about the system and preference for prior information and consent. Denning et al. [4] conducted a study to analyze bystanders' perspectives on the usage of Augmented Reality glasses. Bystanders' experiences were attributed to the subtleness, ease of recording, and the technology's lack of prevalence. While similar to our study, it only focused on video recording, and did not cover reactions to video streaming (e.g., using Skype in public spaces). We expect that capture mode will affect bystanders in different ways due to the difference in storage and access properties of the capturing modes.



Figure 1: Smartphone setup



Figure 2: Google Glass setup

## Study Methodology

The goal of our study was to learn about bystanders' reactions to video capture in public spaces. Specifically, we wanted to learn if people had privacy concerns and whether or not these differed depending on the mode of capture—recording vs. streaming—and the type of device—smartphone vs. wearable camera.

### Study Setup

Five field sessions were held at our university campus. These sessions were conducted in different areas of the campus over the course of two weeks and ranged in duration from 40-70 minutes each. The field sessions took place at different times of day and on different days of the week, including weekends. During each session, a researcher (Researcher A, male) stood at the corner of a wide hallway using one of two video capturing devices: a smartphone or Google Glass.

1. Smartphone – Researcher A held the smartphone in both hands in a horizontal orientation and pretended to record an open space on campus. He was panning his camera to suggest to passersby that some kind of camera activity was happening (Figure 1).
2. Google Glass – a researcher wore Google Glass while looking towards an open space on campus. He panned his head as if he was recording or streaming a video (Figure 2). He repeatedly tapped on the touchpad of the Glass to show that he was interacting with the device.

In both setups, a second researcher (Researcher B, male) was standing approximately 25 feet away observing the bystander's reactions. After the bystander passed by the first researcher, the second researcher approached the bystander to ask if he or

she was comfortable and willing to participate in a short interview. Our field sessions yielded nine interviews.

### Participants

The participants (M=5; F=4) were mainly undergraduate or graduate students in the age group of 19-25; however, their areas of study varied and included interaction design, film and media, engineering, history, business, and the sciences. Five participants saw the smartphone setup and four participants saw the Google Glass setup. This was based on whichever device was being used by the researcher when the participant passed the hallway.

### Interview

Interviews lasted from 10-17 minutes. The initial questions were dependent on the camera device and setup that the participant saw. For example, we asked: Did you notice that he was using a mobile camera? Do you know if the person captured you in his personal video? Do you think the person was recording a video or streaming video (similar to a Skype call) and why? If any, what concerns do you have about this activity? Next, we asked questions in a speculative manner about the other capture mode that the participant did not actually experience in this setup. The protocol served as a guide for a semi-structured interview; based on the flow of the conversation, we modified or discarded questions.

### Data Collection and Analysis

We collected audio recordings of all interviews and handwritten notes of user behaviors while they were approaching the camera setup. Audio recordings were transcribed and then we performed analysis using open, axial, and selective coding [12]. We then drew

out the similarities and differences between bystanders' answers. For each unique observation, we coded it with a descriptive label. Then we subsequently compared the observations with the coded ones and marked out the recurring similar observations with the best matching code. Observations that did not fit were given a new code. Next, we outline our main findings.

## Findings

### *Initial Behavior*

Our observations of participants showed that they reacted more towards the Smartphone setup as compared to Google Glass because none of them noticed the Google Glass user. In the Smartphone setup, most participants deviated from their normal walking path and avoided looking directly towards the cameraperson (Researcher A). Another noticeable reaction was an increase in their walking pace. In the Google Glass setup, the participants did not notice the user and simply passed by.

### *Capture Mode (Stream v/s Record)*

We asked participants whether they thought they were being recorded or streamed (i.e., a Skype call) in the setup. Everyone in the Smartphone setup thought that Researcher A was recording video. However, in the Google Glass setup, 3 of 4 participants were uncertain about it. They thought Researcher A might be doing something that did not involve the camera. Instead, they thought the person might be surfing the web on Google Glass, for example. In the Smartphone setup, it was relatively easier to identify the capture mode based on the way people interacted with the device.

*"I would think he would not be doing neither of these [recording and streaming], I would hear him talk if he*

*was streaming and recording; I don't think that's likely."*- P1 (22, Male, Mechatronics student, Google Glass setup)

### *Comfort and Acceptability*

Participants said they were more comfortable in the Smartphone setup, while in the Google Glass setup they expressed being more cautious, especially about their personal data and information. This was because they felt it was difficult to identify a Google Glass user and even more difficult to determine if the person was using the camera on it.

*"I don't really care if they are just recording me. This is how I appear in public anyways, if they have a record of me, it does not make a difference to me. In terms of privacy I would be more cautious about my data more."*- P1 (22, Male, Mechatronics student, Google Glass setup)

In the Smartphone setup, their reactions were related to their activities in public spaces and the prevalent use of Smartphones for taking picture and videos. That is, because they were already used to seeing smartphones quite commonly, they were less concerned about what people might be doing on them.

*"I feel everyone is using their mobile camera's everywhere and it doesn't matter to me if they are just taking random pictures or videos."*- P6 (22, Female, Design student, Smartphone setup)

### *Concerns*

Throughout the course of the interviews, we captured the common factors which affected the bystanders' reactions. While some of these concerns have been

surfaced in past research that looked at different types of devices (e.g., CCTV) and setups [4,7], we show that they arise again with smartphones and wearable cameras and they affected both capturing modes. We describe each in turn next.

#### ACTIVITY

First, participants felt that their current activity would determine how acceptable it was to capture them on camera. They expressed more concerns for video recording as compared to streaming in both the Smartphone and Google Glass setup. During recording, they were concerned with activities that were either personal, covert or embarrassing in nature for a public space. As such, they did not want such activities to be captured by others.

When video was being streamed and not recorded, their concerns were limited as they thought the video was not saved on a disk. And it was hard to recognize people in the video as they were captured only for a few seconds. However, two participants were concerned that their activity might be misinterpreted since it would only be partially captured.

*"He won't capture my entire activity when I would be walking by. But I would be concerned if it's not perceived as some other activity."* – P3 (21, Female, Management student, Google Glass setup)

#### PLACE

Second, participants felt that their surrounding plays a major role in whether or not it is acceptable to capture them. Here, again, participants expressed more concerns on recording as compared to streaming. In addition, their concerns were more for Google Glass

due to its design and ability to capture videos in a covert way (e.g., there is no visual feedback on the device showing it is recording/streaming). Most of the participants in the Google Glass setup expressed their concerns on recording in a public area where they might be stationary and be more likely to stay on camera for a longer period of time.

*"In a more private place, like a restaurant having a meal and sitting stationary, I would be very concerned."* - P4 (19, Male, Engineering student, Google Glass setup)

In the Smartphone setup, participants were only concerned with the frequency of recording in any given space. They said that if the camera was constantly pointing towards them, they would be more concerned. Yet if it periodically moved away from them, they would have fewer issues.

*"If it was all the time, I would be upset. Maybe in the [public train] and I do not know them, it would depend on the vibe I get from that guy. I would say it also depends on their physical appearance like creepy looks since I am a woman."*- P5 (25, Female, History student, Smartphone setup)

#### GENDER

Three out of four female participants expressed concerns about the gender of the person using the device. They said they would be more comfortable with a person of the same gender using the camera. This is because they feel safe with a female as compared to a male, and with a male the reason for capturing them may be inappropriate.

*"Yes, it would be a different situation with a woman. I would be more comfortable with a woman as a woman. Since a man could be checking me out or commenting on me. It also depends on the personality of the guy; the way he does the recording, his looks, his intentions of the video are a deciding factor."* - P6 (22, Female, Design student, Smartphone setup)

#### *Prior Permission*

All of the participants said that they would prefer to provide permission prior to being recording. This would make them aware of the camera activity and they would be more cautious about themselves. In recording mode, one of the participants expressed his desire for prior permission, as the video might be saved and distributed without his consent.

*"If he was recording and distributing it, then I would want to know about it. But if he was having a personal conversation (in a Skype call) then I won't mind just walking by."* - P9 (25, Male, Biomedical Psychology Undergraduate student, Smartphone setup)

Participants expressed less desire for prior permission in the case of streamed videos. They thought they would be visible for a few seconds only.

*"Whenever someone is recording you, they should ask for consent. However, if they don't and it's just a one-time thing it doesn't bother me. If it was happening all the time, it would make me feel uncomfortable."* - P5 (25, Female, History undergraduate student, Smartphone setup)

## **Discussion and Conclusions**

Our analysis found that participants described Google Glass capturing as being different from other types of recording due to the subtle design of the camera and the current scarcity of such devices in our location. This suggests that designers should consider adding visual cues for the camera in order to make the camera activity recognizable. Participants expressed concerns over their location and activity when being captured, and their concerns were stronger for recording over streaming in public spaces. They further expressed interest for prior permission before recording them. In practice, gaining such permission would be extremely difficult, especially for all of the people present as potential bystanders. Thus, while people feel they want to give permission, other design considerations may be more appropriate to allow people to be aware that recording or streaming is occurring such that they can appropriate themselves for the given situation. This might involve simple solutions like visual feedback on the device. Another possible solution might be to design interactions for controlling the camera such that they appear unique and are visibly identifiable by others. This would make bystanders aware based on one's interactions with the device that the camera was being used. Other possible design strategies might involve automatically masking out bystanders in videos or designing capture resistant environments to prevent recordings in public space.

While our work is still preliminary and focused on a university space where people were comfortable with cameras, it sheds light on the ways that people think differently about camera recording compared to streaming in public settings. Future work should build on our study by exploring additional capturing setups.



## References

1. Jane Bailey and Ian Kerr. 2007. Seizing control?: The experience capture experiments of Ringley & Mann. *Ethics and Information Technology* 9,2 (September 2007), 129–139. DOI:<http://dx.doi.org/10.1007/s10676-007-9135-5>
2. Karissa Bell. 2014. 72% of Americans Refuse Google Glass Over Privacy Concerns: Report
3. Victoria Bellotti and Abigail Sellen. 1993. Design for privacy in ubiquitous computing environments. In *Proceedings of the third conference on European Conference on Computer-Supported Cooperative Work (ECSCW'93)*, Giorgio de Michelis, Carla Simone, and Kjeld Schmidt (Eds.). Kluwer Academic Publishers, Norwell, MA, USA, 77–92.
4. Tamara Denning, Zakariya Dehlawi, and Tadayoshi Kohno. 2014. In situ with bystanders of augmented reality glasses: perspectives on recording and privacy-mediating technologies. In *ACM Press*, 2377–2386. DOI:<http://dx.doi.org/10.1145/2556288.2557352>
5. Batya Friedman, Peter H. Kahn, Jennifer Hagman, Rachel L. Severson, and Brian Gill. 2009. The Watcher and the Watched: Social Judgments about Privacy in a Public Place. In Steve Harrison, ed. *Media Space 20 + Years of Mediated Life*. London: Springer London, 145–176.
6. Giovanni Iachello, Khai N. Truong, Gregory D. Abowd, Gillian R. Hayes, and Molly Stevens. 2006. Prototyping and sampling experience to evaluate ubiquitous computing privacy in the real world. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '06)*. DOI=<http://dx.doi.org.proxy.lib.sfu.ca/10.1145/1124772.1124923>
7. Michael Massimi, Khai N. Truong, David Dearman, and Gillian R. Hayes. 2010. Understanding Recording Technologies in Everyday Life. *IEEE Pervasive Computing* 9, 3 (July 2010), 64–71. DOI:<http://dx.doi.org/10.1109/MPRV.2009.89>
8. David H. Nguyen, Aurora Bedford, Alexander Gerard Bretana, and Gillian R. Hayes. 2011. Situating the concern for information privacy through an empirical study of responses to video recording. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11)*. ACM, New York, NY, USA, 3207–3216. DOI=<http://dx.doi.org/10.1145/1978942.1979419>
9. David H. Nguyen, Gabriela Marcu, Gillian R. Hayes, Khai N. Truong, James Scott, Marc Langheinrich, and Christof Roduner. 2009. Encountering SenseCam: personal recording technologies in everyday life. In *Proceedings of the 11th international conference on Ubiquitous computing (UbiComp '09)*. ACM, New York, NY, USA, 165–174. DOI=<http://dx.doi.org.proxy.lib.sfu.ca/10.1145/1620545.1620571>
10. Jason Procyk, Carman Neustaedter, Carolyn Pang, Anthony Tang, and Tejinder K. Judge. 2014. Exploring video streaming in public settings: shared geocaching over distance using mobile video chat. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '14)*. ACM, New York, NY, USA, 2163–2172. DOI=<http://dx.doi.org/10.1145/2556288.2557198>
11. Thad Starner and Steve Mann. 1997. Augmented reality through wearable computing. *Presence: Teleoperators & Virtual Environments* 6, 4 (August 1997), 386.
12. Anselm Strauss and Juliet Corbin. 1998. *Basics of Qualitative Research*, 2nd Edition, Sage Publications.
13. [https://en.wikipedia.org/wiki/Google\\_Glass](https://en.wikipedia.org/wiki/Google_Glass)