Eyes and Apps on the Streets: From Surveillance to Sousveillance Using Smartphones

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Abstract

This article explores the concept of surveillance by assessing the nature of data gathered by users of a smartphone-based tool (app) developed in Sweden to assist citizens in reporting incidents in public spaces. This article first illustrates spatial and temporal patterns of records gathered over 9 months in Stockholm County using Geographic Information Systems (GIS) to exemplify the process of sousveillance via app. Then, the experiences of user group members, collected using an app-based survey, are analyzed. Findings show that the incident reporting app is more often used to report an incident and less often to prevent it. Preexistent social networks in neighborhoods are fundamental for widespread adoption of the app, often used as a tool in Neighborhood Watch schemes in high-crime areas. Although the potentialities of using app data are open, these results call for more in-depth evaluations of smartphone data for safety interventions.

Keywords

guardianship, location-based services (LBS), crowdsourced data, crime, safety

Since Jacobs's seminal work, *The Death and Life of Great American Cities* in 1961, we have heard the powerful key concept of "eyes on the street" countless times. Jacobs (1961) wrote that in order for a street to be a safe place, "there must be eyes upon the street, eyes belonging to those we might call the natural proprietors of the street" (p. 35). But the era of smartphones and location-based services (LBS) has changed the way that the individuals interact with a city. Now, "eyes" are complemented by "apps," giving expression to new ways of depicting what happens in public space and perhaps redefining the role of guardians in surveillance. Compared with the traditional eyes on the street, the new exercise of social control invites a number of senses other than sight, such as touch and sound. An incident that happens on the street is still local (attached to a physical place with a pair of coordinates) but can now be seen by faraway eyes, literally by the whole world. Jacobs' sense of "natural proprietors of the street" acquires a different meaning, as those who set a record on the (m)app are not only

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local residents but also visitors or transients, perhaps with no attachment to the area. With networks of smartphone app users, the process of *sousveillance* (Mann, 2004, p. 620), from French for “to watch from below,” seems to be more appropriate than surveillance (“to watch from above”). “*Sousveillance* describes the present state of modern technological societies where anybody may take photos or videos of any person or event, and then diffuse the information freely all over the world” (Ganascia, 2010, p. 489). This article calls for a reconceptualization of the term surveillance in the context of crowdsourced data (as *sousveillance*) gathered by LBS apps.

The aim of this article is to explore the concept of surveillance and related terms by evaluating the nature of the data captured by users of an incident-reporting app,¹ which was developed to support crime-prevention initiatives across Sweden. The aim is achieved by first characterizing this type of crowdsourced data as a result of the processes of *sousveillance* with an LBS app. Nine months of reports (app entries) in Stockholm County are assessed using geographic information systems (GIS) in relation to other indicators of safety and area characteristics. Also, the experiences of app users are analyzed via a survey. Then, by looking at the nature of the app-based data and the characteristics of the app users, we reflect upon some ideas that are taken for granted and traditionally characterize the process of surveillance.

A reason to choose Stockholm, the capital of Sweden, as a case study is the availability of app-based data coming from smartphones (the app is an award-winning, free digital tool) that promote *sousveillance* through an online “Neighborhood Watch” scheme (NWS) and support local emergency services. Moreover, another reason for this choice is the degree of media penetration in the country, which is one of the highest in the world (Fox, 2013). According to The Internet Foundation in Sweden, as many as 77% of the population has a smartphone, 62% uses the Internet on their smartphone on a daily basis, and 57% navigates with help of a GPS in the smartphone. In 2015, over 95% in the 8–55 age-group were using the Internet, and this percentage is increasing within all age groups (Internetstiftelsen i Sverige, 2016).

This article is structured as follows. It first reviews the literature in guardianship and surveillance and indicates how they may be affected by new technological developments, for example, LBS apps. We identify the current knowledge gaps in the international literature and use the Stockholm case study to contribute to filling some of these gaps. Note, however, that the Stockholm study presented here is based on a small sample data set, which means that some of the conclusions are driven by an exploratory analysis of the data rather than by rigorous, confirmatory hypotheses testing. Instead of claiming generality of the results, this analysis provides examples that are illustrative for the field. This article ends with a discussion of relevant topics to be pursued in future research and some of the technical, legal, and ethical challenges that lie ahead when using smartphone data.

Theoretical Background

The Evolution of the Concepts of Surveillance and Guardianship

While the concepts of surveillance and guardianship in city environments appeared in different fields, in particular architecture, sociology, and environmental psychology in the 1960s and 1970s (Barker, 1968; Hollis-Peel, Reynald, van Bavel, Elffers, & Welsh, 2011; Jacobs, 1961; Newman, 1972; Thomlinson, 1969), these notions already existed in planning practice (Lambert, 1993). In general, surveillance can be defined as “the monitoring of behavior and activities for the purpose of influencing and directing them” (Lyon, 2007). It can perhaps be first linked to Jeremy Bentham’s Panopticon—the notion of being under observation from a central point, the “big brother.” However, one of the field’s most known expressions of the concept of surveillance is not associated with a single point of observation but rather with multiple ones. The concept of eyes on the street from Jane Jacobs’s seminal work, *The Death and Life of Great American Cities*, in 1961, highlights that certain

types of environments create the natural opportunity for visual and auditory surveillance. Interestingly, the link between the physical and social environments and the opportunities for surveillance had already long been recognized by Elizabeth Wood in Chicago, since the 1950s. She was one of the first to advocate for the designing of neighborhoods by promoting ideals of natural surveillance and racial and economic integration. Wood urged planners to build small projects (rather than high-rise buildings which was the trend of that era) to include shops, parks, and even pubs to turn housing complexes into real neighborhoods. According to Lambert (1993), Wood argue that a building's height should be limited to the distance that a mother in a window could be heard when calling to a child in a playground below.

This notion has been essential not only for urban planning theory and practices in recent decades but also for the development of environmental criminology itself. The eyes on the street notion was taken up by scholars such as the criminologist C. Ray Jeffery in 1964 as well as the architect Oscar Newman in 1972 in the book *Defensible Space*. For them, eyes—visibility—became a critical element underlying surveillance (Jeffery, 1977; Newman, 1972). In environmental criminology, the notion of surveillance has been implemented in ways that overlap the concepts of “social control in neighborhoods” and “guardianship,” which are both used to reflect the mechanisms behind crime prevention and the creation of safe environments. According to Cohen and Felson (1979), guardianship is a “spatio-temporally specific supervision of people or property by other people which may prevent criminal violations from occurring” (p. 392). Reynald (2010) suggests that a guardian first needs to be available and present, then comes monitoring and supervision, and finally, as the consequence of supervision, crime prevention occurs.

However, not everybody who witnesses or notices an incident, a call for help, or an emergency reacts or takes preventative measures. It was actually a 1960s incident in New York that led scholars to investigate the role of bystanders in emergency situations (Darley & Latane, 1968) and the reasons behind what came to symbolize “urban apathy” in the United States. The iconic case was the murder of Katherine Genovese, a young woman who was stabbed just outside her apartment. What is particular about this case was the fact that more than 30 people had heard the attack and some even saw parts of it, yet none of them attempted to intervene (Rosenthal, 2015). Despite the controversy of whether this was true or not, at the time, this event triggered a discussion about the types of people living in cities, but more importantly, it led to research on intervention and responsibility “if such an event occurs” again.

Although most people want to discourage crime from happening, nobody can be blamed for not intervening. Clarke (1992) indicated the varying degrees of responsibility for discouraging crime to happen while Felson (1995) adapted them, listing four steps of crime discouragement, namely *personal discouragement* exerted by family and friends, *assigned discouragement* exerted by those so employed (e.g., by police officers), *diffuse discouragement* exerted by those employed but not assigned to that specific task (e.g., a shop keeper), and *general discouragement* exerted by unpaid persons lacking a personal tie or occupational responsibility (e.g., anyone witnessing the event). The “level of responsibility affects not only the likelihood that crime will be discouraged but also that such discouragement will occur directly and quickly” (Felson, 1995, p. 57). From the point of view of the offender, guardianship activities must be visible to be an effective deterrent (Hollis-Peel et al., 2011).

Beyond intervention by “duty,” recent research shows that there are several factors, some situational, affecting people's decision to intervene (Reynald, 2011a, 2011b). Increased social interaction in neighborhoods has long been associated with willingness to intervene, as has been the relative stability of the community and the neighborhood's collective efficacy (Hackler, Ho, & Urquhart-Ross, 1973–1974; Sampson, Morenoff, & Felton, 1999; Sampson, Raudenbush, & Earls, 1997). Reynald (2011b) showed the importance of neighborhood conditions in facilitating surveillance and individual intervention to prevent crime. This author found, for instance, that individuals in low-crime neighborhoods are considerably more willing to supervise and to stop a crime if needed than

elsewhere in the city. Also, individuals in low-income neighborhoods are the least willing to supervise their surroundings, while individuals in high-income neighborhoods are the most willing. Findings also indicate that most individuals who were unwilling to supervise their surroundings or intervene came from neighborhoods with a high percentage of ethnic minorities. Yet, even if individuals do not intervene, their presence might make a difference (Cook & Reynald, 2016). Recent research confirms the importance of the presence of a potential guardian for reducing the risk of crime or at least disrupting and reducing its severity (Leclerc, Smallbone, & Wortley, 2015).

Despite the rapid advancement of Information Communication Technology, little is documented in the international literature about the impact that new technologies may have on the processes of surveillance and guardianship. Therefore, we identify some of knowledge gaps in this area and offer our case study (on LBS apps) as a way to contribute to filling some of those important gaps in the literature.

Surveillance and Guardianship in the Era of Apps: Gaps in Knowledge

The first gap refers to the way scholars currently conceptualize surveillance and guardianship. Note that, so far, the way researchers conceptualize these concepts has been in line with how it has been conceptualized elsewhere (e.g., Felson, 1995; Hollis-Peel et al., 2011; Reynald, 2010). But this definition—it is argued here—is insufficient to account for the new practices of social control with new technologies. The original ideas of surveillance and guardianship are based on one-to-one action; for example, a bystander would just by his or her presence prevent an incident from occurring. Instead of one person, surveillance can also be carried out remotely via closed-circuit television (CCTV) assisting police patrols (even though they turned out to be innocuous to prevent crime, see Gerell, 2016, or to solve crime cases; Ashby, 2017). However, with networks of smartphone app users, the process might look more like a process of *sousveillance* instead of surveillance. The term *sousveillance*, coined by Mann (2004, p. 620), refers “both to hierarchical *sousveillance*, e.g. citizens photographing police, shoppers photographing shopkeepers, as well as personal *sousveillance*, bringing cameras from the lamp posts and ceilings, down to eye-level, for human-centered recording of personal experience.”

The second gap in knowledge refers to the way this new technology challenges the traditional, static, assigned roles of individuals to a particular event—as criminals, targets, or guardians. When people are involved in an event (a crime) captured by an app, it is not always easy to remotely assign the exact roles of those involved and act upon it. Should individuals act as guardians in case of an emergency call that was recorded by someone else miles away from the event? The literature in this area shows that evaluations of guardianship-related interventions with high-quality field tests of guardianship are wholly lacking even in a more traditional guardianship setup (see, e.g., Hollis-Peel et al., 2011, for reference). This issue leads us to unsolved problems of responsibility and accountability.

The third gap is about individual integrity, and it is linked to the previous gap in knowledge. In the case that apps utilize LBS, they are applications integrating general services with a particular geographic location, such as *x, y* coordinates (Schiller, 2004). This geographical location is a benefit to users but may also generate concerns of individual integrity—especially regarding a crime scene.

Fourth, it is also suggested here that traditional principles of guardianship become problematic when surveillance is linked to nonphysical (remote) intervention and responsibilities, which are attached to information attained remotely via smartphones. As with any other technological innovation, its diffusion and use depend on the purchase of the technology; all segments of society cannot attain it, at least not initially. Critics of crowdsourced data suggest that the technology creates information bias between those who have access (to these apps and the information that is shared) and those who do not (i.e., data samples may be completely self-selected). Research on crowdsourced data has highlighted the problems of “participation inequality” (Nielsen, 2006) and

Table 1. Reconceptualization of Surveillance: From “Eyes on the Streets” to “Apps on the Streets.”

Characteristics	Eyes on the Streets	Apps on the Streets
1. Basic requirements or action	Presence and availability lead to potential action (e.g., intervention)—the person that records the event is the one who takes action(s)	An event can be registered by one individual in the app, but action(s) can be performed by individuals not present at the place and moment of the event (e.g., requesting an ambulance after detecting a call for help in the app)
2. Type of activity	Surveillance	Sousveillance
3. Level of responsibility	Personal/assigned	Diffuse/general
4. Senses	Mostly visual, real-time—ambient environment	Visual, auditory (also touch) remote, it can be retrospective—virtual environment
5. Status of action (engagement/neglect)	Immediate and known by the group	Not known by the group
6. Scale	Uniscale (local-to-local)	Multiscale (local, global, global-to-local) Information is added and spread remotely
7. Common environment	“Context dependent,” microenvironments, for example, windows, facade	Meso—macro context, street, neighborhood but also “context irrelevant”
8. Type of social interaction	More dependent on local social ties	Less dependent on local social ties
9. Access to “the event”	Time-specific	Priori and posteriori
10. Participation	Imposed by presence, location	Voluntary, at individual and group level

inaccuracy of information (Marjanovic, Fry, & Chataway, 2012). Others have looked at the use of apps to assess issues of penetration rates and participation inequality, which is particularly important when apps are used as tools in crime prevention (but see, e.g., Taniguchi & Gill, 2018).

We now turn our analysis to reflect upon some of the ideas that characterize the process of surveillance in the traditional sense, by looking at them in relation to the nature of smartphone app data. We call for a reconceptualization of the term *surveillance* in the context of crowdsourced data gathered by LBS apps.

From Eyes to Apps on the Streets: Sousveillance in the Making

Jane Jacob’s traditional notion of eyes on the streets as a measure of social control is left behind with the use of apps when we no longer need to look through the window to know what is happening. Although we still need someone reporting the event (a witness to create the App entry), the local context becomes less important, when crowdsourced data gathered by smartphones can deliver and disseminate the information that once was limited by those who were in place at the time of the event. Table 1 compares the differences in surveillance from eyes to apps, or sousveillance. Traditionally, it is crucial that an individual is physically present and available at a particular place for intervention to happen (Reynald, 2010). When using an app, this condition remains for one witness only, the one that reports the event. For all other app users, they may “witness” an incident in the map or as an emergency call in the smartphone. In such cases, the incident is witnessed secondhand,

outside the incident environment (see Table 1, Items 1 and 2). Note that it is this dissemination/secondhand witnessing that it is new, an additional layer on top of the traditional conceptualization.

There is a temporal dimension that is relevant to be discussed when using apps (Table 1, Item 9). With an app, there is always a flexible time window so that one can look back in time at previous entries and even use the information to help forecast the future (new crime events). With traditional exercise of social control, surveillance is time-specific; one is there when the event happens, which cannot be easily planned in advance, it is a spontaneous act. Traditionally, the police-recorded data might be retrievable (databases, Internet), but rarely these records report the intervention process, as it is done using apps.

There is also a spatial dimension that is important to be noticed. Surveillance and intervention take different meanings when they become less dependent on the spatial scale (Table 1, Items 6 and 7). Traditionally, the scale was *local-to-local*; an event happens on the “street,” and help and intervention would take place at that scale. The emergency services and transients would gather around the victim. By using an incident-reporting app such as this, we are simultaneously informed of what happens both in a neighborhood in Stockholm and in a neighborhood miles away, for instance, in Pajala (North Sweden) and both of which we can potentially act upon to try to help (for instance, by calling local emergency services if the victim cannot) or calling someone locally to help when ambulances are busy or taking too long to arrive, typically in remote areas. This means that, at least in theory, intervention can be multiscaled and triggered by information diffusion that has no geographical boundaries (e.g., local-to-global). Those who intervene by distance could be called “second and third order controllers,” for instance, those who are already working voluntary in emergency-related services (e.g., missing people). Their role is enhanced by technology, easy access to information, data preservation, and information sharing over time. Despite the fact that still someone needs to show up in a particular place, the new, enhanced aspect of this interaction process is that it is interlinked in space and time.

This aforementioned space-detached information imposes restrictions to our actions as controllers. It can be informative, but, in practice, we cannot transfer ourselves instantaneously from Stockholm to Pajala to help someone in distress. Moreover, there is a need for further reflection upon how one can link individual actions to levels of responsibility when one only has information from a smartphone indicating that a crime is happening somewhere. Obviously, questions of “being in charge” and accountability are more diffuse in virtual user networks promoted through apps than in “real life.” This issue is not new, and it is similar to, although not the same as, issues of responsibility and guardianship in cyber contexts (Reyns, Henson, Fisher, Fox, & Nobles, 2016). In the case of apps such as the one in this study, there are indications that they may just be a “digital expression” of the “traditional” NWS (Table 1, Items 3 and 5).

In terms of the participation process (Table 1, Item 10), the voluntary character of remote sousveillance using the app means that the sense of obligation that someone has to act becomes more relaxed than in real life. Yet, as we noticed by the iconic case of Katherine Genovese, this is not an exclusive quality of app sousveillance, but with apps (and not eyes or ears), one can more easily be away from the device. One can be active one moment and switched off a second later, relying on “someone else in the group” to be active and take on the responsibility of acting, if something happens. Also, the status of surveillance in the traditional sense is immediately known (whether one is active or not), as the person is present and seen by the others who are present, while in a virtual surveillance scheme (sousveillance), the status of each member (latent, inactive, or active) may not always be visible and known by the group.

This is also what occurs when eyes through the window give place to cameras in the smartphones. The new exercise of social control demands a number of senses other than sight, such as touch (the screen) and hearing (a voice message on the phone; Table 1, Item 4). The use of a smartphone app as a tool for sousveillance also requires a technological proficiency and virtual social interaction in the group (Table 1, Item 8) that may be exclusionary (e.g., older individuals, people with hearing or sight impairment) but surely facilitates the participation of other groups (e.g., the tech-able people or

individuals that are interested in safety and security issues) and information sharing through other media. It is expected that the process may be less dependent on local social cohesion in a traditional sense since it can be multiscaled, as previously discussed.

Although this study is exploratory in nature due to the small sample size, our intention is to contribute to filling some of the previous described gaps in knowledge, in particular, by exploring the spatial nature of the app data as well as by characterizing its users. We start by describing data and methods used in this study.

Data and Methods

The app and the study area. We first briefly explain how the incident-reporting, smartphone app works and the types of data sourced by it. Launched in March 2015, the free-of-charge app is intended to support crime prevention and provide tools for emergency calls by utilizing individuals' networks of acquaintances and friends to help deter criminal activity and enhance safety. Smartphone users can use the app to coordinate action when emergency services are not available or before they arrive on scene. The app is currently available for iOS (iPhones and iPads) and Android devices, while a scaled-down version is available online; this version is mobile friendly for Windows and Blackberry phones. Menus are available in both Swedish and English. The app covers the whole of Sweden, but most users are concentrated in Stockholm region.

The app has two data sources: (a) "traditional" incident data such as police and emergency services data that can be retrieved by the app (and its users) in real time and (b) user-generated data, that is, "events" that app users themselves input. The data from the police appear on the screen with a description of the crime type, location, and time of occurrence (as registered by the police officers). When a user wants to create an event, one can choose the event location, type, urgency, and degree of visibility (from public to private groups), as well as add images. The app also allows users to receive and share events directly via a map or through group chats; events can also be shared via social media (Figure 1). Users can also become part of one or more virtual "groups," for example, NWS. As of April 2016, there were 20,000 users participating in 677 open groups (anyone with the app can take part), 1,092 closed groups ("searchable" but group admission has to be approved by the group leader), and 313 private groups ("hidden" and group admission has to be approved).

The user-generated data are the main interest in this study, as the entries or events (incidents) are classified automatically in the app as acts of surveillance, monitoring, guardianship, and warning, which in many cases, lead to real-life action/interventions outside the app. The location information (X , Y coordinates) provided with the report is the location where the individual making the report encountered the incident, and the submission time of the report approximately reflects the time the incident was detected. In this article, we analyze 5,210 entries from open groups gathered over 9 months (July 2015–March 2016). According to a preclassification by the app itself, more than half of the entries were created to report a crime, followed by actions that indicate communication in crime prevention (i.e., some type of communication for entries other than crime reports) and, in a minority of cases, an emergency call. For our specific area-based analysis, only Stockholm municipality was used due to data limitations—the data entries were sparse outside the Stockholm area, and no sociodemographic data at the small unit level were available so as to include a larger area or the whole of Sweden.

Mapping app data. Using GIS, the app entries were geocoded and added as attributes to the smallest units of analysis in Sweden—"base areas" or *Basområden*—for all of Stockholm municipality ($N = 408$ units) from Stockholm municipality (2013). Note that these geographical units vary in shape, size, and total population (a mean population of 1,975 inhabitants with a standard deviation of

Figure 1. App functions and data collection and sharing.

1,861). This database also contains a selection of data on population characteristics (e.g., demographics, socioeconomic conditions, housing tenancy) as well as crime data from Stockholm police headquarters (2013) and perceived safety (percentage of people who declared feeling unsafe in their neighborhood) from the 2011 Stockholm safety survey (City of Stockholm, 2011). Since the data only cover 9 months, we decided against modeling the data and applying confirmatory analysis. However, some basic descriptive statistics were performed between different data sets of data, such as correlations between the app data and fear of crime.

Each entry from the app was linked to the base areas (*Basområden*) and split by the type of neighborhood using GIS. App data by neighborhood were classified by average of particular variable (e.g., by income). Since observations were not covering homogeneously all base areas, the data were manually split in GIS into two groups: upper levels of the values in the sample (which means 1 standard deviation above the mean) and the rest of the values. Data entries from the app were then compared between these two types of base areas, namely high-income areas and the rest of the city (by calculating the average number of entries per area). Similar procedures were performed for the share of ethnic minorities, type of housing tenancy, police crime records, and declared fear of crime from Stockholm survey.

Surveying app users. Via the app itself, a user survey was also applied to “open group” users with the intention to better understand the process of surveillance and actions using the app functions. It was also thought that the survey responses could be used to improve the app; the survey questions are available on request. A total of 72 responses were gathered over 2 weeks. This is a limited sample collected over a short period of time, and any conclusion drawn from this sample has to be made with caution.

Here follows a description of the profile of the respondents of the survey. Note that it is difficult to have a precise measure of the overall profile of the app users since some are no longer active and some are anonymous with very little information attached to the particular individual. But, according to the producers of the app, the profile of those who answered the survey somewhat matches the overall profile of the app users. As much as 61% were male, 11% had been victims of crime in the past 12 months, 13% worked for emergency services, 13% feel unsafe in their neighborhood, and 52% declared that they feel uneasy having their identity visible in the app.

Additionally, the author of this article has used the app to take part in a selected number of closed user groups, mostly in NWS across the area of study. The intention of participating has been to get an idea of the conversations carried out within these groups, and the authors’ impressions have also been used as background information in the analysis of the data.

Results

We first discuss the nature and the geography of the app data and then the characterization of app users.

The Nature and the Geography of the App Data

Most events are reported during the day, regardless of where the entry is recorded in the city. There were expectations that inner-city entries would tend to take place during the evening and night, but this was not the case. The app is mostly used in residential areas and it is very common for users to be a member of a local NWS. Of the 5,210 entries, slightly more than 60% are to report a crime, more commonly, burglary (26.7%) and robbery (17.8%). More than one third of the entries can be classified as crime-preventive actions, mostly composed of information related to potential risk as situational conditions have changed in certain areas or warnings such as a suspicious person or car in the neighborhood (Figure 2). Note that we assume that the time when the user makes the report is the time at which they witness the event, as the time data are generated by the app when making the report. However, it is possible that the user notices the event at a certain time but reports it later, which would create an unknown time lag.

As observed in Figure 3, overall, the geography of the app data does not match the police-recorded data or patterns of fear of crime in neighborhoods. However, in some areas, there were some indications of links between low fear of crime and relatively low numbers of app entries.

An alternative approach is to look at the degree of communication of incident activity (number of entries) by area. The greater the number of entries, the higher the communication, indicating more incident activity. Clearer patterns emerge when app data are geographically compared with income, ethnic composition, neighborhood crime, and declared fear of crime (Figure 4a–d). Traditionally, users in high-income areas are considerably more willing to actively use the app and surveil than elsewhere in the city (Figure 4a). Yet our findings indicate that there is also a relatively high number of users coming from areas with a higher share of ethnic minorities (Figure 4b). In addition, when it comes to crime, individuals in areas with higher levels of crime used the app more often to supervise their surroundings than those in other parts of the city (Figure 4c). These are unexpected findings since a higher share of ethnic minorities, especially in high-crime areas, tend to mean lower

Figure 2. The nature of app publicly input data. $N = 5,210$ entries.

Figure 3. Crime, fear of crime, and app data in Stockholm.

participation rates in participatory schemes (Hirschfield & Bowers, 1997). However, according to Gerell's (2017) recent research findings from the Swedish city of Malmö, levels of collective efficacy (i.e., where neighbors are willing to intervene to prevent disorder or crime) can be high in neighborhoods with high percentages of ethnic minorities. Another potential explanation for our finding is the fact that these areas with high app penetration have been pretargeted by the municipality, where the app is only one part of an overall set of crime-prevention measures. Of the four comparisons, the only exception was for fear of crime—there was virtually no difference between reporting (app entries) in areas characterized by high fear of crime and the rest of the city (Figure 4d). One of the reasons for this mismatch can be that inner-city areas have a higher share of individuals feeling fearful, while entries from the

Figure 4. Average number of app entries per type of “base area” (*Basområde*; the smallest statistical units of analysis in Sweden) in Stockholm municipality, 2015–2016.

inner-city area are relatively sparse when compared with those in the outskirts, where relatively more entries are recorded per base area.

Characterizing Users of App

Nearly 80% of the respondents declare using the app to share information with friends and neighbors, especially within an NWS (newly created NWS or completing an existent one), and to a lesser extent, with the police, safety walking groups, and the municipality.² By far, most surveyed users declare using the app to inform other users that they are witnessing suspicious behavior, such as someone “casing the area” before committing a crime (87%). The next most common usage is for warning other users about a crime, when the user was also the victim (71%), as well as warnings of seeing a suspicious person/car in the base area (71%). The other remaining entries are about communicating the fact that the user is witnessing a crime or accident, about finding or losing something, or even seeing the police in action. Note that nearly all these remaining entries are attempts to warn other users (Figure 5).

Most respondents (87%) are ready to help in case of an emergency call from the app, when a security alarm from another group member is activated (an indicator of an accident, crime, or other problem). Nearly the same percentage of respondents (86%) notes that if they are notified that someone is committing a crime against family members or neighbors, they would immediately act when informed through the app. Similar numbers are found not only for a number of other types of

Figure 5. For what reason do people use the app? Answers from app users.

calls for help from the app, such as a fire alarm, but also for events that happen near the respondent. Note, however, that around 10% of the respondents indicate that they would most certainly *not* act upon the emergency call, although the reasons for refraining remain unknown. The fact that people might not be present at or near the incident (or even that they do not want to potentially be the only person that responds to the incident) might help explain why people would choose not to respond to a call for help from the app.

Among those who reported what they witnessed, we found several cases in which someone else outside the app group was informed first (e.g., police) as the crime occurred, while the “owner” (e.g., a property crime) was informed at a later stage, often because the owner is unknown or not present at the moment. In other words, with the use of apps, the sense of responsibility does not follow a clear hierarchical pattern (see, for instance, Felson, 1995), as it might have in a traditional guardianship model. This finding was expected since these incidents generally occur in residential neighborhoods and/or public spaces that often lack assigned and/or diffuse controllers that would intervene with (or without) the existence of the app. In this case, *sousveillance* through apps also enables *opportunistic controllers*, among others, to act and register the event. In this context, *opportunistic controllers* are those with little attachment to the area (e.g., do not reside or work there) who witness an incident while in transit and feel they can afford to stop and take the time to use the smartphone/app to record the incident and/or call the police (cf. Felson, 1995). See an example below:

13:35 Östermalm, Theft. The witness called the police and said that he saw a man stealing a bike as he was passing by Humlegårds Street. The witness followed the offender up to Birger Jarls Street and when the offender left the bicycle on the street, the witness took the bicycle back to where it came from . . .

We also wished to understand why and when users used specific app functions. From the survey, most respondents add a comment to an incident in the app (e.g., a person uses the comment function to link an event with a previous crime in the area) when they feel they can help solve a problem or deal with a situation (87%) or when they want to give positive feedback to someone or highlight an issue that needs to be discussed with the group (75%). Some add comments even when there is no

emergency or crime happening. Note that 68% of the respondents add a comment when they do not agree with other people's opinions (e.g., when they want to make a point about someone being rude or making inappropriate comments), especially in cases of views that are not shared by the group members such as racist and derogatory comments.

Discussion

This article sets out to explore the new nature of surveillance (*sousveillance*) via a new tool, namely an LBS app on a smartphone. The analysis first compared the nature of the app's user-reported event records with other indicators of safety and area characteristics. Then, using information from a survey of the app's users, the study characterized the types of *sousveillance* activities performed with the help of the app and how they compare with the traditional exercise of surveillance.

Our exploratory findings indicate that the exercise of social control via apps does not follow a random pattern. The app is often used to report a crime, mostly in residential areas (as opposed to inner-city areas), often stemming from preexistent NWS as opposite to new virtual ones as it was initially expected (see Table 1). These findings indicate that *sousveillance* with an app is still dependent on local social ties. These findings are corroborated by the geography of use of the app by crime and income levels in Stockholm. Contrary to what was initially expected (Table 1), the local context continues to be relevant in this exercise of *sousveillance*. While Reynald (2010) in Holland found in a traditional guardianship setup, the use of the app in Stockholm has been relatively greater in high-crime areas than elsewhere in the city, partially because in these areas, there are relatively larger numbers of public and private initiatives devoted to reduce crime, making individuals more aware of the surveillance tools available. Reynald's findings are corroborated at least partially in Stockholm when we look at the geography of app entries by income in the base areas—this is, however, an issue worth to be further studied in future research.

The issue of inequality of participation in the generation of crowdsourced data is not unique for Stockholm case. Data from a survey of app users can rarely represent the actual population of those using the tool, or the population residing and working in these areas (for details, see Nielsen, 2006). A note of caution is also advised by Taniguchi and Gill (2018) who demonstrated the difficulties of using a smartphone-based crime mapping technology (app) and why it is not easy to make people adopt the tool. In the European context, Charitou, Kogias, Polyakas, Patrikakis, and Cotoi (2018) indicate other issues that can arise when using mobile applications for crime reporting, including data handling, privacy, and compliance with national and European legal frameworks, including the General Data Protection Regulation.

In terms of the profile of the users, the data show that most people are ready to help, yet note again that 10% of the respondents (app users) declared that they would not act upon an emergency call from an app. As the iconic case of Katherine Genovese indicated more than 50 years ago, although most people would intervene, not everybody can be considered responsible for not intervening, which affects a person's decision to get involved or not. Surely, some people will prefer not to get involved and since their status is not visible in the app, they cannot be held accountable. As suggested in Table 1, the degree of participation becomes more voluntary than it is in a traditional setting since the individual who gets the emergency call might not be present at the moment of the event (responsibility is diffuse). It would have been useful to obtain a real-time measure of virtual network "strength" in the app such as the percentage of active members in an area, and if it was low, one could get push alerts to become active if one was inactive or latent. Issues not only of the veracity of the call (which can be impossible to know remotely) but also of distance to the victim (physical or emotional) might play a role in people's decision to answer an emergency call.

Taken together, our results provide evidence to support the importance of local neighborhood context in facilitating *sousveillance* via apps, but further research is needed. In particular, the roles of

opportunistic controllers (those with little attachment to the area who can afford to stop and take the time to use the smartphone/app to record the incident and/or call the police) and *second- and third-order controllers* (secondhand witnesses) are worth to be further investigated in the sousveillance context.

Limitations of the Study and Future Research

This article shares the limitations with other analyses of this kind. One example is that the study is based on a small sample data set (in-depth analysis of Stockholm municipality), which means that some of the conclusions are driven by an exploratory analysis of the data. Data permitting a more rigorous set analyses would be more appropriate in the future based on correlations between data at the level of the smallest unit of analysis, rather than aggregate into two groups as shown in Figure 4. Future research should be more theoretically driven than what has been done in this article, based on in-depth analysis of reports by crime type and times of the day but also a thorough analysis of the activity process of sousveillance. In particular, the role of physical bystanders in emergencies would be important to be further investigated. This should also include a qualitative assessment of the nature of people's behavior and their promptness to help (or not) in case of an emergency.

Another issue, studies in the future should go beyond analysis based on average numbers of entries per area, as was done in this study. A deeper, perhaps qualitative analysis of the content of conversations via the app would certainly help to understand in greater detail the quality of support provided by these apps. As of now, there is little analysis done on individuals attempting to intervene when remotely located from the incident or crime. Also, we need to know how the app entries differ from police reports (official statistics) and the reports shared through mechanisms other than first-hand observations, such as discussions between neighbors, television/news coverage, newspaper, and other printed media reports.

Future research is needed to gather evidence that people actually attempt to intervene when located remotely from the incident. This can be informative for emergency services, but overall, there is a need to assess how this information is used by users three-dimensionally (at crime scene, at different times, remotely and locally, and how these scales relate to each other).

Impact on Research and Practice

The use of digital tools in smartphones opens up new opportunities for research and practice. With today's capabilities of recording images and sounds, there comes a need to create "filters" to locate "interesting regions" in a scene (Chi, Cheng, Chuang-Wen, & Chen, 2016) that can later be explored as crime evidence or for potential use in multimedia applications. Furthermore, the diffusion of CCTV (surveillance) and cameras in smartphones (sousveillance) is generating a vast amount of image information that should be better explored in, for instance, policing and crime control, urban planning, or public health (Ashby, 2017; Ceccato, Nyberg, Vrotsou, & Wiebe, 2018; Cerezo, 2013; Gerell, 2016; Ratcliffe, Taniguchi, & Taylor, 2009; Reid & Andresen, 2014; Taylor, 2010; Welsh & Farrington, 2009; Zelniker, Gong, & Xiang, 2008).

Smartphones, along with other wireless gadgets, are also set to become powerful new tools for detecting lawbreakers both in outdoor and in indoors. Fleming (2011, p. 42) suggests that these new ways of surveillance and sousveillance may create the "public and governments" eyes and ears in a thousand places at once, creating what amounts to a 21st-century Neighborhood Watch. In this particular case, it is important to further assess the ethics of data use and sharing. Data privacy is put at stake when an individual with an app posts pictures of someone's burglarized house, revealing details of property location and time of the event, without the owners' knowledge and consent. The sensitive nature of revealing people's movement patterns over space and time can be problematic, but also depicting events without proper detailed knowledge of the circumstances of each case

(Mallén, 2016). This can happen by (in)voluntarily posting inaccurate or false information, or more seriously, assigning criminal behavior to innocent individuals.

Finally, an assessment of the main obstacles ahead—technological, legal, institutional, ethical, and cultural—that limits the use of apps/smartphones for planning purposes is fundamental. Issues of data privacy, responsibility of actions (e.g., intervening) and accountability—to name just a few—are unlikely to be resolved in the short term but should be addressed before data of this kind is used as evidence or for safety interventions.

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Notes

1. This app is produced by United Eyes AB, <https://www.safe.land/gb/home/>. This app is operational in smartphones, a mobile phone with an advanced mobile operating system, which combines features of a personal computer operating system with other features useful for mobile or handheld use (Andrew, 2009). There are other apps on the Swedish market, see also <http://coyards.se/>
2. There is no information about how much of these records become police statistics, neither are there standardized details by crime type, such as age of victim.

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