

In the Best Families: Tracking and Relationships

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ABSTRACT

A growing body of research has been exploring the use of control mechanisms to address the privacy concerns raised by location-tracking technology. We report on a qualitative study of two family groups who used a custom-built tracking application for an extended period of time. Akin to sociological breaching experiments, the study focuses on the interferences between location tracking and relationship management. We analyze the tensions that can arise between affordances of the technology and uses that the *contracts* between family members legitimize. We describe how, by fostering misperceptions and ‘nudging’ behaviors, location-tracking technology can generate anxieties and conflicts even in close relationships. We discuss their vulnerability to the overreaching effects of tracking, against which the use of mechanisms such as location-sharing preferences and feedback may not be socially viable.

Author Keywords

Location-based technology, location tracking, family contract, family relationships, privacy

ACM Classification Keywords

J.4 Social and Behavioral Sciences: sociology; K.4.1: Public Policy Issues: privacy; I.4.8: Tracking

General Terms

Experimentation, human factors

INTRODUCTION

In recent years an increasing number of location-based applications and services have become available and have been introduced into a variety of social contexts. Concomitantly, the use of location tracking has been the focus of much investigation within mobile HCI research, especially with regards to the potential implications for sensitive aspects of people’s lives. Many studies have sought to identify and address the privacy concerns raised by the use of location-tracking technology, mainly looking

at how it is used within loose social networks. There has been little research investigating how location-tracking technology impacts upon social relationships and dynamics within more tight-knit groups, such as families.

Our work is concerned with how location-tracking technology can affect close relationships, in particular within families. What constitutes a family is debatable (see [15]); here, we refer to a nuclear unit including a father, a mother and their children, and to an extended unit also including other relatives, such as grandparents or children’s partners. Such units are characterized by social dependencies, spanning from economical co-operation to emotional attachment, and complex social dynamics that modulate those dependencies. The way in which location-tracking technology can interfere with family dynamics has been explored between particular household members [4]. We are interested in exploring the effect of this technology on the relationships between all members of the nuclear family and others who may join it at some point. In particular, our focus is on how location-tracking technology can impact upon the way family members negotiate the mutual accountabilities that explicitly or implicitly define their relations; what it means to be a family and the trade-offs that being a family involves.

To investigate how different individuals and relationships can be affected we conducted a qualitative user study of a network of participants from two sizeable family groups. They comprised a close nucleus including mother, father and children together with partners and friends who had become more closely part of the family unit. The families used a custom-built location-sharing application that was installed on their mobile phones for a period of three weeks. The application provided high frequency automatic location updates using both textual and visual information. An experience sampling method was used to elicit the participants’ reactions during the study, together with extensive face-to-face individual interviews at the end.

The contribution of our work is twofold. First, we provide an in-depth analysis of the dialectic interplay between the use of tracking technology and the social roles, norms and practices in a close family group. Second, we show how the introduction of location-tracking technology into what might be considered ‘safe’ environments can generate tensions between the features of the technology and the

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CHI 2011, May 7–12, 2011, Vancouver, BC, Canada.

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behaviors relationships may legitimize. Our study shows how such technology can support the fulfillment of *family contracts* but also trigger detrimental anxieties and inner conflicts. Finally, we discuss how close family members may feel it is legitimate to keep a close eye on one another, while feeling reluctant to assert boundaries. This can make them particularly vulnerable to the effects of pervasive tracking practices, against which control mechanisms such as location-sharing preferences and feedback, may not be socially viable.

BACKGROUND

Tracking

Tracking is hard-wired in us. Its exercise was once essential to our survival and we still practice it for various purposes, such as conservation, eco-tourism, hunting, military operations, espionage, etc. In the physical world, this is a hazardous enterprise, in which exposure may have serious consequences. It is also a complex biosemiotic activity [6], which requires the skillful recognition of visual, auditory, olfactory and tactile signs left behind by a living target. It is an intrinsically voyeuristic activity, as the tracker eventually sets eyes on and contemplates the object of his quest, if only for the brief empowering moments that precede a strike. Those close moments can be so gratifying that they may be all a tracker seeks, when from the safety of his vantage point he ‘captures’ the motions of another’s life, coming closer to the reality of their identity.

As a voyeuristic act, tracking objectifies the person who is being tracked, therefore placing itself outside any social interaction. However, the practice of tracking still takes place within a network of social relationships and its significance is determined with respect to the *contracts* defining those relationships. By this term we refer to the unique combination of social rules, norms and practices determining the set of explicit or implicit *expectations* that define the relationship between two *individuals* in a wider *social context*. These are informed by each individual’s set of values and beliefs, and regard their own obligations, responsibilities, rights and inclinations towards others, as well as the others’ obligations, responsibilities, rights and inclinations towards them. Moreover, these expectations determine the way in which individuals manage their own social boundaries and observe the social boundaries of others (see [16,8]).

Schoeman [17] argues that we are inherently “*social beings whose stake lies in life with others*” not as a mean to other ends, but as an *end to itself*. It is in relation to our dependence on others that privacy can be understood. For Schoeman, privacy affords us social freedom, not by granting us autonomy from society, but by allowing us to participate in a variety of associations, within which we can find safe spaces for self-expression. By restricting access to the ones outside those spaces, privacy enables us to relate in meaningful ways to the ones inside. In other words, privacy

is deeply socially embedded and so too is privacy violation, which, therefore, is not without social consequences. Tracking is intrinsically prone to violating privacy, as it can easily bypass the system of boundaries set up within family contracts to modulate and maintain relationships, exposing them to undesirable states. Provided tracking remains a resource intensive and hazardous enterprise, it is only viable in response to significant demands or in prediction of significant benefits, but what happens when tracking another can be safely done at the click of a button?

Location-aware research

The impact of location-aware technology on people’s privacy has been studied extensively. Some of these studies have used hypothetical scenarios to explore people’s location-privacy attitudes (see, [1,2,7,13,24]), identifying a number of determining factors, for example, one’s relationship with the person requesting their location [7,13] or their immediate context at the time of the request [1]. Other field studies have looked at the use of mechanisms such as feedback or location-sharing preferences to regulate access [10,22]. Generally, there has been a tendency to focus more on the point of view of the person being tracked, not taking into account that tracking and being tracked constitute the reversible roles of the same phenomenon and that both roles need to be studied dialectically to understand how tracking really affects people. Moreover, there tends to be a presumption that participants are fundamentally in control, as they are allowed to share their location with others actively and selectively by accepting or declining location-disclosure requests or by setting up ad hoc location-sharing policies. However, members of close relationships may not feel at liberty to take such a pragmatic approach to boundary management.

Another body of research, investigating the use of location-tracking technology in the wild, includes studies that are characterized by the reciprocity between trackers and tracked: participants play both roles or both the point of view of the tracker and the tracked are taken into account. For example, Troshynski *et al.* [21] and Shklovski *et al.* [19] have studied the effects that the use of tracking devices respectively have on parolees and parole officers in Californian prisons. The authors found that not only the lives of the parolees, as one would expect, but also the lives and roles of the parole officers were profoundly affected, as they spent increasing amounts of time interacting with and reacting to the technology instead of interacting with the parolees. Others, however, found that the use of location-aware technology can foster a sense of connectedness and serve co-ordination functions in cohesive groups. For example, a study by Barkhuus *et al.* [3] looked at how the use of the status and location-sharing application Connecto afforded small groups of friends both practical and psychological advantages by allowing them to share a combination of location and profile abstraction. Similarly,

Brown *et al.* [5]’s Whereabouts Clock allowed families to co-ordinate their activities while fostering a sense of reassurance, connectedness and belonging. Boesen *et al.* [4] also found that location-tracking applications could be used for benign purposes such as ensuring or reassuring oneself about the safety of family members. However, the authors also found other ambiguous and questionable uses, such as curiosity, bordering on voyeurism, and even surveillance. They note how the surveillance afforded by tracking technology has the potential of undermining the very trust work that is necessary to maintain domestic relationships.

Much research has suggested that the relationship between two people is the most important factor in determining when tracking is perceived as socially acceptable [9,15,16]. But what are the elements that modulate the reactions and interactions within those relations with respect to location-sharing? On the one hand, tracking is in itself an objectifying activity sitting outside social interaction but, on the other hand, it is a social practice taking place within a network of relationships, entailing roles and dynamics. By affording tracking, new mobile technologies can generate unprecedented tensions between an innate self-preserving drive, and an intrinsic inclination for relatedness. The aim of our study was to investigate how location-tracking technology brings out and affects these tensions.

FIELD STUDY

The field study comprised two family groups of respectively 7 and 5 participants. Each group was asked to use a custom-built location-tracking application installed on their mobile phones for a period of three weeks and through four different phases, each lasting 5 days. During each phase participants were allowed or asked to do different things such as remaining exposed, carrying out tracking tasks on other participants or using location-sharing preferences.

Methodology

Technology

A custom-built location tracking application, Buddy Tracker [12], was used in the study. The tracking functions were accessible via the application’s interface (see Figure 1). They included a map displaying simultaneously the location of all group members, a description of each member’s individual profile with textual information about their current address, and a link to an interactive map application displaying their geographical position. Other features included: feedback notification similar to those in IMBuddy [10] and location-sharing preferences similar to those in Locyoution [22]. Notification that a participant had looked-up someone’s location was delivered in real time via a text message. An aggregated feedback mechanism allowed users to see who had accessed their profile, location or location history, and view on a map where both tracked and tracker were each time. Location-sharing options included time-sensitive, coarse-grained visibility

settings (e.g., becoming invisible for a few hours) and peer-to-peer coarse or fine-grained settings (e.g., allowing a particular group member to see one’s location only at city level). Accurate location updates were automatically provided every 10 minutes. Because the user interface was a web application, features could be instantly activated or deactivated and system usage could be monitored via a web-based administration panel.



Figure 1. Three screens from Buddy Tracker: Main menu (Left); Individual Profile (Center); All on Map (Right)

Participants

We solicited participants through word-of-mouth, mailing lists, and social networking sites and recruited two families of experienced iPhone users who were not related to each other or to us. The choice was based on their composition, cultural differences, and diversity of mobility patterns: we wanted to observe many instances of tracking behavior in socio-culturally different groups for whom tracking could be a worthwhile exercise and meaningful activity.

The first group (F1) was a South African family who had relocated to England two years ago after suffering an abduction and an armed robbery. They consisted of a married couple in their fifties, their three daughters and the partners of the two older daughters. The husband, a lawyer who worked locally, and his spouse, a housewife, lived in Milton Keynes, in Buckinghamshire, with their youngest daughter, who was in her late teens and attended high school. The middle daughter, in her early twenties, lived and attended university in Sheffield. Her boyfriend of six months, in his late twenties, lived in London and worked as a restaurant manager. The eldest daughter, in her mid twenties, worked in London for a law firm and lived with her long-term partner, who was in his early thirties and worked in London as a financial advisor. In South Africa, where crime levels are high and abductions frequent, it is common for families to use tracking technology for security purposes. This family had also done so but none of them had used it after relocating to England, prior to the study.

The second group (F2) was a British family who lived in Daventry, a small town in Northamptonshire, England, and consisted of a married couple, their son and younger

daughter, plus a family friend and housemate of the son. Husband and wife, both in their forties, worked locally, the former as a company director, the latter as a social worker. They lived with their younger daughter, who was in her early twenties and worked as a nurse and child caretaker at various locations out of town. The older son, in his mid twenties, was a PhD student and lived in Daventry with his long-term friend, also in his mid twenties, who worked as a business consultant at various locations around the country. None of them had ever used tracking technology prior to the study.

Schedule

During the three weeks of the study, the participants were asked to carry and keep their phone on at all times, in order to be always traceable by the other members of their group. All participants were monitored to ensure they were connected and active. The overall period was divided into four phases, each 5 days long. In **Phase1**, participants familiarized themselves with the application by freely tracking their co-participants. In **Phase2**, participants were asked to locate a particular co-participant at various times depending on when the latter appeared to be in a location of interest or far away. Each member of F1 was asked to do this 2 times a day, making a total of 10 tracking tasks for each. The location tracking tasks were provided via text messages manually sent to them from the administration panel. This intervention was introduced so as to enable us to observe emotional and behavioral reactions, when tracking others under external pressure. Specifically, we were interested in whether the participants would feel uncomfortable by having to track a co-participant they would have not otherwise tracked at a particular time. In **Phase3**, each member of F1 was given four further tracking tasks. In this phase we also introduced tracking feedback to observe how the participants would react. Would the translucency [9] afforded by this new feature make them hesitant about tracking others? Would it discourage them from any less-than-benign uses of the technology? Without pre-warning, all participants started receiving real-time feedback notifications. Every time they were located by a co-participant, they would be alerted by text and told what location information about them had been requested; they could then view the location of the tracker and their own at the time of the request. The feature was enabled throughout the remainder of the study. Finally, in **Phase4**, members of F1 were given 3 other tracking tasks. In this phase the participants were also provided with location-sharing preferences that allowed them to blur or hide their location completely for up to two hours at a time. This was in addition to the real-time feedback notifications. Given the opportunity to prevent others from seeing their whereabouts, would they now use the location-sharing preferences to hide from other family members? This phase enabled us to observe how participants would use and react to the introduction of various privacy settings on the location-tracking application. Among the other tracking

tasks, we asked the participants of F1 to change their location-sharing preferences three times: 1 time we asked the partner of the first daughter of F1 to reduce his visibility to city level (and he complied) and 2 times we asked the first daughter of F1 to make herself invisible (however, she made herself invisible 3 times and 1 time extended her invisibility beyond her given task).

Data collection

We collected participants’ reactions both during the study and at the end. During the study, we used experience sampling, sending instant requests to the participants’ mobile phones, upon each tracking event. Every time a participant tracked a co-participant, the system would send them a text message asking them to follow a link and fill an online questionnaire accessible via their phone. This included three pre-defined multiple-choice questions and a request for a memory phrase to help them remember the specific episode during the debriefing interview [14]. The sampling form contained the following text: “You have just done X (e.g., tracked Y): 1) What made you want to do X? 2) Is what you found what you expected? 3) How do you feel about it?” Additionally, there was a text box for a memory phrase. The experience sampling data was to be used as mnemonic trigger during interview.

At the end of the study, participants individually took part in extensive debriefing interviews, which lasted between one and two hours. The materials used during the interviews included: 1) the experience sampling forms they had submitted, 2) the print-outs of the maps outlining their daily trajectories for the duration of the study, 3) the records of the activities they had undertaken as trackers and those they had undergone as tracked. They were asked detailed questions about all the data they had generated. The questions aimed at exploring their *reasons for, feelings about* and *context around* their tracking behavior.

FINDINGS

Participant		Total	Ph1	Ph2	Ph3	Ph4
F1	Father	36	1	3	16	16
	Mother	88	13	19	24	32
	Daught1	21	2	6	8	0
	Daught2	49	12	5	21	10
	Daught3	50	24	7	13	6
	Part D1	73	8	23	11	31
	Part D2	42	2	15	14	11
F2	Father	97	93	2	0	2
	Mother	194	122	23	22	27
	Son	51	26	18	1	6
	Daught1	33	28	4	0	1
	Friend S	47	47	0	0	0
Total:		781				

Table 1: Summary of tracking events for all participants

We recorded a total of 1092 unique tracking events on the participant’s mobile phones, of which 305 were compound events (a participant looking at a co-participant’s current

address and then looking at their location on the map) .We recorded 5 changes to location-sharing preferences, 2 of which were compound (a participant prolonging their invisibility). The combined total of single and compound tracking events was 781, none of which was accidental. Table 1 summarizes the single and compound tracking events produced by the two families in the different phases of the study. As the data shows, participants of F1 didn't always carry out the assigned tasks (for example, in Phase2 the father of F1 only produced 3 tracking events, as he missed some of the tracking requests).

Qualitative findings

The findings from the interviews reveal a complex interplay between a) the participants' personal set of values and beliefs, b) their perception of the family contracts defining their relationships, and c) their assessment of their and others' motivations for tracking. We describe these in terms of values and beliefs, family contracts and motives, describing an interplay that we might call a 'morality of tracking'.

Morality of tracking

Values and beliefs. Unsurprisingly, we found that the participants' sets of values and beliefs informed their general attitudes towards location tracking technology. For example, the two mothers manifested very different attitudes towards location tracking, in particular towards their children.

The mother of **F1** commented that, compared to South Africa, she found England very safe and did not feel that tracking her children was needed: *"Like if they were in South Africa and I was living here I would worry more...but here they are safe...nothing happens here so I'm crossing the line. I do it because I can and that's not good enough"*. However, the mother of **F2** commented that, doing social work in the rehabilitation of young offenders, she was aware of how many dangerous people there are out there, especially driving on the road. Therefore she found herself frequently checking on her adult children to make sure they had made it to their destination safely: *"I'm a big worrier and especially since my son moved out and if my daughter goes out because I know what people are like on the road and I just know what it could be like...I think it's alright checking on them"*. The two participants' different personalities and experiences had apparently led to different outlooks on the appropriateness of location-tracking.

Again, the mother of **F1** commented how, unlike partners, children have a life of their own and as a parent she ought to respect that: *"I think I would feel bad checking on the kids because I do feel that is overstepping a privacy line...I think mummy can't know everything about children...I would only check on the kids in an emergency"*. Quite differently, the mother of **F2** commented that their children were aware of and accepted the fact that she was a protective mother: *"It's not to go in their space, I mean*

both of them have said any time I can phone them or text them". This shows how different views on parenting also influenced the participants' outlook on location-tracking.

Another example is that of the eldest daughter of **F1** and her partner, who had very different views on location-tracking technology. She felt very uncomfortable about the whole idea of tracking, whether she was tracking or being tracked: *"I must say I don't feel very comfortable with this technology so I don't like using it very much at all"*. Whereas her partner had no problem with it; he was very enthusiastic about the technology and what it could achieve: *"Makes me feel closer to her and 99% of the time I know exactly where she is anyway, because we are speaking or standing next to each other, so that is nice"*. This was partly motivated by his propensity towards technology in general, which the eldest daughter did not share.

These findings suggest that all participants recognized that while there were privacy boundaries to be observed, the configuration of those boundaries varied for different participants, depending on personality, experiential and cultural factors such as country of origin, profession or gender.

Family contracts. The participants' perception of what was entailed by the family contracts defining the various members' relationship with each other played an important role in assessing their motivations for and determining their use of the technology. Participants clearly distinguished between the meaning of tracking those whom they defined as 'parent', 'child', 'partner', 'sibling' or 'friend'. Their attitude varied with the accountabilities and responsibilities they felt towards each co-participant. The mother of **F2** used the tracker almost exclusively towards her children, rather than her husband, as a way of fulfilling her maternal role: *"I felt good about it because even though they've got mobiles and I can get hold of them at any time...with this I was looking where they were without disturbing them...because [my son] doesn't live at home anymore, it's reassurance that I know he's in a certain area"*.

Each of the older sisters of **F1** felt more inclined to using the technology to track the younger one/s, as they felt more protective towards her/them: *"I feel more protective of [my youngest sister] than I do for [my other sister], I feel as though I am entitled to know what she is up to, more than with [my other sister], because I know [my other sister] is grown up, she'll be fine, she's running her own life"*. Likewise, the young males of **F1** also used the tracker more protectively towards their partners than the other way round: *"I looked and I saw that she was at home, I knew that she was safe, it was nice"*.

However, for the son of **F2**, tracking his younger sister was not part of the contract he had with her. He felt less comfortable about tracking her than he did about tracking his mother: while he assumed that a mother should always be there for her children and hence could be legitimately

tracked at all times, tracking his sister encroached on her independence: *"I feel I shouldn't check on her so much, as she is her own person and I ought to respect her independence"*. This was symmetrical to how the mother felt legitimized in tracking her children to ensure their safety, symmetry that reflected what in this group looked like a family culture. The mother of **F2** drew the line between tracking her own children and her son's friend: *"I thought I was really naughty...what am I doing checking on him, he is not even my son"*. That was not part of her social deal with him.

Interestingly, as the relationship between co-participants developed, their contracts with each other underwent unspoken revisions. Concomitantly, their attitude towards tracking the other also changed. As the mother of **F1** became acquainted with the recent partner of her daughter, her feelings about tracking him became more ambivalent. Prior to their acquaintance she did not feel motivated to look up his location, but at the same time felt perfectly comfortable in doing so. Following their acquaintance she felt more motivated to protectively check on him, but at the same time started feeling uncomfortable about entering his space uninvited: *"Quite honestly I wouldn't have known he was sick, I wouldn't have cared, but because he spent the weekend here and he tried so hard not to be sick and he was polite and charming and helpful so he really went out of his way...I looked where he was, because if he was at home I probably wouldn't have texted but because I saw he was at work I texted to say I hope you are better...it felt a little uncomfortable [though]"*.

One participant confessed that they had no problem tracking one co-participant following an episode in which they had breached their trust, hence the social deal between them. As a result of that episode, the participant deemed the co-participant no longer deserving of boundary observation and was checking on them to catch them at fault: *"I feel because [they] have shown in the past that [they] are not trustworthy, that kind of [they] started it and it means I can check up on [them] and not feel too bad...[they] are unlikely to do what [they] say they do so anything you see [on the tracker] is probably just going to confirm that"*.

Overall, these findings indicate that within their family contracts participants tended to feel varying levels of motivation and responsibility towards each other, which proportionately translated into either a sense of entitlement to entering others' personal space or concern over crossing boundaries. Outside of these contracts, there tended to be no motivation or responsibility towards others and therefore neither there was sense of entitlement or concern. However, if others breached a contract, there remained (negative) motivation but not responsibility, and there was sense of entitlement but not concern, which permitted behavior of a more predatory nature.

Motives. We found a connection between the way in which participants felt about tracking and the way in which, within

their set of values and beliefs and with respect to their own family contracts, they assessed their motives for checking on others. These included protection, care, connection, reassurance, co-ordination, curiosity, surveillance and execution (when participants were carrying out a given task). Some of these are consistent with the findings of previous studies (e.g., [11]). We focus on how they fit in the dynamics of close social relations, when they are seen as compatible with those relations and why.

At times, participants looked at a co-participant's location with the intent of protecting them from potential harm and, because that intent was seen as honoring their social deal with the co-participant, they deemed that acceptable. For example, the mother of **F1** once tracked her youngest daughter hoping to be able to spare her the reproaches of the sisters for being late: *"They were asking where is she and the sisters sometimes do have words between each other so I thought I would try and find her and tell her to move it. I was trying to save a fight between the sisters"*.

Other times, participants used the tracking application to offer some form of care and support to their loved ones, which was also seen as a way of fulfilling their contract each other. For example, the eldest daughter of **F1** once looked at her younger sister's location knowing that she was unwell and unable to take a phone call because she was studying: *"So it was kind of like I wish I was there with her because I could bring her tea...when you're sick you want people to look after you, you want them to be there but you know that was the next best thing I could do and I knew she was trying to study so I wasn't going to call her and disturb her"*.

Participants might also track a co-participant to bridge physical distance between them and feel closer, as the partner of the eldest daughter of **F1** did several times with no concerns: *"So I was already checking on her, I'd only just arrived at the airport and I was already missing her"*.

However, tracking a co-participant with the intent of reassuring oneself evoked mixed feelings and was assessed accordingly: reassuring oneself that a loved one is safe was seen as a caring but self-serving act; similarly, reassuring oneself that everyone is where they are expected to be and that everything is in order was seen as self-gratifying and not always acceptable. For example, the father of **F1** one night, when his youngest daughter went to a party, checked on her to reassure himself she was safe: *"I saw that she was still at the party and not somewhere else... I felt reassured that she was in no riskier place than I expected...this would be a prime example of where I would have difficulty with that [kind of tracking]"*.

Reassuring oneself that one still occupies a certain rank in the social scale of another was seen as altogether dangerous. The mother of **F1** once looked at her eldest daughter's location from whom she had been waiting for a phone call to reassure herself that the daughter had not

forgotten about her: *"I would have been very disappointed if I had seen her back in her office...that she had not found two minutes to phone me...that would be almost like checking on a spouse...if it was a spouse it puts the seed in your mind, so I think it can be a very destructive tool"*.

Curiosity was seen as a non-legitimate motive, having no other aims than the voyeuristic intent to take a peak in someone else's personal life, as the mother of **F2** was well aware: *"I think it is not good when someone is just being nosy, that's not right, just looking to be nosy"*. Tracking was seen as socially questionable when carried out as a voyeuristic act, which could easily turn into surveillance. Typical example was that of the participant (mentioned earlier) who checked on a co-participant out of mistrust expecting to catch them at fault: *"I was checking on [them]...if the tracker had shown [them] anywhere else [other than where I expected them to be] I would have gone ah! My worst suspicions are confirmed"*.

Quite differently, the intent to co-ordinate one's movements with another to save time and work seemed to have no emotional or social implications and was clearly seen by everybody as a legitimate motive for tracking. For example, the father in **F1** reported: *"If I am going to be picking her up from university and I want to check where she is so that I am not too early or too late I don't have a problem with it, because it is part of an interaction between the two of us and it is leading to that interaction"*.

Sometimes when participants were carrying out a tracking task they felt completely detached. In those instances, they delegated responsibility for that action altogether and didn't even need to assess its legitimacy: *"It was easier to [check on others] when I was asked to do so...I didn't feel it was my responsibility...it wasn't me doing it, I was just carrying out a task"*.

These findings suggest that participants found their motives for tracking others acceptable or even commendable when they saw them as honoring their contracts with them. However, when their motives could not be justified with respect to these, the participants felt a degree of discomfort. Yet, there were times in which they could have abstained from using the tracking application but chose not to. There were also times in which they could have prevented others from tracking them but did not. The reasons for this seemingly contradictory behavior are discussed in the next section.

Liabilities of tracking

Often participants noted feeling uncomfortable about tracking and being tracked via the mobile technology. Their concerns pertain to how the location awareness application can afford or interfere with *social interaction*, on the one hand, and *'a-social' action*, on the other. In this context, by social interaction we mean behavior that is intended and can be accounted for as an exchange between two subjects. By *'a-social' action* we mean behavior that cannot be

legitimately accounted for as an exchange between two subjects; instead, this is behavior that objectifies the other and sits outside the bounds of social interaction, as is the case with voyeuristic or predatory uses of tracking technology. We examine the participants' concerns with respect to both social and *'a-social'* aspects.

Social interaction. As tracked, one of the participants' main concerns was the possibility that their behavior might be misinterpreted on the basis of location information alone. They felt that, if they did not appear to be where they were expected to be, or if they did not appear at all, others might jump to conclusions about their behavior. The partner of the elder daughter in **F1** reported an incident: *"She was really sick one night and I was at home...[she could not see me on the tracker] and she was ringing me to say she can't sleep, and I didn't answer my phone coz my battery was flat and I remember the next day she said what happened why did you turn your phone off and I said my phone wasn't off, my battery was flat"*. Equally, participants were concerned about the possibility that they might make unexpected discoveries about the location of others and not being able to refrain from making assumptions, as the elder daughter from **F1** reports from the same incident: *"There was one night...I know he had gone out and I wanted to know where he was, so that I could know if he was at home and I could phone or if he was still out and wouldn't answer his phone, so I looked him up but it said it was last tracked four hours ago which was when he left work. So I thought oh did he turn his phone off...or did he turn the tracker off and why did he do that because I knew he was going out, and so then and also I was ill so I start thinking so why didn't he tell me? Who is he with? And why is he there? And that was the thing"*.

Likewise, because of their concern about how others would see them, some participants felt unable to stop others from tracking them. Of all the participants, only one (the eldest daughter from **F1**) ever made spontaneous use of the location-sharing preferences, and only twice. A number of participants said that they did not or would not have used the location-sharing preferences because others would have questioned why they felt they needed to hide: *"No I didn't use the privacy settings because if I had they could have asked me why did you hide your location, have you got something to hide?"*. The same preoccupation made some participants reluctant to take advantage of the translucency afforded by the real-time feedback. Some related that they would prefer not to receive real-time notification when someone checked their location, because that would make them question others' motives: *"I would prefer not to know, because otherwise I would have to start asking myself why they are checking on me...have I done something wrong...are they after something?"*. When they were not worried about others' perception of them, some participants were concerned about letting others down: *"At times I'd rather [my mother] didn't track me...but I wouldn't use*

privacy preferences [as] I know that would hurt her feelings”.

These comments suggest the tracking technology triggered concerns and anxieties about the participants’ ability to maintain good relationships: these could have been affected by the perceptions and expectations that the use of the technology triggered in them and others.

‘A-social’ action. Both trackers and tracked seemed to be aware of and uncomfortable with the voyeuristic aspects of tracking. Trackers were most uncomfortable when tracking was just motivated by curiosity without a justifiable purpose, yet some found it difficult to resist the temptation of tracking others: *“I don’t think it makes me a better person checking up on people...I think what drives these questions is never really a positive thing ”; “it is not my place [to check on people] and I know that, so I try and stay far out of it as I possibly can because it’s none of my business at all, but this [technology] makes it a little bit too easy, doesn’t it, you are only human”.* Others found it even addictive: *“It’s quite addictive...I got used to using it a lot and now that the study is over I really miss it”.* As they started receiving real-time notifications, these participants realized that their co-participants must be getting notifications, too. Some commented that it made them think twice about tracking others again. However, the event data does not indicate that this had a significant impact on their behavior.

Some participants were clearly uncomfortable when they were shown the printouts of the maps outlining their daily trajectories: not only was this evidence of the fact that we had been tracking them, it was also placing them in a self-voyeuristic position that made them aware of their potential vulnerability: *“Even seeing my life all laid out on a map, if I cannot remember a place I went to and I can’t explain, it’s really uncomfortable”.* Even though they had nothing to hide and even though where they had been or what they had done was not significant, some felt that they would have to be able to offer their co-participants (for example, to their wives) an explanation that they did not have: *“It might be I’ve done nothing wrong but I might have not done enough right. I thought you were at the office but it took you long enough to get there. Well I got lost, didn’t do anything wrong. Well why did you get lost? Well it doesn’t matter”.*

These comments indicate participants concerns about how tracking technology was at times able to push them into acting as voyeurs or even predators, just as it was making them vulnerable to other’s voyeurism or predation.

DISCUSSION

Our findings illustrate a dialectical interplay between what location-tracking technology may afford and what family contracts, in terms of their social roles and relations, may allow or require. The participants’ set of values and beliefs informed their perception of what the social obligations defining their relationships with others entailed. This

substantiated the way in which participants assessed their motivations for tracking their co-participants and their co-participants’ motivations for tracking them. Our analysis has shown how the technology can disrupt people’s lives and how this interference might be managed. We have done so primarily by taking the point of view of the tracker rather than the tracked: in this active role participants found themselves compelled to reflect much more on what they were doing. This is consistent with findings by Wagner *et al.* [24], who report that people demonstrate more awareness and attention in making decisions that could affect others. Overall, our research raises a number of questions that we formulate in the following sections.

Margins of tacit misunderstanding

Within nuclear families extended by one or two members, our study has highlighted how the use of tracking technologies can interfere with the fulfillment of family contracts and generate social tensions. One such tension is the way in which social contracts change within a family. For example, as children grow up into teenagers and beyond their privacy status changes [16], which requires adjustments in how the contract between them and their parents is managed. Similar adjustments may be required as others, for example the partners of the adult children, join the family and start developing a relationship with the parents. Tracking technologies may make explicit what would otherwise remain implicit, unspoken or dealt with in other ways, which may cause anxieties or even conflicts.

But by rendering more explicitly one’s assumptions about the mutual accountabilities that define one’s relationships with others, the technology reduces the *margin of tacit misunderstanding* that sometimes allows relationships to work smoothly. For example, while one of our participants said that she thought her mother would be always thrilled to be tracked by her, the mother said that she would find that disturbing. The often delicate understandings that need to build up gradually and seamlessly between parents and their growing children, or between natural and acquired members of the family group, may be compromised as a consequence of an increased access to what the person is doing when out of sight. These concerns are reflected by the findings of a study, in which half of the interviewed parents stated that they had discounted using tracking technology with their children [23].

Extremes of accountability

There are trails in our daily life that we cannot explain and that may be completely insignificant. However, their representation via a tracking device objectifies and gives them significance, seemingly calling for an extraordinary degree of accountability [19]. This generates anxieties, especially within close relationships, in which people may feel under greater pressure to account for things they simply cannot account for. Moreover, location-based awareness applications can be very tempting, allowing people to

indulge in behaviors that they would not have had, by luring them to becoming more voyeuristic. It also generates a conflict between what people do out of weakness and what they can morally justify. They may be tempted to manage this conflict, for example, by expanding the range of responsibilities supposedly entailed by their social roles in order to justify their propensity for tracking others. But doing so puts further pressure on their relationships with other members in the group and on the individuals partaking in them. How the adoption of such tracking technology might affect the way in which people reason about what is remarkable or unremarkable within the representations of theirs and others' movements made possible by it is an important question that needs further investigation.

Tracking technology may also serve or even foster a reduced sense of accountability. Schoeman [17] observes that when others (or aspects of their lives) are not relevant to us we are not motivated nor legitimated to encroach on them, which affords them a measure of privacy. However, our findings indicate that, while there might not be motivation to encroach, there may not be concern about it either. This opens up possibilities for less benign forms of tracking. Moreover, consistently with Boesen *et al.* [4]'s findings that tracking is sometimes motivated by lack of trust, our findings suggest that, where a breach of a contract is perceived, tracking technology can easily turn the other into fair game and become an acceptable avenue for an objectifying drive. It seems that temptations to follow socially de-constructive impulses may be engendered by tracking technology in what are otherwise socially constructive environments. This propensity to switch easily from social to a-social covert actions, without recourse to any negotiation within a family contract, needs more consideration than it has previously been given.

Impressions of reality

As noted, the incompleteness of the information provided by the tracking technology triggered the participants' concern that others might misperceive their behavior or that they might misperceive the behavior of others. The problem of signaling and interpreting social meaning via digital artifacts has been studied in other domains [18], but our findings suggest that it should be focused on more closely in this domain, too. As a medium, location-tracking technology presents important biosemiotic issues that ought to be addressed. By this we mean an approach that analyses the production, action and interpretation of signs in the biological realm. The exercise of tracking through the impoverished representation provided by location-tracking technology currently available [19] is far removed from the skilful biosemiotic activity of physical tracking and raises concerns for both the tracked and the tracker. While physical tracking and the use of tracking technology may differ in many ways, they share a fundamental aspect: they both entail approaching (in more ways than one) another

from a vantage point prior to any interaction. Before any communication can be established, the tracker is drawn to making inferences about the tracked based on whatever signals they can interpret in whatever way. Indeed, our participants would often make inferences about their co-participants' behavior or circumstances based on the position of a dot on a map, as if the signs and assumptions that triggered those inferences could be relied upon. What is it about a dot on a map that triggers in us such an *impression of reality*? How could tracking devices provide us with the information we need not to make wrong assumptions, without causing us even greater exposure? These are questions that future research should address.

Closeness versus control

Other important questions concern the intricate socio-cultural elements that may influence the morality of tracking. There seems to be a widespread assumption, in the current research trends on location tracking and privacy, that if people are offered easy and sophisticated enough controls over location-sharing options and sufficient translucency on others' action, this would go a long way in resolving the privacy issues raised by this technology. However, our findings indicate that within close relationships such a rational approach to privacy management may simply not be viable.

As Schoeman [17] reminds us, "*we understand ourselves as proper objects of moral and social manipulation, by ourselves and by others*" and this is particularly true within close-knit connections, such as family relationships, in which many more aspects of our lives are relevant to those with whom we belong. The more stakes one has in a relationship, the more one has to lose; the more one has to lose, the less one can act as an autonomous agent. Within close social groups, location-tracking technology could, therefore, paradoxically make users more vulnerable than they would be within less cohesive groups. We suggest that future research should focus on investigating further the interplay between culture, social contracts and the use of location-tracking technology within different cohesive social groups. We need a much better understanding of what is socially viable for people to do when using such location awareness applications in order to protect themselves from the overreaching power of others.

CONCLUSIONS

Our research has investigated the way location tracking can affect and perturb relationships within closely related groups. We conducted a user study using a technology intervention akin to a sociological breaching experiment. Our detailed analysis showed the possible interplays that can emerge between location-tracking technology and social dynamics in relationships characterized by mutual dependencies, such as those found within families. Our approach uncovered and articulated a breach between what tracking technology can afford and what social contracts

within close knit group may legitimize, with the anxieties and inner conflicts that may pressurize relationships as a result. Our findings suggest that the use of control mechanisms such as location-sharing preferences and feedback may not be compatible with the delicate and subtle dynamics on which certain social relationships are based. New tracking technology needs to be designed based on a better understanding of the complex interplay between technological affordances and social dynamics in a variety of social groups.

ACKNOWLEDGMENTS

We are indebted to the participants who took part in the study for their invaluable contribution. We thank all our reviewers for their generously thoughtful comments. This work is funded by the EPSRC grant EP/F024037/1 and SFI grant 03/CE2/I303_1.

REFERENCES

1. Anthony, D., Henderson, T., Kotz, D. (2010). Privacy in Location-Aware Computing Environments. *Proc. IEEE Pervasive Computing*, vol. 6, no. 4, pp. 64-72
2. Barkhuus, L. and Dey, A. (2003). Location-Based Services for Mobile Telephony: a Study of User's Privacy Concerns. *Proc. INTERACT '03*. Zurich, Switzerland: IOS Press, pp. 709 -712.
3. Barkhuus, L., Brown, B., Bell, M., Sherwood, S., Hall, M. and Chalmers, M. (2008). From awareness to repartee: sharing location within social groups. *Proc. CHI'08*. Florence, Italy: ACM Press, pp. 497–506.
4. Boesen, J., Rode, J. Mancini, C. (2010). The Domestic Panopticon: Location Tracking in Families. *Proc. UbiComp '10*. Copenhagen, Denmark: ACM Press.
5. Brown, B., Taylor, A., Izadi, S., Sellen, A., Kaye, J., and Eardley, R. (2007). Locating family values: A field trial of the whereabouts clock. *Proc. UbiComp'07*. Innsbruck, Austria: ACM Press, pp. 354–371.
6. Conesa-Sevilla, J. (2008). Thinking in Animal Signs. *The Trumpeter*. vol. 24, pp. 116-125.
7. Consolvo, S., Smith, I.E., Matthews, T., La Marca, A., Tabert, J., and Powledge, P. (2005). Location Disclosure to Social Relations: Why, When, & What People Want to Share. *Proc. CHI'05*. Portland, OR: ACM, 2005, pp. 81-90.
8. Dourish, P. and Palen. L. (2003). Unpacking privacy for a networked world. *Proc. CHI'03*, Ft. Lauderdale, FL: ACM Press, pp. 129–136.
9. Erickson, T. and Kellogg, W.A. (2000). Social translucence: an approach to designing systems that support social processes. *TOCHI*, vol. 7, pp. 59-83.
10. Hsieh, G., Tang, K.P., Yong Low, W., Hong, J.I. (2007). Field Deployment of IMBuddy: A Study of Privacy Control and Feedback Mechanisms for Contextual IM. Krumm, J. *et al.* (Eds.): *UbiComp2007*, LNCS 4717, pp. 91-108.
11. Iachello, G., Smith, I., Consolvo, S., Chen, M., Abowd, G.D. (2005). Developing Privacy Guidelines for Social Location Disclosure Applications and Services. *Proc. SOUPS'05*. Pittsburgh, PA: ACM Press.
12. Jedrzejczyk, L., Price, B. A., Bandara, A. K., Nuseibeh, B. (2010). On the impact of real-time feedback on users' behavior in mobile location-sharing applications. *Proc. SOUPS '10*, pp. 14-16.
13. Lederer, S., Mankoff, J. and Dey, A.K. (2003). Who Wants to Know What When? Privacy Preference Determinants in Ubiquitous Computing. *Proc. CHI'03*. Ft. Lauderdale, FL: ACM Press, pp. 724-725.
14. Mancini, C., Thomas, K., Rogers, Y., Price, B.A., Jedrzejczyk, L., Bandara, A.K., Joinson, A.N., and Nuseibeh, B. (2009). From Spaces to Places: Emerging Contexts in Mobile Privacy. *Proc. UbiComp'09*, Orlando, FL: ACM, 2009, pp. 1-10.
15. Martin, B. (1984). 'Mother Wouldn't Like it': Housework as Magic. *Theory, Culture and Society*, vol. 2, no. 2, pp.19-36.
16. Petronio, S. (2002). *Boundaries of Privacy: Dialectics of Disclosure*. Albany, NY: State University of New York Press.
17. Schoeman, F.D. (1992). *Privacy and Social Freedom*. Cambridge: Cambridge University Press.
18. Shami, N.S., Ehrlich, K., Gay, G., Hancock, J.T. (2009). Making sense of strangers' expertise from signals in digital artifacts. *Proc. CHI'09*. Boston, MA: ACM Press, pp. 69-78.
19. Shklovski, I., Vertesi, J., Troshynski, E. and Dourish, P. (2009). The commodification of location: dynamics of power in location-based systems. *Proc. UbiComp'09*. Orlando, FL: ACM Press, pp. 11-20.
20. Stacey, J. (1997). *In the Name of the Family: Rethinking Family Values in the Postmodern Age*. Beacon Press.
21. Troshynski, E., Lee, C. and Dourish, P. (2008). Accountabilities of presence: reframing location-based systems. *Proceedings CHI'08*. Florence, Italy: ACM Press.
22. Tsai, J.Y., Kelley, P., Drielsma, P., Cranor, L., Hong, J., Sadeh, N. (2009). Who's Viewed You: The Impact of Feedback in a Mobile Location Sharing System. *Proc. CHI'09*. Boston, MA: ACM Press.
23. Vasalou, A., Oostveen, A-M., and Joinson, A.N. (in review). Location sharing in the family. Paper currently under review.
24. Wagener, D., Lopez, M., Doria, A., Pavlyshak, I., Kostakos, V., Oakley, I., Spiliotopoulos, T. (2010). Hide and Seek: Location Sharing Practices with Social Media. *Proc. MobileHCI'10*. Lisboa, Portugal: ACM Press.