

# A Case Study of Non-Adoption: The Values of Location Tracking in the Family

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## ABSTRACT

A number of commercial location tracking systems exist which enable parents to monitor where their children are when outdoors. The adoption of these services and whether, through their design, they reflect parental values has not been investigated. This question was pursued with a large-scale survey of 920 parents from the UK. The use of location tracking was not prevalent amongst parents and only a minority had considered using these technologies. Parents favoring location tracking described it in the context of security, peace of mind and the need to reduce uncertainty. Parents who were against location tracking described a general lack of need as they had established reliable mechanisms for security and valued trust in the family as well as children's self-direction. Our findings show that location tracking concurrently *supports* and *threatens* parental values. By focusing on the values it undermines, we are able to suggest new directions for location systems.

## Author Keywords

Family, children, parents, GPS, location tracking, control, privacy, security, trust, self-direction, values, adoption.

## ACM Classification Keywords

J.4. Social and Behavioral Sciences: Psychology. K4.1 Public Policy Issues: Privacy.

## INTRODUCTION

The last decade has seen a rise of commercial location tracking systems (e.g. Nu.M8 digital watch, Guardian Angel, UbiSafe) designed explicitly for families with underage children. Promising to keep children safe, these products provide parents with the facility to track them while outside of the home. Two features are typically shared across different systems: parents have one-

directional views of their children's present location and movement history on a map, and they can define a geographical boundary that if trespassed, activates a text notification.

Despite their long-standing presence in the commercial domain, there is growing consensus that 'the commercial success of location awareness applications has been limited' [5]. Tangible evidence to this claim is provided by a recent study: in seeking to recruit users of commercial location tracking systems in the London area, over the course of several months, only a minority of families were identified [2] [3]. The significance of this finding is profound when we compare it to recent statistics on mobile phone use by families with adoption rising from year to year. According to the Childwise Monitor Report, for example, mobile phone adoption among children in the UK has leveled off in 2010 with seven out of ten 5 to 16 year olds owning a mobile phone [6].

The endorsement of children's mobile phone ownership [32] suggests that the non-adoption of location tracking systems is not due to parents' diminished ability to recognize the benefits of technologies in the realm of the family. In seeking to understand why families have not taken up location tracking, recent work that explores the relationship between technology and values is instructive. Sengers et al. argue that designers consciously or unconsciously give prominence to a particular set of values through the socio-technical features they propose [34]. By functioning as guiding principles in people's lives [7] [33], values have been shown to be a motivating force in users' technology adoption decisions [13]. Brown et al. also express this view by positing that commercial location tracking systems may have failed precisely because they have not adequately engaged with the complex dynamics of family values [5].

User research on location tracking systems has primarily focused on understanding the uses and implications of custom-made prototypes amongst select, small cohorts of novice users. In contrast to this research tradition, we turn our attention to commercial location tracking systems to ask why families have not adopted them, focusing in particular on understanding the values this technology supports or

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threatens. Our work is guided by the belief that in studying users' rejection of these widely-available products we can gain valuable insights on how to redirect their design so that it aligns with the values and needs of the social groups they aim to reach.

This was achieved through a large-scale survey of parents across the United Kingdom. We focused on parents in particular, as they are often the gatekeepers who determine what technologies are introduced in the family [4]. Given the little we know about the adoption of location tracking, adoption was measured using the exploratory framework proposed by Rogers' diffusion of innovations theory [30]. The diffusion of innovations theory formalizes technology adoption with a time trajectory that decomposes the decision to use a given technology into several stages. It begins with users' exposure to the technology's existence (knowledge stage). Once users are aware of the technology, they are influenced by its characteristics, a process that shapes their attitudes towards it (persuasion stage). The persuasion stage is followed by the decision to adopt or reject the technology (decision stage). Finally, people put the technology in use (implementation stage), constantly re-affirming their decision through the outcomes that follow (confirmation stage). To form an initial understanding of the parental values activated by the design of location tracking, we consulted two sources. First, we drew on the values, tensions and anxieties of parenthood as evidenced in the fields of sociology and psychology. Next, we looked at the interplay of these values during the use of location tracking as revealed in previous research.

Our study contributes to the location tracking literature in several ways. It is the first large-scale study to show that families across the UK have not integrated these technologies into their routines with only a small fraction using them. Even though previous research has found that keeping an eye over children through technology is now part and parcel of family life [9], 39% of our panel was not aware that location tracking is available. A minority of parents, 16%, felt that the control location tracking affords would alleviate anxiety over their children's safety. Even so, they had yet to take the leap to implement these technologies. Most importantly, 43% of our respondents felt that location tracking was unnecessary. It did not serve a meaningful purpose in family environments where routines and rules assisted parents to know where their children are. When parents were uncertain about their children's exact location, they trusted their children to keep safe. In line with recent concerns regarding the use of location systems e.g. [22], parents perceived the monitoring facility of location tracking to compromise children's independence and trustworthiness.

## BACKGROUND

### Parental values

From infancy, children seek a sense of security established through the reliability of their parents, a

psychological process that Winnicott [37] terms 'basic' trust. This interdependency becomes deeply entrenched in familial relations and is constantly affirmed through parents' affection and confirmations of reliability [10]. Personal values shift when becoming a parent from seeking individual achievement to a desire for security [33]. The need for security is framed within, and *modulated* by, the practices of a risk averse society [11] whose policies have had grave consequences for children's freedom in particular as access to outdoor spaces and its opportunities for play are increasingly replaced by seemingly safer activities [14] [20]. The effect of the 'fear society' on parental perceptions of risk is demonstrable in the results of a recent UK survey, which shows that despite statistical data reporting a low incidence of abductions, a large number of parents maintain that abductions are an imminent threat [19]. Other research has shown that Australian parents discouraged their children to go outdoors by recycling stories of crime incidents that went as far back as 20 years [20].

In moving toward adulthood, children must gradually develop independence both in thought and in action, a rite of passage that takes place under parental direction. Some researchers have warned that without freedom to discover their environment and to make their own mistakes, children may not develop resilience, thus rendering life's risks and dangers a daunting enterprise [14] [20] [22]. Evidence to this, is the finding that children growing up in controlling homes exhibit less self-reliance and confidence [12] [16]. This task is not trivial for parents who must balance the control required in protecting their children, with the openness that allows them to explore their environment in order to develop self-direction. Though self-direction and security are both universal human values [7], they are achieved by antithetical strategies [33].

Trust is often the mechanism through which these tensions are resolved. Indeed, the openness and thus uncertainty required to attain self-direction is a necessary precondition in the process of trust building [22] [27]. Removing uncertainty can bear in different ways on both trustor (parent) and trustee (child). Parents who know more about their children's daily activities report more trust toward them, an effect that holds only when this knowledge is obtained through children's *spontaneous* disclosure [15]. Children whose behavior is regulated through extrinsic forces – such as fear of punishment – are less likely to internalize the values of reliability and honesty as their own in order to go on to become trustworthy people [12] [22].

### Location tracking systems for the family

Location tracking systems have been deployed mostly for loose networks of friends with only a few prototypes evaluated in the family context. The Whereabouts Clock was tailored to preserve family privacy. Its aim was to uncover the values evoked by location. Designers positioned the clock within the domestic environment so that it naturally fit into the rhythms of family life and

Figure 1: Examples of existing commercial location tracking systems.



Verizon Chaperrone



lok8u num8



UbiSafe

excluded unauthorized parties from accessing it. Each family member was given the choice to set up three coarse-grained location labels ('school', 'work' and 'home') that were displayed on the clock throughout the course of the day. Additionally, users could send custom messages to home members via the clock. In studying the uses of this system, it was found that the clock communicated what families already knew, as such posing few privacy concerns. Location became a token of reassurance, instilling a sense that 'all is well', evoking feelings of connectedness amongst family members and assisting them into smoothly coordinating their everyday routines [5].

Buddy Tracker was a mobile application that allowed family members to search for one another, displaying fine-grained location coordinates on a map. The application sent out a notification to users once they had been tracked. In evaluating Buddy Tracker, it was shown that family members had variable motives for tracking one another including coordination, care and affection, surveillance and curiosity, reassurance and security. Parents, in particular, often sought reassurance and tracked their children in the name of security. They legitimized the intrusion into their children's private spaces, which left their children feeling uncomfortable [21]. A similar set of findings emerged in a study that focused on the uses of commercial location tracking systems (e.g. Follow-us, Google Latitude). This work also revealed that parents rationalized the use of location tracking as a method for trust building, adopted after breaches of trust. The authors of this work argued, that in removing uncertainty, location tracking risked disintegrating the very notion of trust within these families [2].

These studies draw attention to the variable motives of security and the behaviors that establish it. The Whereabouts clock was carefully integrated within users' environment while it gave individual members control and choice when communicating their location. Its use provoked feelings of security, affection, reassurance and ultimately togetherness. By contrast, in making location

searches an explicit act that was beyond the control of those who were tracked, Buddy Tracker accentuated surveillance practices in the family. Amongst its positive uses, it also became a tool for alleviating parental anxieties in relation to children's security and at times undermined children's freedom, as well as family trust. Thus, the morality of location tracking is likely to follow from the design sensibilities underpinning different classes of applications. As with the design of Buddy Tracker, commercial location tracking systems (see Fig. 1) feature *control* as the main mechanism to attaining security. Parents can view fine-grained information about their children's location at any given time. Control is asymmetric: parents are the trackers and children take the role of the tracked. Nonetheless, even though there is some evidence that parents have withheld from using commercial location tracking [2] [3], it is unclear whether the moral character of these technologies has influenced parents' decisions. The next section describes a survey study we conducted whose aim was to shed light into this domain.

## METHODS

### Participants

A panel of 1,130 parents living in the UK whose children were between the ages of 6 and 18 was contacted on our behalf by a market research agency to fill out a survey. A total of 920 (39% male) parents took part in the survey. The average parental age was 43 (SD=8.7) and the average child's age was 11.3 (SD= 4.5). Each household had on average 1.57 children (Median=1). The mean deprivation score for family residence was 22,821 (SD = 16,411), which is comparable with deprivation scores collected in the UK over 2010 (M=21.67; SD=15.51) [35].

### Measures

Participants completed the survey online, which was timed to take no longer than 10 minutes. The survey was organized in three parts. In the first section, participants provided demographic information. In the second part, they were asked a question which enabled us to place them in

one of several technology adoption stages. The final section measured parental values set in the context of location tracking. The three sets of measures are described by the order in which they were presented.

#### Controls

Previous work has found that user demographics influence adoption decisions. Younger users are more likely to accept new technologies and similarly, males are quicker to adopt technologies than females [30] [36]. However, in the context of families, mothers' nurturing role often motivates the use of technology so that we might expect a balanced form of participation across gender [29]. To control for these variables, we asked participants to report their age and gender.

The use of domestic technologies in particular can also be driven by concerns that form during specific developmental milestones. For instance, when transitioning from primary to secondary school, children gain more independence. This may in turn fuel new parental fears that encourage the adoption of location tracking. Thus, children's ages were also collected. Since we expected children's ages to have a non-linear relationship with adoption we coded each age point as a categorical variable.

Parents may also have legitimate concerns about their neighborhood safety that in turn bear on adoption decisions. Residential postcodes were collected and used to obtain an objective measure of neighborhood security. For this, we used the index of multiple deprivation (IMD 2007) [23], which is a government-led initiative for measuring deprivation at a small area level. The IMD is a relative measure with higher values indicating higher deprivation. For instance, during the 2010 assessment, the Tendring District (North-East Essex) was the most deprived ( $M=87.80$ ) and the Three Rivers District (Hertfordshire) was the least deprived ( $M=0.53$ ) [35]. The IMD combines 37 different indicators measuring income, employment, health and disability, education, skills and training, barriers to housing, living environment and crime. Family postcodes were uploaded to the online GeoConvert tool (<http://geoconvert.mimas.ac.uk/>) and converted to scores of deprivation.

#### Dependent variables

After completing the demographic questions, participants were presented with a short introduction about commercial location tracking systems that described their ability to record children's location and transmit it to family members. They were also provided with illustrative examples of three systems available for family use (ChildLocate, IonKids Child Locator and Trackstick). Participants were then directed toward one of four possible paths allowing us to place them at a specific point in the technology-decision process.

- **Knowledge stage:** Participants were asked to report if they had previously heard of location tracking. Those

who provided a negative response terminated the survey and were coded as belonging to the knowledge stage.

- **Implementation stage:** Affirmative answers were allowed to progress to a second screen that asked respondents whether they use location tracking with their children. Those who answered affirmatively were categorized in the implementation stage.
- **Persuasion stage:** Participants, who reported not using location tracking, were redirected to a third screen that asked whether they had seriously considered using or decided against using location tracking. Those who had considered using location tracking were coded in the persuasion stage.
- **Decision stage (reject):** Those who had decided not to use location tracking were categorized in the decision (reject) stage.

#### Independent variables

Except for participants who belonged to the knowledge stage and had thus not formed an opinion about location tracking, the remaining respondents were asked to elaborate on why they would, or would not use, this technology. To avoid biasing responses towards this question with directive items, we measured values through parents' use of language. Language reveals important information about people's psychological states, personality, mental, and social processes [25]. To our present interest, it can show the concerns most salient when raising a family and the associations that parents draw between location tracking and their ongoing needs, values and practices.

Computer-aided content analysis was performed on participants' open-ended responses to convert them to quantitative scores. Using the Wmatrix software [26] (<http://ucrel.lancs.ac.uk/wmatrix/>), keywords that appeared unusually frequently within the open-ended responses were identified. This was achieved by comparing participants' written responses to a written sample of the British national corpus (BNC). The BNC can be seen as representative of general language use and thus served as a control condition.

Keyword	% of words in the survey	% of words in the BNC	Log-likelihood
Need	1.90	0.05	594.60
Mobile phone	0.33	0.00	203.82
Safety	0.62	0.01	263.64
At all times	0.21	0.00	103.40
Privacy	0.16	0.00	72.00
Knowing	0.21	0.00	72.67

**Table 1: Keyword examples from survey responses and the BNC**

Keywords retained through this analysis were significant at the .05 level. Table 1 displays a few examples of keywords as they appeared across the two datasets.

This inductive method was followed by thematic analysis. We consulted the texts in which each individual keyword appeared to interpret the issues expressed by participants (see Table 2). This allowed us to identify emergent themes of parental values. For instance, in inspecting the phrase *in case of*, and then subsequently the word *lost*, we found that in both cases participants were describing the security that location tracking would provide during exceptional occasions. These words were coded as describing security concerns and ultimately formed part of the linguistic category *Security*. To ensure that univocal items composed the categories, if a keyword was used in multiple contexts, and thus expressed more than one parental value, it was removed. Our theoretical understanding of parental values (as presented earlier) informed the interpretation of this data. At the same time, our coding scheme remained open to accommodate other sensibilities vital to location tracking that may be unforeseen by our framework. This process yielded 79 words organized across the following six categories:

- **Security** (keyword e.g.: *safe, security, in case of, lost*; Mean category word frequency=4.3%): participants felt that location tracking would keep their children safe and secure when they are not under direct supervision. As one female participant noted ‘I can assure their safety when they are away from the house.’ They believed these devices would be valuable in exceptional occasions during which children’s wellbeing was at stake. In the words of one mother, ‘...it will also help me track them easily in case of emergencies.’ Some participants also perceived the level of outdoor risk to be particularly high noting that modern societies pose unprecedented dangers. This view is encapsulated in one father’s response: ‘In this day and age you never know what can happen.’
- **Anxiety** (keyword e.g. *peace of mind, worry*; Mean category word frequency=.65%): alongside the need to keep children secure, participants described personal anxieties that would be alleviated if location tracking was put to use. A male participant voiced this worry: ‘...if anything happened it would give you the peace of mind to know you could track them and find them.’
- **Uncertainty reduction** (keyword e.g. *locate, track, exactly*; Mean category word frequency=1.12%): participants felt that location tracking would allow them to know more about their children’s precise whereabouts. Overall, a pressing need to have control over what children are doing at all times transcended many descriptions. As one mother stated, ‘I think if my sons are away for a long period of time it would be good to know exactly where they are.’

Safety (37 occurrences)
To know where they are for extra <i>safety</i> .
<i>Safety</i> in case of kidnap.
So that I can assure their <i>safety</i> when they are away from the house.
... especially while away from home, for <i>safety</i> in case of emergency.
We often worry about his <i>safety</i> , considering the dangerous people there are.

**Table 2: Keyword in context analysis (KWIC) for the word safety**

- **Need** (keyword e.g. *do not need, not appropriate*; Mean category word frequency=6.25%): participants expressed a general lack of need for location tracking. Statements such as ‘No need for it’ echoed in many responses.
- **Awareness and boundaries** (keyword e.g. *mobile phones, don’t allow*; Mean category word frequency=2.95%): parents were aware of their children’s whereabouts by drawing on numerous practices. Mobile phones, for example, formed part of this repertoire. In line with this, one mother noted, ‘My son has a mobile phone and we can contact each other whenever we need.’ Many participants had forged rules and agreements over location boundaries with their kids. A female participant described this arrangement: ‘...I don’t let my children roam aimlessly. If they go out somewhere, there are boundaries and times set.’ By contrast, those who had younger children felt that their children’s movements were sufficiently supervised: ‘At the moment my children do not go out unsupervised. We always know where they are, as we are usually with them.’
- **Trust and self-direction** (keyword e.g. *privacy, intrusion, spying, freedom, trust, honesty, responsible*; Mean category word frequency=2.21%): participants viewed location tracking as a threat to their children’s freedom and independence. This outlook is reflected in the response of a male participant: ‘children need degrees of freedom without feeling like they are been watched.’ Furthermore, some participants felt that location tracking was meaningless since they trusted their children. Its surveillance function was thought to undermine trust. A female participant articulated the trust issue by stating: ‘I trust my kids not to do or go anywhere they’re not supposed to.’ A second mother drew the link between trust and the control afforded in location tracking in saying: ‘I trust my child and I don’t find the need to follow where they are. It is a form of spying.’ Issues of trust and self-direction were interwoven as both were achieved through uncertainty: without respect for children’s self-direction, trust work

	B	S.E.	Wald	Sig.	Exp(B)	95% CI. For Exp (B)	
						Lower	Upper
Age	.004	.018	.060	.807	1.004	.970	1.040
Area Deprivation	.012	.011	1.030	.310	1.012	.989	1.035
Gender	.600	.321	3.511	.061	1.821	.974	3.411
<b>Security</b>	<b>-.142</b>	<b>.030</b>	<b>22.010</b>	<b>.000</b>	<b>.867</b>	<b>.817</b>	<b>.921</b>
<b>Anxiety</b>	<b>-.192</b>	<b>.077</b>	<b>6.231</b>	<b>.013</b>	<b>.825</b>	<b>.709</b>	<b>.959</b>
<b>Uncertainty Reduction</b>	<b>-.313</b>	<b>.061</b>	<b>26.250</b>	<b>.000</b>	<b>.731</b>	<b>.648</b>	<b>.824</b>
<b>Need</b>	<b>.374</b>	<b>.111</b>	<b>11.440</b>	<b>.001</b>	<b>1.453</b>	<b>1.170</b>	<b>1.805</b>
<b>Awareness and Boundaries</b>	<b>.152</b>	<b>.040</b>	<b>14.677</b>	<b>.000</b>	<b>1.164</b>	<b>1.077</b>	<b>1.258</b>
<b>Trust and Self-direction</b>	<b>.303</b>	<b>.096</b>	<b>9.922</b>	<b>.002</b>	<b>1.354</b>	<b>1.121</b>	<b>1.634</b>
Constant	.218	.845	.066	.797	1.243		

**Table 3: Predictor weights (B), significance levels (Sig.) and confidence intervals (95% CI. For Exp(B)).**

**Note:** The coefficients should be interpreted as follows: the persuasion stage was coded as 0, and the decision stage was coded as 1.  
For gender, females were coded as 1.

was not possible. This is expressed in one father's response: 'Our children know to let us know of their movements all the time. We trust them to be responsible and therefore give them freedom of movement, in return they are honest enough to give us their actual locations.'

## RESULTS

### Stages of adoption

Over a third of participants, 361 (39%), belonged to the *knowledge stage*. They had never heard of location tracking. A small number of participants, 16 (1.7%), reported using location tracking with their children and were thus classified in the *implementation stage*. The *persuasion stage* group comprised of 148 people (16%) who declared favorable toward using location tracking. The *decision (reject) stage* included 395 (43%) respondents who had decided against the use of location tracking.

Those in the knowledge stage had yet to assign personal meaning to location tracking. We describe the implications of this finding in the discussion section. As expected, only a small segment of users had implemented location tracking in the home (for a full discussion about this user group see [2]). The next stage of our analysis focused on the dominant groups of the technology cycle, parents belonging to the persuasion and decision (reject) stage. Specifically, we investigated how values forge parents' membership across these two stages while controlling for demographics. To verify that the two groups of participants were not qualitatively different, we conducted a multivariate ANOVA with the demographic variables as dependent

measures and adoption stage as the independent variable. No significant differences were found.

### Predicting stages of adoption

A logistic regression was calculated with two blocks, demographics and parental values, predicting the stage of adoption participants ascribed to. We first explored the data and verified model assumptions. A cross tabulation of the categorical predictors by adoption stage showed that for the variable child's age there were not enough cases in some cells. For instance, only 9 parents with children of the age of 18 belonged to the persuasion stage. This led to the exclusion of child's age from the model. Diagnostic tests suggested that data from 20 participants should be removed because of their undue influence on the model.

The demographics block was non significant (chi-square=3.55, *ns*) explaining less than 1% of variance (Nagelkerke R square=.010). It correctly classified 0% of the cases in the persuasion stage and 100% of the cases in the decision (reject) stage. An examination of the second block which included parental values explained 67% of the variance with the chi-square test showing significance (chi-square=315.987,  $p<.001$ ). 65% of cases were correctly classified in the persuasion stage and 97% in the decision (reject) stage. The log likelihood difference between the two blocks was 316.69 ( $df=6$ ), which was significant at the .001 level. This indicates that an integrative model of values and demographics fit the data better than the demographics only model.

Table 3 summarizes our findings. All six parental value predictors were significant. The values of Exp (B) were

greater than 1 for the following predictors: *need, trust and self-direction, awareness and boundaries*. As these values increase by 1, the odds of deciding against the use of location tracking increase. Conversely, values of Exp (B) were less than 1 for the *security, anxiety, and uncertainty reduction* predictors. The odds of favoring the use of location tracking increase when words from these categories increase. The confidence intervals for each predictor indicate that the values of Exp (B) in the population lie between these two values. From the demographic variables, gender was marginally significant. The odds of being in the persuasion stage increased when the participant was female. This finding should be interpreted with caution however. The confidence interval crossed over zero suggesting that in the population this relationship may be opposite to that observed in our data.

## DISCUSSION

This paper reported the results of a large-scale survey that investigated parents' commercial location tracking adoption patterns and the values these technologies activate. The discussion that follows is framed around the contributions of this work, its moral implications and its applications for design.

### Families do not use location tracking

It has been previously suggested that location tracking has not had commercial success. Nonetheless, empirical evidence for this claim has not been reported. Drawing from a large sample of parents across the United Kingdom, we showed that location tracking has not reached the home. Only 1.7% parents reported using this technology with their children (*implementation stage*).

### Parents have not heard of location tracking

A significant number of parents, over one third of our participants, were not aware these technologies existed (*knowledge stage*). This finding is surprising given that location tracking has been commercially available over the past decade. Although our research cannot directly show why parents were not aware of these services, lack of awareness is suggestive that parents have not *needed* to look for these types of systems [30]. This explanation is viable given that parents in the decision (reject) stage repeatedly noted a general lack of need as a key reason to non-adoption.

### Values are the motivating force in the adoption of location tracking

Our findings inform the technology adoption literature by showing that contrary to previous work, demographics (e.g. age and gender) did not predict adoption. Values were the only robust predictors for both persuasion and decision (reject) stages. Before implementing a technology, users will engage in a 'mental exercise of thinking and deciding' [30]. In the domestic context, parents act as technology advocates [4] whose choices ultimately bear on children's wellbeing. Parents acknowledge this responsibility by

reflectively evaluating their motives when using technologies with their children [21]. Thus, in the adoption of home technologies, general technology acceptance dispositions may be secondary to the concerns parents have about changing their family practices.

### Only a minority of parents is in favor of location tracking

A small group of parents, 16%, were favorable toward location tracking (*persuasion stage*). Location tracking was seen as a tool to reduce uncertainty by providing constant information about children's movements (*uncertainty reduction* category). According to parents, this knowledge would ensure their children were safe and protected. Parents believed that children faced increasing environmental hazards indicating that risk perceptions are a primary driver in the intention to use location tracking (*security* category). Framed within this context, they felt that location tracking would reassure them and give them peace of mind (*anxiety* category).

The decision to track a loved one is often driven by the tracker's desire to relieve personal anxieties. This observation has resulted in concerns over the self-serving nature of tracking [2] [17] [21] [28]. The implication of this practice in our domain is disconcerting as parents' need to calm their short-term worries may cloud concerns over the long-term consequences that tracking poses on children's independence. Indeed, the self-serving nature of location tracking was pronounced in our findings. Parents reported high levels of anxiety. At the same time, adoption was not driven by objective measures of neighborhood safety, i.e., those living in more deprived neighborhoods were not more likely to favor location tracking. As Giddens [11] has argued, 'preoccupation with risk has little to do with life threatening conditions' and in the absence of a direct relationship between neighborhood deprivation and adoption, it seems that positive attitudes toward these technologies are formed on *perceptions* of risk as opposed to tangible and imminent dangers.

More generally, parents' accounts show that location tracking technologies are understood to be 'preventive innovations' that have the ability to reduce the risks facing children. Despite their positive attitudes, however, it is noteworthy that parents had not adopted these systems. The weak relationship between attitudes and behavior (or in the language of the diffusion of innovations theory, the persuasion and implementation stages) has been repeatedly documented in the social sciences. The motivational force of attitudes becomes even weaker in the context of preventive innovations as people ultimately understand the low likelihood of risks becoming dangers [30]. Therefore, not only does location tracking misrepresent the prevailing values of parenthood as we will describe next, but also its preventive function may introduce barriers even to those who are positively predisposed to adoption.

### Parents do not need location tracking

Just under half of our participants were positioned against the use of location tracking (*decision stage*). The control provided via location tracking was considered to be a threat to self-direction and trust (*trust and self direction category*). Parents wanted to preserve their children's ability to freely explore their environment without being judged. Similarly, trust was seen as a reliable mechanism for managing uncertainty and particularly vital for personal growth. Keeping children safe was equally important for parents, who established security through various means. After expressing a lack of need for location tracking (*need category*), parents went on to explain that they were generally aware of their children's whereabouts either through adult supervision, by relying on a trusted group of friends, agreeing to rules with their children or using mobile phones to keep in touch (*awareness and boundaries category*).

The reliable routines used by parents to keep their children secure questions the usefulness of location tracking as a purely preventive device. Nonetheless, knowing that one's family is safe is at the very core of parenthood and family life. Indeed, the application of the Whereabouts clock shows that designing to reassure parents that 'all is well' is not a misguided objective. The Whereabouts clock, however, was created with a holistic framework of values in mind. Contrasting the responses of the persuasion stage with those of the decision (reject) stage we find that the current paradigm puts security at center stage, while it undermines trust and self-direction. To address this problem, Boesen et al. propose developing richer privacy settings that will maintain trust and also allow family members to tailor the way they are perceived by others [2]. Follow up work has shown that family members refrain from using privacy settings precisely because they fear how their restrictive actions will be perceived by others [21].

Rogers has argued that technologists must engage people more actively in their current practices, giving them tools to be constructive and allowing them to have choice in their interactions [31]. In a similar vein, Brown et al. have proposed that designers of domestic technologies should be providing families with opportunities to 'do the work of being a family' [5]. Overlaying new controls onto the current paradigm may be a poor application of these sensibilities: firstly, as noted above it is dubious whether privacy settings address the question of choice; secondly, the main emphasis that commercial systems place on security and control certainly does not reflect the mores and practices of family life.

To this end, our data shows that monitoring is not the primary behavior through which families feel safe and connected. Although some of the methods parents applied to keep children secure indeed involved control (e.g. supervision), other practices (e.g., agreements on curfew or activity boundaries) represented negotiations between children and parents where uncertainty was omnipresent.

*Trust work* enabled these dynamic arrangements to take place. This balancing act has also been revealed in the uses of a ubiquitous family technology, mobile phones. When children are outdoors, parents tend to initiate communication with a view to reaffirm the agreements that support security [18] [24]. Children respect these contracts, but at the same time they are given the space to use uncertainty to their advantage in the telling of occasional white lies [18]. Systems that feature *spontaneous* location disclosure (e.g. checking-in) might be more reflective of this web of values and behaviors. By weakening the power relationship previously established through one-directional control [2], spontaneous location reports can give choice to children and nurture a sense of responsibility as well as honesty without stifling their freedom and autonomy. For parents, location information can provide peace of mind with the optional nature of sharing restoring or even strengthening their faith in their children.

### CONCLUSION

Academic and media discourse has expressed strong concerns about the control location tracking affords arguing that privacy in the family is becoming obsolete, e.g. [1] [22]. In articulating these harms, scholars often overlook people's agency in the partaking of technology. Critical to this debate should be the acknowledgement that our personal beliefs, needs and values are motivating forces in the technologies we choose to use [13]. As Dobson and Fisher [8] rightfully argue in relation to location tracking: 'parents who choose to protect their children through surveillance and location control now may do so in the extreme'. The social determinism encapsulated in this perspective is in line with what our study found: while some parents were ready to relinquish control in the service of self-direction and trust, others sought to reduce uncertainty in the name of security. Therefore, location tracking merely offers a new stage for enacting existing values and concerns, a stage that without doubt may amplify the effects of already harmful practices.

With this perspective in mind, parents willing to use these technologies with their children were a minority. This finding provokes new implications for the current research agenda that tends to study the uses of location tracking by recruiting novice family users, when indeed, the same families would be unlikely to voluntarily introduce these technologies at home. It also suggests that designers of commercial location tracking systems take a critical turn away from the current paradigm. Our findings provided some initial ideas to this end. We hope our work serves as a scaffold for moving forward with fresh prototypes, informed by further research, ethnographic and participatory, that can give us an even deeper understanding of the dynamic interplay of values taking place within this sensitive and multidimensional context.



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