Surveillance & Society

Article

How far can child surveillance go?
Assessing the parental perceptions of an RFID child monitoring system in Japan

Arisa Ema

University of Tokyo, Japan. a.ema22@gmail.com

Yuko Fujigaki

University of Tokyo, Japan. fujigaki@idea.c.u-tokyo.ac.jp

Abstract

There have recently been increasing numbers of studies on ubiquitous computing to build pervasive communication infrastructures. In Japan, a national strategy to become a ubiquitous network society in which anyone can easily access and use a network any time, anywhere and from any appliance, has been promoted for the sake of social security. A child monitoring system using radio frequency identification (RFID) is one example of a security system accepted by Japanese parents since 2004; the system informs parents of the exact time their child enters and leaves the school gate. Along with the technical development of RFID, the government and ubiquitous computing industries are suggesting various advanced monitoring systems to promote a ubiquitous network society. However, tagging people with an RFID always raises the controversy about the trade-off between security and privacy. In this article, by investigating parental perceptions of advanced child monitoring systems as an example, we aim to suggest an appropriate way to introduce ubiquitous security systems to the public. The findings indicate not only the need to consider the technical and regulatory frameworks, but also that relationships with actual users are essential for building ubiquitous security systems.

Introduction

Assuring security is one reason to justify introducing a surveillance system; however, "security" is an umbrella term. Some studies categorize security into objective and subjective conditions. For objective conditions, security indicates "without threat," "neutralization of threats" and "avoidance of danger"; and subjective security indicates "feeling safe" and "free from anxiety" (Kamisato 2004; Zedner 2006). These two conditions are correlated, but distinguishing them is essential when considering reasons how people perceives a surveillance system. Furedi discusses in his book that the obsession with "risks" should be critically examined (Freudi 1997). Equally, the obsession with "security" also needed to be examined with reference to certain situations and contexts. In particular, how security is perceived is significantly influenced by context and the relationship between the surveyor and the surveilled (Zedner 2003).

Michael *et al.* (2008) categorized typical combinations of "who monitors who" into six relationships: employee and employer, citizen and government, patient and doctor, individual and family, consumer and corporation, and individual and society. In this paper, we focus on the relationship between the individual

Ema, Arisa and Yuko Fujigaki. 2011. How far can child surveillance go? Assessing the parental perceptions of an RFID child monitoring system in Japan. *Surveillance & Society* 9(1/2): 132-148.
http://www.surveillance-and-society.org | ISSN: 1477-7487

and their family, especially on the relationship between children and their parents. We consider this relationship primarily because children currently under surveillance may grow more accustomed to surveillance than their predecessors. This might affect future generations (Dobson and Fisher 2003). In addition, this allows us to consider basic difficulties that a surveillance system contains, namely that caring and controlling are two sides of the same coin (Lyon 2001).

Under the rhetoric of child security and care, various information and communication technologies (ICTs) are introduced with economic, political and commercial interests (Wrennall 2010). The most well-known ICT is CCTV and many schools have introduced CCTV inside/outside schools (McCahill and Finn 2010). For more individualized security, Ground Positioning System (GPS) and Radio Frequency Identification (RFID) are well commercialized. In the United States, for example, students in some states wear an RFID chip embedded in small cards around their necks. RFID readers are installed where teachers and parents want to record the exact time of a child's location: the boarding of a school bus, entering the school gate, being in the classroom, and even in the bathroom.[1] Similar child monitoring systems have been introduced in South Korea[2] and Japan.

Among various examples of surveillance technologies, this paper examines parental perceptions of tagging children with RFID. Since around 2004, RFID child monitoring system has been introduced in many elementary schools as a security system at both the request of parents and through government initiatives in Japan. There has been little dispute over accepting RFID child monitoring system but the important question, "at what point does surveillance become un unacceptable form of control (Lyon 2007)," remains unexamined. The next section describes how economic, political and social initiatives interacted and shaped RFID child monitoring system in Japan. We then analyze parental perceptions of advanced child monitoring systems by questionnaire surveys collected from the parents of Japanese private elementary school children.

RFID Child Monitoring System: The Japanese Case

The Japanese government has supported a number of social experiments through national ICT strategies to realize a "ubiquitous network society" (Japanese Ministry of Internal Affairs and Communications 2007). In its use of the Western word *ubiquitous*, it does not merely indicate computers embedded everywhere, but envisions a society in which "anyone can easily access and use a network any time from anywhere and from any appliance (Ministry of Internal Affairs and Communications 2005)." This scheme not only emphasizes the importance of technical development but also considers social implications such as regulatory frameworks and public perceptions of ubiquitous computing (Sakamura 2006). Therefore, investigating public perceptions of ubiquitous computing such as RFID becomes essential in realizing a ubiquitous network society.

---

[1] In 2003, a small K-8 charter school in Buffalo, New York, introduced an RFID child monitoring system to record students arriving at school. This included a plan to track library loans, disciplinary records, cafeteria purchases and visits to the nurse's office (http://www.wired.com/science/discoveries/news/2003/10/60898). In 2004 in Spring, Texas, a few schools began monitoring student arrivals and departures using RFID chips to prevent the loss of a child through kidnapping or more innocent circumstances (http://www.nytimes.com/2004/11/17/technology/17tag.html?_r=1&oref=slogin). In 2005, a school in Sutter, California, used mandatory RFID chips to track students' movements. This was a pilot program to track students on the school grounds and in the washrooms (http://w2.eff.org/Privacy/Surveillance/RFID/schools/). However, in the last instance, parents and civil liberties organizations objected to the wearing of RFIDs, claiming this system invaded children's privacy (http://w2.eff.org/Privacy/Surveillance/RFID/schools/). In 2006, the Tucson Unified School District in Arizona tested a system called BusPass, which combines RFID and a GPS to track when and where students board and get off school buses (http://www.rfidjournal.com/article/articleview/2383/1/1/).

[2] In South Korea, some schools are introducing RFID child monitoring systems – see http://networker.jinbo.net/zine/view.php?board=networker_4&id=1608&page=2&category2=12&SESSIONID=0ca00649cc28fb9ccc84a3a30534cdcb (In Korean).

In Japan, interestingly, RFID child monitoring systems have been introduced as a result of demand from two sources since 2004: from government projects to realize a ubiquitous network society, and from parents and teachers to monitor children's behavior. The former, top-down governmental projects, promoted child monitoring systems in a series of social experiments on a ubiquitous network society. The system relays the exact time of a child's arrival at and departure from school to a parent's mobile phone through an RFID tag attached to a school bag. Through government subsidies,[3] public schools in villages and cities have been introducing RFID child monitoring systems.[4] At about the same time, in the latter bottom-up demand, a similar monitoring system was developed through the collaboration of a private elementary school in Tokyo and an IT company (Sato and Ishii 2004).

Most studies on RFID child monitoring systems in Japan have concluded that parents accepted these systems because their security requirements surpassed child privacy concerns (Nakano 2007). With close scrutiny of the term "security," some studies revealed that parents accepted these systems even if the system did not guarantee the "reality of security" for children such as preventing kidnapping or car accidents (Hibino, Kato and Ito 2007; Ema and Fujigaki 2008). In addition, privacy was less of a concern not only for parents, but also for children. Elementary school children regarded the system as not intruding on their privacy and expressed their feeling of security when watched over by their parents, though this feeling gradually declined in junior and high school students (Ema and Fujigaki 2008). In summary, current RFID child monitoring systems are accepted without controversy when applied only to elementary school children because it keeps away children from having a mobile phone, which is socially and physically a controversial security tool.

However, a study implied that some parents demanded an advanced monitoring system to obtain more information on their children any time and anywhere until they graduate from high school (Ema and Fujigaki 2009). Due to substantial governmental support, a number of security industries have been developing more advanced RFID child monitoring systems to cultivate the new market.[5] One reason this system has been promoted in Japan may relate to children's commuting styles. Unlike Western children, Japanese elementary school children traditionally go to school on foot without parents accompanying them, or use public transport since there is no school bus system. Thus, monitoring systems substitute for parents' watchful eyes in monitoring children's behavior.

Research questions

Will advanced monitoring systems be interpreted as favorable or unfavorable? If system preferences varied among parents, what would be the influencing factors in deciding whether to adopt such systems? What sociopolitical concerns regarding surveillance (if any) do parents have? To examine these questions about parental perceptions, we created six advanced RFID child monitoring scenarios with systems that could possibly appear on the market within the next 10 years. Compared with other methods, providing scenarios is an effective way to stimulate and influence public opinions since most people cannot presuppose future systems by themselves. By reading scenarios, respondents understand the contexts in which monitoring systems are required and how they actually operate.

---

[3] In 2007, the Ministry of Internal Affairs and Communications (MIC) budgeted nearly 12 million US dollars for child monitoring systems. In addition, the Liberal Democratic Party of Japan promised "popularizing child monitoring systems using RFID" in a manifesto in 2008 election.

[4] In a village in Gifu prefecture, three public elementary schools have introduced this child surveillance system since 2007 (http://www.soumu.go.jp/s-news/2007/pdf/070601_2_25.pdf). In Osaka prefecture, a city distributed RFID tags to the children in all seven public elementary school (3750 children in total) and introduced the system. (http://mytown.asahi.com/osaka/news.php?k_id=28000000708310001).

[5] It was expected that the RFID surveillance system market would grow to nearly 30 million US dollars in 2008 (Asahi newspaper, "RFID systems: detect pupils passing through a school gate and a preparatory school," 2006.8.28).

We investigated parents' perceptions of scenarios both quantitatively and qualitatively. For quantitative analysis, we examined a number of factors that influence the perception of systems. For the first factor, we investigated the influence of the scenario content by creating two versions of the same scenario; one explained only beneficial and fail-safe information about the system, while the other also informed of anxieties that might be caused by the system. We created two versions because these security systems are often explained only from the beneficial technical aspects, while the social aspects such as privacy and autonomy issues tend not to be mentioned: to sell the commodity, the system providers would be unlikely to mention sociopolitical issues associated with their products. In creating these two versions of scenarios, we seek to investigate what kind of differences appear.

The second to fourth factors studied were the influence of personal attributes on the perception of monitoring systems. Previous studies on the public understanding of other controversial technologies such as biotechnology implied that knowledge is essential if people are to decide whether to accept technologies, but a better understanding of science and technology issues will not automatically lead to an increased acceptance of technology (Evans and Durant 1995, Frewer *et al.* 1999). Rather, social context such as relationships between people will be adequate indicators of the acceptance of technology (Wynne 1992). Therefore, we examined the knowledge of RFIDs as a second factor and the parent-child relationship as a third factor. Among other relationships such as the parent-system provider, we regarded the parent-child relationship as an influential relationship that has rarely been studied quantitatively. To collect data quantitatively, we decided to examine this factor by asking parents about their perception of the parent-child relationship. In addition, for the last factor, we analyzed the peripheral factors such as environmental conditions concerning child security, and demographics.

For qualitative analysis, we categorized the pros and cons of the system from free comments on the scenarios. Investigating the reasons why parents accept or refuse monitoring systems would reveal parental concerns about child surveillance.

Method

Scenario designs

To investigate parental perceptions of child monitoring systems, we created six scenarios based on a commonly prevailing child monitoring system in Japan. It consisted of six elements as follows: (1) RFID readers are installed only in limited places such as at the school gate, (2) the RFID tag contains only a unique tag number and limited child information such as a name, (3) parents receive a text message when the RFID reader detects a child's tag, (4) only a few people such as parents or school teachers receive the text message, (5) the text message example is as follows: "XX (child's name) arrived/left school at YY:ZZ (time)," and (6) the RFID tag is attached to a child's school bag.

As an extension of the six elements of the current system described above, the six advanced scenarios are as follows: (1) RFID readers are installed everywhere in the whole town, (2) the RFID tag contains more personal information such as transportation pass data and medical records, (3) parents can send messages and alarms to children at any time and in emergencies, (4) children's information is shared with security guards, and with volunteer staff in the case of an emergency, (5) children's photos are available from monitoring cameras linked to RFID readers, and (6) an RFID is chip implanted under the child's skin. Ideas for scenarios were gathered from articles introducing the RFID systems of location based services (Garfinkel, Juels and Pappu 2005; Mayer 2003; Perusco and Michael 2007; Weinberg 2004) and future ubiquitous computing scenarios illustrated by the Japanese Ministry of Internal Affairs and Communications (Japanese Ministry of Internal Affairs and Communications 2006; 2007). Each of the six scenarios depicted a particular pathway to realizing a ubiquitous network society. All technologies in the scenarios could be applied within 10 years technically, and indeed some of them are already available, although they still remain to be examined socially.

To afford a better understanding of the scenarios, we provided a format of parents and engineers communicating when introducing each scenario[6] (Figure 1).

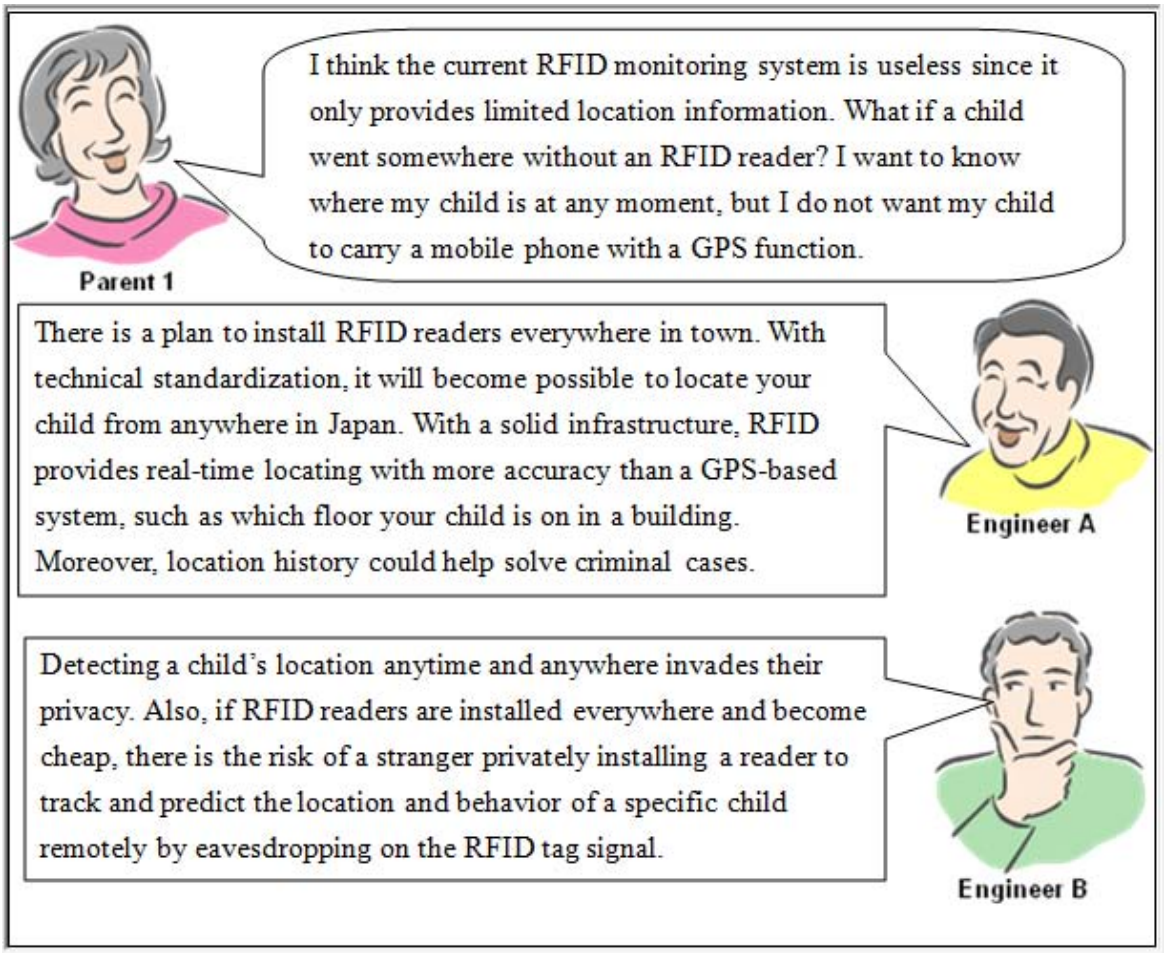

Fig. 1 Sample for scenario description

Respondents read the parent's anxiety and dissatisfaction with the current situation and the two engineers' responses: Engineer A only transfers beneficial, regulatory and technically fail-safe information such as employment of cryptographic systems; whereas Engineer B indicates the possibility of the abuse of technology and effectively accuses Engineer A of ignoring the problems other than technological issues. Table 1 briefly describes each scenario.

Questionnaire design

Parental perceptions of each advanced system were scored on a seven degree scale, from not favorable (-3) to favorable (+3). Using these preference scores, we conducted quantitative analysis with four factors. For the first factor, two versions of scenarios were prepared to investigate the influence of scenario content: in Version I, Engineer A only explains beneficial information, whereas in Version II, both beneficial and risk information are offered by Engineers A and B. For the next factor, knowledge about RFID, Table 2 shows a 10-item statement on the operation of RFID technology (1, 3-8, 10),[7] and a

[6] For clarity, scenarios were reviewed in advance by Parent-Teacher Association officials at a private school who assessed whether these scenarios were understandable for non-experts.

[7] Because most of the child monitoring systems employ active RFID tags, questions here feature it.

statement related to Japanese Personal Information Protection Law (2, 9).[8] Parents were to choose whether each sentence was "correct," "wrong" or "don't know." If they answered correctly, one point was scored, up to a possible ten points.

Scenario 1 Increasing the number of RFID readers	
Parent 1	Complaint about limited location information
Engineer A	Increase monitoring spots by installing RFID readers in the whole town to detect a child's location any time and anywhere
Engineer B	It is possible a child will feel an invasion of privacy. Also a child's location might be tracked by a stranger eavesdropping on RFID tag signals
Scenario 2 Increasing the amount of information in the tag	
Parent 2	Requirement for multi-purpose RFID tags
Engineer A	Add more personal information (e.g. transportation passes and medical records) in RFID tags for convenience and emergency measures. The information inside is protected by cryptographic systems, so there is no need to be concerned about information leaks
Engineer B	It is possible a child's information can be identified by combining it with other information, even if it is coded technically. Also, if a child lost the tag, a stranger could use it
Scenario 3 Sending an alarm and sound	
Parent 3	Requirement for two-way communication with RFID system
Engineer A	Include an alarm and voice messenger in the child's RFID tag to enable pseudo-two-way communication. Linked to RFID readers, the alarm beeps and sends a message automatically to parents when a child goes into an unsafe place
Engineer B	It is possible for the messages to be wiretapped. Furthermore, it may be harmful to a child's autonomy to become accustomed to being controlled remotely
Scenario 4 Sharing child information	
Parent 4	Complaint that it is useless in the case of actual danger to the child
Engineer A	Share the child's information with volunteer staff in the community, or security guards, in the case of emergency. It is possible to limit access authority to specific people
Engineer B	It is possible the information could be abused by stalkers, or information about the child misused for commercial purposes by expanding access to information about the child
Scenario 5 Receiving photos	
Parent 5	Complaints about receiving a text message simply with a location but without context
Engineer A	Link monitoring cameras to RFID readers and take a child's pictures when they approach. Monitoring cameras would inform not only about child's behavior and context, but also help in an emergency
Engineer B	It will possibly invade privacy by including other objects in the pictures taken. Children might feel stressed by being constantly monitored
Scenario 6 Implanting an RFID chip	
Parent 6	Anxiety about the tag being misplaced, either by forgetting it, losing it, or it being removed
Engineer A	Implanting RFID chip under the skin prevents a child forgetting to wear the RFID tag or it being removed by offenders. Many experiments and studies proved that there is no physical influence and it can be removed when the child grows up. It is already practiced in medical practices and for personal identification in other countries
Engineer B	It could have a radio wave effect on the child's body, there are human rights issues and/or physical harm by trying to remove it using a knife could occur

Table 1 Brief descriptions for six advanced monitoring scenarios with parent and engineers

[8] Questions No. 2 and 9 referred to "Guidelines for Privacy Protection with Regard to RFID Tags" published by the Ministry of Internal Affairs and Communications and the Ministry of Economy, Trade and Industry, Government of Japan, 2004 (http://www.rfidconsultation.eu/docs/ficheiros/JP_RFID_PrivacyGLsRev_METI.pdf).

Questions	Answer
1. RFID runs on batteries and need to be replaced every year	Correct
2. RFID providers are not obliged to inform the tag users when they collect and utilize the user's information from the tag	Correct
3. RFID emits radiation only when it goes through the school gate and when a button attached to the tag is pressed	Wrong
4. Wireless communication is coded in the current child monitoring system's RFID tag	Wrong
5. RFID radiation can be detected from more than 30 meters away	Correct
6. RFID radiation does not harm human body	Correct
7. The unique RFID number can be changed by a special rewriter	Wrong
8. RFID radiation is not blocked by thick walls and metal	Wrong
9. Even if information in the RFID tag alone is insufficient to identify a person, the information in the tag is treated as personal information protected by the Personal Information Protection Law if that personal information can be associated with another information database that can identify the person	Correct
10. RFID frequency ranges are different from those of medical devices	Correct

Table 2 Questions and answers on RFIDs

To examine the third factor, parental perception of the parent-child relationship, we adopted a 42-item inventory called the "Parental Role Assessment Scale" created by Tanii and Kamichi (Tanii and Kamichi 1993). It requires respondents to rate their perceptions of parental role on a four-point scale ("Very Unlikely" to "Very Likely," scored 1-4). Factor analysis on the inventory generated six factors: control, acceptance, separation-anxiety, facilitation of independence, assistance with social adaptation, and confidence in nurturing, which was the same as previous studies of Tanii and Kamiichi. Table 3 lists sample statements, the number of items and Cronbach's alpha of each factor.

The last factor pertained to the child security conditions in the environment, and demographics. That is, the child's commuting environment, and demographic variables of both parents and children.

Factors	Sample statements	Items	Cronbach's alpha
Control	I am always nagging my child	8	0.83
Acceptance	I like talking with my child	8	0.69
Separation-anxiety	I feel lonely in my child's absence	8	0.74
Facilitation of independence	I think my child can deal with difficulties by him/herself	6	0.68
Assistance of social adaptation	I always help with my child's homework and would like to look after him/her continuously	8	0.70
Confidence in nurturing	I feel sorry for my child for the way I treat him/her (reverse statement)	4	0.75

Table 3 Factors from the Parental Role Assessment Scale: samples of the wording of statements, item numbers and Cronbach's alpha

Participants and procedure

The sample for the current study was collected from a private elementary school in Tokyo, Japan in November 2008. There were 373 elementary school children from years one to six, and the number of households was 333.[9] The school was one of the pioneers that first introduced the current child monitoring system in 2005. The system they introduced consists of the basic six elements explained

[9] If two or more children in a family were attending the same private school, we asked parents to complete only the questionnaire which the youngest child brought home.

above: the number of RFID readers, information in the tag, the content of a text message and accessibility to the message are all limited and the RFID tag is attached to a child's school bag. An RFID tag costs about 30 US dollars and the system provider charges parents about 10 US dollars monthly for the maintenance. As a private Christian school, it is safe to say that most students belong to the typical upper middle class and so their parents are both able and not reluctant to pay the monthly fees. We chose this school expecting that parents as early users would understand child monitoring systems sufficiently and could evaluate them appropriately.

We asked school teachers to distribute the questionnaire to parents via children. Because the school had two classes in each grade, we handed scenario Version I (only Engineer A explains) to one class (n = 166) and Version II (both Engineers, A and B, explain) to the other (n = 167). The response rate was 78.92% (n = 131) and 82.04% (n = 137) respectively (see Table 4 for details of the demographics of the participants).

Demographic characteristics (Parent) *n* = 268		**Respondents % (n)**
Gender	Male	15.00 (40)
	Female	85.02 (227)
Age	Under 35	10.19 (27)
	36-40	33.21 (88)
	41-45	36.21 (96)
	46-50	15.85 (42)
	Over 51	4.53 (12)
Education Level	Less than high school	2.26 (6)
	High school grad	10.90 (29)
	College grad	73.68 (196)
	Graduate or Prof. school grad	12.41 (33)
Number of children	One	46.64 (125)
	Two	43.28 (116)
	Three or more	10.08 (27)
Demographic characteristics (child)		
Gender	Male	52.07 (138)
	Female	47.93 (127)
Grade	One	16.04 (43)
	Two	16.42 (44)
	Three	19.03 (51)
	Four	17.54 (47)
	Five	19.78 (53)
	Six	11.19 (30)

Table 4 Demographics of study population. If the respondent had two children or more, the information about the youngest child was used.

Analysis

This study focused on the parental perceptions of advanced child monitoring systems. First, we compared "preference scores" between the current monitoring system and advanced systems. Second, to investigate factors that influenced the preference scores, we conducted quantitative analysis including four factors for each of the six scenarios: (i) difference between the scenarios provided, (ii) knowledge about RFIDs, (iii) parental perception of the parent-child relationship, and (iv) child security conditions in the environment, and demographics. Finally, to explore qualitatively, we categorized comments for the six scenarios written in the free space provided, into four attitudes: complete acceptance, conditional acceptance, resistance and indecisiveness. We described each of the six scenarios using the capital letter S with numbers zero to six; S0 indicated the current system. The questionnaire was conducted in Japanese and translated into English by the authors.

Results

Quantitative findings: Preference scores of scenarios

Of the seven degree scale from -3 to 3, the current monitoring system (S0) was the most acceptable, with average scores of 2.56 (SD = 0.79). Whereas 69.76% of respondents scored "most favorable (+3)" to the current system, the *Advanced scenarios* preference scores diffused and their standard deviations (SD) were higher. *Increasing the number of RFID readers* (S1) was the next most acceptable with average scores of 1.07 (SD = 1.77) and the average for *Implanting an RFID chip* (S6) was the lowest score of -1.70 (SD = 1.66) with 53.52% of respondents scoring "most unfavorable (-3)." In between was *Increasing the amount of information in the tag* (S2), *Sending an alarm and sound* (S3), *Sharing child information* (S4), and *Receiving child photos* (S5) with average scores (SD) of 0.65 (1.85), 0.37 (1.92), 0.23 (1.88), -0.28 (1.90), respectively. Figure 2 describes each scenario's preference score distribution.

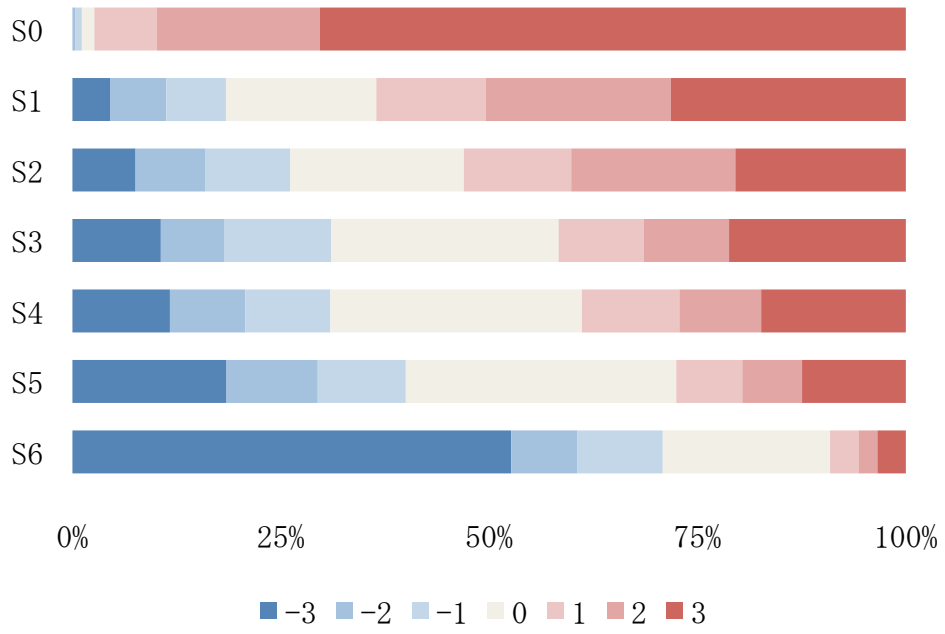

Fig. 2 Preference scores for each scenario

Factors influencing preference scores

In this section, we investigate what factors influenced each of the six scenarios' preference scores. First, the *t* test result showed that for all six scenarios, responses to Version I, with beneficial and fail-safe information, scored significantly higher than responses to Version II with both risk and benefit information (Table 5). However, the numerical value of each version's standard deviation was close or the same. This indicates that although differences between the explanations provided in the scenarios influenced the average score for system preference, their score distribution remained the same regardless of the information provided.

Second, correlations between each preference score and RFID knowledge score were investigated. The score distribution of RFID knowledge was normal (Mean =4.37, Mode =5). The result was not statistically significant for any scenario, suggesting that more knowledge about RFID did not relate to system preferences. In addition, *t* test results showed that the RFID knowledge score and the difference between scenario versions (I or II) was also not statistically significant ($t = 0.84$, $p = 0.40$). This implies that the

differences between respondents' RFID knowledge scores were not influenced by the information provided in the scenarios.

Scenario	Version	n	Average score	SD	*t*	p
S1 Increasing the number of RFID readers	I	131	1.73	0.15	-6.25	<0001
	II	135	0.45	0.14		
S2 Increasing the amount of information in the tag	I	127	1.38	0.15	-6.77	<0001
	II	137	-0.05	0.15		
S3 Sending an alarm and sound	I	129	1.21	0.15	-7.93	<0001
	II	135	-0.48	0.15		
S4 Sharing child information	I	129	1.14	0.15	-9.01	<0001
	II	136	-0.69	0.14		
S5 Receiving photos	I	130	0.50	0.15	-7.17	<.0001
	II	135	-1.04	0.15		
S6 Implanting an RFID chip	I	129	-1.13	0.14	-5.20	<0001
	II	135	-2.16	0.14		

Table 5 Results of the t test for scenario version difference (I or II)

Third, the correlation between system preference scores and parental perceptions of the parent-child relationship were investigated. Each factor of the Parental Role Assessment Scale correlated differently with each advanced system as Table 6 shows. Except for the system that *shares child information* (S4), all systems significantly and negatively correlated with the factor of "confidence in nurturing." Other than that, "assistance with social adaptation" (S1, S2 and S5), "separation-anxiety" (S3 and S5), and "control" (S3) correlated positively.

	S1		S2		S3		S4		S5		S6	
	r	p	r	p	r	p	r	p	r	p	r	p
Control	.11	.07	.13	.04	**.19**	*	.06	.36	.12	.05	.09	.13
Acceptance	-.02	.79	.02	.69	-.02	.77	.00	.94	-.01	.81	-.16	.01
Separation-anxiety	.09	.14	.16	.01	**.17**	*	.13	.04	**.20**	**	-.02	.77
Facilitation of independence	-.04	.51	-.03	.66	-.13	.04	-.07	.27	-.04	.48	-.07	.25
Assistance with social adaptation	**.22**	**	**.17**	*	.15	.01	.08	.20	**.22**	**	.08	.17
Confidence in nurturing	**-.22**	**	**-.19**	*	**-.23**	**	-.14	.03	**-.17**	*	**-.21**	**

*p<01,** p<001

Table 6 Correlation between factors from Parental Role Assessment Scale and the six scenarios. Bold indicates statistically significant figures.

Lastly, we examined whether the environmental conditions concerning child security and demographic factors influenced preference scores. The environmental conditions of child security were investigated by four Yes/No questions: "Has your child actually faced danger such as being spoken to by a suspicious-looking person?" (Yes = 32.26%, No = 67.74%); "In the case of emergency, are there any relatives or persons other than parents whom children can trust and visit by themselves?" (Yes = 82.13%, No = 17.87%); "Do you chauffeur your child to and from school or the nearest station/bus stop?" (Yes = 84.59%, No = 15.41%); and "Does your child carry some security tools such as a mobile phone with a GPS system?" (Yes = 31.06%, No = 68.94%). The results showed that *t* tests for all four questions were statistically not significant through S0 to S6. In addition, other questions seeking quantitative data, such as

"How long does it take your child to get to school?"; "How much time does your child spend with parents in a day?" and "How much can you afford to spend on a child security system?" also had no significant correlations through S0 to S6. For demographic factors, children's age and gender were not statistically significant.[10] Parent's age, number of children, and academic education were also not statistically significant. However, parents' gender was statistically significant only for the current system (S0) and mothers tended to score higher than fathers (t = 3.63, p = .0003). There were no correlations with the six advanced systems.

Among the four factors described above, the results showed that only scenario version differences and some of the factors of the Parental Role Assessment Scale influenced system preferences. To investigate which factors influenced the preference for advanced monitoring systems most, regression analysis was conducted on the models as follows: only analyzed by scenario patterns (Model 1); Model 1 plus the most significant factor of the six Parental Role Assessment Scale (Model 2); and Model 2 plus the next significant factors of the Parental Role Assessment Scale illustrated in Table 6 (Models 3 and 4, if three factors correlated).

		R sq.	F change	Sign. F
S1 Increasing the number of RFID readers	Model 1	0.12	39.12	<.0001
	Model 2 (+Assistance with social adaptation)	0.17	28.51	<.0001
	Model 3 (+Confidence in nurturing)	0.18	21.03	<.0001
S2 Increasing the amount of information in the tag	Model 1	0.15	45.78	<.0001
	Model 2 (+Confidence in nurturing)	0.16	25.70	<.0001
	Model 3 (+Assistance with social adaptation)	0.18	20.31	<.0001
S3 Sending an alarm and sound	Model 1	0.19	62.94	<.0001
	Model 2 (+Confidence in nurturing)	0.22	36.76	<.0001
	Model 3 (+Control)	0.22	24.80	<.0001
	Model 4 (+Separation-anxiety)	0.24	20.41	<.0001
S4 Sharing child information	Model 1	0.24	81.22	<.0001
S5 Receiving photos	Model 1	0.16	51.35	<.0001
	Model 2 (+Assistance with social adaptation)	0.21	35.39	<.0001
	Model 3 (+Separation-anxiety)	0.22	23.03	<.0001
	Model 4 (+Confidence in nurturing)	0.23	19.12	<.0001
S6 Implanting an RFID chip	Model 1	0.09	27.06	<.0001
	Model 2 (+Confidence in nurturing)	0.11	16.89	<.0001

Table 7 Regression analysis of system preference scores. Model 1 is the different versions of the scenario. Model 2 adds the most significant factor in the Parental Role Assessment Scale, to Model 1. Model 3 and 4 add the next most significant factors

[10] If a respondent had two children or more, the youngest child's attributes were taken for analysis.

Table 7 shows that the scenario pattern difference (Model 1) was the stronger independent predictor for preference score on every advanced system, since Model 1 added most to the prediction of system preferences. Model 1 explains 12-24% of the variance in system preferences. Models 2 to 4, added with factors from the Parental Role Assessment Scale, explained less compared with the scenario difference described in Model 1 (1-5% of the variance). This result suggests that among these factors, the scenario difference provides the most influence on the scenarios' preference scores, and parental perceptions of their relationship with their children have secondary influence on preference scores.

Qualitative findings

We examined respondents' free-comments to investigate the contents of the pros and cons of advanced monitoring systems. Table 8 shows the number of comments for each scenario. About half of the respondents commented on each scenario and the *t* test showed that the number of responses to Version II was significantly larger ($t = 4.60$, $p = .001$). This implies that when provided with controversial information, people tend to express more opinions than when provided with beneficial information.

We list typical pro and con comments below. The parentheses after each comment indicate the preference score, the scenario number, the scenario pattern, and children's school grade, in that order. First, we introduce comments from favorable respondents. They regarded child security as the issue with the highest priority, other than child privacy:

> I think monitoring children at least until high school would enable them to cope with dangers such as drugs, alcohol and flirtation. The RFID tag is a tool to assist supervising children. (+3, S3, II, Year 6)

> It is not that we are doing the wrong thing; I think there is no problem in using these systems. I am also happy to know how my child is behaving. (+3, S5, II, Year 1)

They also regarded it as impossible to omit completely the problems with the technology and accepted a compromise:

> Excessive anxiety about the misuse of technology would prevent us from using effective systems. I expect these technologies to develop. (+2, S2, II, Year 1)

> Anxiety about the abuse of technology is endless, so I value this system. (+3, S2, II, Year 6)

System	Version	No. of Comments	(%)
S1 Increasing the number of RFID readers	I	71	55.47
	II	90	68.18
S2 Increasing the amount of information in the tag	I	57	44.53
	II	82	62.12
S3 Sending an alarm and sound	I	57	44.53
	II	76	57.58
S4 Sharing child information	I	62	48.44
	II	72	54.55
S5 Receiving photos	I	64	50.00
	II	76	57.58
S6 Implanting an RFID chip	I	67	52.34
	II	77	58.33

Table 8 Number of free comments

Others also appreciated the systems but faced dilemmas as well. Therefore, parents set various conditions on their acceptance of a system, such as the child's agreement, the child's age, technical development and regulatory frameworks:

> Although this system is convenient, I am afraid that this would reduce communication between children. However, the system would be effective if mutual consent between children and parents was obtained. (+2, S1, I, Year 3)

> I think child security is the most important thing and privacy is in second place. However, how many measures parents have to take would change according to the child's age. In addition, the technology should be developed so that a stranger cannot identify my child. (+2, S1, II, Year 2)

> I am anxious about information leaks and abuse; however, today the fear of indiscriminate attack on children is about more than that. Therefore, I expect urgent development of technical protection. Some experts say that encoding technology should be renewed, and I expect the development of technology. (+3, S2, II, Year 2)

> In the case of a child facing danger, a police officers' or guards' rescue system would be helpful for busy parents. However, rescuers should be identified and controlled by creating strict guidelines. (+1, S4, II, Year 2)

On the other hand, those opposing the use of the system took the child's privacy or autonomy to be the most prioritized issue. They were afraid of miscommunication between children by introducing the system, which might lead to a loss of human dignity:

> Obtaining limited information about the child is enough. Making rules between a school and parents, parents and children would work in the case of emergency. Introducing ICT too much will weaken local relationships. (-3, S1, II, Year 4)

> Although I am anxious about my child becoming a victim of crime, controlling a child too much sounds like an experiment on mice. Children have to learn to protect themselves, and predict risks. It is unsatisfactory to think of solving problems by introducing new technology. (-2, S1, II, Year 5)

> A weak radio wave will be harmful to children both physically and mentally. Moreover, this system is too controlling. It will deprive a child of privacy. A child is not a subject to control, but a human being with individuality. A child is neither a robot nor a parent's property. (-3, S6, I, Year 3)

In addition, the necessity for technology was questioned:

> The system does not address the cost since the risks of the misuse of technology cannot be avoided completely. Too much control is also annoying. (-2, S1, II, Year 5)

> The system's effectiveness is unclear since knowing a child's location does not lead to the child's actual safety. (+1, S1, II, Year 5)

> I expect a minimum level of child security, so I do not need complex technology. I do not want to risk my child being exposed to criminals using ICT by introducing a non-essential system. (-1, S2, II, Year 1)

However, many parents hesitated to comment that the system is completely unnecessary. On the contrary, they evaluated the system very highly but because of that, they were afraid of becoming dependent on it and invading too much of their child's privacy:

> On the one hand, I really appreciate the system, but on the other hand, I am afraid of becoming too dependent on the system and might feel anxious when a message does not come at the expected time. (-1, S1, II, Year 3)

> The system might sound excessively controlling of children, but as a parent, I want to know about all my child's behavior, so it is difficult to decide the pros and cons. (+1, S6, I, Year 4)

Also, some parents stated that it is not necessary "now," but the system might be required in the future.

> I think the situation nowadays in Japan does not require this kind of system. From the aspect of a child's human rights, too much surveillance and control is undesirable; however, if social conditions change, the system might be required. (0, S6, II, Year 1)

Discussion

The findings from the questionnaire survey raised some important issues about the difference between the current and advanced systems. Compared with the broadly diffused scores of the six advanced systems, about 70% of parents scored the current system (S0) "most favorable (+3)." Despite this support for the current system, the evaluation of this system was controversial when it was first introduced. However, previous studies indicated that once a system is introduced and people become accustomed to it, most parents become dependent on it and tend to make comments such as "I cannot imagine life without this monitoring system now" (Ema and Fujigaki 2009). Therefore, examining systems before actually introducing them is useful when evaluating them later from a distance.

Figure 2 shows that the majority of parents were favorable to the system of *Increasing the number of RFID readers* (S1) and *Increasing the amount of information in the tag* (S2). Since the concept of increasing location and personal data is familiar with other devices such as GPS or PDA, these systems have the potential to become the next standard of child monitoring systems. Preference scores on the system of *Sending an alarm and sound* (S3), and *Sharing child information* (S4) were almost equally divided between favorable, unfavorable and indecisive attitudes. However, the number of opponents increased slightly when it came to the system of *Receiving photos* (S5). This implies that visual information is considered much more seriously than text information from the aspect of surveillance. Lastly, for *Implanting an RFID chip* (S6), the majority of parents scored "most unfavorable (-3)." This suggests the difficulty in promoting this system unless antipathy to body modification is eradicated.

Each scenario's preference score was diffused and quantitative analysis illustrated that the difference between the scenarios provided was one factor that influenced preference scores. The result showed that the average score for every system was statistically lower when risk information was provided; however, as we find from qualitative comments, some parents scored high even if they were provided with risk information. These results imply that even if parents are given unfavorable information about the systems, they will not immediately reject it. On the contrary, if they regarded the system as worthwhile despite its risks, they compromised and valued it. Therefore, this suggests that although providing both risk and beneficial information may degrade preference, it enables parents to pre-examine the system and let parents choose what they prioritize most. In addition, the result implies that better understanding and more

technological and legal knowledge would not lead to a preference for the system.[11] Rather than the amount of information and knowledge, parental perception towards parent-child relationship seems essential of assessing a monitoring system.

Other than varying the scenarios, some factors from the Parental Role Assessment Scale affected preference scores. Among them, "confidence in nurturing" correlated negatively with five out of six systems. This suggests that systems were accepted by parents who want to compensate their parenting skills by technological aid. Monitoring systems offer responsible and caring parenting with convenience even without their physical presence (Marx and Steeves 2010). Other positively correlated factors such as "assistance with social adaptation," "separation-anxiety" and "control" also represent parental desire for commitment with children by obtaining more precise information (S1, S2, S5) or controlling remotely (S3). However, the *Sharing child information* system (S4) bore no relation to the factors of the Parental Role Assessment Scale. Compared with other systems that complementing parenting skill only by technology, S4 was designed to involve people such as security guards and volunteers as well. Probably because involving others goes beyond parenting skill and role, no factors from "Parental Role Assessment" scale had relevance with S4.

From the result of fourth factor, we found that the environmental conditions concerning child security and children's demographic factors had no correlation to parents' preference scores. This implies that parents do not expect the system to assure children's "reality of security"; rather, they pursue their own "feeling of security" by obtaining information about their children through the system. For example, if these systems are regarded as assuring children's "reality of security," and as being capable of protecting their children from physical danger, systems would be favored by parents whose children actually faced danger before and probably children in a lower grade. However, the result showed no significant correlations to all systems. This idea that parents favor systems that assure their own "feeling of security," was supported by qualitative comments by parents. Parents who are in favor of monitoring systems tend to express emotional term such as "happy," "fear" and "anxious" to explain the necessity of the system. On the contrary, parents who are against the system focus on factors such as the "cost" and "effectiveness" of the system, which doubt whether the system really contributes to children's actual security.

In addition to the quantitative investigations that focused on factors that may influence preference, qualitative comments reveal various parental concerns about the surveillance system for children. Parents are conscious not only of technological problems but also how their relationship with children would be influenced by introducing the monitoring system. This implies that parental ideas of appropriate security systems depended on how they viewed their children's skill to cope with danger, or in other word, the problem of trust (Rooney 2010). On the one hand, parents feared that introducing security systems would spoil children's skill to avoid danger by themselves; on the other hand, they appreciated systems that enabled parents to take care of their children. The former parents were facing a dilemma: they wanted to remove in advance, dangers and fears that a child might face, but they also felt that children need to learn what risk is by themselves, and cope with it. Therefore, "communication between children" and "mutual consent" becomes important issues. On the other hand, the latter parents tended to feel that children cannot cope with risks by themselves. From their perspective, parents have a duty to monitor and guide children, so children's autonomy was not respected. For them, the monitoring system would be an extension of their eyes to watch over children and it is parents' responsibility to keep an eye on them. From this perspective, there is no space for children to give voice. However, the definition of "children" varies from person to person. To consider the future of these child monitoring systems, these comments of

[11] Because the research subjects were all parents of children at a school which has been actually using an RFID system in place, a preference of them, early users, might be biased. A comparison study with a school without an RFID monitoring system would be useful to discuss this point further. In that case, scenarios created in this paper would help system non-users to grasp images of monitoring systems.

pros and cons needed to be discussed not only on technological and commercial dimensions but also from these social and local dimensions.

Conclusion

In this paper, we aimed to provide some insights into introducing child surveillance systems by investigating parental perceptions of advanced child monitoring systems and the factors influencing their preferences. Compared to the existing monitoring system (S0), the preference towards advanced monitoring systems was broadly diffused. This suggests that we are in the middle of the discussion to choose how far we could go on child surveillance. In other words, we revealed some ambivalent attitudes towards parents' idea to monitor children. For example, how should parents deal with trusting their children's ability to deal with danger? This dilemma always appears when parents monitor their children (Fotel and Thomsen 2004). In addition, when discussing this dilemma, the paper suggests that it is important to question what kind of "security" the system assures. Are parents aware of the difference between objective and subjective security? Do they demand the monitoring system knowing that it only assures their "feeling of security"? Do system providers offer enough information to parents regarding technological and social concerns arising from the monitoring system?

To briefly investigate the last question, we would like to introduce a compact guidebook which the Japanese Ministry of Internal Affairs and Communications published for introducing a child monitoring system for the local community in 2009 (Japanese Ministry of Internal Affairs and Communications 2009). There, under the friendly name of "security," the necessity for a monitoring system was taken for granted and sociopolitical issues of surveillance were excluded from issues to be discussed; that is, they have been promoting systems by explaining how beneficial monitoring systems are to obtain parents' "feeling of security," not mentioning "reality of security" and trust problems between parents and children.

As we have suggested, parental perceptions of assessment of the perception on advanced child monitoring systems are still diffuse. Therefore, further discussion on this social problem as well as on technical and regulatory problems is essential. Table 8 implies that one procedure to open discussion to the public is to provide not only beneficial information but also risk information. Providing both kinds of information assists people to express their views. Arguably, results in this paper would be interpreted within the limited context of child protection measures in Japan; however, the desire for RFID security systems is not unique to Japan and not limited to child security. Since a child monitoring system has the potential to be extended as a public monitoring system, this article provides some insights into introducing a ubiquitous security system for the public.

Acknowledgements

We thank parents and teachers of a private school for conducting the questionnaire survey. This work was partly supported by the Japan Society for the Promotion of Sciences (JSPS).

References

Dobson J.E., Fisher, P.F. 2003. Geoslavery. *IEEE Technology and Society Magazine* Spring: 47-52.

Ema, A. and Fujigaki, Y. 2008. How information and communication technologies effect to "safety" and "privacy"?: Case study of RFID surveillance system to Japanese school children. Proceedings of 7th Science and Democracy Network Annual Meeting.

Ema, A. and Fujigaki, Y. 2009. How to balance "privacy issues" and "safe and security?: Case study of using RFID tag child surveillance system. *Journal of Science and Technology Studies* 7: 195 – 211 (Japanese).

Evans G, Durant J. 1995. The relationship between knowledge and attitudes in the public understanding of science in Britain. *Public Understanding of Science* 4: 57-74.

Fotel T, Thomsen T.Y. 2004. The surveillance of children's mobility. *Surveillance & Society* 1: 535-554.

Frewer L.J., Howard, C., Hedderley D., Shepherd R. 1999. Reactions to information about genetic engineering: impact of source characteristics, perceived personal relevance, and persuasiveness. *Public Understanding of Science* 8: 35-50.

Furedi, F. 1997. *Culture of Fear: Risk-taking and the Morality of Low Expectation*. Continuum International Publishing Group Ltd.

Garfinkel, S.L., Juels, A., Pappu R. 2005. RFID Privacy: An overview of problems and proposed solutions. *IEEE Security and Privacy Magazine* 3: 34-43.

Hibino A., Kato, K., Ito, K. 2007. A watch over system for children based on radio frequency identification technology in Japan: Information Technology in a surveillance society. *Journal of Group Dynamics* 24: 60 – 79 (Japanese).

Japanese Ministry of Internal Affairs and Communications. 2006. Sample of child surveillance system utilizing a ubiquitous network technology. http://www.soumu.go.jp/s-news/2006/060330_3.html. Accessed 22 December 2009 (Japanese).

Japanese Ministry of Internal Affairs and Communications. 2007. Adoption of cases of model child surveillance system. http://www/soumu.go.jp/s-news.2007/070330_18.html. Accessed 22 December 2009 (Japanese).

Japanese Ministry of Internal Affairs and Communications. 2009. Guidebook for introducing child monitoring system. http://www.soumu.go.jp/menu_news/s-news/2009/pdf/090109_2_tb.pdf. Accessed 22 December 2009 (Japanese).

Kamisato, T. 2004. "Anzen / Anshin" discourses and its background. *Journal of Japanese Science and Technology Studies* 3: 71 – 84 (Japanese).

Lyon, D. 2001. *Surveillance society: Monitoring everyday life*. Buckingham, England: Open University Press.

Lyon, D. 2007. *Surveillance Studies: An Overview*. Cambridge: Polity Press.

Mayer R.N. 2003. Technology, families, and privacy: Can we know too much about our loved ones? *Journal of Consumer Policy* 26: 419-439.

Marx, G. and Steeves, V. 2010. From the Beginning: Children as Subjects and Agents of Surveillance. *Surveillance & Society* 7(3/4): 192-230.

McCahill, M. and Finn, R. 2010. The Social Impact of Surveillance in Three UK Schools: 'Angels,' 'Devils' and 'Teen Mums.' *Surveillance & Society* 7(3/4): 273-289.

Michael, M.G., Fusco, S.J. and Michael, K. 2008. A research note on ethics in the emerging age of uberveillance. *Computer communications* 31: 1192-1199.

Ministry of Internal Affairs and Communications (eds). 2005. *u-Japan policy*. Tokyo: Gyousei (Japanese).

Nakano, K. 2007. *Social safety system*. Tokyo: Denki University Press (Japanese).

Perusco, L. and Michael, K. 2007. Control, trust, privacy, and security: Evaluating location-based services. *IEEE Technology and Society magazine,* Spring: 4-16.

Rooney, T. 2010. Trusting Children: How do surveillance technologies alter a child's experience of trust, risk and responsibility? *Surveillance & Society* 7(3/4): 344-355.

Sakamura, K. 2006. *Building the next generation social infrastructure with ubiquitous computing*. Tokyo: University of Tokyo Press (Japanese).

Sato, M. and Ishii, T. 2004. Assuring child safety by active RFID tag. *FINIPED* 5: 12 – 14 (Japanese).

Tanii, J. and Kamichi, Y. 1993. Parental role assessment scale based on the self-rating of the parents of junior or senior high school students. *Japanese Journal of Counseling Science* 26: 113 – 122 (Japanese).

Weinberg, J. 2004. *RFID and privacy.* http://ssrn.com/abstract=611625. Accessed 22 December 2009.

Wrennall, L. 2010. Surveillance and Child Protection: De-mystifying the Trojan Horse. *Surveillance & Society* 7(3/4): 304-324.

Wynne, B. 1992. Misunderstood misunderstanding: social identities and public uptake of science. *Public Understanding of Science* 1: 281-304.

Zedner, L. 2003. Too much security? *International Journal of the Sociology of Law* 31: 155-184.

Zedner, L. 2006. The concept of security: an agenda for comparative analysis. *Legal Studies* 23: 153-175.