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# Developing Digital Privacy: Children's Moral Judgments Concerning Mobile GPS Devices

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RUNNING HEAD: DIGITAL PRIVACY

**Abstract**

New technology poses new moral problems for children to consider. We examined whether children deem object-tracking with a mobile GPS device to be a property right. In three experiments, 329 children (4-10 years) and adults were asked whether it is acceptable to track the location of either one's own or another person's possessions, using a mobile GPS device. Young children, like adults, viewed object tracking as relatively more acceptable for owners than non-owners. However, whereas adults expressed negative evaluations of someone tracking another person's possessions, young children expressed positive evaluations of this behavior. These divergent moral judgments of digital tracking at different ages have profound implications for how concepts of digital privacy develop, and for the digital security of children.

Developing digital privacy: Children's moral judgments concerning use of mobile GPS devices

Mobile tracking devices have become more widely used, inconspicuous, and precise in recent years. These include special "item finders" that can be placed directly on valuable objects such as wallets or keys; mobile applications that can indicate where someone's computer, tablet, or phone is located; and programs that use a device’s hardware (e.g., camera or satellite usage) to identify its position. Such devices offer valuable affordances, such as the recovery of lost

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possessions, while at the same time creating the possibility that privacy and anonymity may be compromised if one's property were to be tracked by someone else (Tavani, 2008; Ziegeldorf, Morchon, & Wehrle, 2014). The legal and societal consequences are potentially serious (Ashworth & Free, 2006; Nissenbaum, 2009). Surveys suggest that both younger and older adults are concerned about the privacy implications of modern technology (Hoofnagle, King, Li, & Turow, 2010).

A critical unresolved question is how privacy is viewed in childhood. How do children assess the moral consequences of having another entity 'keep track' of their possessions? From an applied perspective, this question is particularly important, given young children's increasing use of mobile technology. Cell phone ownership doubled over a five-year period, from 2004-2009, and by 2009 included 31% of children 8-10 years of age (Rideout, Foehr, & Roberts, 2010). From a theoretical perspective, this question provides a unique opportunity to address the nature and breadth of children's understanding of property rights. By 3 years of age, children have firm expectations that non-owners may not use objects owned by others without permission (Nancekivell & Friedman, 2014; Rossano, Rakoczy, & Tomasello, 2011), and by 6-8 years of age, children extend ownership rights to non-physical items, such as ideas (Shaw, Li, & Olson, 2012). However, we are aware of no research examining whether children would deem virtual object-tracking to be a property right (i.e., an activity that only owners may do). On the one hand, children below 6-8 years may at first restrict property rights to physical objects, given important differences between physical objects and virtual objects. For example, a physical object can only be in one place at a time, such that one person's possession of an object necessarily deprives another person of that object. In contrast, the same is not true of information regarding an object's location, which can be simultaneously held by multiple individuals. On the other hand, even young children may have a broad sense that property rights extend to virtual tracking, and thus view with suspicion any non-owner keeping tabs on an item that is not their own.

We conducted three experiments, asking children to assess whether individuals have the right to track another person's possessions, using a mobile GPS device that indicates an object's location. In each experiment, participants first received a demonstration of how a mobile GPS device functions, and then were asked to judge the acceptability of someone else tracking their possessions, or their tracking someone else's possessions. Experiment 1 examined reactions to

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someone placing the device on an object and tracking the device on a computer. Experiment 2 examined reactions to someone placing the device on an object but not tracking it. Experiment 3 examined reactions to someone tracking the device on a computer when the owner has placed it on an object. These different methods permit us to differentiate perceived implications of tracking from perceived implications of one's personal space being violated via physical contact.

## Experiment 1

### *Method*

*Participants*. Participants were 36 4- and 5-year-olds ($M$ = 5.07, $SD$ = 0.53; 16 girls, 20 boys) and 24 adults ($M$ = 19.11, $SD$ = 0.31; 16 women, 8 men). Children were primarily white and middle-class (by parental report: 83% white, 8% Black/African-American, 8% multiracial). Three additional children were tested but dropped, one due to experimenter error and two due to equipment error. Adults were undergraduate students at a Midwestern research university (by self-report: 79% White, 8% Black or African-American, 4% Chaldean, and 4% Unreported). Adults were tested between August and October of 2013; children were tested between September of 2013 and February of 2014.

*Materials*. Materials included a laptop computer; computer overhead-view images of two lab rooms, each with a pulsating red dot that could be located anywhere on the image; two small plastic buttons (one red, one blue; one per block as described below); and laminated drawings of a boy, a girl, a backpack, two cats, two dogs, and an elbow.

*Warm-up procedure*. Participants were tested in an on-campus lab. Children first received a warm-up task designed to introduce them to the mobile GPS device. First the experimenter showed an aerial-view color drawing of the testing room, explained that it was a picture of the room they were in, from up above, and pointed out two objects in the room and the corresponding images on the computer (couch, table). Children were asked to find an image in the picture corresponding to an object in the room (green chair), and to find an object in the room corresponding to an image on the computer (blue chair). The experimenter then introduced a button, explaining, "This button is really special. You can always see where it is on the computer!" They practiced moving the button to different locations in the room, and looking on the laptop to see the red dot appear in the corresponding location in the picture. (The researcher surreptitiously moved the dot on the screen to match the button's location.) The experimenter also demonstrated that the button's location appeared on the computer when they moved to a

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different room in the lab (as shown by a pulsating red dot on an aerial-view of the second room). Finally, the experimenter showed that when they walked outside the room into the hallway, they could still see the location of the button on the computer. Finally, the experimenter said, "People use buttons like this to keep track of their things."

Adults did not receive the warm-up but were asked if they knew what a GPS device was, and then were shown the button and told, "This device is an electronic 'button' that someone can put onto their things in order to track them. People can look at a computer screen or cell phone and see an image of where their objects are in relation to other objects and their surroundings."

*Test procedure*. For each item, participants were asked whether it was okay or wrong for a person (self or other) to track the item with the button ("Is it OK for you to put the button on X to keep track of it?"), and to indicate how much on a 5-point Likert scale consisting of circles increasing in size. If the participant answered "yes" ["no"], they were asked, "How OK [wrong] is it? A little OK [wrong] like this [point to smallest circle], a lot OK [wrong] like this [point to largest circle], or somewhere in-between like one of these [point to intermediate circles]?" See online materials for wording. Items included the participant's own: backpack, pet (pictures of two cats and two dogs were given as choices of the animal closest to that owned by the child, or, if they did not own a pet, then an animal that they would like to have), elbow, and special object that they identified ("Out of all of the things that you own, which is the most special to you?"). A picture was provided for all items except the special object. In one block (Self condition) participants were asked about tracking their own possessions; in the other block (Other condition) they were asked about another person ("Sam", matched to participant in age and gender) tracking their (the participant's) possessions. The backpack, pet, and elbow were presented in counterbalanced order; the special object was always presented last because the set-up was more involved. Participants were tested individually in a quiet laboratory on campus.

*Scoring*. For each object, we multiplied each 'okay' (1) or 'not okay' (-1) response by the Likert scale value (1-5), yielding a score ranging from -5 to +5.

*Open-ended explanations*. For each item, following their initial responses, participants were asked to explain their answer ("Can you tell me why?"). Answers were written down verbatim and later coded. Responses appealing to right or wrong (e.g., "It's wrong for someone to track you all the time and know what you're doing"), permission (e.g., "If she doesn't have permission she shouldn't"), and privacy (e.g., "It's like an invasion of privacy") were summed to

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create a single Morality score. Each response was independently coded by two coders, and disagreements were resolved by discussion. Agreement ranged from 96-99% per code and Cohen's kappas ranged from .79 to .93.

*Results*

Preliminary analyses revealed no effects of block order, so this factor was excluded from the primary analyses. We conducted a 2 (age group: child, adult) x 2 (tracker: self, other) x 4 (item: backpack, pet, elbow, special object) repeated-measures ANOVA, with age group as a between-subjects factor, and tracker and item as within-subjects factors. Results are shown in Figure 1a. Here we report only the statistically significant effects; all analyses can be found in the online materials, Table A. As predicted, self-tracking was judged more positively than other-tracking (*M*s = 3.34 and -1.05, respectively), $F(1,58) = 139.48$, $p < .001$, $\eta_p^2 = .71$. There was also a main effect of age group, $F(1,58) = 7.13$, $p = .01$, $\eta_p^2 = .11$, indicating more positive responses from children than adults, and a tracker x age group interaction, $F(1,58) = 64.24$, $p < .001$, $\eta_p^2 = .53$. Although the self-other difference was significant in both age groups, *p*s < .01, the effect was substantially greater for adults (4.23 vs. -3.14) than children (2.44 vs. 1.04). Adults were both more positive about self-tracking and more negative about other-tracking than were children, *p*s ≤ .001.

Finally, there was a main effect of item, $F(3,174) = 5.25$, $p = .002$, $\eta_p^2 = .08$, and an item x tracker interaction, $F(3,174) = 2.91$, $p = .036$, $\eta_p^2 = .05$. These were examined with follow-up *t*-tests using the Bonferroni correction with adjusted alpha levels of .008 per test (.05/6). In the self-tracking condition, participants were more negative about tracking their elbow than any other item, all *p*s ≤ .006, whereas in the other-tracking condition, there were no significant differences $p \geq .045$. Importantly, the self-other difference emerged robustly for all four of the items, *p*s < .001. We also conducted independent t-tests comparing performance against chance (mean score of 0), collapsed over item, using the Bonferroni correction with adjusted alpha levels of .0125 per test (.05/4). In the Self condition, both children ($t(35) = 6.41$) and adults ($t(23) = 19.98$) were significantly above chance, *p*s < .001. In the Other condition, however, adults were significantly below chance ($t(23) = -9.42$, $p < .001$), whereas children were at chance ($t(35) = 2.14$, $p = .039$).

For the open-ended explanations coded as Moral, we conducted a 2 (tracker: self, other) x 2 (age group: child, adult) ANOVA, obtaining significant effects of tracker, $F(1,58) = 52.40$, $p <$

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.001, $\eta_p^2$ = .48, age group, $F(1,58) = 32.67$, $p < .001$, $\eta_p^2$ = .36, and tracker x age group, $F(1,58) = 12.63$, $p = .001$, $\eta_p^2$ = .18. At both ages, Moral explanations were higher in the Other condition than the Self condition (child *M*s = 0.69, 0.11, $p = .005$; adult *M*s = 2.46, 0.75, $p < .001$).

*Discussion*

When considering the use of a mobile GPS device, both preschoolers and adults were *relatively* more negative about a stranger tracking their items, as compared to the participant himself or herself tracking his or her own items. Thus, even preschoolers indicate some sensitivity to virtual tracking as a property right. At the same time, however, we obtained sharply different *levels* of evaluations at the two ages. Whereas adults overwhelmingly judged that it is "not OK" for a stranger to track the location of their items, preschool children judged such actions to be "OK". The children seemed unaware of the potential dangers of such privacy violations. Moreover, even when considering relative sensitivity to self- versus stranger-tracking, it is unclear whether children's judgments reflect assessments of the tracking behavior per se, or rather simply reflect judgments of the act of placing the button, which entails directly touching an object owned by either self or other. We thus wished to assess to what extent tracking per se (i.e., intrusion on informational privacy) has an added cost, beyond merely touching another person's items. Experiment 2 was designed to address this question by testing beliefs about physical contact. The method was identical to Experiment 1, except that tracking was never mentioned. The mobile GPS device was introduced by explaining that it could be placed anywhere, and participants were asked to judge how OK or not-OK it would be for self or other to place the button on each of the four target objects.

## Experiment 2

*Method*

*Participants*. Participants were 36 4- and 5-year-olds (*M* = 4.92; *SD* = 0.58; 19 girls, 17 boys) and 24 adults (*M* = 20.72, *SD* = 2.03; 8 women, 16 men). Children were primarily white and middle-class (by parental report: 86% White, 3% Indian, 3% Mexican and Chinese, and 8% not reported). Adults were undergraduate students at a Midwestern research university (by self-report: 58% white, 29% Asian or Asian-American, 8% Black or African-American, and 4% White and Native American-Pacific Islander). Three additional children were tested but dropped, one due to experimenter error, one out of age range, and one who refused to answer questions. One adult was tested but dropped, due to experimenter error. Adults were tested between June

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and July of 2014; children were tested between June and August of 2014.

*Materials*. The materials were the button and pictures from Experiment 1.

*Procedure*. Participants were tested in an on-campus lab. The procedure was identical to that of Experiment 1, except that the child warm-up consisted of demonstrating how the button could be placed on different locations in two rooms in the lab, and adults simply heard, "See this button? You can put it on places and things."

*Open-ended explanations*. Open-ended explanations were coded as in Experiment 1. Agreement ranged from 93-99% per code and Cohen's kappas were .50, .71, and .72. The low kappa was for the “privacy” code, which was used very rarely (only 6 times total).

*Results*

Preliminary analyses indicated that block order did not interact with any of the other variables, so this factor was excluded from the primary analyses. We conducted a 2 (age group: child, adult) x 2 (placer: self, other) x 4 (item: backpack, pet, elbow, special object) repeated-measures ANOVA, with age group as a between-subjects factor, and placer and item as within-subjects factors. See Figure 1a. Here we report only the statistically significant effects; all analyses can be found in the online materials, Table A. As predicted, participants overall were more positive about self- vs. other-placement of the button (*M*s = 1.94, -0.83, respectively), $F(1,58) = 53.10$, $p < .001$, $\eta_p^2 = .48$. This effect was stronger for adults (*M*s = 3.14 and -0.54) than children (*M*s = 0.74 and -1.11), as indicated by a placer x age group interaction, $F(1,58) = 5.77$, $p = .02$, $\eta_p^2 = .09$, and children were more negative overall about placing the button than adults (Ms = -0.18, 1.30), $F(1,58) = 6.37$, $p = .014$, $\eta_p^2 = .10$. Nonetheless, both ages judged self-placement more positively than other-placement, *p*s < .001. We also obtained a main effect of item, $F(3,174) = 9.06$, $p < .001$, $\eta_p^2 = .14$, and a significant item x age group interaction, $F(3,174) = 3.91$, $p = .01$, $\eta_p^2 = .06$. Post-hoc t-tests, using the Bonferroni correction with adjusted alpha levels of .0125 per test (.05/4), revealed that adults were more positive about the button being placed on their backpack and pet than were children, *p*s ≤ .005, but there were no age group differences for the elbow (p = .019) or special object (*p* = .89), as scores were low for these items in both conditions.

We also conducted independent *t*-tests comparing performance against chance (mean score of 0), collapsed over item, using the Bonferroni correction with adjusted alpha levels of .0125 per test (.05/4). Adults were significantly above chance in the Self condition, $p < .001$. The

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other values were at chance (adults in the Other condition, $p = .32$; children in the Self condition, $p = .14$; children in the Other condition, $p = .026$).

For the open-ended explanations coded as Moral, we conducted a 2 (placer: self, other) x 2 (age group: child, adult) ANOVA, obtaining significant effects of placer, $F(1,58) = 11.42$, $p = .001$, $\eta_p^2 = .17$, and placer x age group, $F(1,58) = 10.06$, $p = .002$, $\eta_p^2 = .15$. Adults provided more Moral explanations in the Other condition than the Self condition (*M*s = 1.54, 0.67; $p < .001$), but children did not (*M*s = 0.64, 0.61, $p = .87$).

We next examined whether participants placed greater significance on tracking the items (Experiment 1) than simply placing the button (Experiment 2). Recall that in both experiments, either the self or someone else (hypothetically) placed the button on the participant's objects; the only difference was whether the button was also used to track the location of the item. We conducted a 2 (action: tracking [Experiment 1], placing [Experiment 2]) x 2 (age group: child, adult) x 2 (actor [i.e., tracker in Experiment 1; placer in Experiment 2]: self, other) x 4 (item: backpack, pet, elbow, special object) repeated measures ANOVA, with action and age group as between-subjects factors, and actor and item as within-subjects factors. Given that each experiment was already analyzed separately, we only report cross-experiment (i.e., action) effects. As before, we report only the statistically significant effects; all analyses can be found in the online materials, Table A. We obtained significant interactions involving action x age group, $F(1,116) = 13.14$, $p < .001$, $\eta_p^2 = .10$, action x actor, $F(1,116) = 9.32$, $p = .003$, $\eta_p^2 = .07$, and action x actor x age group, $F(1,116) = 15.13$, $p < .001$, $\eta_p^2 = .12$. As predicted, adults were considerably more negative about someone else tracking their items than merely placing a button on their items (-3.14, -0.54, $p = .001$). In contrast, they were equally positive about self-actions across the two experiments (tracking [Experiment 1]: 4.23, placing [Experiment 2]: 3.14, $p = .092$). Surprisingly, and in contrast to the adults, children were significantly more positive about tracking than mere placement, for both self (*M*s = 2.44, 0.74) and other (*M*s = 1.04, -1.11), *p*s $\leq .002$. Finally, we also obtained an action x item interaction, $F(3,348) = 5.33$, $p = .001$, $\eta_p^2 = .04$. The only difference obtained across experiments was for the special object. Participants were overall more positive about tracking the special object than about placing the button on the special object, $p = .001$.

*Discussion*

Experiment 2 was designed as a control study, to disentangle judgments of tracking from

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judgments of physical contact. Given that ownership rights include the right to touch and manipulate an object (Neary, Friedman, & Burnstein, 2009), we anticipated that Experiment 2 would also elicit higher ratings for self than other, which is indeed what we found in both age groups. However, the more pertinent question was whether placement plus tracking (Experiment 1) would be judged more negatively than placement per se (Experiment 2). Here we obtained qualitatively different patterns for children than adults. Whereas adults more negatively evaluated someone who tracked their possessions than someone who merely placed a button on their possessions, children showed the reverse pattern. These preschool children were more *positive* about tracking than mere placement, whether the tracker was the self or someone else. We speculate that children may have appreciated the functional benefit of object tracking, whereas placing the button for no purpose was unmotivated and thus judged to be not-OK. Children's negative evaluation of button placement may have reflected the belief that placing the button infringes on the owner's use rights, or that it may risk damaging the object in some way.

Taken together, Experiment 1 and 2 raise three additional questions. First, at what point in development does sensitivity to the moral implications of digital tracking emerge? Experiments 1 and 2 revealed qualitative differences with age in moral evaluations of using a mobile GPS device to track someone else's possessions: negative for adults, positive for children. Yet the two age groups in Experiments 1 and 2 represent developmental extremes (preschoolers vs. adults). Testing intermediate ages creates an opportunity to learn when (if ever) children come to hold similar moral evaluations of a mobile GPS device as adults. Second, how do people feel about object tracking, when it is independent of physical contact? Were the self-other differences obtained in Experiment 1 attributable to the act of placing the button (e.g., distaste of someone else touching one's possessions), or would these effects appear even when focused on tracking per se? Third, do these judgments reflect a principled belief that it is wrong for someone to track items not in their possession, or are there asymmetries depending on whether the self is the owner versus the tracker? Experiments 1 and 2 focused exclusively on items owned by the participant. Although ownership rights apply generally to both self and other, there is a self-bias in both children's and adults' tracking and recall of owned items (Cunningham, Brebner, Quinn, & Turk, 2014; Gelman, Manczak, & Noles, 2012; Ross, Anderson, & Campbell, 2011). Thus, people may more negatively evaluate intrusions on one's own ownership rights than intrusions on the ownership rights of another individual. However,

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this possibility remains untested.

## Experiment 3

Experiment 3 was designed to examine the three questions listed above: (1) What are the developmental patterns across early childhood? (2) How do participants evaluate tracking of possessions when controlling for physical contact? (3) Do participants consistently judge that tracking someone else's possessions is wrong, or are there asymmetries depending on who is the owner (self vs. other)? The design was similar to that of Experiment 1, with three major modifications. First, we included children ranging from 4-10 years of age, as well as adults. Second, the person placing the button (i.e., the mobile GPS device) was always the object's owner, so that self-other differences in tracking would reflect judgments of tracking per se, not evaluations of physical contact. Third, we examined self-versus-other tracking both when the objects belonged to the self and when the objects belonged to another person. Additionally, most of the children were tested in a children's museum, which gave us access to a broader age range.

### *Method*

*Participants*. Participants included 31 4-year-olds ($M$ = 4.50, $SD$ = 0.29; 19 girls, 12 boys), 34 5-year-olds ($M$ = 5.44, $SD$ = 0.27; 18 girls, 16 boys), 36 6- and 7-year-olds ($M$ = 6.97, $SD$ = 0.58; 22 girls, 14 boys), 36 8- to 10-year-olds ($M$ = 9.51, $SD$ = 0.91; 17 girls, 19 boys), and 72 adults ($M$ = 19.18, $SD$ = 0.84; 49 women, 23 men). Given that most of the children were tested in a museum setting, demographic data on the children were incomplete; participants included a mix of ethnic and racial backgrounds, but most were white. Adults were undergraduates at the same Midwestern university as in Experiments 1 and 2, and were 60% White, 23% Asian or Asian-American, 10% Black or African-American, 4% Biracial, and 2% Unreported. Seven additional children were tested but dropped, 2 for not completing the study, 3 for language comprehension problems, and 2 due to experimenter error. Adults were tested between October of 2014 and March of 2015; children were tested between November of 2014 and August of 2015.

*Materials*. In addition to the materials from Experiment 1, a picture of a teddy bear was used to represent the special object, and two electronic devices were used to display stimuli.

*Procedure*. Children were tested individually in either an on-campus lab or a local children's museum; adults were tested in the on-campus lab. The warm-up was identical to that of Experiment 1 but modified for children tested in the children's museum, to match the available

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museum space. The testing session was identical to that of Experiment 1, with three modifications. First, participants were randomly assigned to consider items that were owned by the participant or by someone else (Sam), as a between-subjects variable. Second, the button was always described as being placed on the items by the owner (i.e., in the self-owned condition, the button was placed by the participant; in the other-owned condition, the button was placed by Sam). Importantly, this design permits us to vary who is tracking the object (owner vs. non-owner), while keeping physical contact constant (i.e., only the owner ever touches the object). Third, the test questions assessed judgments of either the participant or Sam tracking the object (e.g., "Is it ok for you to look on a computer to see where Sam's backpack is?"). Participant-tracking and Sam-tracking questions were presented in counterbalanced blocks. The backpack, pet, and elbow were presented in counterbalanced order; the special object was always presented last because the set-up was more involved.

*Open-ended explanations*. Open-ended explanations were coded as in Experiment 1. Agreement ranged from 96-99% per code and Cohen's kappas ranged from .82 to .94.

*Results*

Preliminary analyses indicated that block order did not interact with any other variable, and so was excluded from the main analyses. We conducted a 5 (age group: 4, 5, 6-7, 8-10, adult) x 2 (tracker: owner, non-owner) x 2 (owner: participant, Sam) x 4 (item: backpack, pet, elbow, special object) repeated-measures ANOVA, with age group and owner as between-subjects factors, and tracker and item as within-subjects factors. The dependent variable was the composite judgment score. Results are shown in Figure 1b. Here we report only the statistically significant effects; all analyses can be found in the online materials, Table A. There were no significant effects involving owner (participant vs. Sam). As predicted, participants overall were more positive about owners versus non-owners tracking the objects (*M*s = 3.42, 1.08, respectively), as indicated by a main effect of tracker, $F(1,195) = 131.13$, $p < .001$, $\eta_p^2 = .40$. However, this effect differed by age, as indicated by a tracker x age group interaction, $F(4,195) = 44.60$, $p < .001$, $\eta_p^2 = .48$, as well as a main effect of age group, $F(4,195) = 13.86$, $p < .001$, $\eta_p^2 = .22$. Follow-up tests using the Bonferroni correction with adjusted alpha levels of .01 per test (.05/5) revealed that the two youngest age groups did not judge owner-tracking more positively than non-owner-tracking (4 years: $p = .89$; 5 years: $p = .026$), but the older age groups consistently did so (6-7 years: $p = .001$; 8-10 years: $p < .001$; adults: $p < .001$). Developmental

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differences were primarily centered on judgments of non-owner tracking (using the Bonferroni's correction with adjusted alpha levels of .005 [.05/10] for all comparisons): adults were more negative than all other age groups, *p*s < .001, 8-10 year-olds were more negative than 4-year-olds ($p < .001$) and 6- to 7-year-olds ($p = .005$), and the three youngest groups did not differ from one another (*p*s > .12). In contrast, for owner tracking, the only differences were with adults, who were overall more positive than all groups except 6-7 year-olds, *p*s ≤ .001.

Finally, we obtained a main effect of item, $F(3,585) = 16.91$, $p < .001$, $\eta_p^2 = .08$, revealing an aversion to tracking the elbow compared to the other items (*p*s < .001). This aversion was sporadic between 4-7 years of age, and stronger in the older two age groups (8-10, adults), as revealed by an item x age group interaction, $F(12, 585) = 4.12$, $p < .001$, $\eta_p^2 = .08$, an item x tracker interaction, $F(3,585) = 3.91$, $p = .009$, $\eta_p^2 = .02$, and an item x age group x tracker interaction, $F(12,585) = 1.98$, $p = .024$, $\eta_p^2 = .04$. When collapsing over age there was a significant effect of tracker for each of the four items, *p*s < .001. However, follow-up tests using the Bonferroni correction with adjusted alpha levels of .0125 per test (.05/4) revealed that effects of tracker (owner higher than non-owner) broadened with age: first appearing for the backpack (5 years and older), then for the special item (6-7 years and older), then for the pet (8-10 years and older), and finally for the elbow (adults only).

We conducted independent *t*-tests comparing performance against chance (mean score of 0), separately for owner- and non-owner tracking in each age group (collapsed over item), using the Bonferroni correction with adjusted alpha levels of .005 per test (.05/10). All scores in all age groups were significantly different from chance, *p*s < .001, with the exception of 8- to 10-year-olds evaluating non-owner tracking, $p = .55$. This indicates that children ranging from 4-7 years of age were on average *positive* about someone using a mobile GPS device to track someone else's possessions, that children 8-10 years of age were on average *neutral* about such usage, and that only adults were on average *negative* about such usage.

For the open-ended explanations, we conducted a 2 (tracker: owner, non-owner) x 2 (owner: participant, Sam) x 5 (age group: 4, 5, 6-7, 8-10, adult) ANOVA, obtaining significant effects of tracker, $F(1,199) = 55.76$, $p < .001$, $\eta_p^2 = .22$, age group, $F(4,199) = 45.31$, $p < .001$, $\eta_p^2 = .48$, and tracker x age group, $F(4,199) = 13.07$, $p < .001$, $\eta_p^2 = .21$. Moral explanations were higher in the Non-Owner condition than in the Owner condition at ages 6-7 years (*M*s = 0.89, 0.08, $p = .004$), 8-10 years (*M*s = 1.53, 0.42, $p < .001$), and adults (*M*s = 3.53, 1.31, $p <$

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.001). The younger age groups did not show this effect.

*Discussion*

The present experiment finds that the youngest children (4 and 5 years of age) did not appear to evaluate use of a mobile GPS device in terms of ownership rights: when controlling for physical contact (i.e., objects were handled only by the owner), young children's evaluations of tracking someone's possessions were no more negative when a non-owner was tracking than when an owner was tracking. This result is not attributable to insensitivity to the task, as Experiments 1 and 2 showed that children of this age are quite clear that non-owners should not touch someone else's possessions. Rather, it would appear that tracking per se, and attendant privacy issues, are not a concern at this young age.

This sensitivity started to emerge by 6-7 years of age, when children—like adults—judged it to be relatively more permissible for owners than non-owners to track possessions using a mobile GPS device. At the same time, however, there were striking differences between adults' intuitions and those of children throughout the age range studied. Whereas adults consistently judged that tracking someone else's possessions was wrong and provided moral explanations to support this view, none of the child age groups (from 4-10 years of age) viewed this behavior negatively, and indeed children 4-7 years of age were consistently positive in their evaluations.

An important question for future research is why intuitions differ so dramatically as a function of age. Certainly one reason may be that young children are relatively trusting of others and do not spontaneously consider negative consequences of revealing personal information. In contrast, adults in our studies did express such concerns (e.g., "Then she could steal it if she wanted since she'd know the exact location of it"; "Because I don't know Sam and why he's watching my every move"). Interestingly, however, most of adults' explanations focused less on negative outcomes and more on principles of morality, privacy, and ownership ("Cause it belongs to me, not him"; "Invasion of privacy of me and my dog"). We speculate that developmental changes in independence may heighten the value placed on privacy, including digital privacy. For example, as children approach adolescence, they may become increasingly independent, self-conscious, and likely to engage in behaviors of which adults disapprove. It also may be that more experience with owning electronic devices leads to greater awareness of the consequences of electronic tracking, which then affects children's judgments. In future research,

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it would be interesting to study how children who do versus do not have their own cell phones, for example, reason about tracking devices.

Importantly, we found no differences between self as owner vs. other person ("Sam") as owner. Although prior research has found that children display self-other differences in their *attention to* and *memory for* objects (greater attention to and memory for objects assigned to the self), their *evaluation* or *reasoning* about such objects is remarkably constant. This suggests that the present judgments reflect principled considerations of ownership rights, rather than egocentric considerations of protecting one's own possessions.

## General Discussion

Digital privacy is of growing concern, given the increasing use of technological devices that track object locations, revealing personal information regarding an individual's movements and activities. Although many children make use of this technology, for example with cell phones that track their location throughout the day, and sharing photos that are tagged with time and location stamps, little is known regarding how children of different ages evaluate digital tracking, and whether they are sensitive to violations of privacy. Examining children's evaluations of digital tracking is also valuable for assessing whether they view ownership rights as limited to physical objects for which possession is a zero-sum game (if you have X, then I cannot), or whether they extend to the intangible good of information access--as with ownership rights of intellectual property (Shaw et al., 2012).

To fill these gaps, the present experiments examined how children 4-10 years of age and adults evaluated the hypothetical situation of someone using a mobile GPS device to track items that they either do or do not own. Results indicated marked age differences. Adults were consistently negative about someone tracking items that they did not own, regardless of whether the tracker physically touched the object in question. They not only identified possible negative material consequences of someone tracking others' possessions (such as stealing or stalking), but they also referred to moral principles ("It's an invasion of privacy"; "Without permission it's wrong") as well as an amorphous sense of unease (e.g., "It's weird"; "He has no business to know where [my] dog is"). In contrast, children 4-10 years of age did not indicate the same negativity, and the youngest children (4-7 years) were actually quite positive about someone tracking others' possessions. Indeed, children expressed greater negativity about merely placing a mobile GPS device on an object (and not tracking it) than they did about placing the device in order to track

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the object.

At the same time that children and adults display qualitatively distinct evaluations of use of a mobile GPS device, more subtle measures indicate emerging sensitivity starting in early childhood. Results indicated that by 5 years of age, physically placing a button to track someone else's possessions was judged to be less acceptable than tracking one's own possessions, and by 6-7 years of age, children spontaneously invoked moral considerations to explain this belief. At the same time, children were much more accepting of this behavior than adults, perhaps focusing on the benefits of object-tracking (e.g., the utility of being able to find lost objects) more than its costs. Thus, young children, like adults, are starting to view object tracking as an ownership right, but there are important changes in how this technology is viewed from a moral perspective.

These findings raise serious concerns for children's digital safety and security. Children up to 10 years of age display robust positive moral judgments about digital tracking and digital privacy, at a point in development when many children play with, use, or own a variety of types of mobile devices with a built-in GPS. Without the skepticism displayed by adults, children are vulnerable to those who might exploit their digital 'fingerprint' to track their location or obtain private information. An urgent question for the future is thus how best to protect children, perhaps by educating children about potential dangers and providing clear guidelines and limits for how and when their phones and accounts should be shared.

These findings also raise a number of additional questions regarding their scope and bases. What is the generalizability of the obtained developmental patterns across cultures? Our finding that even preschool children are sensitive to privacy concerns may reflect the focus on autonomy and independence in the U.S., which differs from that of more collectivist or interdependent societies (Markus & Kitayama, 1991). It would be valuable to gather comparative data from cultural contexts that differ in this regard (see, for example, Kanngiesser, Rossano, & Tomasello, 2015). Another unresolved issue concerns the role of prior experience with technology. Some scholars have suggested that younger generations may be relatively unconcerned about digital privacy compared to older generations, having grown up with electronic surveillance as ubiquitous and normative (Marwick, Diaz, & Palfrey, 2010). Conversely, younger generations may be more suspicious of the negative consequences of electronic tracking, given their greater familiarity with technology--and how it can be used to manipulate, defraud, and deceive. More generally, an important question is the role of digital

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practices and experience on how children reason about privacy beyond the digital domain. Do commonplace practices of digital tracking and digital openness shape children's notions of what is or is not appropriate to reveal about themselves, and does this differ for in-person versus on-line interactions? When and how do children distinguish between those with whom it is appropriate to share personal information (e.g., friends, family) and those for whom it is not? Answers to these questions may help guide future efforts to help children learn to protect their own interests in the digital world.

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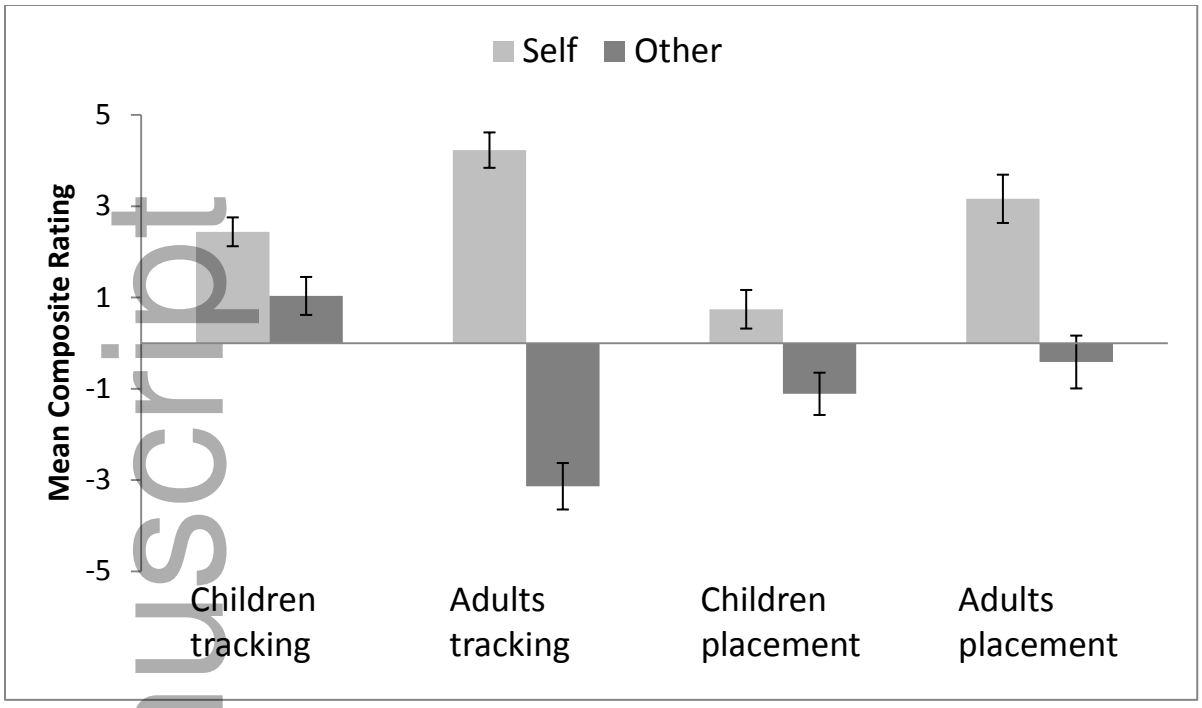
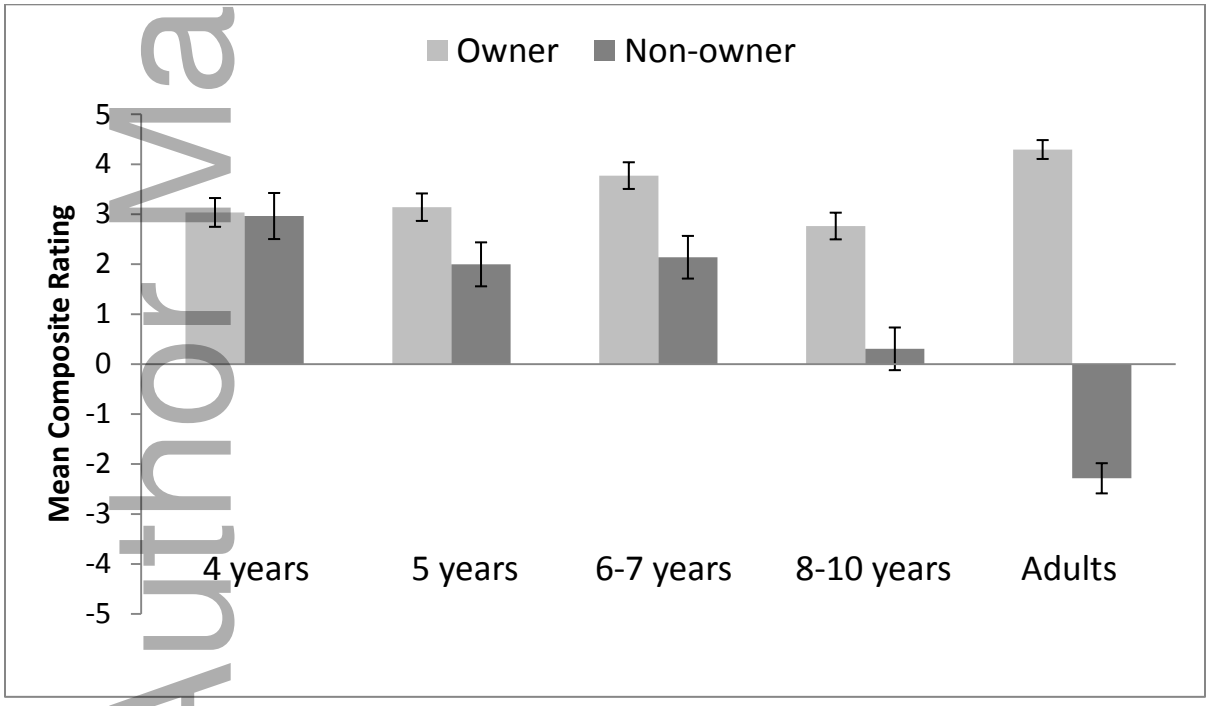



(a) Experiments 1 and 2




(b) Experiment 3

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Figure 1. Mean composite ratings (on a scale of -5 to +5) of how OK/not-OK it is for an owner versus a non-owner to track possessions, as a function of age group. (a) Experiments 1 and 2; (b) Experiment 3.

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