The Roles of Privacy and Trust in Children's Evaluations and Explanations of Digital Tracking

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Abstract

A "digital revolution" has introduced new privacy violations concerning access to information stored on electronic devices. The present two studies assessed how U.S. children ages 5-17 and adults (N=416; 55% female; 67% white) evaluated those accessing digital information belonging to someone else, either location data (Study 1) or digital photos (Study 2). The trustworthiness of the tracker (Studies 1 and 2) and the privacy of the information (Study 2) were manipulated. At all ages, evaluations were more negative when the tracker was less trustworthy, and when information was private. However, younger children were substantially more positive overall about digital tracking than older participants. These results, yielding primarily medium-to-large effect sizes, suggest that with age, children increasingly appreciate digital privacy considerations.

Keywords: Children, conceptual development, digital tracking, privacy, ownership, mobile devices, social groups

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Over the past few decades, a "digital revolution" has created increasing access to mobile devices that can reveal private information—with or without the owner's knowledge. For example, others may be able to access a person's current location, their digital photos, their data usage, or their banking information. Access to others' information may be innocuous or even beneficial (e.g., sharing location information when the goal is to find a lost item), but at the same time it may compromise the user's privacy and anonymity—especially when used by one party to obtain information about another (Ziegeldorf et al., 2014). Although adults express concern about the privacy implications of modern technology (Hoofnagle et al., 2010), they may be unaware of the many ways in which private information may be shared (Acquisti et al., 2015) and often find it easier just to ignore possible incursions on their privacy (Kokolakis, 2017). This gap between their self-reported willingness to disclose personal information through technology platforms and their actual disclosure behavior is referred to as the "privacy paradox" (Norberg et al., 2007).

It is important to determine how children think about digital privacy, given the growing accessibility and marketing of these devices to children (Common Sense Media, 2017; Influence Central, 2016; Rideout et al., 2010). Unfortunately, we know relatively little to date about digital privacy attitudes and understanding in childhood, and most of the available work has focused on older children (ages 10 and up) (e.g., Bagnaschi & Geraci, 2003; Livingstone et al., 2019; Yan, 2006). Yet digital privacy is not just an issue for older children. By elementary school or even earlier, children have access to smartphones and tablets that are internet connected and have the potential to reveal where they are or what they are doing. Indeed, the average 8-year-old spends nearly an hour a day on a mobile device (Rideout, 2016), yet much remains unknown about how access to such technologies influence child development (Yan, 2018).

In one of the few papers examining digital privacy concepts in young children, Gelman et al. (2018) studied children 4-10 years of age and found that they did not seem to treat digital tracking as a privacy concern. This work focused on children's attitudes regarding digital location tracking (e.g., someone looking on a computer to track the location of an item that is not their own). In a series of three experiments, children were asked whether or not digital tracking was acceptable (e.g., "Is it OK for Sam to look on a computer to see where your backpack is?"). Critically, what varied was whether the tracker was the owner of the object being tracked or not. In that work, Gelman et al. (2018) found that it was not until about 6-7 years of age that children judged tracking someone else's possessions to be less acceptable than tracking one's own possessions. Moreover, even up through 10 years of age, children were untroubled by a stranger tracking their possessions or even tracking themselves. And even when children were less positive about someone tracking another person's belongings compared to tracking their own, their ratings never dropped below the scale midpoint, indicating that the behavior was not deemed especially bad. This was in sharp contrast to college students, who viewed digital object-tracking another's possessions as highly suspect, and who explained their reasoning via moral concerns (e.g., breach of privacy, not their business) and concerns about potential negative consequences (e.g., stealing, stalking).

A critical question is why these developmental differences were obtained. Adults' negative judgments seemed to reflect two distinct assumptions, either of which may reveal developmental differences: (1) that digital information is private and belongs only to the object's owner, and (2) that non-owners who track this information cannot necessarily be trusted to use the information in a safe or fair manner. We refer to these as privacy and distrust, respectively. Both themes were frequently expressed by adults—and less often by children—to explain their judgments that digital tracking was not OK. It is unclear whether the developmental differences obtained in that work reflect differences in privacy assessments, differences in trust assessments, or both. In other words, do children not yet understand digital location information as private, or do children place too much trust in others?

There is reason to suspect that at least some of the developmental difference may involve trust toward others. Prior work shows that children have a positivity bias (Boseovski, 2010) and have a default stance to trust others. For example, one method is to present children with informants who are either helping or tricking, and who provide testimony about the location of a hidden sticker. The basic finding from these studies is that by three years of age, children are capable of discerning who is more vs. less trustworthy—yet younger children are more trusting (Chen et al., 2013; Heyman et al., 2012; Mascaro & Sperber, 2009; Vanderbilt et al., 2011). At the same time, these studies deal with trust in an epistemic sense (whose information do you value), and it is unclear whether the findings with epistemic trust extend to trust in an interpersonal sense (who will be good to you, not hurt you, etc.).

Moreover, there were two aspects of the study design in Gelman et al. (2018) that may have contributed to the developmental differences. First, the tracker was depicted as smiling, which may have affected children's judgments more than adults'. Children use facial expressions to judge a person's trustworthiness (Ewing et al., 2015; Krumhuber et al., 2007). Adults are more likely to recognize that someone's emotional expression may be deceptive (Wellman & Liu, 2004). And second, the tracker was matched to the participant's age—that is, a child for child participants, an adult for adult participants. Participants may have assumed that an unfamiliar child was more trustworthy (less likely to engage in nefarious activity) than an unfamiliar adult. Importantly, this confound between age of participant and age of tracker could not completely account for the developmental differences, because adults were also less positive than children when participants were asked to imagine that they themselves were doing the tracking (and the unfamiliar person was the owner). Nonetheless, what this means is that throughout the series of studies, children only considered scenarios in which the tracker was non-threatening—that is, a friendly, smiling, innocuous-looking child.

The current studies

The current two studies were designed to examine the theoretical basis underlying developmental differences in children's evaluations and explanations of digital location tracking. Specifically, we aimed to examine developmental differences that may be linked to judgments of interpersonal trust and privacy. We presented a series of scenarios in which a person (the "tracker") engaged in digital tracking of items that belonged to someone else (the "owner"), systematically manipulating trust in the tracker (Studies 1 and 2) and privacy of the information (Study 2).

In Study 1, we described scenarios in which the tracker obtained information about the location of an item owned by someone else. We manipulated trust by systematically varying whether the tracker and the owner were from the same social group or different social groups, given that prior work has shown that children are highly sensitive to group membership in evaluating the behaviors of others (Roberts et al., 2017), and more trusting of ingroup members compared outgroup members (Dunham, 2018). Even when social groups differ only minimally, children as young as 5 years of age show preferences toward ingroup members (Bigler et al., 2001; Dunham et al., 2011; Rhodes & Chalik, 2013; Rizzo et al., 2018) and expect people to behave more positively toward those in the same group than those from a different group (Rhodes, 2012). We manipulated group membership using the method developed by Roberts et al. (2017), in which participants see two novel groups of people, Hibbles and Glerks, and learn that they contrast in a number of socially relevant but innocuous and morally neutral respects (e.g., the food they eat, the music they listen to). This introduction sets the expectation that Hibbles and Glerks are distinct with different customs, though otherwise equivalent (i.e., there is no reason to treat one group as more trustworthy than another).

Study 1 also expanded the age range, testing participants from 5 years of age through to college. This allows us to fill out the gap in the prior research by Gelman et al. (2018), which included only young children (4-10 years) and adults. By including the intermediate ages, we were able to fill out the developmental trajectory and determine when in development children first displayed concerns about digital tracking. Our approach was to gather cross-sectional data, so we cannot make longitudinal claims, but we propose that developmental changes may be occurring.

In Study 2, we described scenarios in which the tracker obtained access to photographs that were taken by someone else and stored on their phone. We manipulated trust by systematically varying whether the tracker was smiling and described neutrally (as in Gelman et al., 2018) or scowling and described as mean. Furthermore, we manipulated the privacy of the information, by including some photographs of public entities (e.g., stop sign, rainbow) and some photographs of private entities (e.g., a home safe, a messy bedroom).

These designs allowed us to test the effects of trust versus privacy. If a participant sees digital tracking as negative strictly because they do not trust the tracker to use the information in a safe or fair manner, then they should be negative toward digital tracking when the tracker cannot be trusted (e.g., when the tracker is from a different social group from the owner, or when the tracker is described as 'mean'). However, if a participant sees digital tracking as a privacy violation, then they should be negative toward digital tracking even when the tracker can be trusted. Moreover, if digital tracking is viewed negatively because it is a privacy violation, then judgments should be especially negative when the information is more private, and explanations should express moral and privacy concerns. Of course, it is possible that both trust and privacy affect judgments, in which case evaluations should be negative across the board, but especially in the low-trust conditions and when information is private. Finally, it is possible that neither trust nor privacy affect judgments, in which case evaluations should be equivalent across the board.

STUDY 1

Method

Participants

Participants were 158 children (ranging in age from 5.14-17.82; mean age 10.26; 93 girls, 64 boys, and 1 unreported) and 40 college students (ranging in age from 18.18-22.66; mean age 19.67; 24 women and 16 men). Children’s race or ethnicity as reported by parent or guardian was: White (n = 59), Black (n = 3), Asian (n = 2), Native American (n = 1), biracial or multiracial (n = 10), Latino (n = 7), not reported (n = 82). (Numbers add up to more than the total because some of those who were Latino/a were also identified as a particular race.) College students' self-reported race/ethnicity was: White (n = 24), Asian or Asian-American (n = 9), African-American (n = 1), Mexican or Mexican-American (n = 2), Indian (n = 1), biracial (n = 2), not reported (n=1). College students were enrolled in an introductory psychology course at a large public university and obtained partial credit for participation. Children were recruited to sample roughly equally from the following age groups: 5-6 (n = 34), 7-8 (n = 31), 9-10 (n = 30), 11-12 (n = 30), and 13-17 (n = 33). Child participants were tested at either an on-campus child development lab or a testing space at a local children's museum in the same city. Data collected from five additional children were dropped due to experimenter error (n = 1), equipment error (n = 3), and lack of completion (n = 1). Participants were tested from March of 2018 to March of 2019.

Materials and Procedure

Materials included a laptop computer, iPad, and computerized images of testing rooms depicted from an aerial perspective. Each testing room image contained a red dot that could be moved anywhere on the image. Each participant viewed one of eight PowerPoint presentations that provided introductory material and test scenarios. The characters in these presentations were cartoon images of two novel social groups, Hibbles and Glerks, which were human-like but without identifiable gender or facial expression (see Figure 1 for example). Experimenters also used a small red plastic button and a laminated Likert scale. The online supplement includes details of the wording.

---------- Insert Figure 1 about here ----------

Introduction to GPS device. As in Gelman et al. (2018), children were first asked whether they had any knowledge of GPS devices and their function, then were guided through a task developed to familiarize them with the concept of a mobile GPS device. This introduction involved showing the child a tracking button and demonstrating how the image on the computer or iPad indicated the location of the button. For example, when the button was placed on a couch, the computer image displayed a dot in the corresponding location. Both the experimenter and the child had an opportunity to move the button to different locations, allowing the child to check the location on the computer or iPad.

Adult participants were not given this introduction task but were also asked if they knew what a GPS device was. They were then 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."

Introduction to Hibbles and Glerks. Participants were introduced to two groups of fictional characters, Hibbles and Glerks (with an image depicting four of each on the left and right sides of the screen, respectively). Hibbles and Glerks were identical except for clothing pattern (orange triangles and blue circles, respectively) and a small decoration on their clothing that differed for each individual. As in Roberts et al. (2017), participants were told that Hibbles and Glerks differed in a lot of ways, including food, games, music, and language; each property was illustrated with a different image (e.g., Hibbles and Glerks eating different kinds of berries).

Test trials: tracking of others. Following the introduction, participants received four test trials in which a Hibble or Glerk engaged in digital tracking of a different Hibble or Glerk (see Figure 1 for an example). All four tracker-owner combinations were presented, in counterbalanced order: a Hibble tracking a Hibble, a Glerk tracking a Glerk, a Hibble tracking a Glerk, and a Glerk tracking a Hibble. The item being tracked was a backpack on two trials (one within-group trial [e.g., Hibble tracking Hibble] and one between-group trial [e.g., Hibble tracking Glerk]) and a dog on two trials (one within-group and one between-group trial). Sample wording for a between-group trial was as follows:

> Here is a Hibble. This Hibble has a backpack. He put this button on his backpack. Here is a Glerk. Is it OK for this Glerk [point] to look on a computer so he can see where that Hibble's [point] backpack is?

After providing a yes or no response, participants were asked to indicate how OK or wrong it was, by indicating one of five circles ranging in size from smallest (e.g., "a little OK" or "a little wrong") to largest (e.g., "a lot OK" or "a lot wrong"). Finally, the participant was asked, "Can you tell me why?" and their response was recorded and later transcribed.

Test trials: tracking of self. For the final two trials of the experiment, the participant received two scenarios in which they were asked to imagine that they were a Hibble, and that their belongings were being tracked by another Hibble [within-group trial] or by a Glerk [between-group trial], in randomized order. No pictures were provided for these trials. The wording was as follows:

> If you were a Hibble, would it be okay for [another Hibble] [a Glerk] to look on a computer to see where your stuff is?

As with the tracking-of-other trials, participants first answered yes or no and then indicated degree of how OK or wrong on the same five-point scale.

Results

We organized the results into two primary sections, the first focusing on participants' evaluations of the digital tracking behavior, and the second focusing on participants' explanations for why they answered as they did.

Evaluations

For each item, we created a composite score ranging from 1 (most negative) to 10 (most positive), incorporating both the yes or no response to the initial "OK?" question and the response to the five-point scale. For example, a response of "not OK" followed by the largest circle ("a lot wrong") received a score of 1; a response of "OK" followed by the largest circle ("a lot OK") received a score of 10; intermediate responses were scored accordingly (e.g., "OK" followed by the smallest circle ("a little OK") received a score of 6). Analyses involving age and tracker-owner relationship (same or different group) involved confirmatory hypothesis-testing, whereas those involving item (backpack or dog) and interactions among the variables were exploratory.

Tracking of others: between-groups vs. within-group

We first examined how participants evaluated third-party tracking (someone using a GPS to track an item belonging to an individual of either the same group [e.g., a Hibble tracking a Hibble's item] or a different group [e.g., a Hibble tracking a Glerk's item]) via a mixed-effects linear regression model, which has several advantages over repeated measures ANOVA (e.g., better able to handle missing data and complex clustering of participants; see Field, 2011). Tracker-owner relationship (within-groups, between-groups; effect-coded with within-group = 1), item (Backpack, Dog; effect-coded with Backpack = 1), participant age (standardized), and an interaction among these three variables were our primary predictor variables (entered simultaneously). Participant ID was included as a random intercept, given that each participant provided multiple responses, and participants' scaled response (on a 1-10 scale, where 1 = "a lot wrong", 10 = "a lot OK") was the dependent variable. Analyses were probed via comparisons to chance (i.e., 5.5) and pairwise comparisons. Cohen's d statistics are included as effect size estimates (small effect = .2, medium effect = .5, large effect = .8).

There was a main effect of item (B = .21, SE = .08, t = 2.62, p = .009, 95% CI: [.05, .36]), revealing that people were more positive about someone tracking a dog (M = 5.01, SE = .16) than a backpack (M = 4.61, SE = .16). There were also main effects of age (B = -.97, SE = .10, t = -10.10, p < .001, 95% CI: [-1.16, -.79]), indicating less positivity with age, and relationship (B = .86, SE = .08, t = 10.91, p < .001, 95% CI: [.70, 1.01]), indicating more positivity for within-groups tracking and less positivity for between-groups tracking. These main effects were qualified by an interaction involving age and relationship (B = -.23, SE = .08, t = -2.87, p = .004, 95% CI: [-.38, -.07]). Positivity decreased with age, both within-groups tracking (B = -1.22, SE = .15, t = -8.29, p < .001, 95% CI: [-1.50, -.93]) and for between-groups tracking (B = -.77, SE = .14, t = -5.36, p < .001, 95% CI: [-1.05, -.49]), though positivity decreased more starkly with age for within- versus between-group tracking. That is, positivity toward within-groups tracking was relatively high among younger children and relatively low among older children and college students, whereas positivity toward between-groups tracking was relatively low across the age groups. See Figure 2 for a visual depiction of the age by relationship interaction, including the corresponding pairwise comparisons, and see Table 1 for the chance comparisons.

---------- Insert Figure 2 about here ----------

---------- Insert Table 1 about here ----------

Tracking of self: between-groups vs. within-group

We next examined participants' positivity toward themselves being (hypothetically) tracked by an ingroup member or an outgroup member. To analyze these data, we conducted a mixed-effects linear regression model identical to the one above, with the exception that item (Backpack vs. Dog) was not included in the model, given that the individual trials did not vary along this dimension (i.e., they did not specify what was being tracked). There were main effects of age (B = -.71, SE = .24, t = -5.15, p < .001, 95% CI: [-.97, -.44]), revealing that positivity decreased with age, and relationship (B = .65, SE = .12, t = 5.47, p < .001, 95% CI: [.42, .89]), revealing that participants were more positive when tracked by an ingroup member (M = 4.56, SE = .23, t = -4.06, p < .001, 95% [4.10, 5.01], Cohen's d = .58) than by an outgroup member (M = 3.25, SE = .19, t = -11.59, p < .001, 95% [3.63, 2.87], Cohen's d = 1.65). No other effects were significant. See Table 1 for the chance comparisons.

Explanations

Explanations were transcribed verbatim. Each explanation was given a score of '1' if it fit into any of seven coding categories: morality, privacy, ownership, 'weird', relationship, psychological state, and function. Examples are provided in Table 2. In all cases, the presence or absence of the feature was coded (e.g., for privacy, both “Their backpack is private” and “But since he put the GPS on his backpack it makes it no longer private” were coded). These categories were not mutually exclusive, so a given explanation could receive multiple codes. Responses that did not fit into any of these categories (e.g., no response, don't know, uncodable) received a score of 0 for all codes. Two coders independently coded each of the explanations, blind to hypotheses and participant age, and disagreements were resolved by discussion. Agreement was calculated on all transcripts that were not used for training (90% of transcripts), resulting in high interrater reliability (agreement averaging 92% [per code ranging from 83% to 99.5%]; Cohen's kappa averaging .81 [per code ranging from .69 to .95]).

---------- Insert Table 2 about here ----------

Our primary focus is which themes were expressed when considering digital tracking scenarios, as a function of age. Given the relatively low rates of explanations, we collapsed over all six test trials and computed the proportion of participants in each age group who provided each of the coding categories at least once. For each, we conducted chi-square tests to determine if the likelihood of providing the coding category significantly differed by age group. This was a wholly exploratory analysis. These data are provided in Table 3.

---------- Insert Table 3 about here ----------

A separate chi-square analysis was conducted on each of the primary coding categories (morality, privacy, ownership, weird, relationship, function, and psychological state). That is, for each coding category, each participant was classified as either using or not using the explanation type, and these frequencies were subjected to a chi-square analysis [2 (used or didn't use) x 6 (age group)]. As can be seen in Table 3, four of the explanation categories showed significant age effects (morality, privacy, ownership, and weird, $ps \leq .011$), whereas three of the explanation categories did not (relationship, psychological state, and function, $ps > .07$). These data mirror the evaluation data, in which even the youngest children appreciate the benefits of digital tracking [function] as well as the relationship between individuals, whereas by contrast, consideration of digital privacy as a moral concern, as an invasion of privacy, as a violation of ownership rights, and as "weird", are relatively low in the youngest age group.

Discussion

Study 1 was the first to chart developmental differences in how children from 5-17 years of age reason about digital location tracking, and the role of the tracker-owner relationship in how digital tracking is evaluated. Results revealed several novel findings. First, there were marked and qualitative differences with age in children's attitudes toward digital tracking. The youngest children (5-6 years of age) were generally either positive or neutral about digital tracking, depending on who was doing the tracking, whereas the oldest children and adults (13 years old through adults) were negative about digital tracking across-the-board (whether tracking of self or tracking of others, and whether tracker and owner were of the same or different groups). The more positive evaluations from the youngest children were not due to a lack of sensitivity to the group manipulation, given that in past work, children in this age group were most negative about an individual acting in a way that went against the group (Roberts et al., 2017).

Second, participants throughout the studied age range rated digital tracking more positively when tracker and owner were of the same social group (e.g., a Hibble tracking a Hibble) than when they were of different social groups (e.g., a Hibble tracking a Glerk). By 5-6 years of age, trust in the tracker (or conversely, distrust of the tracker) was a factor in evaluating digital tracking, and by 7-8 years of age, children were more negative than positive regarding digital tracking when it was conducted between groups. That group membership affected children's evaluations is notable, given that the two groups were novel, they were described in innocuous ways (without any negative attributes), they were not in competition, and for the primary trials the child was not assigned membership in either group. Merely establishing two social groups with different everyday practices and preferences was sufficient to elicit greater suspicion of digital tracking between groups (see also Dunham, 2018). Conversely, merely establishing that individuals belong to the same social group was sufficient to elicit greater comfort with digital tracking.

We note that in this study, the goal of varying the novel groups was not to draw inferences about the role of social groups in children's reasoning about the real world, but rather as a straightforward way to manipulate trust in the tracker. An important question for future research is if or when the group differences obtained here would extend to reasoning about actual groups (e.g., based on race, ethnicity, or group affiliations). Additionally, it would also be informative to examine children's judgments when the tracker is not an individual person at all, but rather a company or corporation (such as Google or Amazon) or a personified digital assistant (such as Siri or Alexa). These are the more usual circumstances in which digital location or personal information is shared in actual practice. It would be particularly useful to know whether children at different points in development would treat these as more analogous to a within-group tracker or a between-group tracker.

Third, negative evaluations of within-group tracking emerged only gradually over the age period studied. In contrast to between-group tracking, which (as noted above) was evaluated negatively by age 7-8, within-group tracking was not evaluated negatively until 11-12 years of age. Indeed, children below this age were overall quite positive about digital tracking, as long as the tracker and owner were from the same social group. It appears that up through 10 years of age, children assumed that if the tracker was trust-worthy, then there were no problems with sharing location information. This result suggests that privacy concerns (which are at play regardless of the relationship between tracker and owner) develop on a distinct and slower trajectory than trust concerns (which are at play primarily when tracker and owner are from different groups).

Importantly, the judgments when evaluating the hypothetical tracking of third-party others (e.g., a Glerk tracking a Hibble's belongings) were similar to the judgments when evaluating the hypothetical tracking of the self (e.g., a Glerk tracking the participant, who was asked to simulate membership in the Hibble group). Again, there was an interaction between age group and tracker-owner relationship. We could not directly compare trials involving the participant with those not involving the participant, given the fixed order of the trials (self-trials were always last) and the lack of direct comparability (i.e., those involving the participant did not specify what was being tracked, given that we could not assume that all participants have the same set of belongings). In future research it would be interesting to compare evaluations of tracking the self versus other, though we also note that this did not play a role in prior research (Gelman et al., 2018, Study 3).

A final result was that overall, evaluations of digital tracking were more positive when the item being tracked was a dog versus a backpack. Perhaps participants felt that it was more urgent to find a lost dog than a lost backpack, given that a pet dog (unlike a backpack) is irreplaceable. Another possibility is that dogs do not typically contain private possessions, whereas backpacks do. In any case, this result suggests that the functionality of the tracker may be another factor guiding children's judgments. Even adults may willingly sacrifice their own privacy when doing so enables access to desirable features (e.g., consider an article entitled, “Google’s new Clips camera is invasive, creepy, and perfect for a parent like me”; Popper, 2017).

STUDY 2

The primary goal of Study 2 was to examine a different kind of tracked information from that of Study 1 (which focused on location tracking). Specifically, Study 2 provided scenarios in which a person looked on their own computer to view photos that were taken by another person on their phone. In this sort of situation, the privacy violation had no functional benefit for the owner (i.e., there is no obvious benefit to the owner if a stranger views your photos)--in contrast to Study 1, where third-party tracking could benefit the owner by helping them find a lost pet or backpack. A second goal of Study 2 was to systematically and explicitly manipulate both the trustworthiness of the tracker (mean vs. neutral), and the privacy of the information (public vs. private images). In contrast to Study 1, where trust was indirectly manipulated, in Study 2 trust was more directly manipulated by varying the characteristics of the tracker. Because the most substantial developmental changes in Study 1 occurred in the younger children, Study 2 focused on children ages 5-10 years, as well as college students as a comparison sample.

Method

Participants

Participants were 95 children (ranging in age from 5.03 -10.92, mean age 7.92; 45 girls, 49 boys, and 1 not specified) and 123 college students (ranging in age from 18-22, mean age 19; 66 women, 54 men, 1 other gender, and 2 gender not reported). Children’s race or ethnicity as reported by parent or guardian was: White (n = 71), Asian or Asian-American (n = 12), Black (n = 1), biracial or multiracial (n = 11). College students’ self-reported race or ethnicity was: White (n = 67), Asian or Asian-American (n = 27), Black or African-American (n = 6), Middle Eastern (n = 3), Hispanic or Latino (n = 5), Biracial or Multiracial (n = 10), and not reported (n = 5).

Children were recruited to sample roughly equally from three age groups: 5-6 years (n = 30), 7-8 years (n = 33), and 9-10 years (n = 32). College students were enrolled in an introductory psychology course at the same university as Study 1 and obtained partial credit for participation. This study was initiated during the COVID-19 pandemic when in-person testing was suspended, and thus child participants were tested via videoconferencing and college students were tested via a self-administered Qualtrics survey. Data collected from three additional children were dropped, due to one child not speaking English, and two children whose birthdates were outside the predetermined range. Data from 13 additional college students were dropped due to: failing to complete the survey (n = 4), meaningless responses to open-ended questions (n = 2), failure to verify student status (n = 5), or reporting an age under 18 (n = 2).

Participants were tested from March of 2020 to August of 2020.

Materials and Procedure

Materials included cartoon images of eight items, four public (bird, rainbow, stop sign, and Elmo from Sesame Street) and four private (messy bedroom, piggy bank, safe with jewels, and the inside of a backpack). Items were selected on the basis of a pretest with adults, who rated a larger set of items on a scale of 1 (very public) to 7 (very private). For the items used in the study, the public items had scores ranging from 1.32 to 1.43 (M = 1.37) and the private items had scores ranging from 4.21 to 4.81 (M = 4.48). The child version of the task also included a PowerPoint presentation with an embedded video (described below; see also Online Supplement).

Warm-ups. We included two warm-ups with children, the first to ensure that they understood how one can take pictures on a phone, and that pictures don't change over time (Zaitchik, 1990), and the second to introduce a novel application for accessing a photo from different electronic devices. For the first warm-up, child participants watched a video of a woman holding a playing card, taking a photograph of the card with her phone, and then putting the card back into a box, all the while narrating what she was doing. Children were then asked to say where the card was in the picture, where the correct response was to say it was in the woman's hand (not in the box). For the second warm-up video, children saw a novel photo-accessing app on the same woman's laptop (with a distinctive logo), and then watched as the photo she had taken on her phone was copied, sent to the photo-sharing app on her computer, and opened on that computer. They were then asked what would happen if the woman put a picture of her dog that was on her phone into the special app; here, the correct answer was to say that she would be able to see that picture on her computer, too. The video ended with this statement: "So that's how this app works. When we put a picture in the app we can see it from any computer screen. People use the app to see their pictures from anywhere."

Adult participants were not given either warm-up but read, "This app is a folder in the cloud that someone can put their pictures into, in order to see them from any device. People can take photos on their phone, place them in the app's folder, and then look at any computer screen, tablet, or cell phone and see the photos that they took on their phone."

Test trials. Following the warm-ups, participants received two counterbalanced blocks of four test trials each (eight test trials total). Each block was introduced by showing a picture of a man, providing his name (either Mike or Sam), and saying that he has a computer with the special app on it. One man was smiling and not further described; the other was scowling and described as "kind of mean" and "sometimes [he] isn't very nice". We refer to these as the "neutral" and "mean" character, respectively. Each block included two 'public' items (e.g., rainbow) and two 'private' items (e.g., messy bedroom), Each child was randomly assigned to one of eight different presentations, which fully counterbalanced the order of the blocks (neutral or nice tracker), assignment of item to tracker, and assignment of name to tracker.

For each item, children were first asked if they had ever seen the item (e.g., "Here's a picture of a stop sign. Have you ever seen a stop sign?") and then after they answered, they were asked to imagine that they took a picture of the item with their phone. They were then asked if it was OK for the character to look on his computer to see the picture (e.g., "Is it OK for Mike to look on his computer so he can see your picture of a stop sign?"). They responded either OK or not-OK, and then answered how OK or wrong: a little, medium, or a lot. This yielded a 6-point scale from a lot wrong (1) to a lot OK (6). We used a 6-point scale in Study 2 rather than the 10-point scale from Study 1, due to constraints of the online video testing format, whereby children were required to respond verbally rather than pointing. Finally, the participant was asked, “Can you tell me why?” For 88 out of the 95 children, parents consented to audio-recording and the child's response was later transcribed and coded. The remaining 7 children for whom we did not have audio-recordings were not included in the analysis of the explanations.

College students received a written version of the same task as the children. As noted above, they did not receive the warm-up videos or questions but instead read a short description of the novel app. Otherwise, they saw the same pictures and items as the children and provided their responses on a Qualtrics survey. As with children, for each item they first provided a dichotomous response of 'OK' or 'not-OK'; in contrast to children, the follow-up scales each had 5 points (1 = a little OK or a little wrong to 5 = a lot OK or a lot wrong), yielding a 10-point scale from a lot wrong (1) to a lot OK (10). (College students were tested before we determined that children would receive the simpler scale.) They were also asked to write down an explanation for each answer.

Explanation responses were coded as in Study 1. Two coders independently coded 20% of the transcripts, blind to participant age and all factors in the design, and disagreements were resolved through discussion; the remaining transcripts were each coded by one coder. Interrater agreement averaged 97% (per code ranging from 89% to 100%); Cohen's kappa averaged .86 (per code ranging from .66 to 1.0).

Results

We first examined children's responses on the warm-up trials to confirm that they understood the basic task set-up. The majority of children responded correctly to both warm-ups (80% correct on reporting that in the picture, the card was in the woman's hand; 98% reporting that the woman could see the photo of her dog on her computer). Those who responded incorrectly were corrected. The primary analyses are organized into two primary sections, as in Study 1: the first focused on participants' evaluations of the digital tracking behavior, and the second focused on participants' explanations.

Evaluations

Children's and college students' evaluations were analyzed separately because they received different scales, and because the gap in age between the child sample and the college sample precluded analyzing age continuously across the full set of participants. Analyses involving age, tracker (mean vs. neutral), and item type (private vs. public) involved confirmatory hypothesis-testing, whereas interaction effects were exploratory.

Children. As noted in the Procedure section above, children's responses were scored on a composite scale ranging from 1 (most negative) to 6 (most positive). We analyzed children's responses via a mixed-effects linear regression model with tracker (neutral, mean; effect-coded with neutral affect = 1), item (private, public; effect-coded with private = 1), age (standardized), and the interaction among these three variables as the primary predictor variables (entered simultaneously). Participant ID was included as a random intercept. Children's scaled responses (on a 1-6 scale, where 1 = "a lot wrong", 6 = "a lot OK") was the dependent variable. Analyses were probed via comparisons to the midpoint (i.e., 3.5) and pairwise comparisons, and Cohen's d statistics are included as effect size estimates.

There was a main effect of tracker, revealing that children were more positive about being tracked by the neutral tracker (M = 4.41, SE = .12) than by the "mean" tracker (M = 3.97, SE = .13). There were also main effects of age (B = -.59, SE = .10, t = -6.09, p < .001, 95% CI: [-.78, -.40]), revealing less positivity with age, and of item (B = -.99, SE = .05, t = -20.25, p < .001, 95% CI: [-1.09, -.90]), revealing that children were more positive about public items being tracked (M = 5.17, SE = .11) and less positive about private items being tracked (M = 3.21, SE = .16). Critically, there was an interaction involving age and item (B = -.34, SE = .05, t = -6.83, p < .001, 95% CI: [-.43, -.23]). Positivity was lower at the higher ages, with respect to both public items (B = -.25, SE = .11, t = -2.27, p = .03, 95% CI: [-.47, -.03]) and private items (B = -.92, SE = .13, t = -7.01, p < .001, 95% CI: [-1.18, -.66]), though positivity decreased more sharply with age for private vs. public tracking. See Figure 3 for a visual depiction of the age by item interaction, including the corresponding pairwise comparisons, and see Table 4 for the chance comparisons.

---------- Insert Figure 3 about here ----------

---------- Insert Table 4 about here ----------

College students. The analyses were identical to those used with children, except that age (standardized) was not included in the model, and the dependent variable ranged from 1 to 10, where 1 = "a lot wrong", 10 = "a lot OK" (this was also reflected in the comparisons to the midpoint (i.e., 5.5). There was a main effect of tracker (B = .12, SE = .06, t = 1.97, p = .049, 95% CI: [.01, .23]), revealing that participants were more positive about being tracked by the neutral tracker (M = 4.26, SE = .14) than the "mean" tracker (M = 3.91, SE = .21). There was also a main effect of item (B = -1.40, SE = .06, t = -23.39, p < .001, 95% CI: [-1.52, -1.28]), revealing that participants were more positive about public items being tracked (M = 5.43, SE = .30) and less positive about private items being tracked (M = 2.63, SE = .17). See Figure 3 for a visual depiction of these data and Table 4 for the chance comparisons.

Explanations

As in Study 1, we computed the proportion of participants in each age group who provided each of the coding categories at least once, collapsed over all trials. For each, we conducted chi-square tests to determine if the likelihood of providing the coding category significantly differed by age group. That is, for each coding category, each participant was classified as either using or not using the explanation type, and these frequencies were subjected to a chi-square analysis [2 (used or didn't use) x 4 (age group: 5-6 years, 7-8 years, 9-10 years, College)]. As in Study 1, this was an exploratory analysis.

As can be seen in Table 3, three of the explanation categories significantly increased with age (morality, privacy, and weird, $ps \leq .02$), two significantly decreased with age (psychological state and function, $ps < .03$), and two showed no differences with age (ownership and relationship, $ps > .07$). As in Study 1, these suggest that older children are more likely to appeal to digital tracking as a moral concern, as an invasion of privacy, and as "weird".

Discussion

Study 2 examined children's judgments of a different kind of digital privacy situation from that of Study 1, namely, a person accessing another person's photos on their own computer. Participants considering this scenario once again showed age differences in acceptability ratings, with younger children judging these scenarios more positively than did older children or adults, thus replicating the findings reported in the first study. We also found that children as well as adults were sensitive to the trustworthiness of the tracker (tracking was deemed less acceptable if the tracker was mean vs. neutral) and the privacy of the information (tracking was deemed less acceptable if the photo was private vs. public). And of particular interest, we found an interaction between participant age and privacy information. This last result indicates that approval decreased with child age for the private photos only. This is also consistent with the adult data, in which judgments were overall positive (above chance) for public photos but overall negative (below chance) for private photos.

These data provide four new insights into the mechanisms underlying age-related differences in children's privacy judgments. First, they demonstrate that the age differences from Study 1 (more positive evaluations in younger children compared to older children and adults) were not specific to location tracking, because a similar pattern of results was found when participants were asked about a different privacy violation, namely, access to another person's digital photos. Second, the age differences were unlikely to be due to younger children focusing on the positive consequences of digital tracking, as there were no functional benefits to the owner in the tracking scenarios in this study (i.e., third-party tracking of one's photos did not benefit the person who owned the photos). Third, age-related differences cannot be attributed to differential trust in the tracker, because older children and adults were more negative than younger children, whether the tracker was trustworthy (smiling) or non-trustworthy (scowling and described as 'mean'). And fourth, age-related differences were related to privacy concerns per se. There were no age differences when children were asked about public photos, such as a rainbow or stop sign, but there were marked age differences when children were asked about private photos, such as a piggy bank or the inside of a backpack. These results are consistent with the idea that what may differ across the age groups is concern about privacy violations per se, in other words, differential willingness to share private information.

GENERAL DISCUSSION

In two studies, we examined children's judgments of hypothetical scenarios in which a person engaged in digital tracking of information belonging to someone else. Study 1 focused on tracking of object location (a person's backpack or pet dog); Study 2 focused on tracking of personal photos (pictures taken on a person's phone). Tracker trustworthiness was indirectly varied in both studies: tracker and owner were either from the same group or different groups (Study 1), or the tracker was either seemingly nice (smiling) or explicitly not nice (scowling and described as 'mean') (Study 2). Information privacy was also varied in Study 2, where photos were either of a public entity (e.g., rainbow) or a private entity (e.g., the owner's piggy-bank).

Children as well as adults were sensitive to features of the tracker that might indicate greater or lesser trust (more negative evaluations if the tracker was from another group or was mean) as well as to information privacy (more negative evaluations if the information was private). At the same time, there were striking age-related differences in evaluations in both studies. Children maintained relatively more positive attitudes about digital tracking throughout early and middle childhood (5-12 years of age), whereas older children and adults were overall negative. This pattern is consistent with prior research examining children’s attitudes toward digital location tracking (Gelman et al., 2018), and extends beyond that work by carefully controlling for tracker age, emotional expression, and relationships of the people in the vignettes.

A further important result was that in both studies, privacy concerns appeared to develop on a distinct and slower trajectory than trust concerns. Recall that in Study 1, the largest developmental differences were for vignettes involving an in-group tracker with access to private location information. In such cases, the tracker was relatively more trustworthy, but privacy concerns were nonetheless still operative. The youngest children were comfortable with these scenarios (reflecting their trust in the in-group tracker) but the older children and adults were not (reflecting a sense of privacy violation). Similarly, in Study 2, the largest developmental differences involved tracking of private photos. The youngest children were again comfortable with these scenarios, especially when the tracker was nicer, but the older children and adults were not. An open question for future research is whether these differences in judgments of privacy are specific to digital privacy, or reflect a more general developmental pattern that would extend to non-digital situations as well.

To this point we have noted that adults were the least accepting of the digital tracking scenarios we provided, and even appealed to moral principles in their explanations. However, although adults consistently reported that privacy violations were wrong when directly asked, this does not necessarily mean that they guard against these privacy violations in real-life situations. As is well known, adults willingly permit their purchasing decisions to be shared across platforms, sign privacy policies without reading them, and reveal personal information in order to complete a purchase, reach a desired website, or obtain a small discount. This "privacy paradox" (Norberg et al., 2007) suggests that the developmental changes we see here are only one piece of the puzzle in identifying the challenges in informing people (children as well as adults) how to guard against privacy risks.

These results also raise the question of why digital privacy is so difficult for children to grasp. Why in Study 1 was it not until 11-12 years of age that children deemed it “not OK” for others to track the location of their items digitally? Why in Study 2 did children ages 5-6 judge it "OK" to share private photos with someone they did not know? In part this may reflect broader developmental changes in children's understanding of informational privacy, as has been found in children's understanding of secrets. For example, between the ages of 4 and 11, children are increasingly likely to conceal information regarding a surprise gift from a parent, and these changes corresponded to performance on cognitive tasks (e.g., theory of mind, working memory) (Lavoie & Talwar, 2020). Similarly, by 6 years of age (but not younger), children understand the role of sharing secret information in indicating friendship links (Liberman & Shaw, 2018).

It is nonetheless still puzzling that ownership did not exert a more powerful role for younger children in these studies, given how attentive children are to ownership by preschool age (Nancekivell et al., 2019). Preschool children object if someone touches their belongings without permission, so why don’t they object if someone tracks their belongings without permission? The answer may lie in part with the special qualities of digital ownership. If I give you information, it doesn't remove it from me. Digital tracking also doesn't affect the object being tracked, so there's no worry that the object is going to get broken or lost if someone else has access (unlike physically taking). And physical belongings can be touched, whereas digital belongings cannot. Children as young as 3 years of age judge physical contact (e.g., touching) more than non-physical behaviors (e.g., looking) to link to ownership rights (Van de Vondervoort et al., 2017). More broadly, the negative consequences of sharing digital information may not be as apparent as the negative consequences of sharing physical property. Of course, digital tracking does come with many potential risks (e.g., the ability to stalk someone, to steal an item when knowing its location, or to publicly humiliate someone by sharing a personal photo) -- but younger participants may have difficulty anticipating how information about an object's location or access to a photo could be misused. This would be consistent with children's well-documented positivity bias (Boseovski, 2010). Whether these differences between digital and physical property account for the developmental patterns obtained here is a question for the future (see Olson & Shaw, 2011, for work on children's understanding of the related concept of intellectual property).

Another key question is the extent to which different experiences may affect people's judgments and comfort with digital tracking. In the present study, the differences between age groups may in part reflect cohort effects, given rapid and substantial changes over the past 20 years in young children's exposure to digital devices, as well as changes in the devices themselves. Longitudinal data would be required to disentangle these factors. More generally, experience with technology can vary not only between generations, but also across communities. In 2019, a survey conducted by the Pew Research Center of U.S. participants reported that 83% of adults living in urban or suburban areas possessed a smartphone, compared to only 71% of adults living in rural areas (Perrin, 2019). Most participants in the current study resided in a suburban environment, which may have provided them with more exposure to modern mobile technology. It would also be informative to examine how social influences may affect children's sensitivity to digital privacy. For example, those who hear warnings from parents or teachers, or those who personally know someone who has had a negative experience, may better appreciate the consequences for privacy violations.

It is also important to consider the generalizability of these developmental patterns across cultures. The present study focused on children's conceptualization of digital privacy in a university community in the United States. However, individuals in the U.S. may have higher exposure to various forms of technology than other countries; for example, in 2018, 81% of adults in the U.S. surveyed reported owning a smartphone, compared to 52% of adults in Mexico, and even fewer in other parts of the world (Silver, 2019). The U.S. also values independence and autonomy, which may lead to increased suspicion of digital tracking; this differs from the collectivist or interdependent values that may be promoted by certain cultures (Markus & Kitayama, 1991). Indeed, in relatively collectivistic cultures, children and adults may be more trusting of within-group tracking and may therefore be more accepting of it (Roberts et al., 2018). Furthermore, there are persistent urban-rural differences in digital access even within the US (Perrin, 2019). Given cultural variation in concepts of physical ownership (e.g., Kanngiesser et al., 2015), it would be beneficial to collect comparative data on children's perception of digital privacy from countries with different cultural contexts.

With the increasing use of mobile devices that track object locations and reveal personal information regarding an individual's movements and activities, digital privacy is a considerable issue facing society. Accordingly, an urgent question for the future is how to best protect future generations from exploitation of their digital footprints. The current findings suggest that a first step may involve educating children that their digital information is trackable not only by family members and close friends, but also by individuals and corporations whom they do not know. By creating well-defined guidelines for sharing information through these devices, future research can help children learn to protect their own interests in the digital world.

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Table 1.

Study 1. Mean scores evaluating digital tracking <u>*of others*</u> and <u>*of self*</u> across relationship type, on a scale of 1 (most negative) to 10 (most positive). Statistical tests indicate comparisons against the midpoint (5.5).

Relationship	**Age**	***M*(SE)**	***t***	***p***	**95% CI**	**Cohen's *d***
Within-Groups	5-6	7.68(.40)	3.97	< .001	[6.85, 8.50]	1.38
(Others)	7-8	7.31(.46)	3.97	< .001	[6.37, 8.24]	1.45

	9-10	6.02(.49)	1.05	.30	[5.01, 7.02]	.39
	11-12	4.42(.47)	-2.32	.027	[3.46, 5.37]	.86
	13-17	4.28(.33)	-2.54	.015	[3.30, 5.26]	.88
	College	4.34(.41)	-2.82	.008	[3.52, 5.17]	.91
	5-6	5.93(.56)	.75	.46	[4.77, 7.06]	.26
	7-8	4.45(.49)	-2.14	.04	[3.45, 5.45]	.78
Between-Groups	9-10	3.78(.45)	-3.84	< .001	[2.87, 4.69]	1.42
(Others)	11-12	3.10(.39)	-6.23	< .001	[2.31, 3.89]	2.31
	13-17	3.38(.42)	-5.01	< .001	[2.52, 4.24]	1.74
	College	3.11(.26)	-9.08	< .001	[2.58, 3.64]	2.94
	5-6	6.14(.62)	1.05	.30	[4.89, 7.40]	.37
	7-8	5.68(.67)	.27	.79	[4.31, 7.04]	.10
Ingroup Member	9-10	4.47(.59)	-1.75	.09	[3.25, 5.68]	.65
(Self)	11-12	3.7(.48)	-3.73	< .001	[2.71, 4.69]	1.39
	13-17	3.53(.50)	-3.93	< .001	[2.51, 4.55]	1.37
	College	3.84(.44)	-3.77	< .001	[2.96, 4.73]	1.22
	5-6	5.00(.60)	-.82	.41	[3.77, 6.23]	.29
	7-8	3.32(.53)	-4.11	< .001	[2.24, 4.40]	1.50
Outgroup Member	9-10	3.43(.52)	-3.96	< .001	[2.36, 4.50]	1.47
(Self)	11-12	2.13(.21)	-15.81	< .001	[1.70, 2.57]	5.87
	13-17	3.06(.44)	-5.49	< .001	[2.15, 3.96]	1.91
	College	2.56).30)	-9.78	< .001	[1.96, 3.17]	3.17

Table 2.

Coding categories and examples for the open-ended responses.

Coding Category	Description	Examples
Morality	right/wrong, harm, permission	*He shouldn't be looking for the Hibble's stuff, that's not right. / Because if they're a kidnapper they could watch him. / The Hibble did not ask them to track their stuff.*
Privacy	privacy, personal, self-revealing	*Their backpack is private. / Because my stuff is at my house and then she'd know where my house is. / Because he's always going to see what the Glerk is doing.*
Ownership	appealing to ownership to explain answer (not just possessive pronoun)	*Because it's my backpack. / Because it's my dog and my property. / It's mine, not his. / Since it's my dog and not his.*
Weird	participant indicates the behavior is weird or uncomfortable	*I don't know, it's just weird. / It would make me feel weird. / It's uncomfortable, so no.*
Relationship	relationship between the tracker and owner	*I don't know this hibble/glerk. / Because if we're friends, I could just tell him where his backpack is. / He doesn't know me. / They are from two different groups.*
Psychological	wishes, desires, emotional states	*Because the Hibble/Glerk might want him to. / Because I really love my backpack.*
Function	device would help or serve (not serve) a	*You can find it when it gets lost. / She doesn't need a tracker. / Because sometimes I lose my backpack.*

	function

Table 3.

Proportion of participants providing at least one explanation, for each explanation type, as a function of age group.

Study	Age	Moral	Privacy	Owner.	Weird	Relat.	Psych.	Function
1	5-6	.36	.14	.07	.00	.43	.54	.18
	7-8	.78	.22	.17	.00	.65	.43	.48
	9-10	.71	.50	.25	.13	.75	.71	.33
	11-12	.78	.70	.48	.30	.74	.44	.26
	13-17	.69	.52	.45	.45	.55	.48	.28
	College	.65	.47	.47	.08	.72	.44	.36
	Overall	.66	.43	.32	.16	.64	.51	.31
	chi-square *p*-value	.011	< .001	.002	< .001	.079	.361	.284
2	5-6	.41	.14	.24	.00	.31	.62	.07
	7-8	.89	.68	.29	.04	.39	.68	.21
	9-10	1.00	.87	.37	.03	.47	.83	.07
	College	.81	.82	.16	.15	.38	.41	.05
	Overall	.78	.63	.26	.06	.39	.63	.10
	chi-	< .001	< .001	.075	.018	.673	< .001	.030

square
p-value

Table 4.

Study 2. Mean scores evaluating digital tracking as a function of tracker (neutral vs. mean) and tracked item (public vs. private). Important Note: Children's responses are on a scale of 1 (most negative) to 6 (most positive) and college students' responses are on a scale of 1 (most negative) to 10 (most positive). Statistical tests indicate comparisons against the midpoint (3.5 for children, 5.5 for adults).

Tracker	**Item**	**Age**	**Scale**	***M*(SE)**	***t***	***p***	**95% CI**	**Cohen's *d***
Neutral	Public	5-6	1-6	5.55(.13)	14.86	< .001	[5.27, 5.83]	5.23
		7-8	1-6	5.33(.19)	9.49	< .001	[4.94, 5.73]	3.36
		9-10	1-6	5.28(.23)	7.60	< .001	[4.80, 5.76]	2.73
		College	1-10	5.58(.32)	0.26	.797	[4.96, 6.21]	0.04
	Private	5-6	1-6	4.39(.35)	2.56	.015	[3.68, 5.09]	0.94
		7-8	1-6	3.55(.29)	0.16	.87	[2.96, 4.13]	0.06
		9-10	1-6	2.41(.23)	-4.79	< .001	[1.94, 2.87]	1.72
		College	1-10	2.72(.19)	-14.75	< .001	[2.35, 3.09]	2.67
Mean	Public	5-6	1-6	5.23(.20)	8.60	< .001	[4.82, 5.63]	3.14
		7-8	1-6	5.03(.22)	6.83	< .001	[4.57, 5.49]	2.42
		9-10	1-6	4.59(.28)	3.96	< .001	[4.03, 5.16]	1.42
		College	1-10	5.28(.29)	-0.72	.47	[4.69, 5.88]	0.13
	Private	5-6	1-6	4.10(.34)	1.79	.085	[3.41, 4.78]	0.65

	7-8	1-6	3.00(.27)	-1.84	.075	[2.44, 3.55]	0.65
	9-10	1-6	1.91(.16)	-10.10	< .001	[1.58, 2.23]	3.63
	College	1-10	2.54(.17)	-17.19	< .001	[2.20, 2.89]	3.11

Figure captions

Figure 1. Item from the outgroup tracking scenario in Study 1. In this example, a Glerk is pictured with its dog [left-side image], and a Hibble is pictured tracking the Glerk's dog [right-side image].

Figure 2. Study 1. Mean scores evaluating digital tracking of others, on a scale of 1 (most negative) to 10 (most positive). Asterisks represent which pairwise comparisons (within-group vs. between-group) are significant at each age group (* ≤ .05, ** ≤ .01, *** < .001, ns = not significant) (5-6: t = -2.52, p = .01, 95% CI: [-3.13, -.36], Cohen's d = .61; 7-8: t = -4.27, p = .001, 95% CI: -4.19, -1.52], Cohen's d = 1.09; 9-10: t = -3.37, p < .001, 95% CI: [-3.56, -.91], Cohen's d = .87; 11-12: t = -2.18, p = .033, 95% CI: [-2.53, -.10], Cohen's d = .56; 13-17: t = -1.40, p = .17, 95% CI: [-2.18, .38], Cohen's d = .34; Adults: t = -2.53, p = .01, 95% CI: [-2.20, -.26], Cohen's d = .58).

Figure 3. Study 2. Mean scores evaluating digital tracking of public vs. private items. Children's responses are on a scale of 1 (most negative) to 10 (most positive) and college students' responses are on a scale of 1 (most negative) to 6 (most positive). Asterisks represent which pairwise comparisons (public vs. private) are significant at each age group (* ≤ .05, ** ≤ .01, *** < .001, ns = not significant) (5-6: t = -3.59, p < .001, 95% CI: [-1.79, -.50], Cohen's d = .91; 7-8: t = -6.32, p < .001, 95% CI: [-2.51, -1.30], Cohen's d = 1.56; 9-10: t = -9.55, p < .001, 95% CI: -3.36, -2.20], Cohen's d = 2.39; Adults: t = 7.87, p < .001, 95% CI: [2.63, 5.32], Cohen's d = .95).

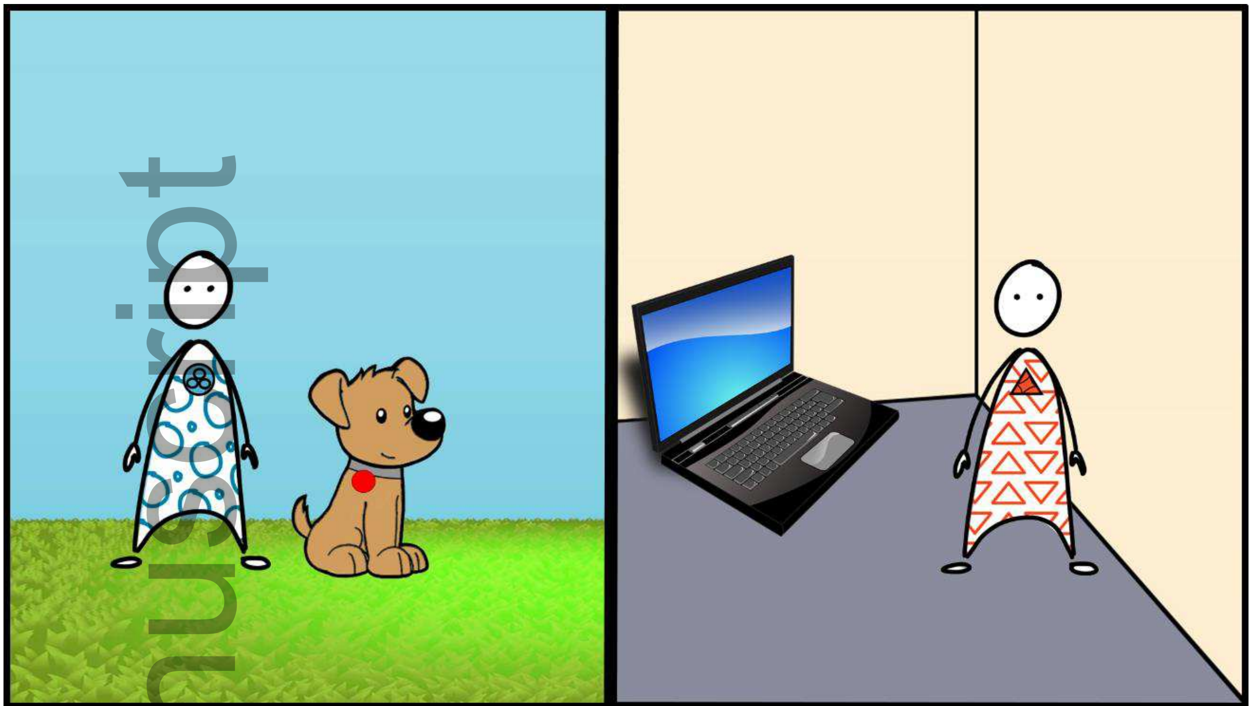

Figure 1.

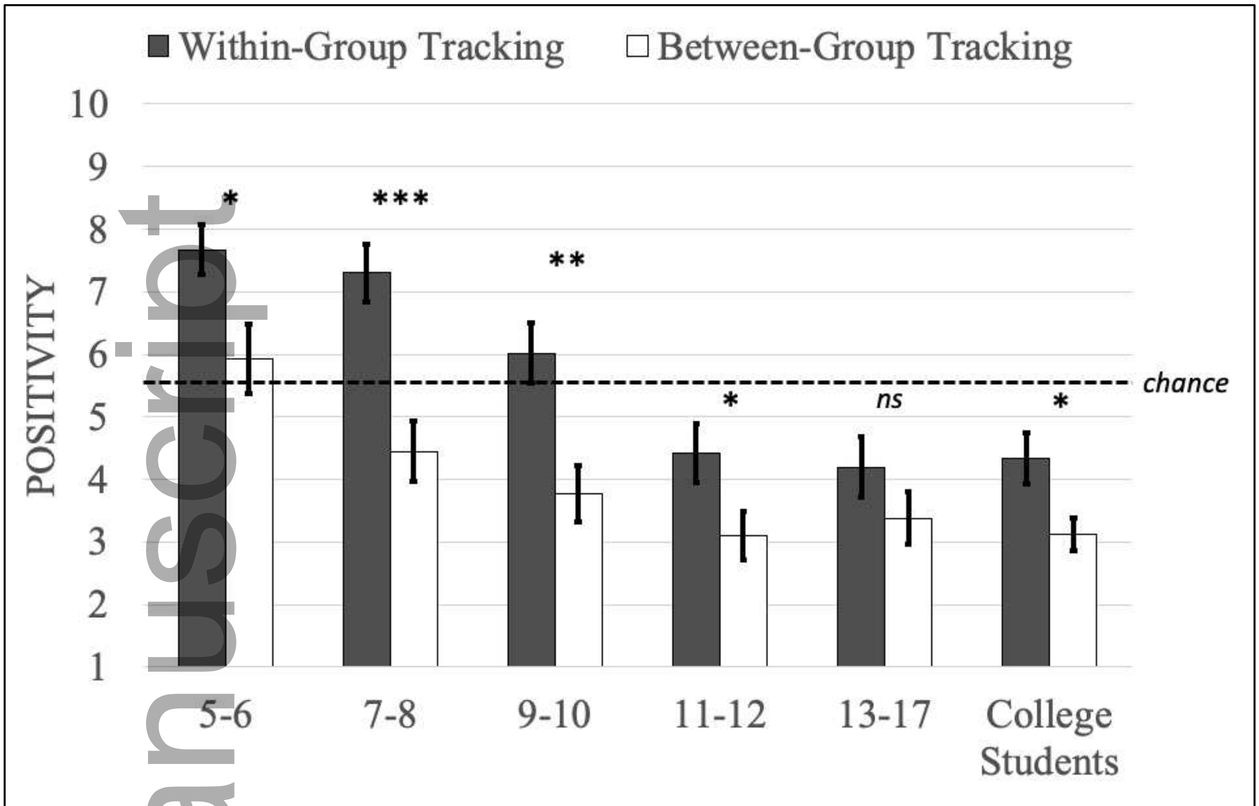
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Figure 2.

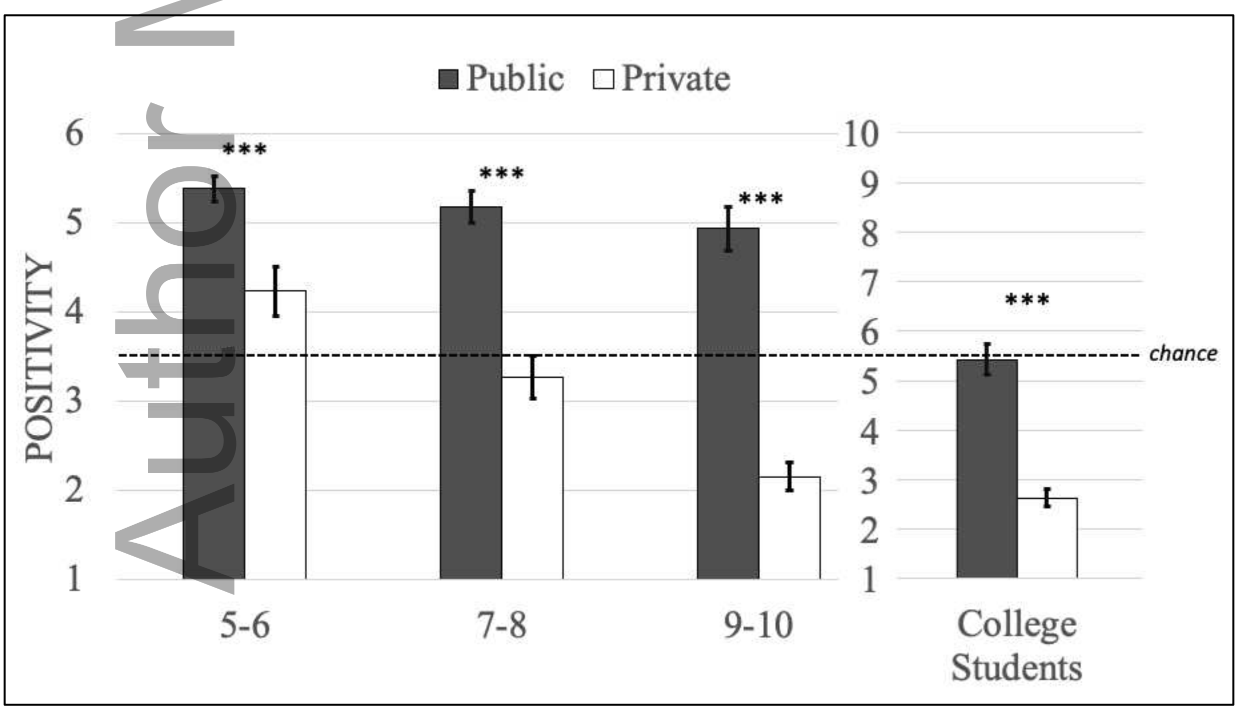
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Figure 3.

Table 1.

Study 1. Mean scores evaluating digital tracking *of others* and *of self* across relationship type, on a scale of 1 (most negative) to 10 (most positive). Statistical tests indicate comparisons against the midpoint (5.5).

Relationship	**Age**	***M*(SE)**	***t***	***p***	**95% CI**	**Cohen's *d***
	5-6	7.68(.40)	3.97	< .001	[6.85, 8.50]	1.38
	7-8	7.31(.46)	3.97	< .001	[6.37, 8.24]	1.45
Within-Groups	9-10	6.02(.49)	1.05	.30	[5.01, 7.02]	.39
(Others)	11-12	4.42(.47)	-2.32	.027	[3.46, 5.37]	.86
	13-17	4.28(.33)	-2.54	.015	[3.30, 5.26]	.88
	College	4.34(.41)	-2.82	.008	[3.52, 5.17]	.91
	5-6	5.93(.56)	.75	.46	[4.77, 7.06]	.26
	7-8	4.45(.49)	-2.14	.04	[3.45, 5.45]	.78
Between-Groups	9-10	3.78(.45)	-3.84	< .001	[2.87, 4.69]	1.42
(Others)	11-12	3.10(.39)	-6.23	< .001	[2.31, 3.89]	2.31
	13-17	3.38(.42)	-5.01	< .001	[2.52, 4.24]	1.74
	College	3.11(.26)	-9.08	< .001	[2.58, 3.64]	2.94
	5-6	6.14(.62)	1.05	.30	[4.89, 7.40]	.37
	7-8	5.68(.67)	.27	.79	[4.31, 7.04]	.10
Ingroup Member	9-10	4.47(.59)	-1.75	.09	[3.25, 5.68]	.65
(Self)	11-12	3.7(.48)	-3.73	< .001	[2.71, 4.69]	1.39
	13-17	3.53(.50)	-3.93	< .001	[2.51, 4.55]	1.37
	College	3.84(.44)	-3.77	< .001	[2.96, 4.73]	1.22
Outgroup Member	5-6	5.00(.60)	-.82	.41	[3.77, 6.23]	.29
(Self)	7-8	3.32(.53)	-4.11	< .001	[2.24, 4.40]	1.50

	9-10	3.43(.52)	-3.96	< .001	[2.36, 4.50]	1.47
	11-12	2.13(.21)	-15.81	< .001	[1.70, 2.57]	5.87
	13-17	3.06(.44)	-5.49	< .001	[2.15, 3.96]	1.91

Table 2.

Coding categories and examples for the open-ended responses.

Coding Category	Description	Examples
Morality	right/wrong, harm, permission	*He shouldn't be looking for the Hibble's stuff, that's not right. / Because if they're a kidnapper they could watch him. / The Hibble did not ask them to track their stuff.*
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Ownership	appealing to ownership to explain answer (not just possessive pronoun)	*Because it's my backpack. / Because it's my dog and my property. / It's mine, not his. / Since it's my dog and not his.*
Weird	participant indicates the behavior is weird or uncomfortable	*I don't know, it's just weird. / It would make me feel weird. / It's uncomfortable, so no.*
Relationship	relationship between the tracker and owner	*I don't know this hibble/glerk. / Because if we're friends, I could just tell him where his backpack is. / He doesn't know me. / They are from two different groups.*
Psychological	wishes, desires, emotional states	*Because the Hibble/Glerk might want him to. / Because I really love my backpack.*
Function	device would help or serve (not serve) a	*You can find it when it gets lost. / She doesn't need a tracker. / Because sometimes I lose my backpack.*

	function

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Proportion of participants providing at least one explanation, for each explanation type, as a function of age group.

Study	Age	Moral	Privacy	Owner.	Weird	Relat.	Psych.	Function
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	9-10	.71	.50	.25	.13	.75	.71	.33
	11-12	.78	.70	.48	.30	.74	.44	.26
	13-17	.69	.52	.45	.45	.55	.48	.28
	College	.65	.47	.47	.08	.72	.44	.36
	Overall	.66	.43	.32	.16	.64	.51	.31
	chi-square *p*-value	.011	< .001	.002	< .001	.079	.361	.284
2	5-6	.41	.14	.24	.00	.31	.62	.07
	7-8	.89	.68	.29	.04	.39	.68	.21
	9-10	1.00	.87	.37	.03	.47	.83	.07
	College	.81	.82	.16	.15	.38	.41	.05
	Overall	.78	.63	.26	.06	.39	.63	.10

Table 4.

Study 2. Mean scores evaluating digital tracking as a function of tracker (neutral vs. mean) and tracked item (public vs. private). Important Note: Children's responses are on a scale of 1 (most negative) to 6 (most positive) and college students' responses are on a scale of 1 (most negative) to 10 (most positive). Statistical tests indicate comparisons against the midpoint (3.5 for children, 5.5 for adults).

Tracker	**Item**	**Age**	**Scale**	***M*(SE)**	***t***	***p***	**95% CI**	**Cohen's *d***
Neutral	Public	5-6	1-6	5.55(.13)	14.86	< .001	[5.27, 5.83]	5.23
		7-8	1-6	5.33(.19)	9.49	< .001	[4.94, 5.73]	3.36
		9-10	1-6	5.28(.23)	7.60	< .001	[4.80, 5.76]	2.73
		College	1-10	5.58(.32)	0.26	.797	[4.96, 6.21]	0.04
	Private	5-6	1-6	4.39(.35)	2.56	.015	[3.68, 5.09]	0.94
		7-8	1-6	3.55(.29)	0.16	.87	[2.96, 4.13]	0.06
		9-10	1-6	2.41(.23)	-4.79	< .001	[1.94, 2.87]	1.72
		College	1-10	2.72(.19)	-14.75	< .001	[2.35, 3.09]	2.67
Mean	Public	5-6	1-6	5.23(.20)	8.60	< .001	[4.82, 5.63]	3.14
		7-8	1-6	5.03(.22)	6.83	< .001	[4.57, 5.49]	2.42
		9-10	1-6	4.59(.28)	3.96	< .001	[4.03, 5.16]	1.42
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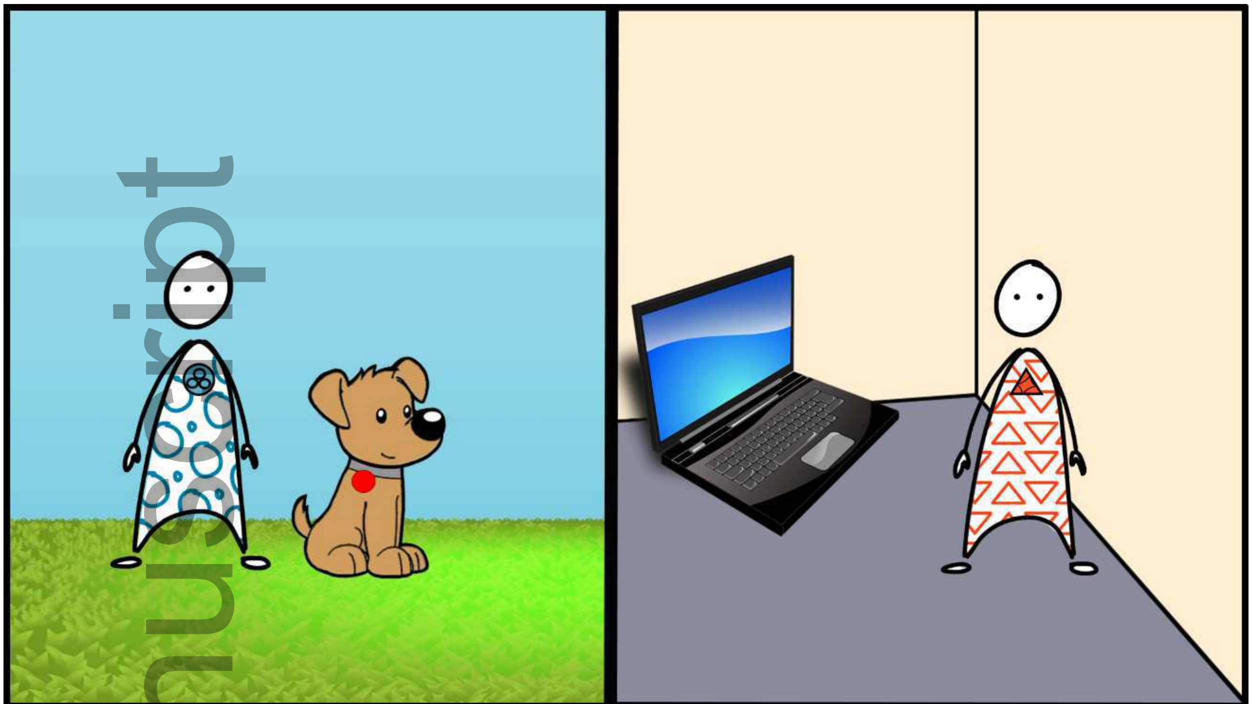
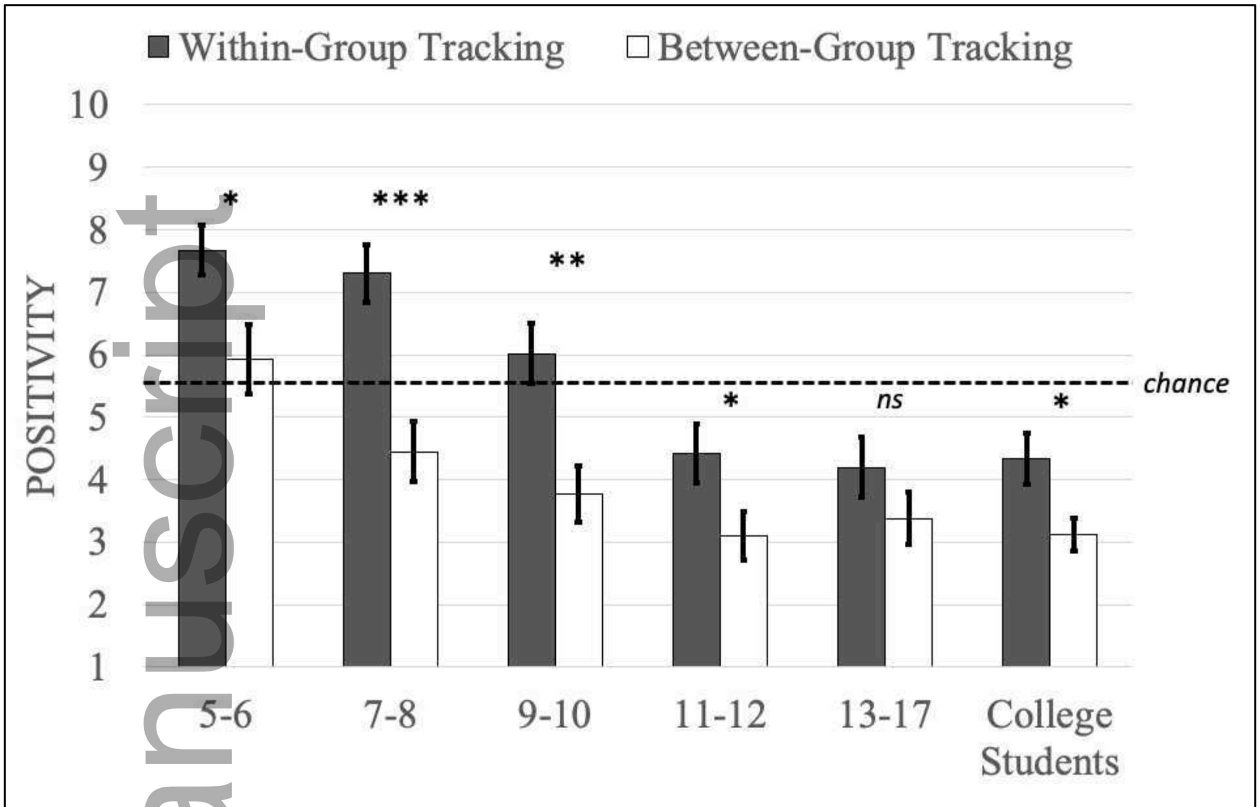
		7-8	1-6	3.00(.27)	-1.84	.075	[2.44, 3.55]	0.65
		9-10	1-6	1.91(.16)	-10.10	< .001	[1.58, 2.23]	3.63





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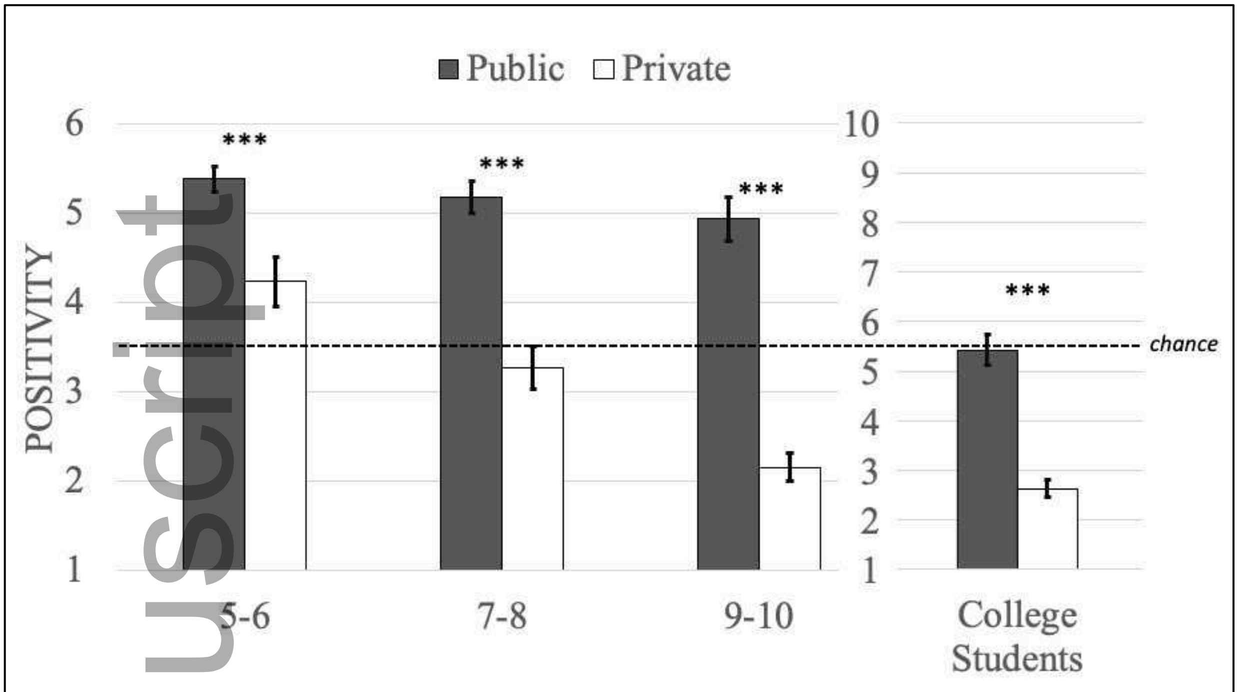
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