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Abstract

When children use online apps, they often share personal information, such as their name, address, and birthday. In the present study, we investigated the mental models children use to reason about what apps are allowed to do with personal data after it has been willingly shared with an app. 57 children ages 8- to 11-years-old were read a story in which they were asked to judge whether an online game (app) was allowed or not allowed to perform four different actions: looking, saving, selling, and showing. We compared these judgments to a comparison condition where we asked children what users themselves should be allowed to do with their data. We found that children viewed the app as less permitted to act on the data than users as well as some further differences by action-type. Our findings suggest that children use something akin to a "lending" model to conceptualize data transfers, in which apps have less rights than users despite the data being willingly transferred to the app. Our findings also suggest that children differentiate among the uses of information as children think certain actions by the app are less permissible than others (e.g., looking is more permissible than selling).

Keywords: child development; rights; digital thinking

Introduction

Internet-connected technology is a part of daily life for many children. A large proportion of the technology children interact with harvest their personal data (Livingstone et al., 2019). Once data has been harvested from children, willingly or otherwise, technology and related companies interact with it in a variety of ways. This includes the monetization and selling of it to third parties.

The present study examines the mental models that govern children's thinking about the transfer of personal data to online games. Put differently, we are interested in children's default thinking about an apps' rights or entitlements to actions such as the selling or sharing of a users' data. We focus on cases where data has been willingly transferred to an online game, a common form of technology for children ages 8- to 11-years-old.

The present work builds on a prior study which established that children, by 8-years-old, view information as a type of property. In this study, Nancekivell and Fahey (2022) found that by 8-years-old, children viewed users as owning the personal, but not general, information they shared with apps. Namely, the present study builds on this work by examining how children judge the transfer of this personal information.

The question of how children represent data transfers is both an interesting applied and theoretical question. First, it has barring on what children believe apps are permitted to do with their data, which has implications for their safety online. For example, if children do not understand that apps are often permitted to sell or give away their data after it has been shared, then they may not fully understand the risks associated with sharing data online. Second, it has theoretical implications for how children reason about an understudied property type: non-physical property. As we review below, little is known about how children think about, and represent, non-physical property. The studies of children's mental models of non-physical property like information have barring on the coherence of their representations of ownership and related rights.

Inspired by the physical ownership literature, we propose there are a few mental models that children might use to think about data transfers. Mental model 1 is a full transfer of rights model where children would view users as fully transferring ownership rights of the data to the app after it has been shared. This model would be akin to giving or selling events in physical contexts. Under this account, the app is entitled to do whatever it wants with the data (e.g., sell it, share it, save it, etc.). Mental model 2 is a partial transfer of rights model where children view users as only partially transferring rights of their data to the app after it has been shared. Under this account, the app is less entitled to act on the data than users would be. This model would be akin to lending events in the physical contexts. Often when we lend physical possessions, we transfer some rights, but not all, to the borrowers. For example, borrowers do not have the right to sell a lent possession, and even young children recognize this fact (Kim & Kalish, 2009).

Prior work has established that by the end of early childhood, children have a sophisticated understanding of ownership rights and transfers (see Pesowski et al., 2022 for a recent review). By 2-years-old, children show an understanding of their own ownership rights and will defend their property against their peers (e.g., Friedman & Neary, 2008; Ross, 1996, 2013; Ross et al., 2015). By 3-years-old, children will protest when their property rights are violated (e.g., Rossano et al., 2011). By 4-years-old, children explain the (un)acceptability of others' actions using ownership (e.g., who is allowed/not allowed to use a toy; Nancekivell & Friedman, 2017) and will list a greater variety of actions when reflecting on what an owner versus non-owner is

allowed to do with property (Nancekivell & Friedman, 2014). At around this age, children also appreciate that consent governs how a non-owner can act on property (e.g., Van de Vondervoort & Friedman, 2015; Van de Vondervoort et al., 2017). They view property claims as being able to differ categorically (claim/no claim) or on a continuum (e.g., stronger or weaker; Davoodi, 2020). By the age of 5, children understand a range of physical ownership transfers (Blake & Harris, 2009). They appreciate that giving but not stealing transfers ownership (Blake & Harris, 2009) and they distinguish among borrowers, buyers, and finders (Kim & Kalish, 2009). At these ages, children also understand the breadth of ways physical property can be legitimately acquired (e.g., making, finding, buying; Kanngiesser et al., 2010; Kanngiesser & Hood, 2014; Nancekivell & Friedman, 2014). However, in contrast to older children (e.g., 7-/8-years), younger children sometimes struggle to disentangle ownership rights from related moral considerations (i.e., what one is permitted to do versus what one should do; Kim & Kalish, 2009).

The present study concerns children's thinking about the transfer of non-physical property (e.g., one's personal data online has no physical instantiation). Although we know little about how children think about the ownership of information, we do know that children can think about ownership of other kinds of non-physical property, like ideas. At the age of 6, children dislike people who take others' ideas (Olson & Shaw, 2011). Around 6- to 8-years-old, children use who first establishes possession of an idea to determine who owns it and appreciate that theft is not a legitimate way to transfer the ownership of an idea (Shaw et al., 2012). Children at this age also do not apply ownership thinking to common words, like *dog*, indicating a recognition that ideas are distinct from other kinds of knowledge (Shaw et al., 2012). Finally, in a recent study on digital possessions, children appreciate that taking files, like an e-book, from a computer without an owners' awareness is theft (Lee & Gelman, 2022). However, the literature on digital property is limited to this singular study and it does not examine how children think about online information or data.

There are a few studies in the human-computer interaction literature that have looked at related issues like children's mental models of privacy (e.g., Kumar et al., 2017; Mai et al., 2022; Sun et al., 2021). For example, Kumar et al. (2017) interviewed children about the privacy of internet-connected devices to better understand their mental models. They found that 10-year-olds, but not younger children, viewed some kinds of information sharing, especially related to passwords, as a threat to privacy (Kumar et al., 2017). Another study by Sun et al. (2021) showed that four key factors shape 4- to 10-year-olds recognition that a data transfer has occurred at all. Specifically, the existence of visual cues in an app, experience sharing information in previous digital interactions, children's age and developmental stage, and non-digital privacy experiences all influenced children's ability to understand when and how data transfers happen,

and thereby their recognition of privacy and safety risks (Sun et al., 2021).

Finally, in related studies on digital tracking researchers find that children's mental models of privacy online and ability to detect violations also change with age. For example, a handful of studies looking at digital tracking suggest that older children (e.g., 11-year-olds) are more likely than younger children (e.g., 5-year-olds) to judge that it is unacceptable to use an app to track someone else without their awareness (Gelman et al., 2021; Gelman et al., 2018). Although this tracking work does not touch on issues related to data ownership or data transfers per se, it does suggest that during later childhood children are developing an understanding of privacy online which could be reflective of the development of a broader understanding of people's rights in online contexts, including an understanding of what happens to those rights when data is transferred to apps. These works also suggest that older children know that sharing information is a risk to privacy in the sense that it could be accessed or used by others. But again, these works do not look at the specific mental models children use to think about data transfers and specific ways they think (or do not think) apps are *entitled* or *should* act on data once they have it. Nonetheless, these works do suggest the target age range of 8-years to 11-years is likely an appropriate time point to capture children's thinking and development therein.

The Present Study

To examine children's mental models of data transfers we conducted one within-subjects experiment. Children ages 8-years to 11-years were told a story where an adult user willingly gives an app their personal information. Children were then asked about the permissibility of the apps acting on the data in different ways. We modelled our study after prior work on physical ownership rights (Nancekivell & Friedman, 2014; Van de Vondervoort & Friedman, 2015; Van de Vondervoort et al., 2017). Specifically, we asked children about two high entitlement actions: selling and showing to others, and two low entitlement actions: looking and saving. High entitlement actions were labelled as such as they represent a case where someone has complete control over the property. Namely, one cannot transfer property to someone else if they do not truly own it (but they might be able to look at it). In a comparison condition, we also asked children about what the user themselves are permitted to do with their information. At test, children were asked a binary permissibility "allowed" question (e.g., what is the app allowed or not allowed to do). This wording was modelled after prior work with preschoolers and ownership rights (Nancekivell & Friedman, 2014).

Mental model 1 (complete transfer) predicts that children will judge that the app is entitled or allowed to act on the information in all cases and in similar ways to the user. Mental model 2 (partial transfer) predicts that children will judge that the app is less entitled or allowed to act on the information than the user. Based on lending cases in the physical world, it also predicts that children would

specifically judge that the app is more permitted to engage in low entitlement actions than high entitlement ones.

Method

Participants

The final sample included 57 children ages 8- to 11-years-old (12 eight-year-olds; 19 nine-year-olds; 18 ten-year-olds; and 8 eleven-year-olds). The sample identified as: 56.14% girls and 43.86% boys. The racial/ethnic identities of children in the sample were divided as follows: 43.9% White, 8.8% Inuit/Metis/First Nations, 10.5% Asian, 7.0% Latin American or Latino, 1.8% Black, 8.8% multiracial, and the racial identities of 19.3% participants were unknown. One child was excluded. Participants were tested at Living Lab locations in the community including the Manitoba Museum and Wolseley Farmers Market. Written parental consent was collected using a waiver of signature of consent to minimize the collection of identifying data and verbal assent was collected from children. We are partway through data collection with a target sample size of 80 children.

Materials and Procedure

Participants heard a short story presented on a Samsung tablet using a survey hosted on Qualtrics. The story was read aloud in third person by the experimenter to control for differences in children's reading ability, which can vary during middle childhood (Harold & Hay, 2005). Responses were recorded using forced choice questions. Children could verbally respond or select their response directly on the tablet. In the case of verbal responses, the experimenter recorded the child's answer for them.

The story was about a grown-up named Riley. The story began with the experimenter explaining that Riley shared her information (i.e., her full name, where she lives, and her birthday) with a new game that she got on her computer. The experimenter introduced this idea by saying: "When she got the game, Riley shared her information. She shared her full name, where she lives, and her birthday when she signed-up for the game." After this introduction, the participants were next asked a series of questions about whether the Game or Riley was allowed or not allowed to perform a series of actions using the information. For example, in one trial children were told then asked: "The game looked at the information. The game read it. Was the game allowed or not allowed to do that?". Children were asked about two low entitlement actions (looking and saving) and two high entitlement actions (showing and selling).

Children considered scenarios where these same actions were either carried out by the Game or Riley herself. Children always heard about both actors. Again, for each actor, participants considered the same four actions. Thus, in total, children saw eight test trials (4 about the Game, 4 about the user Riley). As a reminder, at test participants judged whether each action was allowed or not allowed.

The order in which the actors (i.e., Game/Riley) were presented was fixed. Children always heard about the Game first and Riley second. This was done because hearing about the User (Riley) first could influence children's thoughts on what the Game can do. For example, if they are told that the User sold her information then it could make the Game selling the information appear more permissible.

The nature of the actions, high or low entitlement, were counterbalanced using a Qualtrics randomizer. Within each of these action-type blocks, the individual behaviours (e.g., selling vs. saving) were also counterbalanced using a Qualtrics randomizer.

Results

Data was coded such that any "allowed" response was given a 1 and "not allowed" given a 0. There were no other responses in the data set (e.g., "I don't know").

Mixed binary regressions were run using the lmer package in R with predictors of actor (User, Game), action-type (look, save, show, sell), and age in months centered and all interaction terms. Although we had predictions related to high/low entitlements specifically differing, action-type was inputted into our models as a variable with four levels (look, save, show, sell) as we were unsure if the low and high entitlement actions would indeed be considered in similar ways. Random effects were modelled as 1+actor|id. *P*-values are reported from car package. Figure 1 displays our findings.
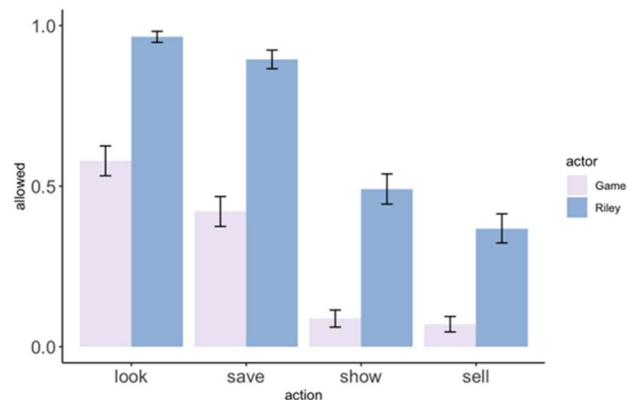

Figure 1: Bar graph showing the average proportion of actions that children judged as allowed displayed by actor and action type.

There was a main effect of actor such that children were more likely to judge that actions were allowed when they were considering the actions of the User as compared to the Game, X^2 (1) = 18.44, $p < .001$. There was a main effect of action-type, X^2 (3) = 18.44, $p < .001$. Actor and action type did not significantly interact, X^2 (3) = 7.74, $p = .051$. There was no effect of age, X^2 (1) = 0.007, $p = .93$, or interactions with age, ps > .21.

Emmeans was used for simple effects analyses. For both looking and saving actions, children viewed the User as more allowed than the Game, $p < .001$. For both selling and showing actions, children's User and Game judgments did not differ, ps > .23. In the Game's case, children were more

likely to judge that looking and saving were allowed as compared to showing and selling, $ps < .002$, but these low entitlement actions did not differ from one another, $p = .056$ and, similarly, showing and selling (i.e., high entitlement actions) did not differ from one another, $p = .99$. The same pattern was found for the User with saving and looking differing from all other actions, $ps < .001$, but not one another, $p = .21$, and the high entitlement actions of selling and showing not differing from one another, $p = .089$.

General Discussion

In the present study, we examined the mental models children use to represent personal data transfers. We found that children viewed the Game as less permitted to act on personal data than users, despite the data being described as willingly shared. We also found that children viewed the Game as less permitted to sell and show the data than look at it or save it as compared to the User. But, this finding is best understood in the context that we also unexpectedly found that children viewed high entitlement actions of showing others and selling as less permissible for *both* the User and the Game as compared to the low entitlement actions. In terms of specific entitlements, children viewed the Game as less entitled to show and sell the data as compared to other actions. Unexpectedly, as mentioned earlier, children also viewed the User as less entitled to show and sell their data as compared to looking and saving it. Together, our findings suggest that children differentiated between the different ways that online apps like games may use information. They also suggest (somewhat unexpectedly) that children have beliefs that some actions like selling information are just generally less permissible than others.

Our results suggest that children likely use something akin to a partial transfer of rights model when conceptualizing data transfers. Specifically, when children share information with an online game, they most likely view it more as "lending" the information, which means they think a game should be permitted to perform less actions with the data than a user, and that some actions are less permissible than others. Namely, high entitlement actions are less permissible for the app than low entitlement actions which is compatible with a partial transfer account.

We also had some findings that remain unexplained by a partial transfer *only* account. As we next discuss, we suspect some of these unexpected findings are due to how concerns about privacy influenced children's judgments in addition to thinking about ownership rights. Incompatible with a partial transfer account, we also unexpectedly found that, overall, children viewed high entitlement actions as less permissible than low entitlement actions, including for the User. We also further unexpectedly found low rates of permissibility across the board for the app's actions including for low entitlement actions. One possible reason these patterns may have occurred is because children might be thinking about issues related to privacy and safety. For example, once personal data is sold to anyone by *anyone*, it can no longer be kept private. Similarly, it is difficult to keep data private once it has been

shared with the app at all. Such privacy concerns may have led children to view the act of selling and showing others as less permissible and thus lower rates of endorsement for the app even for benign actions like looking. This finding is compatible with the physical ownership literature which has found that conventional-moral considerations and rights-based considerations can influence children's thinking about the permissibility of actions directed towards property (Kim & Kalish, 2009). For example, young children are reluctant to endorse *both* owners and non-owners' disposal of property and modification of property (Kim & Kalish, 2009). Future work should try to disentangle potential privacy concerns from rights-based concerns. Nonetheless, children still differentiated between the Game and the User suggesting that they were, at the very least, also reasoning that the Game is less entitled than the User to act on the information. These findings highlight the complex nature of digital data sharing and the mental models we use to reason about them.

These results also have potential implications for children's online safety. The present work increases our understanding of how children think about the use of personal information online. By doing so, it can help develop policies surrounding children's rights to online safety and privacy. As of now, very few studies have looked at the mental models that children use to understand online privacy. Our findings suggest that children, unless told otherwise, will reason that games, assuming a positive moral status, likely do not sell nor share information with others. This assumption may be problematic as it may mean that children may not know that they should be safeguarding their data by limiting the amount of data shared with apps.

The conclusions of the present study have a few limitations. The present study evaluated older children ages 8- to 11-years-old but did not evaluate younger children. We may have discovered an age-related effect if we included younger children (see work on information ownership Nancekivell & Fahey, 2022). Our ability to detect age-effects is also limited by our sample which currently does not contain very many 11-year-olds.

Additionally, because the study did not have a comparison condition, the meaning of children's judgments in the selling and sharing cases is somewhat unclear. For example, it is possible that instead of viewing the selling of information as less permissible, children's judgments might instead reflect some confusion about whether it is possible to sell things online at all. We will be exploring this issue in future research by introducing a comparison condition related to intellectual property. For example, if children judge that selling a song is allowed, but selling personal information is not allowed, this may suggest that children are indeed thinking that selling information in particular is not permissible. This comparison condition would also shed light on issues related to how concerns about privacy might be influencing children's judgments.

Together, our study is the first to investigate children's mental models of personal data transfers. We find that children are likely reasoning about data transfers in terms of

something like a lending model where a game, similar to a borrower, is not permitted to fully act on the information. However, we also suspect that privacy concerns are also driving children to judge that some actions, like selling and showing others your personal data, are less permissible overall than others.

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References

Blake, P. R., & Harris, P. L. (2009). Children's understanding of ownership transfers. *Cognitive Development, 24*(2), 133–145. https://doi.org/10.1016/j.cogdev.2009.01.002

Davoodi, T., Nelson, L. J., & Blake, P. R. (2020). Children's conceptions of ownership for self and other: Categorical ownership versus strength of claim. *Child Development, 91*(1), 163-178. https://doi.org/10.1111/cdev.13163

Friedman, O., & Neary, K. R. (2008). Determining who owns what: Do children infer ownership from first possession? *Cognition, 107*(3), 829–849. https://doi.org/10.1016/j.cognition.2007.12.002

Gelman, S. A., Cuneo, N., Kulkarni, S., Snay, S., & Roberts, S. O. (2021). The roles of privacy and trust in children's evaluations and explanations of digital tracking. *Child Development, 92*(5), 1769–1784. https://doi.org/10.1111/cdev.13572

Gelman, S. A., Martinez, M., Davidson, N. S., & Noles, N. S. (2018). Developing digital privacy: Children's moral judgments concerning mobile GPS devices. *Child Development, 89*(1), 17–26. https://doi.org/10.1111/cdev.12826

Harold, G. T., & Hay, D. F. (2005). Normal development in middle childhood. *Psychiatry, 4*(6), 3–5. https://doi.org/10.1383/psyt.4.6.3.66355

Kanngiesser, P., Gjersoe, N., & Hood, B. M. (2010). The effect of creative labor on property-ownership transfer by preschool children and adults. *Psychological Science, 21*(9), 1236–1241. https://doi.org/10.1177/0956797610380701

Kanngiesser, P., & Hood, B. M. (2014). Young children's understanding of ownership rights for newly made objects. *Cognitive Development, 29*, 30-40. https://doi.org/10.1016/j.cogdev.2013.09.003

Kim, S., & Kalish, C. W. (2009). Children's ascriptions of property rights with changes of ownership. *Cognitive Development, 24*(3), 322-336. https://doi.org/10.1016/j.cogdev.2009.03.004

Kumar, P., Naik, S., Devkar, U., Chetty, M., Clegg, T., & Vitak, J. (2017). "No telling passcodes out because they're private": Understanding children's mental models of privacy and security online. *Proceedings of the ACM on Human-Computer Interaction, 1*(CSCW), 1–21. https://doi.org/10.1145/3134699

Lee, Y., & Gelman, S. A. (2022). The development of digital ownership in children. *Journal of Experimental Child Psychology, 224*, 105519–105519. https://doi.org/10.1016/j.jecp.2022.105519

Livingstone, S., Stoilova, M., & Nandagiri, R. (2019). *Children's data and privacy online: Growing up in a digital age. An evidence review.* London: London School of Economics and Political Science. https://eprints.lse.ac.uk/101283/1/Livingstone_childrens_data_and_privacy_online_evidence_review_published.pdf

Mai, A., Guelmino, L., Pfeffer, K., Weippl, E., & Krombholz, K. (2022). Mental models of the internet and its online risks: Children and their parent(s). In Abbas Moallem (Ed.), *HCI for Cybersecurity, Privacy, and Trust.* Springer Nature Switzerland AG. https://doi.org/10.1007/978-3-031-05563-8_4

Nancekivell, S. E., & Fahey, J. B. (2022). Who owns your information? Young children's judgments of who owns the general and personal information users share with apps. In J. Culbertson, A. Perfors, H. Rabagliati & V. Ramenzoni (Eds.), *Proceedings of the 44th Annual Meeting of the Cognitive Science Society.* eScholarship University of California. https://escholarship.org/uc/item/5550136d

Nancekivell, S. E., & Friedman O. (2014). Mine, yours, no one's: Children's understanding of how ownership affects object use. *Developmental Psychology, 50*(7), 1845-1853. https://doi.org/10.1037/a0036971

Nancekivell, S. E., & Friedman, O. (2017). "Because it's hers": When preschoolers use ownership in their explanations. *Cognitive Science, 41*(3), 827–843. https://doi.org/10.1111/cogs.12358

Olson, K. R., & Shaw, A. (2011). "No fair, copycat!": What children's response to plagiarism tells us about their understanding of ideas. *Developmental Science, 14*(2), 431–439. https://doi.org/10.1111/j.1467-7687.2010.00993.x

Pesowski, M. L., Nancekivell, S. E., Tasimi, A., & Friedman, O. (2022). Ownership and value in childhood. *Annual Review of Developmental Psychology, 4*, 161-183. https://doi.org/10.1017/S0140525X2300122X

Ross, H. S. (1996). Negotiating principles of entitlement in sibling property disputes. *Developmental Psychology, 32*(1), 90-101. https://doi.org/10.1037/0012-1649.32.1.90

Ross, H. S. (2013). Effects of ownership rights on conflicts between toddler peers. *Infancy, 18*(2), 256–275. https://doi.org/10.1111/j.1532-7078.2012.00121.x

Ross, H., Friedman, O., & Field, A. (2015). Toddlers assert and acknowledge ownership rights. *Social Development, 24*(2), 341–356. https://doi.org/10.1111/sode.12101

Rossano, F., Rakoczy, H., & Tomasello, M. (2011). Young children's understanding of violations of property rights. *Cognition, 121*(2), 219-227. https://doi.org/10.1016/j.cognition.2011.06.007

Shaw, A., Li, V., & Olson, K. R. (2012). Children apply principles of physical ownership to ideas. *Cognitive*

Science, 36(8), 1383–1403.
https://doi.org/10.1111/j.1551-6709.2012.01265.x

Sun, K., Sugatan, C., Afnan, T., Simon, H., Gelman, S. A., Radesky, J., & Schaub, F. (2021). "They see you're a girl if you pick a pink robot with a skirt": A qualitative study of how children conceptualize data processing and digital privacy risks. *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems* (pp. 1–34). New York, NY: ACM. https://doi-org.uml.idm.oclc.org/10.1145/3411764.3445333

Van de Vondervoort, J. W., & Friedman, O. (2015). Parallels in preschoolers' and adults' judgments about ownership rights and bodily rights. *Cognitive Science, 39*(1), 184–198. https://doi.org/10.1111/cogs.12154

Van de Vondervoort, J. W., Meinz, P., & Friedman, O. (2017). Children's judgments about ownership rights and body rights: Evidence for a common basis. *Journal of Experimental Child Psychology,* 155, 1–11. https://doi.org/10.1016/j.jecp.2016.10.007