**Ridley Jones | Final Paper | Child-Robot Interaction at the Crossroads**

## Introduction

Robots now live among us. Increasingly, they are playing a part in our work, our health, and our personal lives. Their embodied form, their ability to mimic humans and work alongside them, means that robot design decisions and the assumptions built into them could be enormously consequential for how we go about our lives and understand what it means to be a human in a social world. Much research is being conducted in the fields of social robotics and human-robot interaction (HRI). These disciplines focus on designing and testing robots that are meant not to undertake purely mechanical jobs, but to take on social roles and responsibilities as well (Alač & Tanaka, 2011). Such robots can act as caretakers, service workers, and companions--tireless, highly configurable, and mass produced intimates. What physical features help these machines carry out their assigned tasks more effectively? What software and algorithms do they need to have a smooth, “natural”, useful interaction with their human companions? How do they need to update themselves, reveal their inner workings to humans, integrate into a social milieu that was not created for them? HRI pursues these questions to improve the quality of our relationships with robots.

Yet as with many technologies that are inserting themselves into our lives, we stand to be shaped by our interactions with robots. Social robots may be created to interact with people in a similar fashion to how people interact with each other, but they are not humans. A robot can only interact in ways it was *designed* to interact, and it is often designed, just as with any machine, to optimize for certain outcomes. Rather than mechanical efficiency, this may be interactional efficiency: high compliance with a treatment regimen; emotional comfort in times of distress; customer satisfaction. Humans, meanwhile, are trained to do jobs, but they do not appear to be optimized for any one job, and they may become fatigued or contentious or confused. Does cognitively assigning robots a similar category to humans have an effect on how we understand other people and ourselves? How will this change when those who are still learning what it means to be human--children--grow up with these entities as referential companions?

For this project, I wanted to understand how different research communities approached the ethical implications of the growing use of social robots by children. Since childhood development is intensely social, how might this new social actor--created by humans and with a limited range of affect and ambiguous moral status--affect the children who interact with it? And would different research communities that have an interest in this question (in this case, developmental psychology and human-computer interaction, especially the growing subfield of “child-robot interaction” or CRI (Belpaeme et al., 2013)) be more or less sensitive to these issues since they naturally approach the topic from different lenses?

Before beginning this project, my hypothesis was that psychology texts would be more critical about the robotics thing than the HCI and robotics journals. It seemed likely to me that HCI[[1]](#footnote-1) would have a very positive, solutionistic interest in CRI, since HCI researchers tend to be technologists and engineers with a natural affinity for “solving” human problems with technology. Meanwhile, I believed that since developmental psychologists are intensely focused on understanding the mechanisms of human development at a very fine level, and the resulting pathologies that can emerge when normal patterns of development are perturbed, such a profound novelty as CRI would raise frequent and dire alarms. On the whole, however, my brief comparative sojourn revealed to me that that was not true. I believe the potential for learning about specific variables of human developmental trajectory and response is still too tempting; and the uses for therapy and education too powerful. In fact ,more frequent and varied critique appeared in the HCI publications I reviewed.

## Methods

For this report, I conducted a semi-systematic literature review. I went to the University of Washington online database system and selected the “PsychInfo” research database. I performed a search for peer reviewed articles written since 1990 that included the term “robot\*”. This database has a subject cohort filtering option, so I selected all of the options for children under 12 years of age. The report returned from the search included citations, keywords, and abstracts for each result, and returned 359 results altogether. I performed such a broad search in part because I was unaware of what terminology developmental psychology might use for discussing these issues, and I wanted to cut as wide a swathe as possible. Part of my interest in this subject also stems from a curiosity about how disciplinary lines affect how shared areas of research are pursued. Since I come from more of a social science than technical background, I was amused to note just how ignorant I was of the social psychology literature, and how wide a net I had to cast simply to feel that I had a reasonable glimpse of this body of work.

For the comparative analysis of HCI literature, I was planning to perform a separate search of an information science or HCI database. However, in analyzing my results from the initial search, I discovered that there were a large number of HCI and robotics publications included in the database (such as *Computers in Human Behavior* and the *International Journal of Social Robotics*). Thus, for scoping purposes, I limited myself to this one search. In addition, the results returned a broader selection of psychology research than the expected developmental psychology publications. Neuroscience, learning sciences, autism research, and even animal behavior publications all appeared in my results. I chose to leave them in despite my original conceptualization, since the boundaries between neuroscience and developmental psychology, for example, are likely to be permeable enough when cognitive development is the focus.

I read the abstracts of all these papers to quickly rule out irrelevant ones and identify a list of candidate papers to analyze more closely. I was specifically concerned with studies and papers where the *sociality* of the robot was a key theoretical or methodological concern--not where robots were being created by subjects or being exploited primarily for mechanical properties. Following this rubric, in all there were 182 irrelevant results. These results typically included purely biomechanical uses of robots (such as therapies for cerebral palsy) and STEM education studies (in particular, robotics classes and their impact on technology learning and self-efficacy).

Since I was interested in critical perspectives rather than detailed information about particular methods, and wanted to be able to perform a relatively wide analysis, I read only the introduction and discussion/conclusion of each paper. It is possible that my methods missed large and important bodies of literature, so future analysis should be more systematic. However, I did attempt to obtain a reasonably representative balance of subtopics in both lists. I read the introductions and conclusions of each of these papers and coded the critical/ethical observations they made. The papers are described in Table 1 below. After reading the aforementioned sections of each of these 40 papers, I noted to what extent, if at all, the paper engaged with any ethical critique regarding children interacting with social robots.

**Table 1: Child-Robot Interaction Papers Analyzed for Ethical Critique**

|  |  |  |
| --- | --- | --- |
| **Paper Citation** | **Child-Robot Interaction Ethical Discussion** | **Type** |
| Saylor, M. M., Somanader, M., Levin, D. T., & Kawamura, K. (2010). How do young children deal with hybrids of living and non‐living things: The case of humanoid robots. British Journal of Developmental Psychology, 28(4), 835-851. | Minor ethical critique | Psychology |
| Bernstein, D., & Crowley, K. (2008). Searching for signs of intelligent life: An investigation of young children's beliefs about robot intelligence. The Journal of the Learning Sciences, 17(2), 225-247. | Moderate ethical critique | Psychology |
| Kahn Jr, P. H., Kanda, T., Ishiguro, H., Freier, N. G., Severson, R. L., Gill, B. T., ... & Shen, S. (2012). “Robovie, you'll have to go into the closet now”: Children's social and moral relationships with a humanoid robot. Developmental psychology, 48(2), 303 | Significant ethical discussion of core issues | Psychology |
| Scaife, M., & van Duuren, M. (1995). Do computers have brains? What children believe about intelligent artifacts. British Journal of Developmental Psychology, 13(4), 367-377. | None | Psychology |
| Chen, Y., Garcia-Vergara, S., & Howard, A. M. (2018). Effect of feedback from a socially interactive humanoid robot on reaching kinematics in children with and without cerebral palsy: A pilot study. Developmental neurorehabilitation, 21(8), 490-496. | None | Psychology |
| Moriguchi, Yusuke, et al. "Cues that trigger social transmission of disinhibition in young children." Journal of experimental child psychology 107.2 (2010): 181-187. | None | Psychology |
| Howard, L., & Vick, S. J. (2010). Does it bite? The role of stimuli characteristics on preschoolers’ interactions with robots, insects and a dog. Anthrozoös, 23(4), 397-413. | None | Psychology |
| Wu, W. C. V., Wang, R. J., & Chen, N. S. (2015). Instructional design using an in-house built teaching assistant robot to enhance elementary school English-as-a-foreign-language learning. Interactive Learning Environments, 23(6), 696-714. | None | Psychology |
| André, V., Jost, C., Hausberger, M., Le Pévédic, B., Jubin, R., Duhaut, D., & Lemasson, A. (2014). Ethorobotics applied to human behaviour: can animated objects influence children's behaviour in cognitive tasks?. Animal behaviour, 96, 69-77. | None | Psychology |
| Westlund, K., Jacqueline, M., Jeong, S., Park, H. W., Ronfard, S., Adhikari, A., ... & Breazeal, C. L. (2017). Flat vs. expressive storytelling: young children’s learning and retention of a social robot’s narrative. Frontiers in human neuroscience, 11, 295. | None | Psychology |
| Danovitch, J. H., & Keil, F. C. (2008). Young Humeans: the role of emotions in children's evaluation of moral reasoning abilities. Developmental Science, 11(1), 33-39. | None | Psychology |
| Dunham, P., Dunham, F., Tran, S., & Akhtar, N. (1991). The nonreciprocating robot: Effects on verbal discourse, social play, and social referencing at two years of age. Child Development, 62(6), 1489-1502. | None | Psychology |
| Jipson, J. L., Gülgöz, S., & Gelman, S. A. (2016). Parent–child conversations regarding the ontological status of a robotic dog. Cognitive Development, 39, 21-35. | None | Psychology |
| Moriguchi, Y., Kanda, T., Ishiguro, H., & Itakura, S. (2010). Children perseverate to a human's actions but not to a robot's actions. Developmental Science, 13(1), 62-68. | None | Psychology |
| Schadenberg, B. R., Neerincx, M. A., Cnossen, F., & Looije, R. (2017). Personalising game difficulty to keep children motivated to play with a social robot: A Bayesian approach. Cognitive systems research, 43, 222-231 | None | Psychology |
| Costescu, C. A., Vanderborght, B., & David, D. O. (2017). ROBOT-ENHANCED CBT FOR DYSFUNCTIONAL EMOTIONS IN SOCIAL SITUATIONS FOR CHILDREN WITH ASD. Journal of Evidence-Based Psychotherapies, 17(2). | None | Psychology |
| Crossman, M. K., Kazdin, A. E., & Kitt, E. R. (2018). The influence of a socially assistive robot on mood, anxiety, and arousal in children. Professional Psychology: Research and Practice, 49(1), 48. | None | Psychology |
| Breazeal, C., Harris, P. L., DeSteno, D., Kory Westlund, J. M., Dickens, L., & Jeong, S. (2016). Young children treat robots as informants. Topics in cognitive science, 8(2), 481-491. | None | Psychology |
| Vogt, P., De Haas, M., De Jong, C., Baxter, P., & Krahmer, E. (2017). Child-robot interactions for second language tutoring to preschool children. Frontiers in human neuroscience, 11, 73. | None | Psychology |
| Benvenuti, M., Piobbico, G., & Mazzoni, E. (2017). Robots and Socio-cognitive Conflict Enhance Wayfinding in Children. ANNUAL REVIEW OF CYBERTHERAPY AND TELEMEDICINE 2017, 33. | None | Psychology |
|  |  |  |
| Fridin, M. (2014). Kindergarten social assistive robot: First meeting and ethical issues. Computers in Human Behavior, 30, 262-272. | Significant ethical discussion of core issues | HCI |
| Serholt, S. (2018). Breakdowns in children's interactions with a robotic tutor: A longitudinal study. Computers in Human Behavior, 81, 250-264. | Minor to moderate ethical discussion | HCI |
| Kennedy, J., Baxter, P., & Belpaeme, T. (2017). Nonverbal immediacy as a characterisation of social behaviour for human–robot interaction. International Journal of Social Robotics, 9(1), 109-128. | Minor ethical discussion | HCI |
| Leite, I., Castellano, G., Pereira, A., Martinho, C., & Paiva, A. (2014). Empathic robots for long-term interaction. International Journal of Social Robotics, 6(3), 329-341. | Moderate ethical discussion | HCI |
| Rocks, C., Jenkins, S., Studley, M., & McGoran, D. (2009). ‘Heart Robot’, a public engagement project. Interaction Studies, 10(3), 427-452. | Quasi ethical | HCI |
| Fortunati, L., Esposito, A., Sarrica, M., & Ferrin, G. (2015). Children’s knowledge and imaginary about robots. International Journal of Social Robotics, 7(5), 685-695. | Unclear level of ethical analysis | HCI |
| Nomura, T., Kanda, T., Kidokoro, H., Suehiro, Y., & Yamada, S. (2016). Why do children abuse robots?. Interaction Studies, 17(3), 347-369. | None | HCI |
| Ahmad, M. I., Mubin, O., & Orlando, J. (2017). Adaptive social robot for sustaining social engagement during long-term children–robot interaction. International Journal of Human–Computer Interaction, 33(12), 943-962. | None | HCI |
| Martínez-Miranda, J., Pérez-Espinosa, H., Espinosa-Curiel, I., Avila-George, H., & Rodríguez-Jacobo, J. (2018). Age-based differences in preferences and affective reactions towards a robot's personality during interaction. Computers in Human Behavior, 84, 245-257. | None | HCI |
| Shahid, S., Krahmer, E., & Swerts, M. (2014). Child–robot interaction across cultures: How does playing a game with a social robot compare to playing a game alone or with a friend?. Computers in Human Behavior, 40, 86-100. | None | HCI |
| Kanda, T., & Ishiguro, H. (2006). An approach for a social robot to understand human relationships. Interaction Studies, 7(3), 369-403. | None | HCI |
| Robins, B., Ferrari, E., Dautenhahn, K., Kronreif, G., Prazak-Aram, B., Gelderblom, G. J., ... & Marti, P. (2010). Human-centred design methods: Developing scenarios for robot assisted play informed by user panels and field trials. International Journal of Human-Computer Studies, 68(12), 873-898. | None | HCI |
| Ros, R., Oleari, E., Pozzi, C., Sacchitelli, F., Baranzini, D., Bagherzadhalimi, A., ... & Demiris, Y. (2016). A motivational approach to support healthy habits in long-term child–robot interaction. International Journal of Social Robotics, 8(5), 599-617. | None | HCI |
| Beran, T. N., Ramirez-Serrano, A., Kuzyk, R., Nugent, S., & Fior, M. (2011). Would children help a robot in need?. International Journal of Social Robotics, 3(1), 83-93. | None | HCI |
| Kennedy, J., Baxter, P., & Belpaeme, T. (2015). Comparing robot embodiments in a guided discovery learning interaction with children. International Journal of Social Robotics, 7(2), 293-308. | None | HCI |
| Barakova, E. I., Bajracharya, P., Willemsen, M., Lourens, T., & Huskens, B. (2015). Long‐term LEGO therapy with humanoid robot for children with ASD. Expert Systems, 32(6), 698-709. | None | HCI |
| Kennedy, W. G., Bugajska, M. D., Harrison, A. M., & Trafton, J. G. (2009). “like-me” simulation as an effective and cognitively plausible basis for social robotics. International Journal of Social Robotics, 1(2), 181-194. | None | HCI |
| de Graaf, M. M., Allouch, S. B., & van Dijk, J. A. (2016). Long-term evaluation of a social robot in real homes. Interaction studies, 17(3), 462-491. | None | HCI |
| Beran, T. N., Ramirez-Serrano, A., Kuzyk, R., Fior, M., & Nugent, S. (2011). Understanding how children understand robots: Perceived animism in child–robot interaction. International Journal of Human-Computer Studies, 69(7-8), 539-550. | None | HCI |
| Henkemans, O. A. B., Bierman, B. P., Janssen, J., Looije, R., Neerincx, M. A., van Dooren, M. M., ... & Huisman, S. D. (2017). Design and evaluation of a personal robot playing a self-management education game with children with diabetes type 1. International Journal of Human-Computer Studies, 106, 63-76. | None | HCI |

## Findings

The most striking finding I obtained from this analysis was that despite the different disciplinary commitments of HCI and developmental psychology, the psychology papers did *not* exhibit a higher level of ethical critique around CRI than the HCI papers. Indeed, a *higher* proportion of HCI papers discussed the ethical implications of CRI: five, with one ambiguous/difficult to interpret. Only three of the psychology papers did. This may have been partly attributable to selection and small sample size--with so few data points, one should not infer too much from this comparison, certainly not that HCI is “twice” as concerned with the ethics of CRI as developmental psychology. However, even this small survey is enough to indicate that the majority of papers in both fields do not raise significant concerns. Below, I detail more about how the papers used robots in their research, and how ethical issues were raised, when they were. I then hypothesize about about the potential reasons for this phenomenon.

### Themes and Analysis

The HCI papers and psychology papers exhibited similar usage of robots. (In fact, were I to randomly reshuffle the articles into two buckets, they would not look much different in method and research question development from their original disciplinary assignment.) Researchers from both disciplines created and evaluated robots for therapeutic interventions, such as teaching social skills to children with autism spectrum disorder or improving physical therapy for children with cerebral palsy. The insufficiency of short experiment durations and the “yes bias” tendency of young children (their tendency to automatically say “yes” to an adult even when they don’t meant it) were methodological hurdles bemoaned by both types of researchers. In my initial literature review, robots were used in autism studies very frequently; a common refrain was the claim that autistic children have an affinity for robots, so they may be useful for therapeutic intervention where a less desirable and more confusing human might not. Another theme common to both bodies of work was an attempt to understand how children at various ages understood what a robot *is*: building upon prior developmental work about how children develop theory of mind and understand distinctions between kinds of items, robots offer an interesting probe for testing edge cases. This helps scientists learn at what point an such an ambiguous entity becomes appropriately assigned to a reasonable category. Furthermore, I was surprised at how often the psychology papers described improving the acceptability of social robots as one of their aims.

There were two striking outliers that did seem unique to HCI: “An approach for a social robot to understand human relationships” and “Human-centred design methods: Developing scenarios for robot assisted play informed by user panels and field trials”. The former was highly technical and included algorithmic code and schematics; and the latter focused on using human-centered design methods to create social robots for children. I suspect the specificity of these papers would make them somewhat less legible to developmental psychology publications, but I overall was impressed by the conceptual and methodological intertwining of the two corpora.

### How were ethical issues treated in each body of work?

*Psychology*

Since its research question concerns how children cognitively handle hybrids of living and non-living entities, “How do young children deal with hybrids of living and non‐living things: The case of humanoid robots” asks whether we will face challenges in coping with the prevalence of robots in our lives; but quickly moves on to suggest that we will simply have to become more sophisticated in our inferential mechanisms and “keep up” with the changes around us. It does not suggest that we may wish to change our trajectory of development; some level of capitulation to this change is inevitable. “Searching for signs of intelligent life: An investigation of young children's beliefs about robot intelligence” followed a similar pattern, brushing up against the theoretical implications of children imputing “intelligence” to a robot, leading to a potentially new ontology of subjectivity, but not suggesting any negative consequences for such a new category.

Of the psychology papers, only “’Robovie, you'll have to go into the closet now’: Children's social and moral relationships with a humanoid robot” substantively engaged with ethical consequences of children’s growing intimacy with robots. This paper was analyzed children’s responses to “unkind” behavior toward a robot. It was quite unusual in that it problematized two different “stances” on robot sociality. Being callous and abusive to a robot and being overly empathetic to a robot are both potentially troubling outcomes for different reasons, and it is rare for an empirical paper to acknowledge this. To ameliorate this concern, it recommends clinging to older humanistic notions of emotion and connection to keep us grounded in authentic concepts of humanity. “If we can give voice to such forms of human experience [as deep empathy, intense aesthetic experiences, etc.], they can then become benchmarks (Kahn et al., 2007), which in turn can hold the technologists accountable for the robots they create and all of us accountable for the robots that we accept into our lives and bring into the lives of our children.”

*HCI*

As with the psychology papers, the majority of the HCI-oriented papers contained no relevant ethical critique in the introduction or discussion/conclusion. The ethical critique that did emerge was typically brief and speculative. “Breakdowns in children's interactions with a robotic tutor: A longitudinal study” is largely about breakdowns and usability, but since it also explores children’s emotional responses to different kinds of breakdowns a robotic tutor could experience while interacting with them, it also treats the emotional consequences of such breakdowns. Error handling is an important part of engaging with any complex interface; as such, in the conclusion, it briefly raises the normative question about whether we *should* hide breakdowns from children at all. It establishes the tension where preventing breakdowns at all would limit us to robotic tutors that are technically and pedagogically simple, and concludes with a thought that we shall have to hope that robots eventually achieve a level of intelligence to overcome this impasse.

“Nonverbal immediacy as a characterisation of social behaviour for human–robot interaction” briefly mentions ethics, but primarily at the level of research procedures: observing that long-term experiments may be necessary in order to overcome novelty effects and the “yes bias” children exhibit; but that doing this may have ethical implications. “Empathic robots for long-term interaction” does inquire about the potential consequences of children eventually learning that their empathetic robot friend doesn’t “really” care about them, but does not pursue any of the social development questions that this scenario prompts. Heart Robot, a design installation project, was created in order to prompt questions about the place of social robots in society, and some of the participants did mention the very concerns I am searching for, but the authors of the paper did not themselves discuss them, as they were focused mainly on program evaluation. “Children’s knowledge and imaginary about robots “ was written in a way that was difficult for me to parse, in part because it was written in a more humanities-style fashion, but it does inquire about the eventual conflict between our knowledge about robots and our imaginary about them (though greater practical experience will likely have an impact on what that imaginary is). The HCI paper with the most prominent and pertinent ethical discussion was “Kindergarten social assistive robot: First meeting and ethical issues,” which centered ethics in its methods as well (preemptively addressing concerns with parents and teachers, and preventing the children from missing the robot after the experiment was over). While developmental issues in particular were not a central concern of the paper, the paper did take ethics seriously and foreground them in the procedure, notwithstanding the paper’s position that robots could offer a way to significantly reduce teacher burden.

In the HCI papers, perhaps the most interesting aspect of the ethical critique was what was missing. In “An approach for a social robot to understand human relationship,” the authors described a system for automatically detecting human relationships via a robot that would mingle with children. It would even, over time, potentially learn to identify “rejected” children or bullying and intervene socially. I found this, to be frank, quite creepy. Yet this was one of the majority of papers with no ethical critique at all--it was a perfect example of the kind of unquestioning technosolutionism I expected to find primarily in the HCI papers, but which I also observed (albeit to a lesser degree) in the psychology papers as well.

### Analysis: What Might Explain the Disparity?

Why do we see (at least) the same level of ethical critique of CRI in HCI as in developmental psychology? There are likely a number of reasons, but one is likely to be the fact that robots are useful. Robots are an incredibly useful tool for psychology research, so the sort of enthusiasm that largely permeates the papers I read is easy to empathize with. Robots can be precision engineered to tirelessly enact precise behaviors--asking even the doughtiest graduate student to cock their head at exactly 23 degrees for seven minutes, twelve times in a row is not feasible. The advantages of such a tool go beyond precision and lack of fatigue, however. When attempting to understand human beings and their interactions and isolate causes and effects, there typically are an enormous number of confounding variables to contend with, many of which we may not even be aware of. We are brains attempting to study themselves, and this imposes certain limitations. Robots can, to an extent, allow us to isolate certain variables in a way we cannot with our fellow humans. The potential advantages for low-cost delivery of reliable therapeutic interventions is also a tremendous draw (and this is cited explicitly in many of the papers). Finally, the inherent intellectual interest of being able to observe developing minds reacting to such a novel stimulus can lead researchers to use robots as a probe to understand developing brains.

## Final Thoughts

Much of the public hand-wringing about tech addiction has been about smartphones[[2]](#footnote-2), which have rapidly changed (at least) contemporary Western societies since their introduction in the mid-2000s, and children are growing up with these devices and having to learn how to cope with them. Even minor user interface and information architecture elements in these devices were created to activate very atavistic drives and compulsions, and even adults who grew up prior to their introduction often have difficulty disentangling themselves from their devices. Yet their form factor is static and rectangular. So much more, then, does the highly tailored anthropomorphic appeal of a robot offer vectors of influence to designers. Sociality being a key driver of social *and* cognitive development (as in, e.g., Moriguchi, et al.,2010), the forms of sociality we are creating will have impacts, good or ill, on who we become. A potential result of all of this valuable and exciting research is that designers can learn more and more specific and predictable ways to engineer relationships between robots and children. As Gillespie explains (2009), no technological future is inevitable; each is the result of a vast number of decisions and tradeoffs. The dialogue between HCI and developmental psychology in this area is one key site of such decisions, and the form it takes could profoundly shape the human, and trans-human, experience.

## (Other) Works Cited

Alač, M., Movellan, J., & Tanaka, F. (2011). When a robot is social: Spatial arrangements and multimodal semiotic engagement in the practice of social robotics. *Social Studies of Science*, *41*(6), 893-926.  
  
Gillespie, T. (2009). The Speed Bump in Wired shut: Copyright and the shape of digital culture (65-103). MIT press.

Belpaeme, T., Baxter, P., De Greeff, J., Kennedy, J., Read, R., Looije, R., ... & Zelati, M. C. (2013, October). Child-robot interaction: Perspectives and challenges. In *International Conference on Social Robotics* (pp. 452-459). Springer, Cham.

1. used here as a gloss for HCI itself, social robotics, HRI, and related sociotechnical disciplines with a design focus--subdisciplines that would reasonably make an appearance at CHI [↑](#footnote-ref-1)
2. Alarms being raised academically since at least 2008: Turel, O., Serenko, A., & Bontis, N. (2008). Blackberry addiction: Symptoms and outcomes. *AMCIS 2008 Proceedings*, 73 [↑](#footnote-ref-2)