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Abstract: Research on how children interact with social robots is still a young field of inquiry. This chapter sketches how research on child–robot interaction (CRI) has evolved since its beginning roughly 25 years ago. We further describe three main lines in CRI research and, per line, a central concept: first, children's learning from social robots and the central concept of engagement; second, children's relationship formation with social robots and trust; and third, children's conceptions of social robots along with the concept of social robots as a new ontological category. The chapter also identifies challenges in current CRI research: next to suffering from an adult bias, the field is challenged by a lack of genuine CRI theories and an overreliance on frameworks coming from interpersonal research. Finally, we focus on future developments that may offer opportunities for significant contributions of CRI research to our understanding of how children and humans, more generally, interact with social robots. In our view, CRI researchers should more strongly embrace the increasing merger between social robots and smart/connected toys, study social robots in conjunction with communicative robots, and pay more attention to the issues and demands of responsible CRI.

Keywords: Social robots, children, child–robot interaction, learning, relationship formation

19.1 Introduction

Social robots—that is, robots that "are designed to interact with people in a natural, interpersonal manner" (Breazeal et al., 2016a, p. 1935)—have attracted considerable attention from roboticists, academics, and the public in the past two decades or so (Bartneck et al., 2020; Eberl, 2016; Fong et al., 2003). Although social robots are less widespread than, for example, voice-based assistants and chatbots, they are increasingly used in healthcare, education, and entertainment or are made for companionship (for an overview, see, e.g., Chapter 10 in Bartneck et al., 2020). As social robots in these areas are often targeted at children (Belpaeme et al., 2018; Blanson Henkemans et al., 2017; Turkle, 2011), researchers have turned towards children's interactions with social robots. Research on child–robot interaction (CRI) is a subfield of research on human–robot interaction and on human–machine interaction more generally. In this chapter, we define research on CRI as empirical or theoretical research on children's cognitions and emotions about social robots, as well as their uses of social ro-

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bots, along with the individual and societal consequences that these cognitions, emotions, and uses elicit.

Research on CRI is still in its infancy. An exploratory search in the Social Sciences Citation Index and the Emerging Sources Citation Index of the Web of Science resulted, as of December 2022, in 855 research documents (search terms: child* robot interaction). After the first publications emerged in the second half of the 1990s, it took several years before, in 2010, more than 10 annual publications on the topic came out. Afterward, publications per year rose steadily to an all-time high of 143 publications in 2020 but dropped slightly to 128 annual publications in 2021, possibly due to problems with fielding studies during the COVID-19 pandemic. Over the whole period, the top three disciplines with which research on CRI was associated were robotics (30%), computer science with a focus on artificial intelligence (11%), and multidisciplinary psychology (9%). Research on CRI thus presents a small but burgeoning field that tends to originate mainly in the technical sciences.

Against this background, we present in this chapter an overview of selected topics and issues in research on CRI. We start by sketching the historical development of the field. In the next step, we describe the main lines of current CRI research and elaborate, per line, on one core concept. After identifying some shortcomings in the literature, we conclude with what we consider important developments in the broader field that may also shape future research on CRI. Similar to other current reviews on related topics (De Graaf & Peter, 2023), our use of the literature is illustrative and selective rather than encompassing. Given their prominence in CRI research, we tend towards studies on anthropomorphic robots and primary school children. We do not deal with research on social robots and children on the autism spectrum because an adequate discussion of this thriving and important field is beyond the scope of this chapter. For a more detailed use of the literature, we refer to the reviews on specific aspects of CRI (e.g., Belpaeme et al., 2018; Cabibihan et al., 2013; De Jong et al., 2019; Stower et al., 2021; Van den Berghe et al., 2019; Van den Berghe, 2022; Van Straten et al., 2020b).

19.2 Historical Development of the Field, Main Research Lines, and Major Concepts

As a young field, research on CRI is currently characterized by a variety of theoretical frameworks and methodological approaches (e.g., De Jong et al., 2019; Peter et al., 2019; Van Straten et al., 2020b). Theoretical frameworks in CRI encompass, for example, theories from interpersonal communication (e.g., Van Straten et al., 2021), moral, social, and developmental psychology (Fortunati et al., 2015; Kahn et al., 2012; Serholt, 2018), and psychoanalysis (Turkle et al., 2006). Methodologically, research on CRI ranges from qualitative to quantitative approaches, correlational to experimental de-

signs, and cross-sectional to longitudinal designs, with data collection typically being based on self-reports in interviews or questionnaires as well as on observation (see, e.g., the reviews by De Jong et al., 2019; Stower et al., 2021; Van Straten et al., 2020b). In terms of robot morphologies, finally, studies have relied mainly on anthropomorphic robots, such as Nao, but also on zoomorphic robots, such as iCat, and caricatured robots, such as Cozmo (e.g., Van Straten et al., 2020b).

19.2.1 Historical development of the field

As CRI research comes from disciplines as diverse as robotics, computer science, and social science, it is, to some extent, scattered and has not been based on a commonly shared research agenda. Consequently, it is difficult to identify what would qualify as a history of the field. Still, there are some commonalities in how research has developed in the past two decades. Some of the first studies on social robots and children dealt with the possibilities of such robots in the treatment of children on the autism spectrum (e.g., Dautenhahn, 1999; Werry et al., 2001). Research then expanded towards children not on the autism spectrum and the role of social robots as companions of children (e.g., Kanda et al., 2004; Tanaka et al., 2007). Relatively early on, scholars have also been interested in children's interactions with, and reasoning about, robotic pets (e.g., Kahn et al., 2006), accompanied by critical voices about the relational inauthenticity of such interactions (Turkle, 2007). Moreover, with social robots' ability to interact with children, the use of robots for educational purposes was already attracting researchers' attention in the 2000s (e.g., Han et al., 2008; Kanda et al., 2004) and led, among other things, to research on language learning (e.g., You et al., 2006).

Early on, however, scholars also understood the importance of sociality in children's interactions with social robots and, broadly speaking, by the 2010s, studies on children's relationship formation with social robots had gained more traction (e.g., Kahn et al., 2012), both in terms of design (Belpaeme et al., 2012) and long-term relationships (Leite et al., 2013). Around the same period, researchers also increasingly zoomed in on how children experience and conceptualize social robots (e.g., Beran et al., 2011). Currently, all the aforementioned research foci are still present in the research field. Many of the original ideas are being deepened, broadened, and revised. At the same time, scholars have turned progressively to applying social robots for specific tasks, for example in health and educational settings (Blanson Henkemans et al., 2017; Konijn & Hoorn, 2020). Finally, there is (re)new(ed) interest in, for example, CRI-specific measure development (Van Straten et al., 2020a) and ethical issues (DiPaola et al., 2023; Sharkey, 2016).

19.2.2 Main research lines and major concepts

Given the historical development of the field, three lines of research, in particular, may deserve attention: one line studies children's learning from social robots, a second investigates social relationships between children and robots, and a third centers on children's conceptions of social robots. In identifying and describing the research lines, we largely follow Peter (2022) but specify and extend his approach in our summary of the literature. Notably, we identify for each line one concept or idea that shapes the research it comprises. As the present chapter addresses a wider audience, we also replace Peter's (2022) focus on the *acceptance* of social robots by centering on children's *conceptions* of social robots. The research lines we identify are interrelated and not mutually exclusive, but together they summarize what we consider three important strands of CRI research. As the three lines are defined by the outcomes rather than the purposes of CRI applications, they are not limited to specific situational or societal contexts in which robots are (envisioned to be) used.

19.2.2.1 Children's learning from social robots

Research on children's learning from social robots (for a review, see Belpaeme et al., 2018) can be divided into studies on explicit learning and implicit learning. As defined by Rebuschat (2015, p. xiii), "explicit learning refers to a process during which participants [intentionally] acquire conscious (explicit) knowledge [through instruction]." In primary school settings, scholars have studied how social robots can be used, among other things, to teach children first and second languages (for a review, see Kanero et al., 2018) as well as mathematics education (e.g., Kennedy et al., 2015; Konijn & Hoorn, 2020). Studies on the use of social robots in healthcare have also investigated how social robots can be used, for instance to increase health literacy among children with diabetes (e.g., Blanson Henkemans et al., 2017) and to teach social communicative skills to children with cognitive impairment (e.g., Ismail et al., 2021).

Implicit learning, in contrast, refers to the acquisition of "knowledge about a complex, rule-governed stimulus environment without intending to and without becoming aware of the knowledge they have acquired" (Rebuschat, 2015, p. xiii). In this context, scholars have studied, for example, how children learn prosocial behavior from a social robot while playing a game (Peter et al., 2021), as well as the potential of social robots to increase children's creativity (e.g., Ali et al., 2019; Alves-Oliveira et al., 2020). Moreover, a considerable number of studies have been conducted on children's learning-by-teaching with social robots (e.g., children teaching robots writing, reading, vocabulary, and reasoning skills; see Jamet et al., 2018, for a review). Learning-by-teaching may be considered to lie at the intersection of explicit and implicit learning because children explicitly instruct robots without being aware that the purpose of the interaction is to increase their own knowledge or skills.

An important concept in research on children's learning from and with social robots is engagement because high and sustained engagement levels can increase children's motivation to learn as well as the time they spend on a learning task (see De Haas et al., 2022). Engagement is also relevant to the literature on child–robot relationships (see, e.g., Kanda et al., 2007). However, its relevance to CRI for educational purposes is twofold: learning outcomes may be affected both by children's *social* engagement with a robot and by their *task* engagement with the learning task at hand (see De Haas et al., 2022). In terms of social engagement, mixed findings have been obtained. While some studies suggest that children's social engagement with a robot comes at the cost of learning gains (e.g., Kennedy et al., 2015; Konijn & Hoorn, 2020), others find a positive relationship between children's learning from and social engagement with a robot (e.g., Ahmad et al., 2019; De Haas et al., 2022). Task engagement seems to be positively related to children's learning from robots (e.g., De Haas et al., 2022; Zaga et al., 2015).

In sum, research has shown that children can learn from social robots. Robots can either explicitly instruct children, be role models, or be taught by children themselves. In all these cases, children tend to learn something, ranging from skills to knowledge to behavioral options. Engagement plays an important part in children's learning from social robots: the more successful a robot is in engaging children in a particular task, the better the children learn.

19.2.2.2 Children's relationships with social robots

As social robots communicate in a natural manner (Breazeal et al., 2016a) and as children typically relate to non-human entities in a social way (e.g., Epley et al., 2007), a second substantial line of research has dealt with social relationships between children and robots (for reviews, see Stower et al., 2021; Van Straten et al., 2020b). A large proportion of research on child–robot relationship formation focuses on robot applications, for example evaluating how children's consideration of robots as trustworthy companions improves the outcomes of CRI applications in healthcare (e.g., Ligthart et al., 2019; Sinoo et al., 2018) and education (e.g., Castellano et al., 2021; Kory Westlund & Breazeal, 2019). However, a growing body of research also investigates the mechanisms that underlie the emergence and development of child–robot relationships in their own right (e.g., Calvo-Barajas & Castellano, 2022; Di Dio et al., 2020; Geiskkovitch et al., 2019; Van Straten et al., 2021, 2022). While research on the topic often addresses child–robot relationship formation in a cross-sectional manner (see Van Straten et al., 2020b), the development of social relationships beyond initial perceptions of friendship potential requires time. The longitudinal investigation of child–robot relationship formation, however, is still somewhat underexplored, some notable exceptions notwithstanding (e.g., Leisten et al., 2024; Leite et al., 2013; Ligthart et al., 2022).

A central concept to understand the formation of relationships between children and social robots is trust (see Van Straten et al., 2020b). Children's trust in robots has at least two components: on the one hand, children may have *social* trust in robots, which manifests itself as a belief in the robot's benevolence and a resulting willingness to be vulnerable towards the robot. On the other hand, children may have trust in the robot's *competence* or broader technological functioning (e.g., Stower et al., 2021; Van Straten et al., 2018). Both kinds of trust may be interrelated (see Van Straten et al., 2018) and may play a role in the development of social child–robot relationships. In addition to distinguishing between different kinds of trust, scholars have recently warned against children's *overtrust* in robots, arguing that future studies should investigate how we can enable children to take a more critical stance towards robots (e.g., Beelen et al., 2021; Geiskkovitch & Young, 2020).

In conclusion, research on child–robot relationships initially mainly focused on exploring how feelings of friendship and trust between children and robots can improve the effectiveness of social robot applications in healthcare and education. In recent years, more research attention has been devoted to the question of how relationships between children and robots emerge and unfold over time. Scholars have suggested that distinguishing between social and competence trust may help better understanding of when and why children trust robots. Finally, children's overtrust in robots has been put on the agenda: enabling children to critically evaluate social robots may enhance their ability to judge when and to what extent a robot can be trusted.

19.2.2.3 (Changing) children's conceptions of social robots

Related to the aim of stimulating children's critical thinking about robots, a third prominent line in research on CRI studies children's understanding of and knowledge about social robots. In two seminal papers, Kahn and colleagues (2012, 2013) suggested that children see robots as mental, social, and moral others. Research on children's conceptions of social robots can be categorized accordingly. In terms of mental otherness, studies have investigated children's perception of, among others, robots' reliability as an information source (e.g., Breazeal et al., 2016b) and ability to make choices (Flanagan et al., 2021). In terms of social otherness, scholars have, for instance, compared how children evaluate being 'together' with peers as opposed to robots (Shahid et al., 2014) and have studied whether robots can exert peer pressure (Vollmer et al., 2018). Children's views of robots' moral otherness, finally, have been assessed by investigating, for instance, children's moral concerns for (Sommer et al., 2019) and sharing behavior with (e.g., Nijssen et al., 2021) social robots.

In addition to studying how children perceive social robots, scholars have started to investigate how children's conceptions of social robots can be altered—by emphasizing robots' machine nature (Van Straten et al., 2023; Van Straten et al., 2020c), re-

vealing to children robots' inability to function autonomously (e.g., Tozadore et al., 2017), or by teaching children about concepts related to artificial intelligence (e.g., Williams et al., 2019). Finally, researchers of educational robotics have shown that having children build their own robots with craft materials diversifies their mental schema of and knowledge about social robots (Fortunati et al., 2014, 2022), while having children create robots from robot toolkits enhances their understanding of the automation of machines (Fortunati et al., 2022). Overall, children conceptualize robots, toys, and humans differently: they see robots as more intelligent than toys and attribute more animacy to human beings than to robots (Fortunati et al., 2015).

Questions regarding the manner in which children see and treat social robots—and to what extent this can be influenced—directly tie in with ethical discussions regarding CRI and the increasing importance being attached to the promotion of children's digital literacy skills (DiPaola et al., 2023). An important idea in this context is the New Ontological Category (NOC) hypothesis, as proposed by Kahn and colleagues (2013). The hypothesis posits that social robots defy traditional distinctions between the "basic categories of being" (Kahn et al., 2013, p. 35). It is based on the observation that children's thinking about and behavior towards robots do not directly map onto their conceptualization and treatment of humans, animals, or artifacts, but rather show partial overlap with each of these categories. Consequently, the hypothesis predicts that children growing up with social robots will find it difficult to make clear judgments about robots' characteristics (e.g., regarding their animate or inanimate status) and will answer questions about such characteristics with both 'yes' and 'no' (Kahn et al., 2013).

The NOC hypothesis, however, remains a hypothesis. Severson and Carlson (2010) have posited that, before we can consider it supported, at least five forms of evidence are required. First, children's attributions to robots should cut across prototypic categories. Second, these attributions should convincingly reflect actual beliefs rather than engagement in pretense. Third, attributions made to robots should demarcate structural, rather than functional, overlap with other ontological categories (i.e., robots should not merely *function* differently from, but truly *be* different from, humans, animals, and objects). Fourth, the hybrid conceptualization of robots should persist across children's developmental stages, and fifth, should not disappear with the introduction of more sophisticated robots in society (Severson & Carlson, 2010). In contrast, Smedegaard (2022, p. 8) recently argued that whether social robots indeed constitute a hybrid ontological category is less relevant than "the fact that we feel the need to entertain the thought—and by it, question fundamental assumptions about what it means to be living; to be conscious; to be social; to be a caregiver; to have rights; to have responsibilities; etc."

In conclusion, there is some emerging evidence that children conceptualize social robots in terms of whether they present mental, social, or moral others. Research also suggests that children's conceptions of social robots can be deepened and broadened when educating children about how robots are built. Similarly, information about ro-

bots' technical nature can modify children's existing conceptions of social robots. The hypothesis that social robots present a new ontological category deserves future research, notably in comparison to other theoretical frameworks, such as evolutionary theory, which would predict different ontological conceptualizations of social robots (e.g., Lombard & Xu, 2021).

19.3 Challenges in the Field

Since its inception more than 20 years ago, the field of CRI has evolved continuously, and now features an impressive breadth of multidisciplinary research and shows a lively diversity in its research activities. However, research on CRI currently also has to face several limitations and criticisms, for example methodological issues, such as the lack of standardized measures, and theoretical challenges, such as little attention to intercultural differences (e.g., Peter et al., 2019). In our view, three more challenges also deserve attention.

19.3.1 Adult bias

Much CRI research relies on studies that were done among adults and uses theories and concepts that were designed for adults (or at least not for children). Given the lack of research on many topics in CRI, this practice may be inevitable and may not always present a problem. However, when adult-based results or adult-oriented concepts and theories presuppose cognitive, emotional, or behavioral abilities that children do not yet have, using them in CRI research may yield flawed research expectations, unrealistic, child-inappropriate research settings, and inadequate interpretations of findings. For example, interactions with social robots are often modeled after interactions between humans (see De Graaf et al., 2015). As communicative processes have been studied more extensively among adults than among children (see Miller-Day et al., 2013), this increases the risk of an adult bias in studies on children's interactions with social robots.

The often implicit adult bias in CRI research is surprising because, in a design context, scholars have emphasized that researchers need to be aware of the potential differences between adults' and children's views when designing social robots (e.g., Woods et al., 2004) and societal robot applications (e.g., Smakman et al., n. d.). In a less design-oriented context, Belpaeme and colleagues (2013, n. p.) have also warned that "children are not just small adults" and that, inconsequence, children's and adults' interactions with robots may be fundamentally different. For example, children often attribute characteristics to robots that adults tend to reserve for people or animals (Severson & Carlson, 2010). Moreover, children can sometimes hold contradic-

tory beliefs about robots, for instance when thinking of robots as entities with a mind while, at the same time, describing them as machines that are designed and operated by people (Bhamjee et al., 2010).

However, even when we are aware of the differences between the reasoning of children and adults, our own adult perspective on CRI may color our expectations about children's responses to social robots (see, e.g., Van Straten et al., 2021). As a result, CRI researchers should scrutinize not only the concepts, theories, and previous research that they use for a potential adult bias but also their own reasoning. Together with a developmental perspective (Peter et al., 2019), reducing the adult bias in CRI research may help us better understand what children, in particular, expect from interactions with social robots, how they experience the interactions, and how these interactions affect them.

19.3.2 Lack of genuine theoretical CRI frameworks

Previous research has identified the absence and/or heterogeneity of theoretical frameworks as one limitation of CRI research (Peter et al., 2019). However, the theoretical progress of a field may not only be hampered when theoretical frameworks are absent or diverse but also when there are no genuine theoretical frameworks that originate within a field and subsequently guide and unify it, at least as far as the research lines sketched above are concerned. Currently, CRI research is defined primarily by the population it studies—children—but broadly speaking, this focus has not elicited theoretical insights that specifically pertain to what is studied. Rather, the theoretical basis of CRI research resembles a patchwork of theories and concepts (Peter et al., 2019) that tend to be inspired by the home discipline of the researchers rather than the topic itself. This does not mean that existing concepts and theories from established disciplines are ill-suited for the study of CRI. We just believe that theoretical frameworks that are genuine to CRI would contribute to the maturity and identity of the field and improve its focus and orientation.

One reason for the absence of genuine theoretical CRI frameworks may be the nascent state of the field: it is still too young and dispersed to produce coherent and focused theoretical frameworks. A second reason is the multidisciplinary character of CRI research itself. With so many disciplines engaging in CRI research, a wealth of concepts and theories is available that can inspire and guide research. A final reason for the lack of genuine theoretical CRI frameworks may be that we have not yet taken the C in CRI seriously enough. As outlined in the previous section, CRI research is prone to an adult bias. In addition, the potential of a developmental perspective on CRI has not yet been fully explored (Peter et al., 2019). Without a child-centered approach to CRI, however, we may not be able to adequately grasp what specifically distinguishes children's interactions with social robots from those of older populations.

19.3.3 Overreliance on interpersonal theories

Given social robots' natural manner of communication (Breazeal et al., 2016a), interpersonal communication theory is a useful starting point for studies on interactions with social robots (e.g., Westerman et al., 2020). However, the applicability of interpersonal communication theory to the study of human–robot interaction has been questioned (e.g., Fox & Gambino, 2021; Gambino et al., 2020; Peter, 2022): Concepts and theories based on insights from interactions between humans, such as interpersonal communication theories, may inevitably carry an anthropocentric bias when uncritically applied to interactions involving non-human interactants (Gambino et al., 2020). Moreover, in the study of social robots, the use of human-based theories, more generally—and interpersonal communication theory, more specifically—may be problematic because social robots may (yet) lack the ability to engage in complex, human-like interactions (Fox & Gambino, 2021). When implementing interpersonal communication processes in CRI scenarios, scholars should, therefore, keep in mind that "robots are not people" (Dautenhahn, 2007, p. 699) and that we may expect different things from interactions with social robots than from interactions with humans (see also Fox & Gambino, 2021; Van Straten, 2021).

Different expectations of interactions with robots may apply particularly to children whose interactions with robotic technologies will be a normal element of their lives (see also De Graaf, 2017; Van Straten, 2021). For these children, traditional face-to-face interpersonal communication may be only one way of communicating and no longer the gold standard of communication against which all other forms of communication are measured (Sundar, 2008). With their insights—as well as their boundaries—being defined by human–human communication, interpersonal communication theories may consequently not fully capture children's interaction with social robots. Making assumptions about CRI based on the literature on interpersonal communication thus warrants caution as it largely remains to be investigated whether and how interpersonal communication processes transfer to children's interactions with social robots (see also Van Straten, 2021).

19.4 Future Developments and Outlook

Research on CRI cannot be separated from technological, economic, and social developments, as well as ethical discussions more generally. We, therefore, believe that CRI research would benefit from paying more attention to at least the following three developments. First, CRI researchers should more strongly embrace the increasing merger between social robots and smart/connected toys. Many smart/connected toys share technological characteristics that are typical of social robots (e.g., interactivity, sensors, movement, embodiment) and differ from robots only in the number and so-

phistication of robotic features (Peter et al., 2019). Smart/connected toys are cheaper than elaborate social robots and more likely to be widely used by children. Moreover, children use smart/connected toys typically in their homes ('in the wild'). This may enrich the ecological validity of existing CRI research, in which children are often invited to interact with social robots in surroundings such as labs, schools, or museums. By studying smart/connected toys, CRI researchers can thus learn a lot about children's use and experience of robot-like devices and their effects.

Second, CRI researchers should more strongly study social robots in conjunction with communicative robots. Communicative robots, such as virtual agents, social bots, and work bots, appear "in the form of software and digital infrastructures . . . [and] are (partially) automated and (partially) autonomous communication media that serve the purposes of quasi-communication with humans" (Hepp, 2020, p. 1413, emphasis removed). Traditionally, materiality and physical embodiment are considered crucial features of (social) robots (Winfield, 2012). However, embodiment can also encompass communicative and infrastructural embodiment (Hepp, 2020). Communicative embodiment emerges from the human-likeness of the digital agents when we communicate with them through software. Infrastructural embodiment is constituted by the material infrastructures in which digital agents are integrated (Hepp, 2020).

Although researchers have started to investigate the effects of physical embodiment on children (e.g., Sinoo et al., 2018), the impact of the different types of embodiment on how children interact with robots is still rather poorly understood. Of the various communicative robots, virtual agents (e.g., chatbots) and voice-based assistants (e.g., Siri, Alexa) may be of particular interest to CRI researchers because they are primarily made for social interaction. A direct comparison of social robots with, for instance, virtual agents is challenging if a virtual representation of the physical social robot does not exist and is generally prone to confounding factors. Still, we believe that insights from research that only deals with virtual agents and voice-based assistants may be useful for CRI researchers to better understand the theoretical implications of different types of embodiment. Moreover, such research may at least initially be informative for questions on the design and applicability of robots in different areas (e.g., whether a robot application needs physical embodiment or whether communicative embodiment may suffice to successfully complete a task).

A third development that we consider crucial for future research on children and social robots refers to responsible CRI. Scholars have increasingly emphasized the ethical dimensions of CRI, both in research and applied settings (e.g., DiPaola et al., 2023; Sharkey, 2016). Following Sharkey (2016), De Graaf and Peter (2023) have recently identified four issues in human–robot interaction that may also apply to CRI. To start with, robots may convey deceptive information about what they are and what they can do, which may elicit wrong expectations about robots (e.g., Turkle, 2007), notably among children, who typically expect much from social robots (see, e.g., Kahn et al., 2012). In addition, robots' agency and independent decision making may lead to questions about accountability if problems occur. Although social robots are currently un-

likely to interact independently with children, the question of accountability in problematic situations is crucial in machine ethics (Misselhorn, 2019) and deserves even more attention when a protected population, such as children, is concerned. De Graaf and Peter (2023) further identify the tension between personalization and privacy as an issue, which may also apply to CRI. Given their multiple sensors and connection to the internet, social robots may collect personal data about children and thus violate children's privacy. Finally, robots' (allegedly) autonomous behavior may increase the likelihood of human–robot relationships that may lack relational authenticity (Turkle, 2007), again an issue that may particularly apply to children, who readily form relationships with social robots (Van Straten et al., 2020b). Responsible future CRI research may benefit from greater attention to these four issues, not only in terms of how CRI research is set up but also in terms of what is studied and which practical recommendations are made.

With all the quick and far-reaching changes in areas that are central to social robotics, such as artificial intelligence, sensor technology, natural language processing, and computing, social robots are likely to play an important role in the future (Eberl, 2016). As much robotic technology is already present in current smart/connected toys (Peter et al., 2019), children will most probably be confronted with more advanced social robots sooner or later. Against this backdrop, CRI research has already addressed several pressing issues since its beginning more than 20 years ago and yielded many insights into how and why children interact with social robots and the consequences this has. The field shows a lively diversity that offers a variety of typically multidisciplinary approaches and a mix of theoretical and applied research. At the same time, the field is challenged to deepen its theoretical grasp of issues that are central to *children's* interactions with social robots and may benefit from approaching CRI in conjunction with broader technological and ethical developments in human–machine communication. If CRI addresses these challenges and opportunities, it will also in the future significantly contribute to our knowledge about how children—and humans more generally—interact with social robots.

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