DESIGN LAB UNIVERSITY OF TWENTE.

KIDS RIGHTS

2022 AI REGISTER OF CHILDREN IN THE NETHERLANDS:

Mapping Children's Awareness, Ethical and Social Sense-making and Imaginaries of Artificially Intelligent Systems Via Meaningful Participation

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ISBN 9789090371450

La Fors, K. (2023) *2022 AI Register of Children in The Netherlands: Mapping children's awareness, ethical and social sense-making and imaginaries of artificially intelligent systems via meaningful participation* Kidsrights / DesignLab University of Twente; The Netherlands ISBN 9789090371450 (e-book)

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Acknowledgments

This project that measures and maps the AI awareness of children has been initiated by Karolina La Fors from the DesignLab, University of Twente, and is the result of a collaboration with KidsRights and the DesignLab University of Twente. This research has also been proposed as the start project of the Dutch ELSALab AI4Youth for which the financial resources have been granted by DesignLab and KidsRights.

Completing this intergenerational, ethnographic research study would not have been possible without the constructive willingness and creative ingenuity of the hundreds of children who offered their eyes, ears, and senses and shared in their own words how they saw AI systems, society and the world around them while living in the Netherlands in 2022. Children's voices from diverse corners of the Netherlands were unique and indispensable to informing this report, AI design, AI ethics, responsible AI, AI policy, and children's rights frameworks.

Special gratitude goes out to their parents and guardians who consented to the participation of their children in this research, to the highly supportive and curious pedagogues, museum staff, and librarians, whose unique expertise and collaboration were all vital to engage with children and collect empirical data for this study. I am especially grateful for the school directors and teachers of the Nutsbasisschool Teteringen, Nutsbasisschool Boeimeer (Breda), SKOE (Enschede), SALTOSchool de Hobbitstee (Eindhoven), Leonardo Basisschool (Dordrecht), De Colignyschool (Katwijk), Fakelschool (Katwijk) where I could provide co-creative lectures. I am also grateful for the teachers of the Nutsbasisschool Oldenzaal, Anna van Buren Basisschool (Enschede), De Bron Basisschool (Hengelo), Kadoes Basisschool (Albergen), De Triangel (Nijverdal) where teachers took the surveys in classes themselves. The list of school names is longer as children have filled in the surveys online while attending other schools. I am also very grateful to Mart Vogel from the NEMO Museum of Amsterdam (NEMO) for facilitating that co-creative, intergenerational dialogue could take place about AI with child visitors, parents, museum staff and researchers. I also thank Cato Smit and Lauren O'Neill from the side of KidsRights for their data collection support and Valeria Estefania Moreta Urbano and Pablo San Gregorio de Lucas from the side of DesignLab for helping to interest families and enabling their children to participate in our study while visiting NEMO.

My warm gratitude goes also to Marc Dullaert for his unshakable commitment and friendship by which he enabled this project on his own and through a great team of colleagues of KidsRights. This included the invaluable project management support provided by Bianca Dyers and the illustrative support of Francesca Caputo Sankowich who produced illustrations, integrated the drawings of child respondents and assisted with the layout of the report.

I am also very grateful to the Management Team of DesignLab, to Miriam Iliohan who supported this project from the beginning to Sabine Wildevuur citizen science expert and director of DesignLab, to Vanessa Evers co-director of DesignLab and to former co-director of DesignLab Peter-Paul Verbeek who encouraged carrying out this project as part of the responsible design programme of DesignLab. I also highly appreciate the commitment and data science-related support for the analysis of DesignLab DreamTeamer: Jasper-Sebastian Hassler. All their invaluable efforts greatly enabled bringing this project to completion and contributing to meaningful child participation on AI in The Netherlands in 2022.

This publication is also the first research report study of the AI4Youth ELSALab and the in-kind support of our consortium partners has been vital to complete this. Therefore, special thanks to Hanny Gijsman (Science Hub Leiden University) and Remke Klapwijk (Science Hub TU Delft) for the project material dissemination and activation of their school networks to recruit participants. Special gratitude goes also to Marjolein Lindeman and Pieter Boerman (Science Hub University of Twente) for offering support and to Hannah Bijlsma for her contribution to testing the co-creative lecture in one school of their network. I am also very grateful to Dennis Reidsma from the Ethics Commission of the Faculty of Electrical Engineering, Mathematics, and Computer Science (EEMCS) for reviewing and approving the survey questions. In addition, I am also grateful to Carola Oortwijn, Rebecca Lombaers from the library network of Rijnbrink, and Marianne Elsjan of Wipper from the Stadkamer Library Zwolle for their collaboration and for enabling that members of our AI4Youth quadruple helix consortium: Liselotte Honing (Dotpin-AI developer); Marc Dullaert (KidsRights); Ella Vellner (robot-child interaction researcher, University of Twente), two children, and myself could organise a transdisciplinary 'child participation in AI' roundtable session as part of the kick-off of the Dutch AI Parade in September 2022. Special thank you for the financial support of the Faculty of Electrical Engineering, Mathematics, and Computer Sciences (EEMCS) and the DesignLab of the University of Twente that made the short film recording of the roundtable session possible.

The research analysis highly benefited from the very constructive reviews provided by expert academics and colleagues at the University of Twente: Dr. Fran Meissner, Dr. Shenja van der Graaf, and Dr. Michael Nagenborg. Both Shenja and Michael have been generous supporters of the AI4Youth ELSALab throughout its development. As to the ELSAlab, I am very grateful for the commitment of my colleague, Dr. Roeland Ordelman with whom we have been working on the lab idea. I am also highly honoured and delighted by the conversations I could have with Emeritus Prof. Karamjit S. Gill about AI4Youth.

Last, but not least I am very much indebted to my family for allowing me to complete this study. Their support and patience by which they let me spend weekends doing fieldwork and evenings analyzing data. I am also truly grateful for my Kodály-method-based music education as a primary schooler and for our teacher who gave us the experience that

each missing voice constituted a direct deficit in the strength of the collective: our choir. The method inspired engaging children early and broadly in constructive dialogue about AI systems and learning from them what it means and should mean for them to interact with AI systems in Dutch society. Inspired by these motivations, conducting this research study has been an ultimate privilege not only because this informs AI ethics, responsible and human-centric AI discourse, and children's rights through the intergenerational, bottom-up inclusion of the youngest generation in The Netherlands, but perhaps most importantly because children thought me through their stories and questions what it means for them to be human and human-centric in an AI-mediated society.

To conclude, I am very grateful for my bicultural parents and grandparents who set examples about the benefits of cultivating a curious mindset towards different ways of doing things. All these influences motivated this study to collect ethnographic evidence of diverse children about their AI-mediated and social interactions, their awareness, ethical and social sense-making, and imaginaries of AI while living in 2022 in the Netherlands.

Executive summary

This project has been initiated and carried out with the purpose to foster meaningful child participation in the Netherlands as enshrined by Art. 12. of the United Nations Convention on the Rights of the Child (UNCRC) and the General Comment 12 (Committee on the Rights of the Child, 2009) about the topic of artificially intelligent systems. Whereas AI innovations are proliferating in society, public dialogue about these systems is scattered and often does not include the youngest generation. This is a miss not only because this generation can be regarded as being more vulnerable than adults, but because they possess a unique human-centric lens on the world. Therefore, the purpose of meaningful child participation was to capture children's intuitive sense-making of AI systems, which they often gradually unlearn till adulthood (Buber, 2008). The research ambition was to involve their empirical insights about their experiences with AI systems in their closest living environments (Bronfenbrenner, 1979) so that they can provide new ethical, social, and for children's rights, AI design and policy frameworks, educational strategies informative insights to rely upon. Children's insights on which systems they recognized as AI and how they described their interactions with these systems and imaginaries with future systems were assumed to indicate which AI systems had a potentially large influence on their development. A second assumption has been that enabling dialogue with children would offer insights into what children value about their interactions with AI and humans. Therefore, evidence of children's insights (ages between 4-18 years) was collected. Out of this age range the vast majority of respondent children were between 6-13 years. They could fill in the survey questions offline or online during the period of July-October 2022 in The Netherlands. Through providing their answers we incentivized them to think about a) which AI systems they recognize, b) the potential good and bad impacts of these systems, and c) the desirable or undesirable impacts of AI systems in the future. Children's accounts are also specific in time for the year 2022, for the context of AI-focused dialogue, for the cultural embedding of the Netherlands, and for the intergenerational activities that enabled meaningful child participation on this topic. Without the vital help of a diversity of committed adults: parents, pedagogues, museum staff, librarians, AI developers, students, academic researchers, and societal partners no such a broad diversity of children could occupy a central role as experts of their own experiences within this research report. Children shared their views, in their own words, on their interactions with AI systems in Dutch society. These insights are key to create room to simultaneously discuss what the development of human-centric AI and responsible humans in the loop of AI, society and Earth shall mean. Only then can ambitions to increase the AI-mediated economic competitive growth of the Netherlands remain closely aligned with ambitions to cultivate human-centric individual and societal growth.

Relevance of measuring children's AI awareness, ethical and social sense-making, and imaginaries of AI systems

1) ***Children in The Netherlands are expected to develop 21st-century skills (OECD, 2019).*** This is also part of the objectives of the European Year of Skills (2023) and also defined as goals by the World Economic Forum (WEF, 2016) and this report contributed to that. Developing AI literacy skills are part of 21st-century skills and is underlined by the OECD's report as being essential for the new generation (2021). To define how to approach AI literacy depending on the age, and social and cultural roots of children, mapping their quantitative and qualitative awareness of AI systems is needed. The results of this report contributed to that.
2) ***Human-centric AI design (Gill, 1996) can be well served by applying meaningful child participation and participatory AI design methods*** simultaneously. By applying meaningful child participation toward *'Adult-initiated shared decision-making with youth'* and participatory methods we aimed for offering more agency for children as informants than only as users (Druin, 2001) This research was not aimed at validating AI systems' existence nor to offer maximal agency to children to develop AI. The aim was to offer children more room for self-empowerment via meaningful participation and intergenerational dialogue about how AI systems affect their lives. The project was also inspired bythe Pan European Youth Manifesto that collected voices from youth from 31 countries as to how to improve the internet (2022).
3) ***Critical thinking skills on AI systems through co-creating knowledge with children through dialogue:*** Incentivizing children to reflect upon their interactions with AI systems went beyond one-sided communication about these systems which is typical for top-down policy-making and formal education in society. Asking children about their interactions with AI systems in their closest living environments engaged them in co-creative and critical meaning-making about AI systems.
4) ***Children's thought experiments on AI have shown that children possess ethical and social sense-making skills that are often unlearnt till adulthood.*** These skills are crucial to informing human-centric AI and normative frameworks. Through engaging with children we could incentivize them to do thought experiments, do philosophy with them (Long, 2005) on AI and society, and to learn from their perceptions. Through their empirical engagement, we also contributed to enacting their digital right to be heard and purposing their activism toward AI ethics. Such activism has been called for with citizens *(Freiman, 2022),* but this time with the youngest generation. Establishing sustainable co-creative practices where children use their sense-making skills about their interactions with AI in their closest living environments was useful to critique fast-adopted and socially embedded AI innovations through the lens of the youngest.

5) ***Building sensitivity towards diverse realities and imaginaries of children regarding their interactions with AI yields anti-bias mechanisms in AI-child, human-child interactions and in society.*** Co-creation and dialogue with a broad diversity of children about AI impacts are crucial to informing AI designers' choices (Code voor Kinderrechten, 2021). However, dialogue with diverse young children about their AI interactions was also aimed at sensitising children early towards the diverse individual, social and cultural realities of others. The sustainable establishment of such co-creative practices could limit and remedy the occurrence of discriminative biases and their detrimental impacts (La Fors, 2022; Mathiyazhagan & La Fors 2023). Children's creative and intuitive stories of their good and bad perceptions and imaginaries of AI proved to be an effective vehicle for collaboration through dialogue about AI and shown potential for societal cohesion within AI-mediated conditions.

Approach and data analysis

The approach relied upon a multi-disciplinary literature review, and transdisciplinary, empirical data collection that was informed by meaningful child participation and participatory AI design methods. Survey questions for children were approved by the Ethics Committee of the Faculty of Electrical Engineering, Mathematics, and Computer Sciences of the University of Twente (please see Annex 1). 374 children's answers were analysed.

Demographic distribution and AI awareness of child respondents

1) ***Children's voices came at least*** **from 34 diverse geographical locations of The Netherlands** (incl. North, South, East, and West) and all informed this report.
2) ***The majority of child respondents were aged between 6-13 years***. Appendix 1 of the main text depicts the survey questions. The total number of child respondents we analysed was 374. 323 of these children were 6-13 years old.
3) ***70,6% of child respondents have not heard of AI systems before the survey.*** For those children who heard of AI before the surveying, the primary sources of information were the following: *television* (programmes, such as Jeugdjournaal, Media Masters, Klokhuis), *schoolmates, family members, or friends.*
4) ***Children have shown that their AI system awareness is largely associated a) with brands and b) with digital devices in which AI systems can be found***. This study introduced children to three criteria as a narrowed-down definition of an AI system before surveying. These included: I.) being *connected to the Internet, II.) could learn by themself* and *III.) could offer recommendations*. The brands and devices children referred to were based on these criteria.

a) ***Children's AI awareness associated with the following brands* included:** Google, Playstation, Youtube, Nintendo Switch, Tiktok, Netflix, Xbox, Apple Watch, XBox, Smart Doorbell (Ring or Tesla), Bol.com, Robolox, NS card, McDonald's console, DALL-E, GPS, Domotica and others.
b) ***Children's AI awareness is associated with devices* including** computers, Chromebooks, Macbooks, iPads, iPods, laptops, smart TVs, smart thermostats, smartphones, smart doorbells, and robot vacuum cleaners. Children viewed devices as locations of smart applications but they have not distinguished between smart applications and devices themselves.

Children's ethical and social value demands in an AI-mediated society of The Netherlands in 2022

Children's answers about their AI interactions were not only used to identify their awareness of AI systems but also to ethnographically collect their ethically and socially relevant perceptions of good and bad AI systems and imaginaries of (ideal) AI systems for themselves as individual persons, and for society in the present and for the future. By applying text-search to all answers of child respondents and by including all codes corresponding to children's favourable and unfavourable reasons for a social robot versus a human, eight ethically and socially relevant value demands of children were identified. These value demands of children are specific to their age group, social and cultural embedding, their interactions with AI systems, and to society of the Netherlands in 2022.

Eight ethical and social value demands child respondents did not want to compromise upon in their interactions with AI systems and society were the following:

1. ***Human literacy***
2. ***Emotional Intelligence***
3. ***Love and Kindness***
4. ***Authenticity***
5. ***Human care and protection***
6. ***Autonomy***
7. ***AI in servitude***
8. ***Exuberance***

Appendix 2 of the main text of this report depicts a first indication of how these value demands of children could inform AI ethics, children's rights, AI policy, and responsible AI design frameworks.

1. Introduction

"Where, after all, do universal human rights begin? In small places, close to home - so close and so smallthat they cannot be seen on any maps of the world. Yet, they are the world of the person; the neighbourhood he lives in; the school or college he attends; the factory, farm, or office where he works. Such are the places where every man, woman, and child seeks equal justice, equal opportunity, and equal dignity without discrimination. Unless these rights have meaning there, they have little meaning anywhere. Without concerted citizen action to uphold them close to home, we shall look in vain for progress in the larger world.' (Eleanor Roosevelt, 1958)"[1]

1.1. AI, children, and society

ChatGPT, Tiktok, Instagram, YouTube, Nintendo Switch, Roblox, Twitch, Fitbit, and Google Home as well as smart toys and facial recognition software are systems enabling artificially intelligent (AI) computing for human interactions. AI-mediated systems become increasingly ubiquitous also in those "small places" where children gather their first interactive experiences in their lives. A broad variety of AI systems are proliferating into the closest living environment of children and receive plenty of negative (Hern, 2019), positive (Rahman, 2020), and cautionary media attention (Rutger, 2022). According to expert prognosis, the Internet of Things devices (IoT) such as virtual assistants will grow from 8.74 billion in 2020 to more than 25.4 billion in 2030 globally (Statista, 2020). These AI systems are not neutral but can profoundly impact children's lives (Livingstone, 2019, Turkle, 2011) by establishing norms, mediating values, affecting children's rights, and transforming what is perceived to be meaningful in societal interactions. Through their fast-paced proliferation, there is often no room for societal contestation and even less where children are active participants. However, the impacts of interacting with AI on children can be profound, for instance, the case of the Wysa and Woebot chatbots exemplifies this: the chatbots have not warned children of participating in sexually abusive conversations while in use (White, 2018). Although AI systems have no legal or moral authority (Van Wynsberghe & Robbins, 2019) children can perceive them as role models.

The developments around large language model-powered AI systems, also called "generative AI" systems as exemplified by DALL-E, ChatGPT, or VALL-E (Hurst, 2023), demonstrate, for instance, how difficult it can become for the human eye and brain to distinguish between AI-generated and human-made art or text content. According to a Stanford study, adult humans are only able to distinguish between human- or AI-made text up to 50% (Kannan, 2023). AI-mediated conversational applications set new norms That already impact children, schools and broader society as schools have trouble

[1] Universal Declaration of Human Rights, Amnesty International https://www.amnesty.org.uk/universal-declaration-human-rights-UDHR

distinguishing between text written by ChaptGPT and by students, and publishers start to ban the use of generative AI (Sample, 2023). Such reactions depict that a new frontier in AI development has been redefining again the path of creative innovation before time and space were offered for societal dialogue in which beyond adults, children could meaningfully participate. Discussing whether or not such creative tasks and outputs - as those so far largely credited by humans - should or should not be delegated to AI systems from the perspective of children, remains urgent and necessitates children's views. Interacting with these systems directly influences their moral, emotional, and cognitive evolution, their meaning of values and human experiences, and their very perception of reality. When AI systems proliferate, the depth of their implications on the civic, mental (Turkle, 2015), biological, moral, and other layers of individual and societal identity development of children in The Netherlands are unknown. Experts already urge for collective engagement with children to discuss these systems' impacts (Caron, 2023).

The urgency for the broad and early engagement of children in dialogue about AI systems is critical because AI systems can facilitate diverse forms of online harm coming to them with long-lasting implications as indicated by the report of the 5Rights Foundation (2021). Generative AI systems only add to the types of emerging risks. The profoundness of the negative impacts only underlines that positive impacts can also be profound because children have to interact with society and have to be open to influences as part of their development (Piaget, 1972). Children are undergoing AI-mediated experimentation which as a consequence of innovation is not new. However, as the fast-paced generative AI (Kannan, 2023) and connected IoT developments demonstrate this (La Fors, 2022a) deploying meaningful ethical, legal, and societal checks amid such AI developments is a mounting challenge yet needed more than ever before. AI innovators and AI auditors are currently overwhelmingly adults. Offering meaningful opportunities for children to emancipate themselves through participating in AI design, AI policy, and auditing AI innovations affecting them (Iversen & Dindler, 2013) enables cultivating responsible humans in the loop. Human-centric AI cannot serve democratic societies without investing into human-centric humans. Children by their biological and psychological needs to grow do their lives in human-centric ways. How they do theirs is often unlearnt till adulthood.

Early and broad dialogue with children, specifically, about the desirable and undesirable impacts of AI systems is crucial to foster healthy human-machine co-existence on Earth. Inspired by Karamjit Gill's Human-Machine Symbiosis (1996) which advocates for a balanced application of human-machine value alignment methods and human-human value alignment methods to achieve human flourishing in a technology-mediated world, this report embraces the stance that the development of current AI-related legal, ethical and design frameworks set a larger emphasis on human-machine value alignment methods than on human-human value alignment methods. This emphasis creates significant challenges for developing 21st-century skills as defined by OECD for the next

generation (2019) and for human-centric AI system development (Gill, 1996). The OECD Learning Compass 2030, for instance, expects children to develop three main skill sets: *"(1) cognitive and meta-cognitive skills, which include critical thinking, creativethinking, learning-to-learn, and self-regulation; (2) social and emotional skills, which include empathy, self-efficacy, responsibility, and collaboration; (3) practical and physicalskills, which include using new information and communication technology devices"* (OECD, 2022). Human-centric AI systems are expected to flow from methods that account both for human-machine and human-human value alignment (Gill, 1996).

1.2. AI design challenges from child perspectives

The experiences of children are barely referred to in the Dutch Strategic Action Plan for Artificial Intelligence (2019). Whereas the necessity for engaging the public is one of the five core principles defined by the WRR, the role that children can play as engaged public in the development of AI and public dialogue about AI also remains underexposed in the Mission AI: The New System Technology (WRR, 2021). Meaningful child participation regarding AI and AI co-design as a method with children - where possible - is, however, recommended by the UNICEF Policy Guidance on AI and Children (Dignum, V. & et al., 2021). Co-design in general with citizens is also recommended by the Assessment Tool of the EU's High-Level Expert Group on Trustworthy AI (EC, 2020). Children's right to participate about their digital interactions is also urged by the resolution of the General Privacy Assembly of which the Dutch Data Protection Authority is also signatory (AP, 2021). Through their interactions, children leave large amounts of their data behind as "behavioural surplus" (Zuboff, 2019) for processing by AI systems. Measuring their awareness, sense-making and imaginaries of AI systems in their closest living environments is a start in this process. The holistic inclusion of child perspectives is limited regarding the ethical, legal, policy, and AI design frameworks.

The following conditions challenge meaningful child participation in AI ethics, responsible AI, children's rights, and AI-related policy frameworks in The Netherlands.

1.2.1. No child-informed ethics codes and implementation

First, more than 160 AI ethics codes (AlgorithmWatch, 2020), principles and guidelines, such as OECD Principles on AI 2019 (OECD, 2019); the AI4People Good AI Principles (Floridi et. al. 2018); UNESCO Recommendations on the Ethics of Artificial Intelligence (UNESCO, 2022); the EU's High-Level Expert Group's sectoral recommendations on AI and the EU's Assessment List for Trustworthy Artificial Intelligence (ALTAI) offer top-down ethical guidance, however, they do not offer concrete tools how to translate and reflect upon ethical values from child perspectives when children interact with AI in their daily lives.

Although the seven principles of the ALTAI suggest the involvement of stakeholders, for instance, to diversify AI design. Fourth, the negative tone of the emerging ethics codes and their non-accessible language for children hampers the exploitation of AI's positive effects (Floridi et. al. 2018) also concerning children. Fifth, these ethics codes are also critiqued for being too abstract for practical implementation and would necessitate "pragmatic operationalization" (Morley et. al., 2021) which also applies to children. Drafting committees of these ethics codes also often have no child members.

1.2.2. No child-informed AI regulations and a large focus on doing 'no harm'

Developments around the European AI Act (EAIA) (EC, 2021b) introduce novel mechanisms for preventing the harmful effects of AI-mediated inferences by dividing systems according to their harmful effects into four risk categories: unacceptable risk, high risk, limited risk, and minimal risk. The focus on 'do no harm' is essential also to protect children, yet insufficient for their flourishing. Generative AI innovations, for instance, in which systems very existent are to be domain-overarching when collecting and associating vast amounts of data to configure creative outputs exemplify how legal systems that are domain-specific have trouble coping with these innovations. Domain-specific intellectual property or privacy regulations demonstrate this. Due to privacy violations Italy, as a first country, had also banned using ChatGPT (McCullum, 2023). The European Digital Services Act (EC, 2020) prescribes that AI developers shall not profile children, but there is no common definition of what constitutes a child in interactions with AI systems (La Fors, 2022b). This can lead to challenges to implementing legal and ethical codes, and auditing mechanisms and can cause a misalignment on how to implement children's rights. Consequently, children's insights on the influence of AI systems would benefit a) defining what shall constitute a child user when interacting with AI and b) informing and implementing ethical, and legal codes, children's rights, and educational and design frameworks.

1.2.3. Limited child-friendly policies, legal codes & implementation

UNICEF's policy guidance on AI and children (Dignum et. al. 2021) offers highly valuable principles to follow for policymakers when designing AI-related policies and AI systems which children can interact with. However, each recommendation needs tobe adapted to local contexts and children's capacities, in our case to the Dutch context. Each AI system can trigger children differently depending on their age, individual character, and living environment. Therefore, adhering to AI-specific legal principles and children's rights considerations while accounting for context, perspectives and children's experiences remain key aspects and challenges to assess AI systems before and after implementation. Rendering legal codes, AI policies, and AI systems for children more accessible, and in the future preferably accompanied by the meaningful participation of

children (Mathiyazhagan & La Fors, 2023) would highly increase the effectiveness of codes and the meaningfulness of AI systems and societal cohesion.

1.2.4. No child-friendly design codes & implementation

Whereas, IEEE age-appropriate design codes (IEEE 2089-2021) are available and their implementation faces challenges. Research on age-appropriate AI-child interaction design acknowledges that "most systems' designs [for children] addressed only a small subset of principles" (Wang et. al., 2022), whereas age-appropriate design breaches are vast (5Rights Foundation 2021). All these systems are connected to the Internet, rely on bulk data, and have the possibility for unsupervised components. However, there is no standard definition for what constitutes a child, and AI developer companies define characteristics on their terms. Large platforms, for instance, introduce sensing systems to define which user is a child (La Fors, 2022b). The European Digital Services Act's auditing mechanisms provide strong possibilities to check large platforms, yet the daily auditability of the impacts of AI systems on children through these platforms requires intergenerational and sector-overarching collaboration.

1.2.5. Limited transdisciplinary, child-friendly engagement mechanisms and spaces

The ALTAI remains vague about how to engage in co-designing AI systems that are aimed at better accommodating children's (and their parents) values to engage in intergenerational dialogue and co-create mutually shared values around AI systems. The Dutch national policy agenda pays limited attention to the potentially detrimental implications of artificially intelligent systems on children (Penagos, Kassir, Vosloo, 2020).

Incorporating their perspectives concerning AI systems would exemplify a form of responsible innovation of AI and guidance with and by children. Realising and enacting a mutually reflexive attitude about the responsibilities of the potentialities and implications of AI systems is instrumental to cultivating healthy children, who can be responsible social partners and humans-in-the-loop of AI on Earth.

There is highly rich child-computer interaction (Desai, et. al., 2019) and child-robot interaction (Zaga et. al., 2021) research that is aimed at unpacking the interactive experiences of children and how AI system goals align with children's perceptions (Druga, et. al., 2017). Child participation in AI research is often focused on AI types and functionalities and involves smaller groups of children as a control group. Such research

is highly important, yet often aimed at meeting user needs and not a broader democratic discussion about the ethical, legal, and social impacts of AI technologies. Research with children with autism (Van Huizen et. al. 2022) or within the educational context (Davidson et. al. 2020) demonstrates this.

To overcome challenges of child participation that are specific to the impacts of AI systems in the Netherlands is vital to see how children's moral, psychological, biological, societal, and civic evolution is influenced by these systems and how AI systems can be more humanised (Zawieska, 2020).

1.3. Research objectives

The objectives for this report are multiple and intertwined with each other.

The main objective had been to invite children to become researchers of their living environments for AI systems and also to audit these systems through children" eyes who are assumed to be more intuitive sense-makers of the world than adults. The assumption has also been that allowing children to express in their own words stories about their conscious and unconscious interactions with AI systems will also provide insights not only into their daily lives with these systems but also into their ethics. This is in line with self-determined learning as part of philosophy with children (Kizel, 2019). By inviting them to speak of their interactive experiences and imaginaries, the report intended to capture children's intuitive sense-making of the world, AI systems, peers, the environment, ethical, and societal values, and their rights.

The report also aimed at applying meaningful child participation and participatory AI design methods to conduct empirical research. The empirical research was aimed at stimulating and following children to formulate their (critical) thoughts of their present and future experiences in a society in which they live with a proliferating amount of AI systems. Gathering children's insights was intended to inform relevant normative and design frameworks and show how participatory methods with children can contribute to the simultaneous development of children's 21st-century skills (OECD, 2021), including their AI literacy skills in The Netherlands.

This main objective had also been defined in support of the Dutch AI Coalition's AI4Youth ELSALab ecosystem (NLAIC, 2022). The lab envisions that Dutch public discourse on such a far-reaching key enabling technology as AI need to be conducted broadly, early, and systematically with the participation of children by stimulating and embracing their meaning-making, expressive, critical, creative, and intuitive capacities regarding AI. This vision is grounded in addressing intertwined and intergenerational societal challenges.

Engaging with children is aimed at bridging the disconnect after the Covid19 pandemic between science and Dutch society (Arjen et. al., 2021) and contributing to a sustainable and AI-focused science dialogue with the engagement of the youngest generation.[2] The report also contributes to bridging the disconnect between citizens and the government in the aftermath of the Covid19 pandemic in The Netherlands (NOS, 2022). Generating dialogue with hundreds of children in The Netherlands also supports the goals of the 'European strategy for a better Internet for children' (BIK+) in 2022which has been the European Year of Youth (EC, 2022c) and contributes to the objectives of the European Year of Skills (EC, 2023) by stimulating children's creative and critical skills through engagement on the topic of this study. In addition, the Council of Europe's strategy on better aligning children's developmental needs and AI design strategies (CoE, 2022). Within the midst of the Council of Europe's efforts to develop international recommendations on Artificial Intelligence (CoE, 2021) dialogue about the societal relation-altering implications of AI systems with the youngest generation remains key. Fifth, the report is also motivated to support the engagement goals on AI with society defined by the Dutch Scientific Council for the Government (WRR, 2021). Sixth, the report supports the recommendations of UNICEF's policy guidance on children and AI (2021) very specifically concerning including their views in co-designing systems (where possible). Seventh, it also fosters principles of diversity and inclusion in line with the EU High-Level Expert Group's ALTAI recommendations onassessing trustworthy AI systems through co-creation (EC, 2020). Eighth, the report also follows the principle of "including children and their expectations in design" aslaid out by the Dutch Code for Children's Rights for designers (2022).

In line with the above, this report has been written in the spirit of allowing children to emancipate themselves, and practice dialogue among themselves and relevant stakeholders more broadly by sharing their experiences with AI systems. Therefore, whereas the report was focused on the insights of children, the enterprise of collecting children's views involved intergenerational exercise as the engagement for support with parents, pedagogues, schools, museums, library workers, researchers and all other stakeholders who assisted from the network of AI4Youth was vital for this project. By offering them experiences of democratic participation and incentivizing them to enter into a dialogue about their experiences with AI systems, this project aimed to provide them with experiences of being experts in their own life experiences, therefore, being the bestresearchers of their AI-related interactions in their everyday lives. The assumption has been that their insights into a) their awareness of AI systems, b) how these systems influence them, c) what they perceive as concerns and benefits of AI systems in their

[2] This also supports the objectives of the new Dutch National Centre for Science Communication and offers the findings to the Dutch government and scientific institutions in The Netherlands.

daily lives and local contexts and d) how human experience with AI systems in the future should or should not look like can inform AI ethics, children's rights, AI (educational) policy, and AI design frameworks by children's expectations, developmental needs, value systems, individual views, and public values. The analysis of this report was based on the following research questions:

a) To what extent are children aware when interacting with AI systems in their closest living environment in The Netherlands?
b) What are children's ethical and social sense-making of AI systems? How do they evaluate their current interactions with AI systems in their living environments and with their peers or other members of society?
c) What are children's imaginaries of interacting with AI systems? How would they imagine changing human agents to more embodied AI agents (robots) in different life scenarios where currently humans fulfill social roles? What does a good or bad AI system currently mean for children and what AI design children would want to see in 2050?

To answer these questions this report is divided into five sections: section one offers the introduction, section two explains the approach and the developed model for the analysis in this report. Section three details the parameters of surveying and the data analysis. Section four specifies the findings offered by the empirical study based on children's AI awareness, ethical and social intuitive sense-making, and imaginaries of artificially intelligent systems. Section five details the conclusions.

2. Approach

This report relies upon a literature review and empirical analysis of children's data (aged 7-18 years). Given schools, one library, and a museum provided the strongest cohort of respondents, we received answers from children (also including a small number of younger siblings in families) between the age group of 4-16 years. Most children we analysed data from came from 6-13 years of age. The 6th year of age has also been referred to as the age of reason (Sameroff, 1996).

2.1. Theoretical grounds

From the theoretical point of view, the report was specifically informed by literature on AI ethics (Coeckelbergh, 2020), responsible AI (Dignum, 2019), value-sensitive design (Friedman et. al., 2013), human-machine interaction (Fails et. al., 2013), technology ethics (Verbeek, 2006), AI ethics (Van der Poel, 2020), educational philosophy, children's rights, data justice (Criado Perez, 2019) and AI system related regulations and international and national policy documents. To achieve the objectives of

the research questions, the approach brought forward a framework at the intersection of the following theories:

First, the approach benefitted from *actor-network theory* (Latour, 1999) considering children, AI systems, and other actors in society as constitutive parts of a network where they mutually shape each other.

Second, the approach benefited from *Bronfenbrenner's bioecological child development theory* (1979) (please see figure 2), according to which children are influenced by different actors in the world, where stimuli stemming from role models in their closest living environments can influence them most.

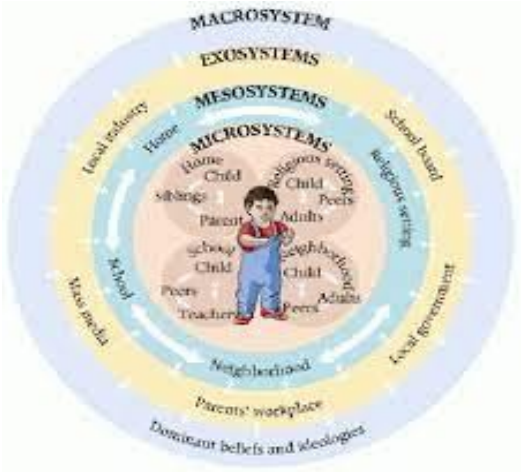

Figure 2: Bronfenbrenner's bioecological child development model <https://educ3040fall13.weebly.com>

Third, the approach benefited from moral development psychology literature. Piaget's (1932) and Kohlberg's (1984) child development theories according to which children develop their moral, psychological, and social skills and different other layers of identity simultaneously through continuous interactions with peers and adults in different phases while growing up. The study also accounts for Carol Gilligan's perspectives, who critiqued Kohlberg by establishing her model of care ethics for children's moral development. The basis of her critique underlines that "integrating the masculine and the feminine, is the best way to realise one's potential as a human" (Gilligan, 1982) and such a perspective is essential to take into account when designing surveys for children about AI systems and the world. When inquiring children about their awareness, sentiments, and imaginaries of AI systems in their living environments, this report particularly aimed at using their own lens on the world by embracing their own position for the analysis. This was influenced by Lucy Suchman's perception of knowledge production. In line with this perception, children's sense-making of the world is also perceived as being situated in time and space (1995).

Fourth, the approach benefited from Martin Buber's theoretical conceptualization of children's intuitive epistemology (2008). Buber considered sense-making of the world as a form of their natural *being and learning through doing their relations.* This can also be called as a *form of dialectic being with others* in the world from the perspective of children.

Fifth, the approach also relied upon John Dewey's *experience-based philosophy of education* (1997). Dewey advocates for embracing immaturity in one's life and defines two components for it: dependence and plasticity. Dewey considers a healthy dependence on others as both individually and socially beneficial, because only in dependence is one capable to learn from experiences. Both dependence and plasticity are necessary for growth. Children offering their views foster their individual healthy development as laid down by Art. 29 of UNCRC and their growth as integral parts of society (La Fors, 2022c). Furthermore, the study took the assumption that children can simultaneously practice a variety of their 21st-century skills (WEF, 2016) and competencies by more active participation through interactive dialogue and design thinking.

2.2. Methodological grounds

From the methodological point of view, the approach of this report has been inspired by Karamjit Gill's Human-Machine Symbiosis (1996) which advocates for a balanced application of human-machine value alignment methods and human-human value alignment methods to achieve human flourishing. In line with this, meaningful child participation had been perceived and applied as a human-human value alignment method and AI participatory design with children (Druin, 2002) had been perceived and reflected upon as a human-machine value alignment method. Concerning the participatory design method, the report acknowledges that participatory design can havefour purposes and stages with participants: to probe *(to let them ideate),* to prime *(immerse them in a context),* to generate *(to give ideas on physical AI forms)* and to prototype AI systems *(stakeholders provide feedback on technological forms)* (Brandt et. al. 2013). From an AI participatory design perspective, this report only aimed at probing, priming, and generating ideas on AI systems, but no actual prototyping of AI systems took place with the respondents. Applying meaningful child participation as a form of citizen science has also been inspired by the ethnomusicologist philosophy of Zoltán Kodály behind reforming music education in Hungary. Kodály collected folklore musical voices from diverse regions of the country and translated them into such bottom-up informed frameworks as curricula and artworks like opera (1966). The participatory AI design methods were chosen in line with such theoretical grounds, as Dewey's arguments about experience-based learning that acknowledges the importance of a no-harm perspective regarding children's negative experiences with AI in order to learn from but also includes

children's positive interactive experiences. Both negative and positive experiences are important to grow from. To learn of these negative and positive experiences empirical data from children is needed. Applying an inductive theory assisted in eliciting children's meanings and value demands in their co-evolution with AI and society on Earth.

Bringing these theoretical and methodological combinations in conversation with each other served as a model to elicit children's way of meaning-making regarding AI systems, societal roles, ethical and societal values, and imaginaries of the world around them. When applying this model, the report relied upon the following definitions.

2.3. Definitions

2.3.1. Artificial intelligence

Children, parents, and pedagogues received guidance before children filled in concerning respect to a specific AI system definition. This a priori-shared definition also provides a degree of bias and limitation to our research. Children received one basic definition of artificial intelligence which only replicated a narrow machine-learning aspect of artificially intelligent systems. This report acknowledges and follows Virginia Dignum's view on AI systems regarding them as being "neither artificial nor intelligent" (2019). While bearing this in mind, the basic definition offered to participants focused on the machine-learning aspects of artificially intelligent systems and took a hermeneutic view (La Fors, 2022c) on the relations between AI systems and children. Such a view entails that during human-AI interactions there is a recursive element in the relationship (Kudina, 2021). When interacting with children AI systems learn from and not only from prior programming. The definition provided to the parents, guardians, pedagogues, and respondents contained specifically three main criteria as to what renders systems smart or artificially intelligent compared to not smart. Smart systems were defined for children as follows: *a) connected to the internet, b) could learn by themselves through such connections, and c) were able to provide recommendationsand suggestions.* This definition is a narrow one for artificial intelligence and is derived from what Dignum calls the overarching “properties of flexibility for intelligent agents" (2019, pp. 10). According to her, the following properties are most desirable for artificial intelligent behaviour: *“Reactivity: the ability to perceive their environment, respond to changes that occur in it, and possibly learn how best to adapt to those changes; Proactiveness: the ability to take the initiative to fulfill their own goals; Sociability: the ability to interact with other agents or humans.”* (2019, pp. 10)

2.3.1.1. Robots as embodied AI systems

The definition of robots as embodied AI systems is not homogenous. Yet, for the analysis of children's answers regarding such specific AI systems as robots, the definition of IEEE also inspired: "*A robot is an autonomous machine capableof sensing its environment, carrying out computations to make decisions, and performing actions in the real world.*" (IEEE, 2023) This IEEE definition has not been introduced to the respondent children. A robot's connection to the Internet as part of the three criteria introduced earlier has been also kept and assumed about a robot for the sake of the study. The children received one additional criterion to the already introduced three criteria for AI systems, notably to consider robots as systems with a body (embodiment) in their social context. We introduced social robots as a special category of AI systems because child-robot interaction scholars already highlighted the educational benefits of robots (Belpaeme, 2018). Given we aimed to co-exploring with children through their generic 'relation-setting intents' of how they make and would make sense of robots in their daily lives, we invited them to imagine specifically "social robots" in different life situations. According to child-robot interaction scholars (Charisi et. al., 2015) embodied agents can have a special influence on children. For instance, through the possible immediacy of interaction, children have a capacity and tendency to easily anthropomorphize robots and associate them with human characteristics (Zaga, 2021). This comes easier than with a non-embodied screen, for instance. Therefore, a set of evaluative survey questions were based on a specific embodied AI: a robot. Beyond the three introduced AI characteristics, the embodiment aspect of the AI was added to the survey.

2.3.2. Children

"I am because we are." (Martin Buber, 2008)

When in this report the societal group of children was identified, the definition of children was aligned with that of the UNCRC according to which every person under 18 years of age should be considered a child (UNCRC, 1989). We surveyed school children between the age of 6-18 years[3]. Children were chosen as they are a different user group

[3] Within the NEMO Museum context younger than 7 years of old children as siblings within families who visited the museum have also been taken into account if parents shared their consent for their participation.

(Vallès-Peris et. al., 2018) from adults and pivotal to engage with when assessing the impacts of their interactions with AI systems. Children are a uniquely diverse group of the population wearing different lenses than adults on what AI-mediated human experiences should or should not be desirable in the present and the future. Childhood is considered a universally binding and passing experience all humans in each hemisphere on Earth share as a common and very formative period of life. Therefore, engaging in dialogue with humans while in childhood about universally proliferating AI systems is very useful because of the profoundly formative experiences of this period. When this study focuses on children it also accounts for what Faruqi (1997) perceives as follows: *"Children…, don't form a homogenous social category. Childhood and the personal history of each child are defined by the material, historical, and socio-cultural circumstances oftheir life, including the social systems, cultural beliefs, and practices, political and legal environment... gender, age, disability, ethnicity, class, caste, religion, are some of the factors which produce different conditions, and hence realities and experiences for different types of childhood."*

While acknowledging these differences the purpose of children's meaningful participation was aimed at gaining unique intuitive insights into their awareness, sense-making, and imaginaries of AI in this study. The approach relied upon Martin Buber's conception of children's intuitive and genuine capacity to relate and imbue the world with its meanings as part of their growing up. Elsewhere this has been referred to as "intuitive epistemology" (Fedyk, Kushnir, Xu, 2019). Scholars underline that this intuitive understanding of what humans possess in childhood the large majority of the population gradually unlearns until adulthood as a consequence of educational systems putting a higher emphasis on the development of cognitive skills (Fedyk, Kushnir, Xu, 2019). This provided a prominent reason to engage with the youngest segment of the population and inform this report and human-centric AI discourse by children's intuitive sense-making capacities. As Buber described in I and Thou (2008) a child's intuitive thought emerges from being engaged (De Venza Tilmanns, 2017) with the world through relating first: *"It is simply not the case that the child first perceives an object, then, as it were, puts himself in relation to it. The effort to establish a relationship comes first… In the beginning is relation – as a category of being, readiness, grasping form, mould for the soul; it is the a priori of relation, the inborn Thou. The inborn Thou is realised in the lived relations with that which meets it.*" (Buber, 2008, p.27). Only after relating, do children imbue the beings and things they encounter with their meanings. Therefore, children's self is a relational one that is utterly prone to dialogue and cannot exist without the other. This relational self is by default inclusive and trusts who or what meets it first. It is the perceived qualities of experiencing the other that can disprove or strengthen children's trust. Children's relational and human-centric skills offer unique resources for the development of human-centric AI and also society. Their intuitive encounter also applies to their interactions with AI systems and therefore this conceptual framing is instrumental to observe and assess how children

"analysed", "evaluated" and provided *"design-related"* imaginaries by answering survey questions that this report relied upon.

2.3.3. Meaningful child participation and participatory AI design with children

While acknowledging children's diverse realities and intuitiveness the report applies meaningful child participation. The stages represented by the flower of participation are brought in parallel with the child participatory design scheme of Druin (please see Figure 3 and Figure 4). Participatory design is a user-centric design method to take the views of users more into account in design, children's daily experiences and imaginary scenarios about AI systems were gathered. The objective behind bringing these methodological schemes together when conceptualising the surveys has not been to demonstrate how to achieve the highest level of agency with children regarding AI systems and related normative framework design. The objective has been to innovate by demonstrating how these schemes are brought in parallel and can be purposed to facilitate children's sharing of their intuitive, ethically, and socially relevant sense-making regarding their interactions with AI systems. The research assumed that gathering and thematizing children's intuitive meanings can inform normative frameworks (AI ethics, policy, children's rights, and design) as forms of citizen ethics with children. By positioning children as young researchers, informants, and experts in observing and reflecting upon the quality of their interactions with AI systems in their closest living environments (Bronfenbrenner, 1995) their performance of storytelling becomes part of the transdisciplinary understanding of AI systems in the world. To structure, thematize and draw conclusions from the data inductive research methods were applied (Gilgun, 2001).

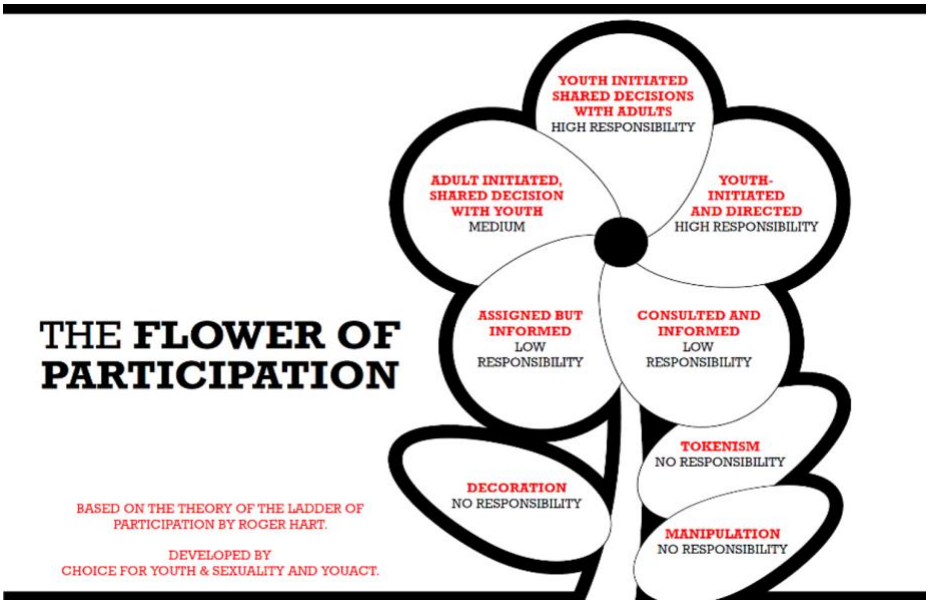

Figure 3: The The Flower of participation (CHOICE for Youth & Sexuality & You Act)

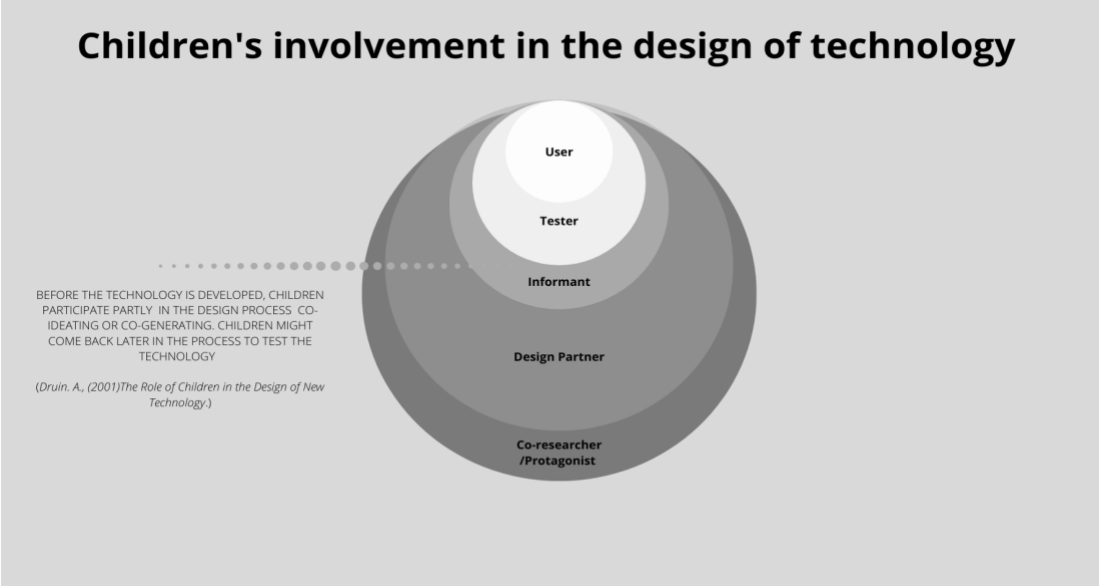

Figure 4: Original image to be found in Druin, A. (2001) The role of children in the Design of New Technology, Behaviour, and Information Technology

By aggregating and analyzing children's answers and sharing this report with Dutch authorities, we aim to achieve that children reach the meaningful participation stage of "adult-initiated shared decision-making with youth" as indicated in the flower. From participatory AI design perspectives, the report intends to reach the stage of "informants" to AI system design frameworks. Without ethics-washing AI systems, the report sets out to showcase how broad intergenerational dialogue in society about AI can inform science, policy and society through co-exploring the question: what do children want from AI?

The theoretical, and methodological methods and the provided definitions for AI, children and meaningful participation, and participatory design offered a fruitful model to conduct empirical survey design, implementation, and data analysis to enable children to participate and capture their intuitive sense-making while living with AI systems.

3. Surveying and Data analysis

3.1. Survey design and validation

The surveys were designed both for offline and online usage for primary school, high school children, and parents in March and April 2022. The survey questionshave been assessed and approved by the Ethics Commission of the Faculty of Electrical Engineering and Mathematics and Computer Sciences (EEMCS) of the University of Twente. A researcher at the Science Hub University of Twente Pre-U tested the questionnaires with a primary school class before the surveying took place. The lessons learnt from this testing have been integrated into the offline and online surveys

which have later been integrated into the project website: kidsrightsonderzoekt.nl. The latter has been developed by KidsRights.

To tap into children's views, throughout July and November 2022 young people in The Netherlands have been interviewed via (online and offline) surveys regarding their awareness of artificially intelligent systems in their closest living environments: home, school, and city. In line with the requirements of the European General Data Protection Regulation (GDPR) (EC, 2016), all child respondents participated with the consent provided on their behalf by their parents or guardians prior to their participation. In this report, we analysed 374 survey answers from children.

In terms of age range, we aimed with our surveys to reach both primary schoolers and high schoolers, but the most frequent willingness came from primary schools and the visitors of the NEMO Museum in Amsterdam to participate. We only received a non-representative amount of 4 surveys filled in by parents.

All children (and parents and pedagogues) were introduced to a narrowed-down working definition of artificial intelligence before they filled in their surveys. This definition included three components highlighting the machine-learning aspects of AI systems. A computer system was said to be intelligent if the following three criteria are applied: *1) connected to the Internet; 2) can learn by itself and 3) can provide recommendations.* Furthermore, children could also see the picture on the project website which is depicted in Figure 5 here below. This contained non-smart and smart devices:

Figure 5: Photo created based on <https://commons.wikimedia.org/w/index.php?>

The smart devices in the picture contained AI systems that corresponded to the three criteria. The design of the surveys was informed by the approach of this study and the questions were developed by applying inductive theory (Gilgun, 2001). The 30 questions were directed to elicit children's views on AI systems by positioning them as expert researchers of their interactions (and of their closest living environments) with AI systems. The first three questions were demographic. As of the fourth, a set of questions were aimed at enabling children first to *analyse,* second *to evaluate,* and third *to express their design imaginaries regarding their interactive experiences with AI*.[4] The overall analysis in this report was limited because not all children answered all questions in the surveys and a considerable amount of the paper-based, handwritten answers, especially after scanning, were not readable.

3.2. Sampling and recruitment of respondents

Primary schools, a museum, and a library were contacted in different parts of the Netherlands (for more on these, please see the acknowledgments). The online availability of surveys and the dynamics of a museum as being a melting pot of visitors with diverse socio-economic and geographical backgrounds yet with common interests offered further modes to diversify the cohort of survey respondents. Each school institution assisted in sharing information with the parents or guardians at least one week before the surveying took place. The parents were asked to provide their informed consent on behalf of their children so that their children could participate in the research. In the NEMO Museum child respondents were accompanied by their parents or guardians who provided their consent before filling in the surveys.

The recruitment started through the dissemination channels of KidsRights and such members of the AI4Youth ELSALab consortium as the Science Hub of the University of Twente, the Science Hub of the University of Leiden, and the Science Hub of the Technical University of Delft. Another AI4Youth partner: Netwerk Mediawijsheid offered valuable help to publish a blog post in Dutch and disseminate the surveys to the broader public in The Netherlands (La Fors, 2022a). Furthermore, the art platform of Tetem shared the surveys and offered to integrate the surveying of children in four of their lectures with the help of their teachers. The report also benefited from the insights gained from the roundtable discussion on *AI and children* as part of the kick-off of the Dutch AI Parade by the library network Rijnbrink and the NL AI Coalition in September 2022 (DesignLab, 2022). The roundtable discussion benefitted from the insights of such quadruple helix

[4] AI bewustzijn van kinderen in Nederland project website: www.kidsrightsonderzoekt.nl For further information beyond the project website (in Dutch), please consult the individual survey questions, see the Annex 1 of this document.

stakeholders as AI developers, NGOs, librarians, academics, and (with the consent of their parents) children.

3.3. Vehicle for broader recruitment: co-creative lecture

The recruitment of children has also been assisted by the development of a co-creative lecture for children[5]. The title of the lecture was: "Can a robot be your friend?" which has also been the last question in the survey. The conceptual motivation behind developing such a co-creative lecture had been to explore with children their co-existence with AI systems. The goal is to explore and co-reflect upon the meaning of friendship as a positive quality in social relationships that is easily accessible and meaningful for them to talk about, rendering it easier for children to relate to the more abstract value of trust and inform the discourse of trustworthy AI. The co-creative lecture started with the surveys and the lecture itself formed a productive way to engage children as informants in public dialogue about AI.

The development and testing of the lecture have been supported by the Science Hub of the University of Twente (Pre-U). The co-creative lecture has been designed in such a way that the surveys with primary school children (age group 6-12 years) were integrated into the lecture and children could answer the questions. The room has been offered for children to raise questions concerning the survey. Each lecture ended with a maker activity around children's preferred or nonpreferred robot ideas. The goal of the maker activity was to stimulate creative, expressive skills and allow children to express themselves by creating an ideal AI. This has also been in line with the good AI-related questions in the survey.

Other members of the AI4Youth consortium, such as Tetem, the Science Hub of the University of Delft, the Science Hub of the University of Leiden, and the library network Rijnbrink assisted in disseminating the surveys in their network. Tetem also offered highly valuable help by offering their teachers to conduct the surveys in 4 schools in their network.

Apart from these networks, the direct help of primary school teachers, directors, and, pupils of the following schools: Nutsbasisschool Teteringen, Nutsbasisschool Boeimeer (Breda), Nutsbasisschool Oldenzaal, Anna van Buren Basisschool (Enschede), De Bron Basisschool (Hengelo), Kadoes Basisschool (Albergen), De Triangel (Nijverdal), SKOE (Enschede), SALTOSchool de Hobbitstee (Eindhoven), Leonardo Basisschool (Dordrecht), De Colignyschool (Katwijk), Fakelschool (Katwijk) has been essential to

[5] "Kan een robot je vriendje worden?" - this lecture is available upon request from the author of this report.

bring in the survey responses. The participating primary schools offered room for the interactive lesson given in Dutch with the title: "Can a robot be your friend?". This co-creative lecture enabled children to take the surveys online or offline in class.

3.4. Coding the data

The answers of the 374 children were clustered according to the 30 survey questions through codes (for the questions, please see Appendix 1). These codes were derived according to a question, a cluster of answers on each question indicated in a column. From the meaning of one answer of a child, similar answers were assigned to the same code. The correlation between an answer to a question of a child and a code was based on the meaning of the diverse answers, children provided. To derive codes and cluster answers according to them this report applied inductive research methods (Gilgun, 2001). The derived codes and value patterns per question assisted in concluding. According to this theory, the gathered data was used to inform "adult-initiated, child-informed" perspectives and was structured to inform AI ethics, children's rights, and AI design frameworks. The inductive research method also assisted in deriving from the codes - in an iterative manner – synthesised values that could be interpreted as *children's value demands* in a society with AI. These valueswere indicative of children's perceptions of AI systems, and we cross-referenced how these would inform AI ethics, AI-relevant children's rights, and design frameworks when children interact with AI systems. Limitations to code included unreadable or absent answers in parts of the survey and certain answers were not elaborate enough for qualitative interpretation.

4. Children's awareness, ethical and social sense-making, and design imaginariesof AI systems

This section specifies the study results based on children's answers regarding AI. The survey was divided into demographic, qualitative, and quantitative survey questions.The qualitative and quantitative questions positioned children to become researchers asthey were perceived as being experts in their interactions in their lives. Therefore, children were enabled to '*analyse, evaluate and design' their interactions with AI systems and society.* For more on the concrete questions, please see Appendix 1.

They were asked to share their reflections and they shared their actual and imaginary acts of doing when interacting with AI systems. Children shared their experiences and were able to qualify them according to how those made them feel. Children were asked to think of six scenarios with social robots, what they perceived as good and bad experiences with AI systems, and what they would have as AI imaginaries for the future.

4.1. Demographic distribution of respondents

The total number of participating children in the Netherlands from which we analysed answers in this report was: 374.

Those children who answered from which schools they were from, pointed to the geographical area where children's answers stemmed from[6]. Five notes here to share when interpreting the map where these locations are indicated: 1) One location depicted on the map was one corresponding to a school name mentioned at least by one respondent child; 2) If a school name was not unique but more schools existed with the same name in multiple cities we omitted those. Only city names are depicted on the uniquely identifiable map based on the school names. 3) All those cities where offline surveying of children took place in schools and the NEMO Museum in Amsterdam are part of the indicated cities on the map. 4) The indicated locations on the map are irrespective of the number of children from one city or village filled in the surveys. 5) Children provided answers at least from the depicted locations on the map, but more places are possible. This is, because not all respondent children indicated their schools, or the school they indicated was not uniquely linkable to one city or village therefore the school's location was not mentioned on the map.

[6] Please see survey question 3 in Annex 1.

Figure 6: Map of The Netherlands with locations where child respondents came from. This map was created by Francesca Caputo Sankowich (KidsRights)

The majority of the participating children out of the cohort of 374 children came from the age group of 6-13 years (please see this more depicted in Figure 7). The number of these children was 323. The choice to focus rather on this group is based on the

the assumption that younger children possessed more intuitive interactions with AI systems. Most responsive were primary schools to participate in surveying children. Only a small group that was older than 12 years of age filled in the survey. Taking thelens of this younger cohort of the population and assessing their interactions with AI systems and society enriched the approach of this report.

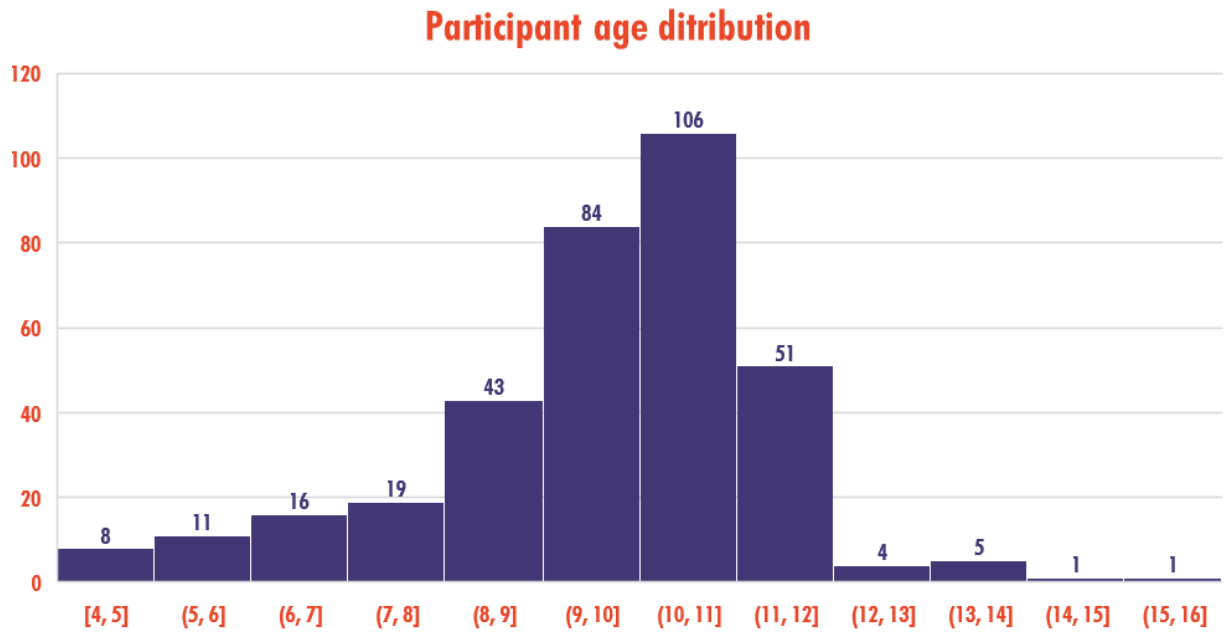

Figure 7: The majority of child respondents came from the age group 6-13 years

4.2. Children's knowledge of AI systems

- 70,6% of respondent children answered "No" to the question, of whether they had heard of AI systems before the survey. For those remaining children, who answered "Yes." the primary sources of information were the following channels: television (programmes, such as Jeugdjournaal, Media Masters, Klokhuis), schoolmates, family members, or friends.
- The survey results indicated that although children knew of AI systems, all participating children have been interacting with a large variety of AI systems daily.
- While bearing in mind the limited AI definition, all children (including those who had not heard of AI) were able to list a broad variety of systems that corresponded to the three criteria of AI systems from their closest living environment in the survey.

- Children's answers show that their awareness of AI systems is a) largely associated with brands and b) associated with the digital devices in which children would locate AI systems when using them.
- The most frequently mentioned brands[7] children could think of corresponding to the three introduced criteria for AI in their living environment were the following:

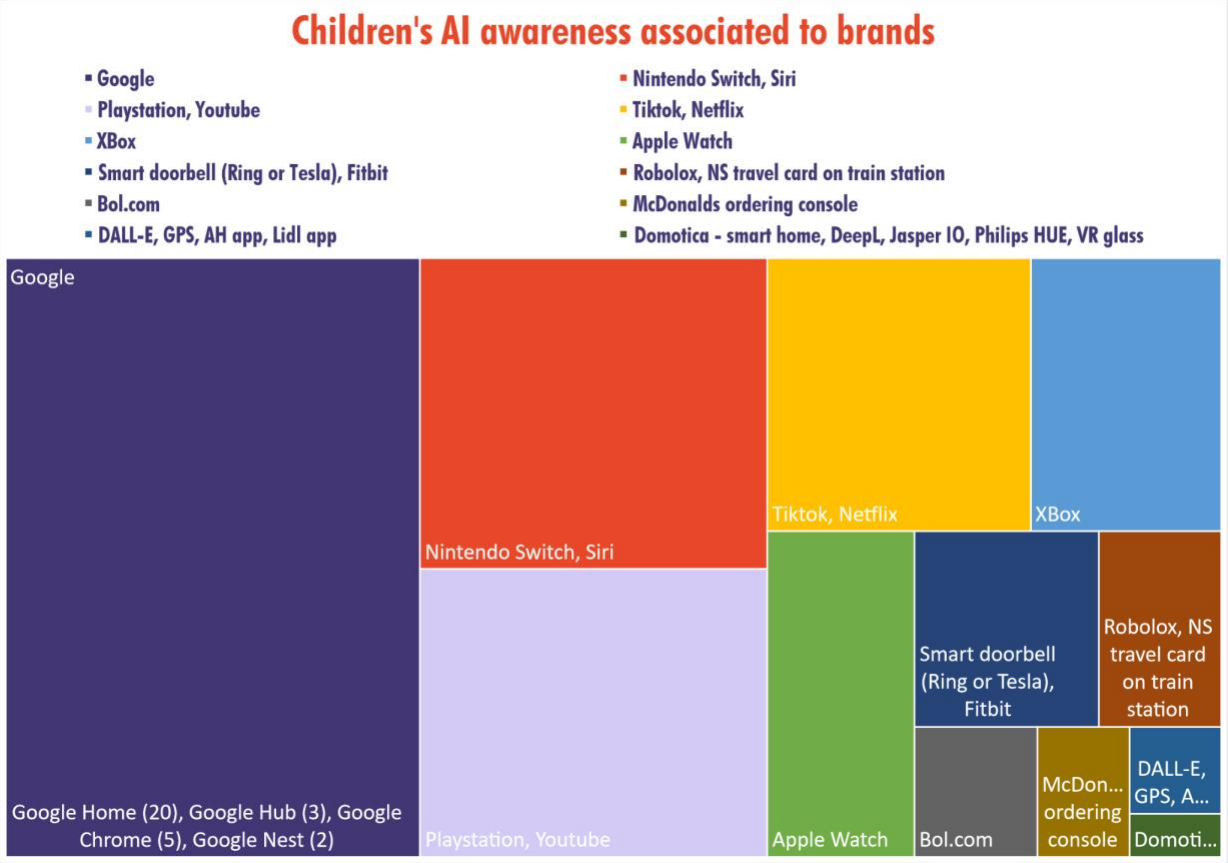

Figure 8: Children's AI awareness associated with brands (image generated from Excel based on the collected empirical data)

Children often also listed smart devices, such as computers, Chromebook, Macbook, iPad, iPod, laptop, smart tv, thermostat, smart phone, smart doorbell, robot vacuum cleaners, etc. These were pieces of hardware. In this report, we interpret these devices which children listed as locations and enablers of smart applications. In this report, it is important to acknowledge that children were not making the distinction between AI and the devices containing AI systems themselves. Given the surveys were taken between July and the end of October 2022, and the large language model-based DALL-E just

[7] In brackets are the number of times these systems have been mentioned by children.

appeared as a novel innovation towards the end of this period, it is remarkable that some young children have already recognized these AI systems.

- An observation from the data is that children were quite self-aware of their usage of smart devices on a spectrum from being ashamed and self-critical of using them to wanting more time for interacting with them:
    - a) some children indicated they felt they are using these systems too long;

> *"I think I would want to use them [my laptop, iPad and telephone] less, because I am using them everyday." (*9 year old primary school girl)

    - b) some children also felt content with the amount of time they usedthese devices;

> *"I find it fine as it is (using these devices everyday)."* (9 year old primary school boy)

    - c) others were unsatisfied with their usage and wanted more time to use such systems.

> *"I would use these [iPad, computers and telephone] more often, but I am not allowed to do so by my father and mother." (*10 year old primary school boy)

A global observation based on children's answers as to the frequency of their AI usage is that children and parents discuss to different degrees about AI systems. Screen time, in general, appears to be a topic that has been spoken about among children and parents. AI systems have not appeared to be a widely bespoken topic at the kitchen table between children and parents. This can in part be caused by the differing awareness of parents' regarding AI systems and the difficulty in decoupling AI from the broader digital settings. If the frequency of using digital systems has not been a bespoken topic, then chances are low that AI systems were discussed in family settings. The vital importance of parent-child discussion about the impacts of conversational AI systems (Caron, 2023), for instance, has already been highlighted.

4.3. Children's thought experiments on six (embodied) AI scenarios

Our child informants were engaged by doing thought experiments about ***five context-specific and one context-overarching AI scenarios.*** In each scenario, they would think through interacting with (an embodied AI), a robot, instead of with a human[8]in a societal role. The scenario-specific exercises were meant to stimulate children's evaluative, experimental, and critical thinking skills.

The first five scenarios were related to ***a robot as a seller, a robot as a police agent, a robot as a GP, a robot as a nanny, and a driverless car.*** The questions corresponding to these scenarios are 13-22[9]. For the ***sixth context-overarching scenario,*** we asked children to imagine whether they consider it feasible that **a robot could become a friend** and why. Question 30 of the survey corresponded to this latter scenario.[10] All these scenarios were chosen, based on the assumption that children have had interactive experiences with humans at least in some of these societal roles in their closest home, school, or city living environments.

Each scenario corresponds to two questions. One question investigates whether a child would like or not to interact with robots in a given scenario. The second question is aimed at learning children's reasoning for their choices. By positioning children to think of the six scenarios we also asked them to think of context-specific social roles and how human-to-robot changes in those contexts would influence them. From their answers, it was possible to elicit what values, according to them, could come under pressure through changes (from human torobot) in their interactions. When asking them of robots as possible friends we also accounted for the context-overarching character of friendship as a specific quality that also defines the social role of a friend in one's life.

The reasonings out of the 374 children were clustered according to codes. A code was derived by interpreting the meaning of each answer. Not each answer was a code assigned, because not each child provided reasons for why a robot scenario is desirable or not. Those answers which contained brief, uninterpretable or no reasons remained unaccounted for. The codes were gained by applying inductive theory to the answers and included favourable and unfavourable reasons children had for robots per scenario.

[8] Please also see the section on the definition of AI.

[9] Please see Appendix 1.

[10] Please see Appendix 1.

Child-robot interaction literature highlights that doing research with children instead of adults about their interactions with robots is more complex because children anthropomorphize robots through "pretend play" (Valles-peris et al. 2018). The questions in the survey directed to trigger children's human-robot imaginaries did not intend to provide an in-depth description of specific robots for children and the contextual impacts of such robots. The intention was meant only to invite children to imagine and experiment with their thoughts on robots as artificial agents that fulfill societal tasks and imagine them in roles that were so far inhabited by humans. As to the robot seller, police agent, GP, and nanny, the respondents have not received any further explanation, or example robot about what type of specific embodied agents they would or could need to think of. This seemed important because child-robot interaction scholars highlighted that the acceptance of a robot determines children's interaction with them (de Jongh et. al. 2019).

As to the driverless car, the surveys contained a 1 min. Video (Drive.AI, 2018) depicting an example of a driverless car that already operates. Except for the driverless car scenario, the answers related to the five other scenarios and contexts were fully based on children's imaginaries of robots. Their shared sentiments and imaginaries about their acceptance or rejection of a robot within a certain context were fully based on their imaginations, meanings of, and attributed characteristics to robots.

Scenario 1: Robot Seller

When asked to reflect upon whether children would want to be assisted by robot sellers in shops: 55,3% of children wanted to be assisted by robot sellers and 41,0% did not.

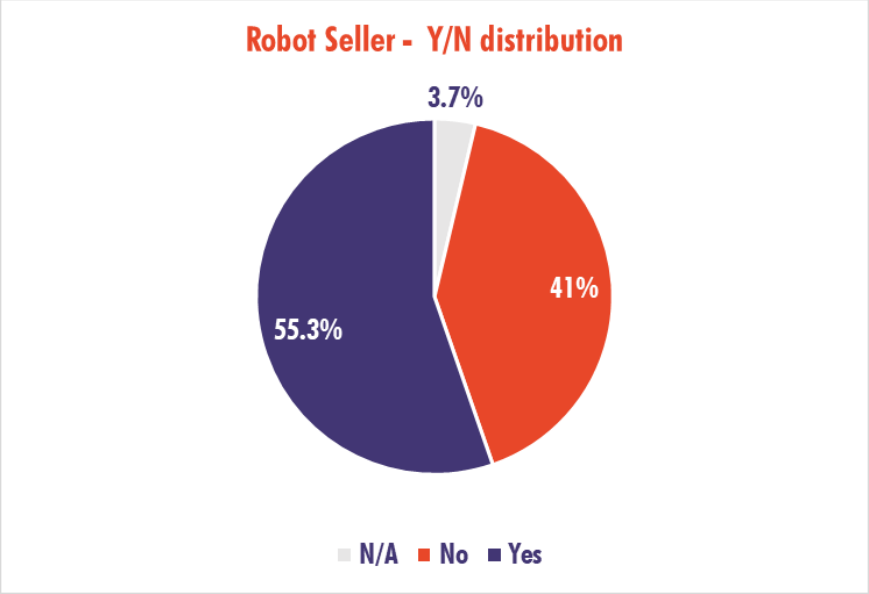

Figure 9: 'Yes' and 'No' distribution of child respondents on whether they would or would not imagine robots as sellers.

Children provided both favourable and unfavourable reasons why they would or would not want to be assisted by a robot seller. These reasons are coded accordingly. Only the answers that show the first 10 largest number of reasons per code are depicted in Figure 10.

The codes that relate to the *favourable reasons* of children include answers in which the largest number of respondents who were in favour of such robots found these cool (code: *cool).* A smaller number found them useful to carry out certain tasks (code: *service robot)* and found robots better at carrying out certain tasks than humans *(code: outperforming humans).* A girl shared the following about the latter:

"...because things go faster than if a robot sells instead of a person, but only if such social robots are more developed, because such robots are currently in beta testing." (10 years old, girl, primary school in Ede) ***(outperforming human)***

Five children perceived robots as more efficient and faster than humans *(code: efficiency and speed).* Four children found that robots needed to be tested first before implementation *(code: testing to see the impact).* Two children shared that they would want to keep a human in the loop only then would they want a robot seller (code: *human-in-the-loop).*

The codes that relate to *non-favourable reasons* children for robots include answers from children in which they found robots not having human qualities (*code: non-human).* Two girls shared the following on this:

> *"No, because almost every seller could lose their job and you cannot really chat nicely with a robot and real people are really much nicer." (7 years old, girl, primary school)*
>
> *"No, because an AI takes away the human in the shop." (8 years old, girl, primary school)* ***(non human)***

Four children found that robot sellers would cause a threat to autonomy *(code: autonomy threat).* Three children also shared their concern that robot sellers would cause human employment problems (code: *employment problem*). Two children perceived that a robot seller would run the risk of an error (code: *robot prone to error*). Figure 10 depicts a ranking of the first 10 largest numbers of reasons corresponding toa code (starting from the left with the highest number).

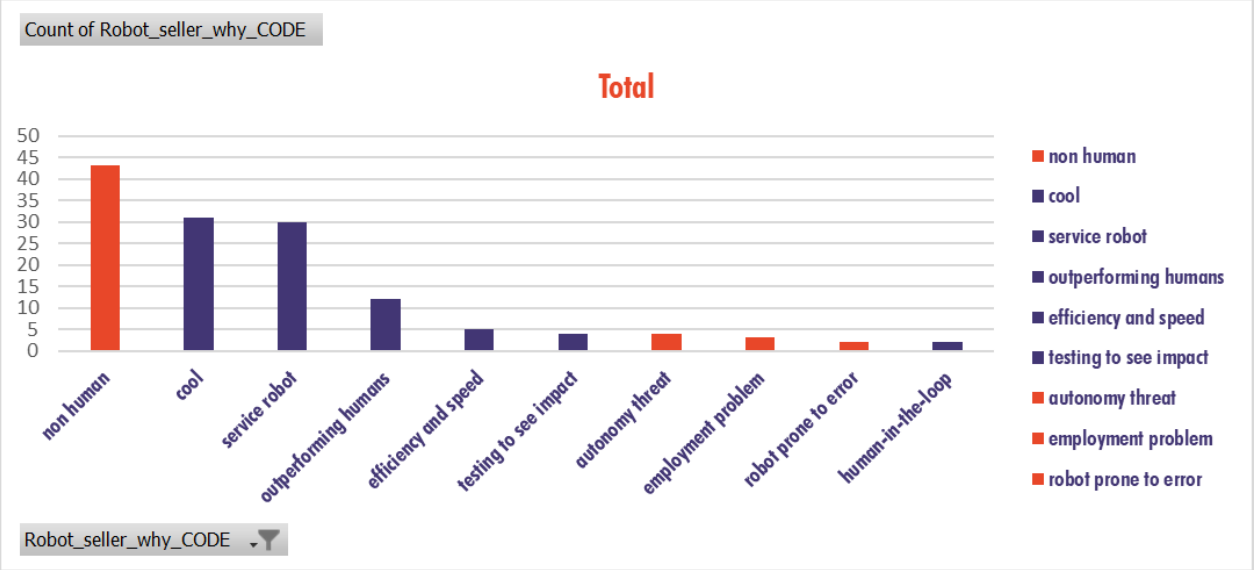

Figure 10: *Reasoning typology of child respondents on why they would or would not imagine robots as sellers.*

Scenario 2: Robot Police agent

54,8% of children did not want and 41,5 % wanted to be assisted by robot police agents.

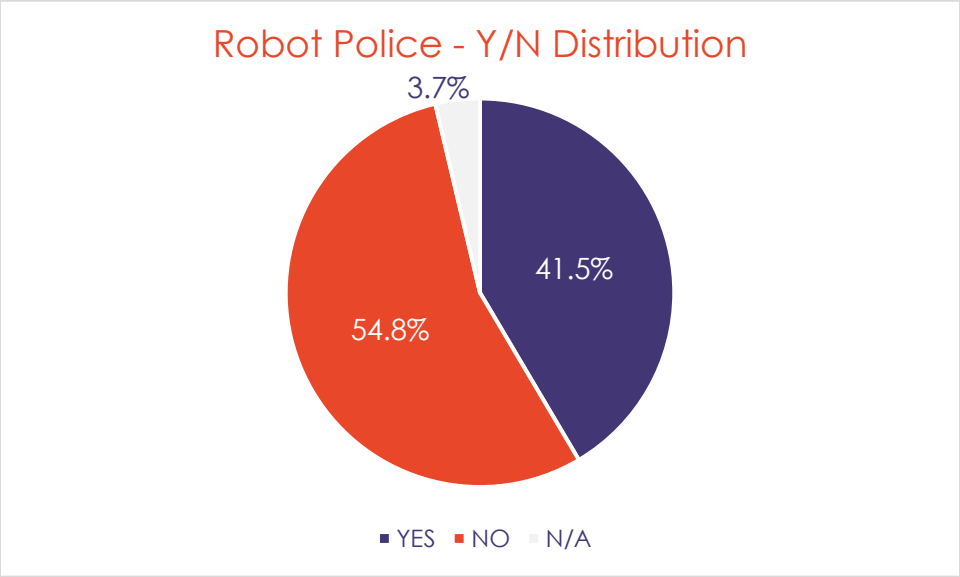

Figure 11: "Yes." and "No." distribution of child respondents about whether they would want or not a robot as a police agent.

Children also shared their favourable and unfavourable reasons for whether they would want to be assisted by a robot police agent. These reasons are coded accordingly and depicted in colours that correspond to the "yes" and "no" answers in the chart of the figure above. Only the answers that show the first 10-11 largest number of reasons per code are depicted in Figure 12.

The codes that relate to *favourable* reasons refer to an aggregated number of answers in which, for instance, some children found robot police agents as more efficient and faster than humans *(code: efficiency and speed),* another group found robot police agents cool (code: *cool),* another group found robot police agents better at carrying out certain tasks than humans *(code: outperforming humans),* other children found police agents useful to carry out certain tasks (code: *service robot).*

The codes that relate to *unfavourable* reasons for robots included answers from children inwhich they found robots not having human qualities (*code: non-human).* A group of children also shared their concern that robot police agents could cause a public safety threat (*code: safety threat*). For instance, a girl shared about this the following:

"No, then it all goes wrong and they can't run that fast. Suppose someone has got shot and the robot says: "'Can I help you with something' and 'please, keep calm'." (12year old, primary school girl) ***(safety threat)***

Seven children found that robot police agents would cause a threat to autonomy *(code: autonomy threat), and* four children perceived a robot police agent would run the risk of an error (code: *prone to error*). Two children were also worried that robot police agents would cause human employment problems (code: *employment problem*) and two children found robot police agents just not cool (code: *not cool*). One girl also highlighted that such a robot police agent would need a human in the loop as follows:

"It's quite special, so you probably attract a lot of people, so yes, but there has to be a person standing next to it because robots sometimes make mistakes." (11 year old, primary school girl) (***human in the loop***)

Figure 12 shows a ranking of the first 10 largest number of reasons corresponding to a code.

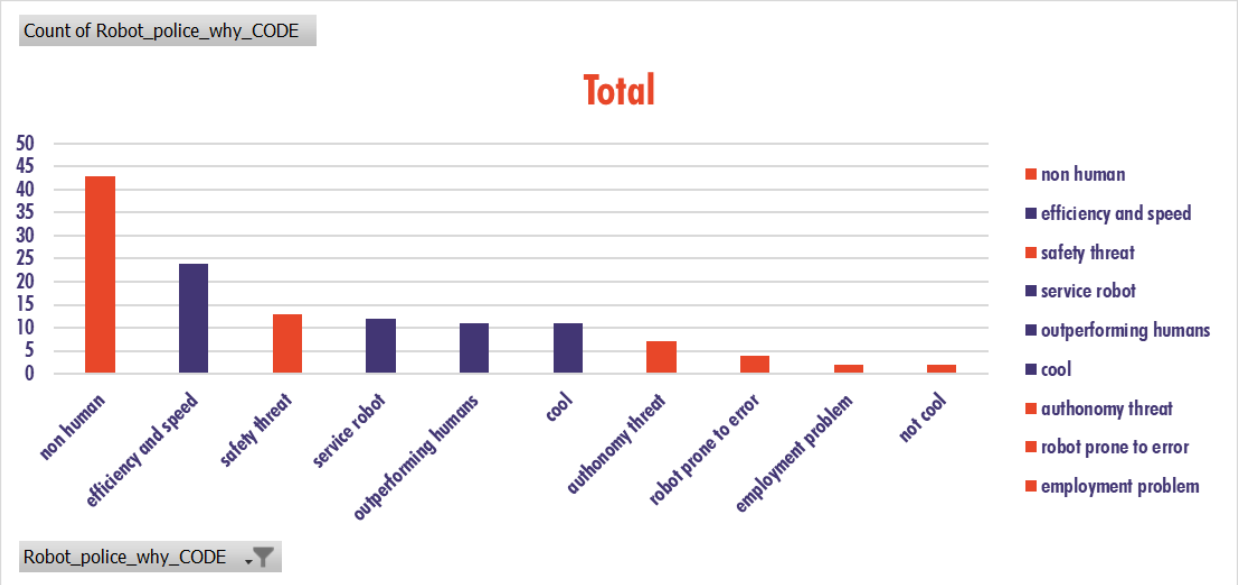

Figure 12: Reasoning typology of child respondents on why they would want a robot as a police agent or not.

Scenario 3: Robot GP

Whether children would or would not want to be assisted by a robot general practitioner, if they were sick, 61,3 % of children did not want a robot GP and 35,3% were positive about the idea.

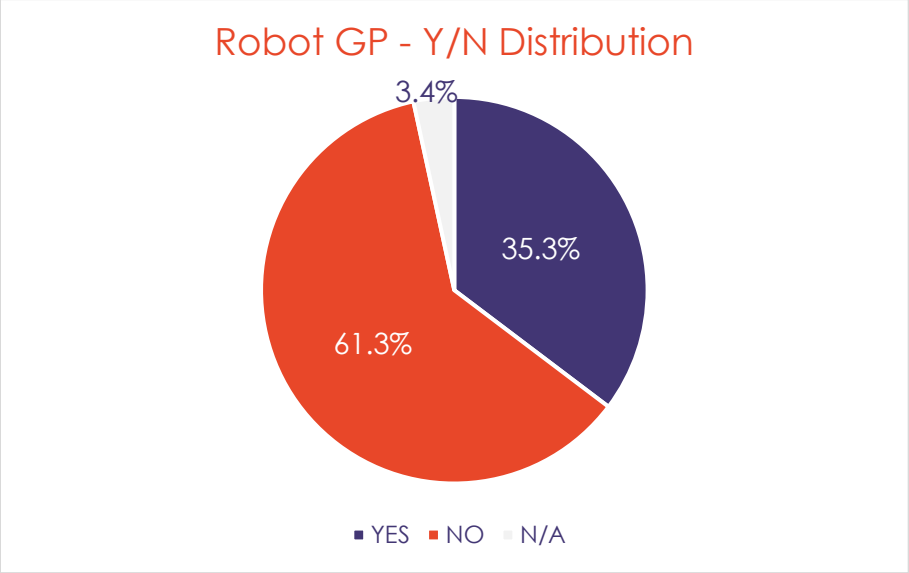

Figure 13: "Yes" and "No" answer distribution of child respondents on whether they would or would not want to imagine robots as a GP.

Children shared both favourable and unfavourable reasons for wanting or not to be exposed to a robot GP and their answers were coded accordingly. Only the answers that show the first 10 largest number of reasons per code are shown in the figure below.

The codes that relate to the *favourable* reasons of children included answers in which they found robot GPs useful to carry out certain tasks (code: *service robot).* Another group of children who found the idea of the robot as GP a good one also praised the potentiality of a robot GP as something that could outperform humans *(code: outperforming humans).* Other children perceived robots as more efficient and faster than humans *(code: efficiency and speed), and* other children found robots cool *(code: cool).*

Out of the codes indicating *unfavourable* reasons for children regarding robot GPs, the largest number of children were concerned with robot GPs not having human qualities (*code: non-human).* An 11-year-old schoolboy shared the following on this:

> *"No, because, I would feel myself safer with a normal human being as a GP."* (11 year

old boy, primary school) ***(non human)***

A smaller group of concerned respondents found the idea of a robot GP to be a safety threat *(code: safety threat).* An 8-year-old schoolboy shared the following on this:

"A robot GP could transmit electricity when it touches me and a human doctor does not do that." (8 year old, boy, primary school, Tilburg) ***(safety threat)***

Six children found that a robot GP would run the risk of not being trustworthy (code: *untrustworthy*). Four children found that robot GPs would cause a threat to autonomy *(code: autonomy threat)* and three thought robot GPs would run the risk of an error (code: *robot prone to error*). Two children found that robots need to be tested first before implementation *(code: testing to see the impact).* Figure 14 depicts a ranking of the number of reasons children provided and which are clustered by codes. The colour of the codes corresponds to the colours of the "yes" and "no" answers.

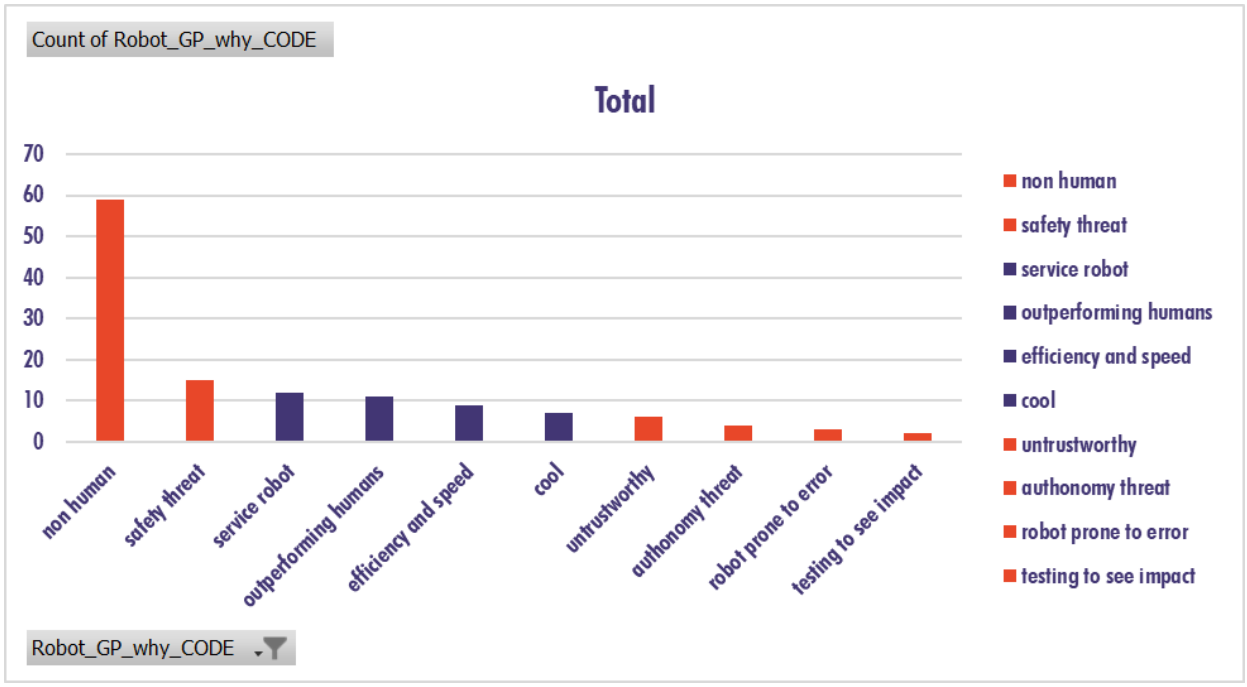

Figure 14: *Reasoning typology of child respondents on why they would or would not want to imagine robots as a GP.*

Scenario 4: Robot Nanny

In the case of the robot nanny scenario, 59,0 % of children did not want and 37% wanted to be assisted by a robot nanny while being home alone.

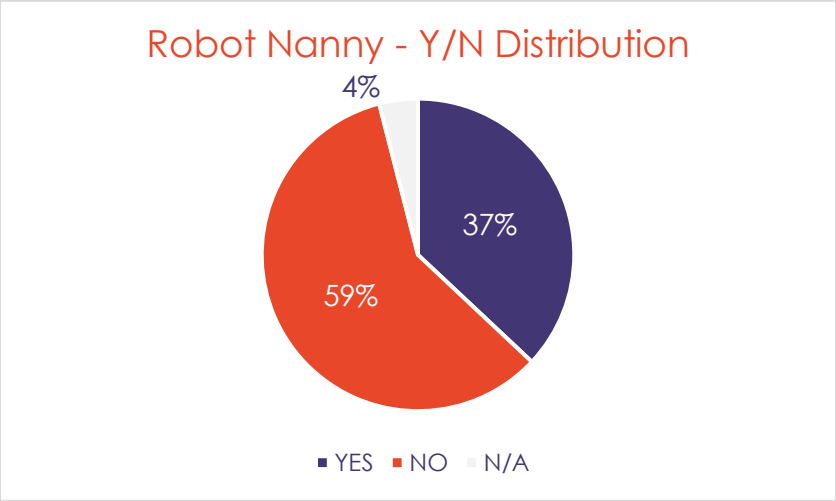

Figure 15: "Yes" and "No" answer distribution of child respondents on whether they would or would not imagine robots as a nanny.

Children shared both favourable and unfavourable reasons for whether they would or not want to be assisted by a robot nanny. Their answers were coded accordingly. Only the first 10 largest number of reasons per code are depicted.

The codes that relate to the *favourable* reasons of children included answers in which they found robot nannies useful to carry out certain tasks (code: *service robot),* other children found robot nannies cool (code: *cool)*, other children perceived robots as more efficient and faster than humans *(code: efficiency and speed),* another group of children perceived robot nannies as less strict than humans (*less strict than human*). A young boy shared on this latter the following:

"Yes, it would be super fun! If it was poorly programmed, it could say yes to everything like going to McDonald's." (8 year old boy, primary school) (***less strict than human***)

Another group of children who found the idea of the robot as a nanny smart also praised the potentiality of a robot nanny as something that could outperform humans *(code: outperforming humans),* other children considered robot nannies that they would have more control over robots than over their human nannies *(more control over a robot).*

Out of the codes that relate to *unfavourable* reasons for robots the largest number of children indicated their reasons when opposing the idea of a robot nanny as robot nannies not having human qualities (*code: non-human).* 13 children found that robot nannies would cause a threat to their autonomy *(code: autonomy threat).* 12 children found that a robot nanny would be a safety threat *(code: safety threat).* A boy in this group shared, for instance, on this the following:

"No, because the robot then replaces all those people who want a part-time job, for example, and a robot can also catch fire." (11 year old female, primary school Soest) (***safety threat***)

Three children found that robot nannies would be stricter than humans *(stricter than humans).* Three other children were also critical of robot nannies being prone to error *(robot prone to error).* Figure 15 depicts a ranking of clustered reasons children provided and which are indicated by codes. The colour of codes about children's reasoning corresponds to the colour of the "yes" and "no" answers.

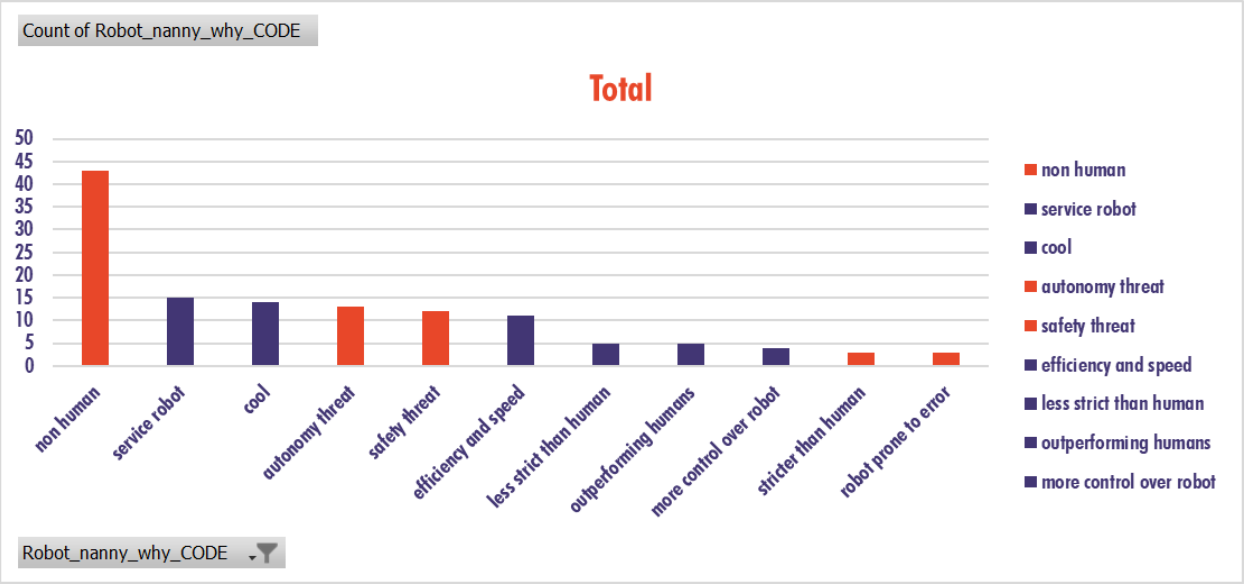

Figure 16: Reasoning typology of child respondents on why they would or would not want to imagine robots as a nanny.

Scenario 5: Self-driving car

144 of the respondent children found that self-driving cars would give them a positive experience and they would find it *cool* if such cars would pick them up and take them to sports lessons. 56 children raised their concerns in terms of self-driving cars being *non-human*. A girl shared her concerns relating to the latter as follows:

> *"I wouldn't like it if I was driven by a self-driving car because they can't talk nicely and don't know how you feel before a competition. Your mother, for example, does know because that's your mother..."* (11 year old girl, primary school, Soest) (***non-human***)

42 raised their concerns that such cars would raise a *safety threat.* A girl raised her concern as follows:

> *"That scares me because it doesn't always go well with such cars. And I don't like it either. It is not nice either that the robots could then take over everything."* (10 year old girl, primary school) ***(safety threat)***

12 children saw the advantage in such cars by reasoning that these would be good *service* robots and 111 children considered such cars to be beneficial because these would be *efficient* and *fast*. A boy praised robots in line with this latter as follows:

"It is handy because a driver would not fall asleep when driving a long distance." 12 year old boy, primary school Bemmel (***efficiency and speed)***

5 children consider that a self-driving car would be *prone to error*. 4 children also listed reasons for self-driving cars not being *cool*, and 3 children considered self-driving cars as causing an *autonomy threat* and would *outperform humans*. The colour codes indicate a typology of children's reasons.

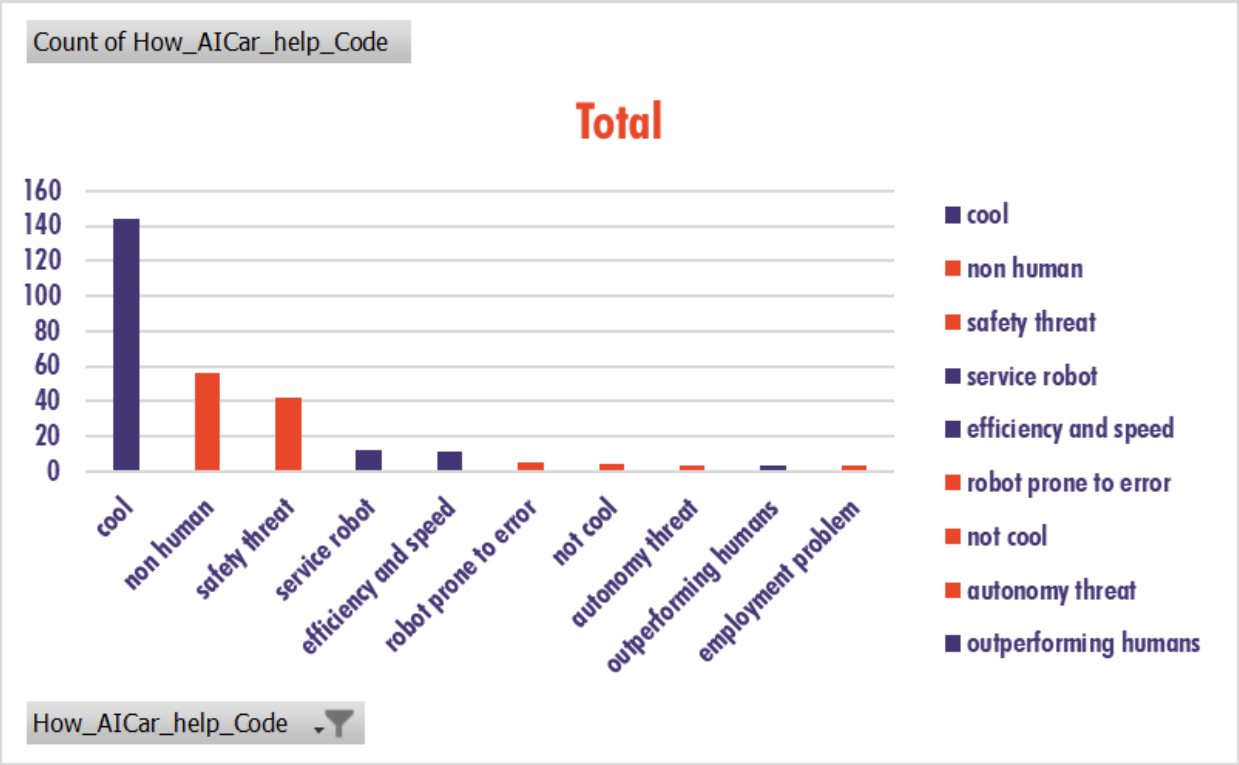

Figure 17: Reasoning typology of child respondents on what they would find about being taken to a sports lesson by a Self-driving Car.

Scenario 6: Robot as a friend

Whether children could or not imagine having a robot as a friend, children shared diverse reasons for[11]. A ranking of these reasons from the largest number of the same reasons

[11] Please see question 30 in Annex 1.

to the lowest number are indicated in Figure 17 below. 53 children listed their concerns that robots would have less *emotional capacities.* A girl shared on this, for instance, her hesitations regarding the latter:

> *"No and yes, you could be having a good time but you wouldn't really feel the other person's emotions and probably the robot isn't at your school either."* (9 years old, girl, primary school) (***emotional capacities****)*

47 children considered that their interactions with robots would be *non-human*.

> *"No, I would rather befriend real living persons, there are plenty of them on this planet."* (11 year old, primary school) (***non human***)

Out of those children who considered robots as possible friends, a significantly smaller number: 11 children emphasised the qualities of being able to *game* with such robots. 6 children thought robots would be good in offering *services* for them. 4 children considered some sort of *playful AI* as an option for a friend. Regarding this latter, a 12-year-old shared the followings:

> "If robots could get humour and feelings then it could be possible." (12 years old, boy, basisschool Amersfoort) (***playful AI***)

3 children could imagine a robot friend as a form of a companion AI, and another 3 an AI that can live up to human skills.

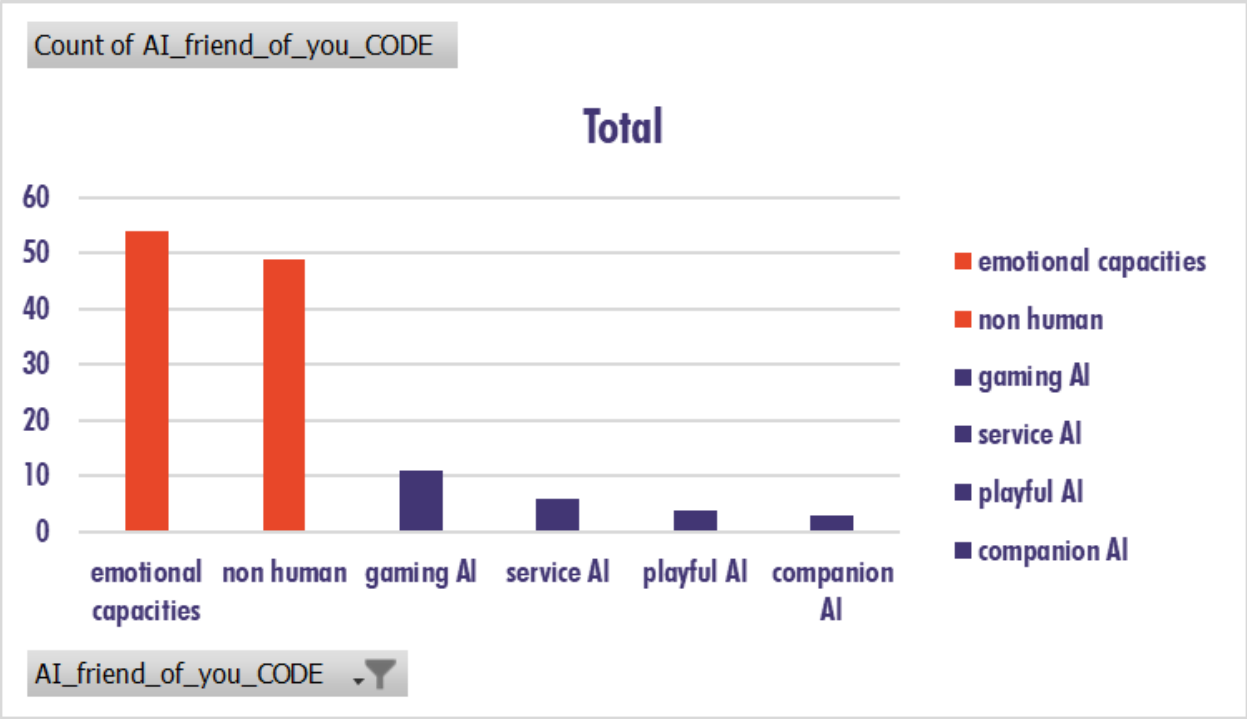

Figure 18: Reasoning typology of child respondents on why they would or would not want to imagine having a robot friend.

Based on the thought-experiments with children through six robot scenarios can be concluded that children were more relaxed of the idea of a robot seller than of a robot police agent, robot nanny and robot doctor. The answers and sentiments of children have shown that during their interactions with human police agents, doctors and nannies' children would have allowed these persons into their most intime spheres. In those spheres children needed to depend on humans with their lives in these diverse social roles. Depending on robots with their lives was not perceived safe and comfortable by them.

4.4. Children's good AI perceptions

When children were asked to think of which AI system would they find good AI systems and what would these systems do for them[12] children provided a very broad diversity of answers for such systems. These answers ranged on a spectrum starting from *science fiction* through *entertainment* to *socially relevant problem-solving AIs.* This section provides only an illustration of the types of answers by accounting for the indicated range.

A girl shared that she would desire an AI system from her perspective as follows:

"An AI could help with extra schoolwork at school. I have dyslexia and it would be nice if there was extra help for that with today's teacher shortage."

(10 year old, girl, primary school) (***socially relevant problem-solving***)

[12] Please see questions 22 and 24 in Annex 1.

Children also raised their AI system-related optimization wishes: developing *AI systems serving their individual needs or entertainment*. A 14-year-old boy, for instance, shared the following on this latter:

> *"The AI would teach children things through games that would make children learn without factual information because you can look that up and that's how children find it more fun to learn."* (14 year old boy, high school) (***entertainment***)

Some children highlighted their AI system preferences for being in service of people:

> *"A robot that can do annoying chores and that doesn't need anything for it, such as: washing dishes, vacuuming, cleaning. Those kinds of things."*
> (11 year old boy, primary school) *(**service**)*

Other children provided imaginaries that could potentially inspire science fiction:

> *"Artificial chicken that can lay eggs."*
> (11 year old boy, primary school Eindhoven) *(**science-fiction**)*

4.5. Children's bad AI perceptions

When children were asked to think of which AI systems would they find bad AIs they also provided a very broad diversity of answers. An interesting observation from children's data is that the largest number of children shared *badly functioning AI* as bad AI from their perspectives. Out of all child respondents, only 4 were concerned with *privacy violations* or *hacking possibilities.* A bad AI example that could hack was sharedby a girl as follows:

> *"A hacker robot because that can be of criminals."* (10 year old, girl, primary school) (***hacking***)

8 other children were concerned with overall AI *safety.* Two of these latter shared the followings:

"I would find the robot scary, for example, if it would suddenly react strangely and no longer do what it should do." (11 year old child, primary school) ***(safety)***

*"If a robot would rule my life." (*10 year old boy, primary school) (***safety***)

5 other children listed *outdatedness*, *non-efficiency,* or *proneness to error* as problems. The majority of children were concerned with AI functions they would like to keep as skills, such as *drawing, cooking, or cleaning,* or prefer not to see in AI systems. A boyhas raised the following preferences regarding the latter:

"An automatic drawing machine, because I want to draw myself." (10 year old boy, primary school) (***drawing***)

Another boy raised the following on this:

"The websites of games because they are often not secured." (11 year old, boy, primary school) ***(privacy violations)***

Raising awareness of online and cyber security harms is indicated by UNICEF (Dignum et. al, 2021) and also the 5Rights Foundation (5Rights, 2021) as effective aspects of risk mitigation, therefore important to raise with children. This indicates that children would benefit from more education on online harms. At the same time, the dilemma arises of how and what to share regarding this with children. Psychologists underline, notably, that a healthy child bonds and by default trusts others. Given children are relational and trusting revealing to them ai-mediated harms and risks shall be guided by child development experts.

4.6. Children's ideal AI imaginaries for themselves as individual persons

Children provided diverse answers and ethically and socially interesting imaginaries of how ideal AI systems would need to look like and what they would need to do for them

personally[13]. A significant amount of the answers related to how children in personal interaction with AI systems would want AI systems to be *in servitude;* that AI systems would offer *human care* in the interaction and that in an interaction, with AI there would be room for human *exuberance*. A girl shared what an ideal AI system serving her would do:

> *"Chores and helping out at school. The AI helps with writing for dyslexia, is a normal human being but inside a robot."* (11 year old girl, primary school) (**AI in servitude**)

A boy shared that he would prefer *AI systems serve* him and how *human care* would be key to uphold in his interaction with such systems:

> *"I would want these systems to look like people, that they can protect us but that they can also clean the house."* (12 year old boy, primary school Uithuizen) (**human care and AI in servitude**)

A boy shared how *human care* is important to him as follows:

> "I prefer to rely on people (human for me) and not on AI because of the big corporations and their algorithms, see Tiktok, for instance." (8 year old boy, primary school Waalwijk) (**human care**)

As also referred to earlier, an important vehicle for children's growing up is playing and joyful discovery. This can also be described by the value of exuberance. A boy shared how his ideal interactions with AI systems would need to be exuberant while being in his servitude as follows:

> "A large running iPad that does not need WiFi to access the Internet. The iPad would walk with you, is equipped with wireless earbuds and arms so that the robot can pour lemonade for you." (8 year old boy, primary school Leiden) **(exuberance and AI in servitude)**

[13] Please see question 24 in Annex 1.

A girl shared how her ideal interactions with AI systems would need to be exuberant and, in her servitude, as follows:

"A computer that you can easily put under your pillow if you secretly would want to take it upstairs in order to start gaming on it." (11 year old girl, primary school Soest) (**exuberance and AI in servitude**)

Overall, it can be observed that children found exuberance and human care from their perspectives some key principles and qualities to uphold also in their interactions with AI in society.

4.7. Children's AI imaginaries for 2050

Children provided diverse answers and ethically, socially, and also culturally interesting imaginaries of what AI systems would be capable of doing in society in 2050 in The Netherlands[14]. The diversity of their answers reveals very different interests and preoccupations about their own human lives and what life in an AI-mediated society of 2050 should look like. Ten of their answers have been identified here to illustrate the diversity of their intuitive sense-making when interacting with AI systems. Each of these answers revealed human characteristics and values that children cherished either as individual persons or as for society when living and interacting with AI systems. These values included: *love and kindness; human care and protection; AI inservitude; emotional intelligence; human literacy, exuberance, and also environmental protection.* Please see below how a girl shared what an AI would do in 2050 that would be *loving and kind*:

"Then I would like a sweet mini robot that always follows me just like a dog. Look up things based on voice messages and then formulate an answer for me and with whom I could also talk and laugh." (10 year old girls, primary school) **(love and kindness)**

A girl shared what an AI would do to provide *human care*:

"Helping the elderly with things like climbing stairs and doing household chores." (11

[14] Please, see questions 27 and 28 in Annex 1. These two questions are very similar but were meant to offer room for elaboration in terms of AI tasks.

year old girl, primary school, Soest) (**human care**)

A boy shared his preference for an AI that would provide *human care* as follows:

"No more non-smart computers. Because then people will stop saying nonsense on the internet." (8 year old boy, primary school, Tilburg) (**human care and protection**)

Another boy suggested that he would prefer to be *served by an AI* as follows:

"An AI would look up things based on voice messages and then would formulate an answer for you." (14 year old boy, high school) **(AI in servitude)**

A girl explained that she would also prefer to be *served by an AI* as follows:

"Automated cycling without having to pedal yourself and driving without me needing to drive." (11 year old, girl, primary school, Katwijk aan Zee) **(AI in servitude)**

Another girl explained that she would prefer AI systems in the future with capacities for *emotional intelligence*:

"AI systems would understand human feelings and would have social skills." (11 year old girl, primary school, Katwijk aan Zee) **(emotional intelligence)**

A 10-year-old shared his AI innovation imaginaries as being able to read human thoughts:

"AI will be able to search what you think (without you typing, speaking or touching them)." (10 year old, primary school child) **(human literacy)**

Two boys shared how their interactions with AI systems would need to facilitate playfulness in 2050:

"Minecraft robot that you can remote control through your speech." (10 year old boy, primary school) **(exuberance)**

"A smart computer that is also a skateboard and can take you anywhere." (10 year old boy, primary school) **(exuberance)**

A girl wished, for instance, for AI systems in 2050 to protect the environment as follows:

"AI would take care of the environment and remove plastic from the sea." (12 year old, primary school child) **(environmental protection)**

Children's imaginaries of AI systems are not only informative because they stem from children's intuitive sense-making, but because these imaginaries stem from a large group of perhaps one of the most intuitive and relational sense-making human beings in the present society of the Netherlands. Children found the above values in their interactions so meaningful in their lives in 2022 that they wanted to sustain them also in an AI-mediated society of 2050 in The Netherlands.

4.8. Children's ethical and social value demands in an AI-mediated society

In this section, children's ethical and social value demands will be presented when interacting with AI while living in a society. The eight values highlighted in this section are the result of an inductive analysis that was based on the aggregate results of text-based searches on all answers of 374 children. During the analysis, children's answers were interpreted according to their ethical and societal value meanings. In the inductive analysis, the value codes and the frequency of these codes relating to the six embodied AI scenarios indicating children's reasoning were also accounted for. Furthermore, children's good and bad AI perceptions and their AI perceptions for 2050 were also taken into account. The goal was to synthesise at least eight value demands children shared throughout all their reflections on their interactions with AI systems. Each value in this section is considered to be sustainably important to uphold by children when living with AI systems and humans in society. Based on these groundsthe eight values inducted from children's responses when living in an AI-mediated society were the following: *human literacy, emotional intelligence, love and kindness, authenticity, human care and protection, autonomy, AI in servitude, and exuberance*.

Here below is a set of quotes from children that also illustrate these eight overarching value-demands they shared in an AI-mediated society:

Human literacy

*"If a robot was made to be my friend and would only learn from me that robot would only be able to replicate what I do? How could I know how to make others happy or what is sad? How can I learn and adapt to others' needs and moods, if I would only learn from a robot friend what I am doing?" (8 year old girl, primary school from Enschede) (**human literacy**)*

Emotional intelligence

*"I think becoming a friend would be impossible for a robot, because they have no emotions and humour." (12 year old boy, primary school Amersfoort) **(emotional intelligence)***

*"Real people, I find still more social. A robot would not be able to help, if I had a quarrel with my sister." (10 year old girls, primary school) **(emotional intelligence)***

Love and kindness

"If you want to be my friend you would need to be able to be loving and kind and a robot cannot do that." (11 year old boy, primary school Katwijk) ***(love and kindness)***

"My best robot friend would be a robot who could keep a secret and to whom I could tell everything I would not want to tell to a human peer." (7 year old, girl, visitor at *NEMO Museum at Amsterdam*) ***(love and kindness)****"For me the best robot would be a mini Minecraft robot that I could take into my pocket and that would guide me how tostay on a good path and do the right things."* (8 year old boy, from primary school in Dordrecht) ***(love and kindness)***

Authenticity

"I think AI systems are unable to express their own opinions, they simply cannot. They always express the opinions of others." (11 year old, primary school from Eindhoven) ***(authenticity)***

Human care and protection

"I would want to be consoled as a human does." (10 year old girl, visitor at NEMO Museum at Amsterdam) ***(human care and protection)***

"Friendship with a robot cannot happen, because I cannot converse with a robot the same way as with a human friend." (11 year old, boy, De Hobbitstee primary school) ***(human care and protection)***

Autonomy

"I do not want robots to take over the world." (10 year old girl, primary school Eindhoven) ***(autonomy)***

AI in Servitude

"My best robot would be an Octopus that would work between 7:30 and 8:30 the hardest with his or her 8 hands so that my parents would have more time for me." (11 year old girl, primary school in Teteringen) ***(AI in servitude)***

Exuberance

"A robot that can play with me outside and can also play a game with me inside." (8 year old boy, from primary school in Waalwijk) ***(exuberance)***

"Not social, not personal, you cannot laugh with a robot and cannot converse like with peers." (9 year old girl, visitor at NEMO Museum Amsterdam) ***(exuberance)***

Appendix 2 depicts a first indication of how these values could be used to inform values and principles within ethical, children's rights, and design frameworks. However, further research is necessary to indicate more specific correlations between each of the 8 values provided by children and the degree to which these values would map more oncertain values and principles and less on others. For conducting further research on thisthe application of Delphi methods could be useful (Green et. al., 2008).

5. Conclusions

This research study explored children's awareness, ethical and social sense-making, and imaginaries of artificially intelligent (AI) systems in their closest living environmentsin 2022 in The Netherlands. The definition of an AI system in this report was based on the machine-learning capacities of these systems and three criteria for this were revealed to children before starting to survey them.

The purpose of the study was to enable meaningful child participation by bringing this method in parallel with participatory AI design on the subject of children's interactions with AI systems in their daily lives. The purpose of children's meaningful participation was to capture children's intuitive sense-making and use their skills as a lens to look at AI systems. Children were asked to think and reflect on the systems they use, the experiences which they consider good and bad with AI, and to imagine scenarios with AI systems where these systems could fulfill or replace human roles. These roles included the role of a seller in a shop, a police agent, a doctor, a nanny, a car driver, and the role of a friend. By positioning children to think of the first five context-specific human roles and social occupations we inquired them to reveal how switching humans for AI within those contexts and roles would impact them. Children's intuitive answers were intended for inductive analysis to elicit what ethical or social values and human characteristics would children consider coming under pressure by such switches from a human to an AI system per individual context.

When inviting children to think of AI systems as friends the inquiry accounted for the context-overarching character of friendship as a specific quality that also defines the social and human role of a friend in one's life. Eliciting children's thoughts and their sense-making of friendship in the survey was also meant to inform the top-down meaning of trustworthiness in AI systems by children's bottom-up meanings of friendship. By sharing their opinions and stories of their daily interactions with AI systems, children revealed their sentiments and imaginations of what they think are good or bad AI impacts and what they would want and do not want from interactionswith AI systems in their lives in the Netherlands in the future.

As a synthesis, the following observations can be drawn from the data: while having been asked mainly about their interactions with AI systems, children, simultaneously, revealed a wide diversity of ethically, socially, and even culturally relevant qualities about their interactions with humans and systems. Mapping children's awareness, sense-making and future imaginaries of AI systems contributed to acquiring insights into children's basic (biological, moral, and societal) skills in navigating the world. These skills have not been possible to programme for AI systems so far (OECD, 2021) and are unique to human evolution. Therefore, children's accounts from diverse cities of The Netherlands can also be perceived as unique pieces of cultural heritage on how children saw the world with AI and imagined interacting with AI systems in society in 2022.

Based on the gained insights eight aggregated values were synthesised regarding what children cherished most in their human-human interactions and what they would not have wanted to lose when interacting with AI systems and humans in society. Enabling children through this project to employ the intuitive sense-making skills of their interactions with AI systems and society and offering room for them to share their views in their own words could also be regarded as additions both to the European Year of Youth 2022 and to the European Year of Skill 2023 and contributed to the Dutch government’s obligation to facilitate child participation also about AI policy (AP.

This endeavor demonstrated the benefits of what it could mean to sustain dialogue with young children as intergenerational participants of 'adult-initiated shared decision-making with youth' and as 'informants' of AI ethics, human-centric AI, digital citizenship, and AI policy. Without children's stories, this research would not have been possible. Their lens on AI and the world around them in this research was instrumental to gather their ethically and socially relevant meanings through their unconscious and conscious acts of doing and sensing the world including AI in it. Children compared to adults were a unique group to explore interactions with AI systems through their 'wanting to relate' rather than 'wanting to know'. This relational doing as a form of dialectic being of children was highly useful to provide novel and specifically child perspectives upon what is more often provided by adult stakeholders, including AI developers, designers,

policymakers, pedagogues, parents, and others: notably, upon what human experience shall be cherished in an AI-mediated society of The Netherlands.

Three important overarching lessons can be formulated as key takeaways from this project. One is that children in their interactions with AI systems (and the world) encountered human values when they were triggered to think of situations potentially void of these. When making sense of authenticity, for instance, it was necessary to make sense of deceit. Similarly, the need for human literacy by children emerged from imagining the possibility that human traits would no longer be recognizable and distinguishable by children when they would interact with robots. A second lesson is that only children can grow as humans when interacting with AI systems and AI systems cannot. Children remain to grow not only cognitively but also organically and systems will remain to have synthetic components. Taking a broad diversity of child perspectives into account when designing normative frameworks for AI systems and systems themselves is key in order to assess what the meaningfulness of these systems in children's lives are and how they influence how children (should) grow. A third lesson is that allowing children to carry out thought experiments and share their sentiments about current AI systems and their future vision is useful to cultivate multiple of their skills needed in the 21st century: creative expression, critical thinking, public speech and debate, creative collaboration, and others. They could, for instance, co-create new perspectives on AI and society while learning about their own agency, rights, and responsibility when interacting with others. Our empirical research engagement fostered meaningful child participation because the purpose by which we intended to operationalize children's right to be heard (UNCRC Art. 12) was to incentivize children to share their own ethically and socially relevant sense-making when interacting with AI systems. Through filling in surveys and attending co-creative lessons as participatory practices children were stimulated to enforce their right to be heard because spaces were created for recording their views, such as classrooms, a library, and a museum.

These practices also contributed to cultivating curiosity toward differing views on experiencing AI systems and enacting children’s civic voices. Participating children had different realities also when discussing ethical and public values, design features of AI systems, and the influences of these systems on their daily lives. Bringing their diverse views sustainably into dialogue in such co-creative spaces would further assist in developing multiple of their 21st-century skills, their digital citizenship, and diversity awareness and could reinforce their perceptions of themselves as worthy dialogue partners in an AI-mediated society and foster multiple of their children’s rights.

To conclude, applying the methodological model of this project with children demonstrates how their natural human-centric and relational being and doing of their lives, sense-making of AI systems and society can be highly informative to AI-relevant ethical, social, children's rights, policy and human-centric design frameworks. The voices of respondent children enriched transdisciplinary scientific knowledge by accounting for

the diversity of their age and social, economic and local backgrounds as coming from diverse corners of The Netherlands. Fostering meaningful child participation and AI development remain interdependent necessities of The Netherlands and other nations internationally. Similarly, keeping the human in human-centric AI. Given the fast and often unchecked deployment of novel AI products in society simultaneous investment into a broad, intergenerational public dialogue about the impacts of AI systems is an existential need.

Establishing practices for public dialogue about AI systems where the youngest generation can be early and broadly involved is key not only to checking the extent to which AI systems are human-centric but importantly to cultivating broadly and with their diversity in society responsible humans in the loop of AI, society, and Earth.

The meaningfulness of top-down ethical, legal, and AI design frameworks and the extent to which AI systems can be designed and used in a human-centred manner hinges upon how broadly can normative frameworks be discussed and informed through intergenerational dialogue and how broadly can AI systems be audited from the bottom-up of society including the youngest members. In this immense AI-focused transdisciplinary work children's human-centric skills and creative expressions remain uniquely valuable and inspiring resources for humanizing AI systems and societies.

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Appendix 1

Question numbers	These survey questions are translated from the original questions in Dutch and are available in Dutch on *Kidsrightsonderzoekt.nl*
1.	How old are you?
2.	What is your gender?
3.	What is the name of your school?
4.	Have you heard of artificially intelligent computers before?
5.	If the answer to the previous question was YES, where haveyou heard about those?
6.	Which AI computers can you find in your home? Name the type of artificial intelligence computer and the locations in yourhome where you can find them.
7.	How often do you use these AI computers?
8.	Would you like to use these AI computers more or less often?
9.	Which AI computers are used by others in your home? (e.g.your father, mother, brother, or sister)
10.	How often are these AI computers used by others in yourhome?

11.	Where can you still find AI computers outside the house, suchas on the street, or n buildings you visit in the city?
12.	What tasks can these AI computers perform for humans?
13.	Would you like a robot to help you in the role of a seller (in a shop)?
14.	Why would you want that or why not?
15.	Would you like a robot to help you in the role of a police officer?
16.	Why would you want that or why not?
17.	Would you like it if a robot helped you in the role of a doctor?
18.	Why would you want that or why not?
19.	Would you like a robot to help you in the role of a nanny?
20.	Why would you want that or why not?
21.	What would you think if a self-driving car took you to hockey; football training; music- or dance class or would you be transported elsewhere instead of an adult driver?

22.	Describe which AI computers you like and why. (You can come up with something yourself or look for ideas in books or on the Internet.) Briefly write down why you like that computer in particular.
23.	Describe which AI computers you don't like and why. (You can come up with something yourself or look for ideas in books or on the Internet.) Briefly write down why you don't like that computer in particular.
24.	If you could think of it yourself: what could the very best AI computer do for you and what would it look like?
25.	If you want to make a drawing about what this AI computer would look like, handing on to your teacher.
26.	What could AI computers do less well than humans?
27.	What tasks will an AI computer do for you in 2050?
28.	What do you think, what will a smart computer do for you in 2050?
29.	Could a smart computer ever be your friend? What would it take for this to happen?
30.	Could an AI computer one day become a "real" friend to your children? What would it take for this to happen?

APPENDIX 2

The below ethical, children's rights, design, and policy frameworks are brought in line with Dutch children's value demands as indicated in section 4. As explained above, the below positioning of children's value demands versus frameworks requires further research to scientifically validate the correspondence, for instance, through the application of the Delphi methods. A first indication of correspondence between children's value demands derived in this study and the principles and rights in the six frameworks here below is depicted through ‘X’s in the tables:

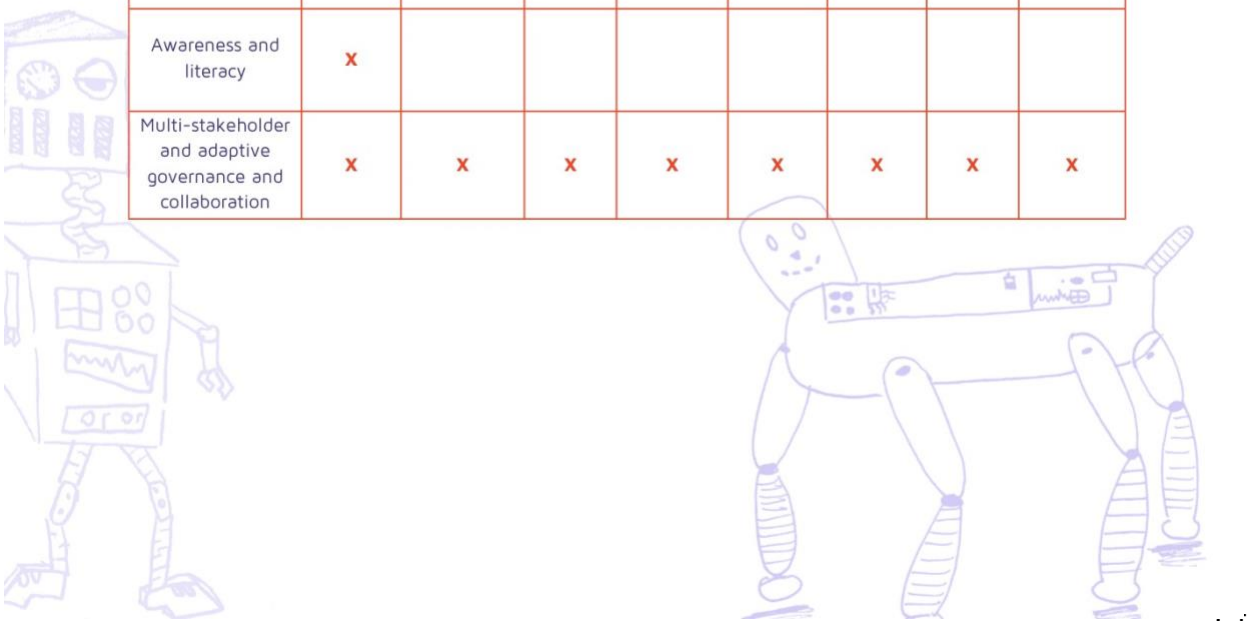
1. **EU's ALTAI High-Level Expert Group's Trustworthy AI Principles (EC, 202)**
2. **UNESCO Recommendations on the Ethics of Artificial IntelligencePrinciples (UNESCO, 2022)**
3. **Dutch Code for Children's Rights (2021)**
4. **Children's rights (online) (UNCRC, 1989)**
5. **UNICEF Policy Guidance on AI and Children (Dignum et. al., 2021)**
6. **Artificial Intelligence for Children Toolkit (WEF, 2021)**

1.Dutch children's value demands informing the EU's ALTAI High-Level Expert Group's Trustworthy AI principles

	Dutch children's value demands in a society with AI							
ALTAI High-Level Expert Group's Trustworthy AI principles	Human literacy	Emotional intelligence	Love & kindness	Authenticity	Human care & protection	Autonomy	AI in Servitude	Exuberance
Human agency and oversight	x	x	x			x		
Technical robustness and safety					x			
Privacy and Data governance					x			
Transparency					x			
Diversity, non-discrimination and fairness			x					
Societal and environmental well-being							x	
Accountability					x			

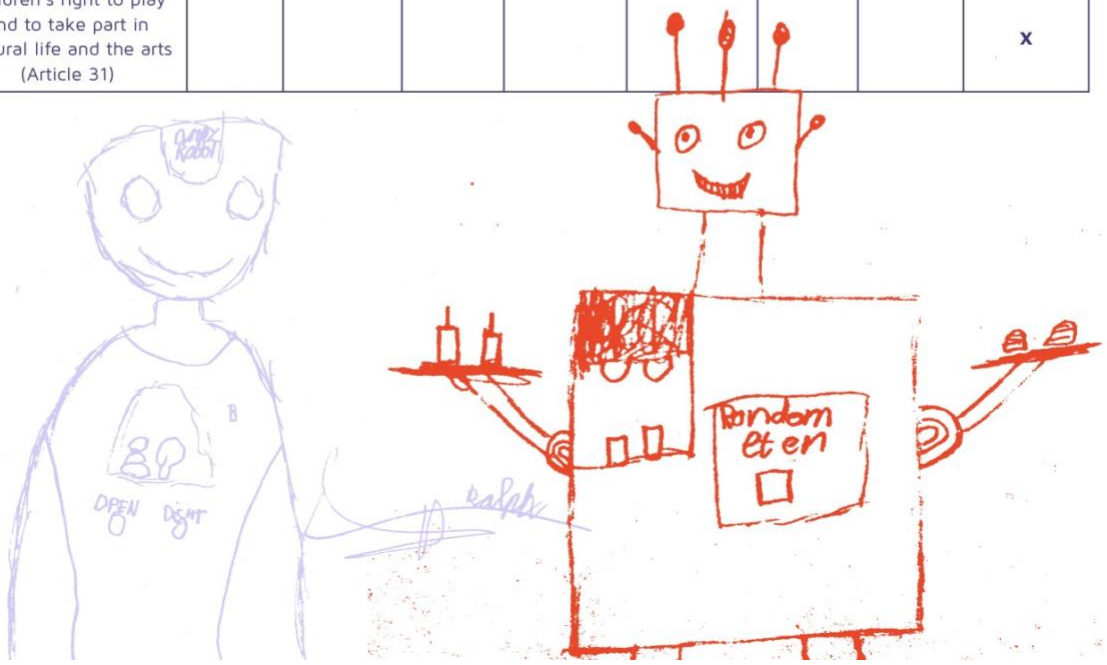
2. Dutch children's value demands informing the UNESCO Recommendations on the Ethics of Artificial Intelligence Principles

	Dutch children's value demands in a society with AI							
UNESCO Recommendations on the Ethics of Artificial Intelligence Principles	Human literacy	Emotional intelligence	Love & kindness	Authenticity	Human care & protection	Autonomy	AI in Servitude	Exuberance
Proportionality and do no harm					x			
Safety and security					x			
Fairness and non-discrimination					x			
Sustainability					x			
Right to privacy and data protection				x				
Human oversight and determination	x	x				x		
Transparency and explainability								x
Responsibility and accountability			x					
Awareness and literacy	x							
Multi-stakeholder and adaptive governance and collaboration	x	x	x	x	x	x	x	x



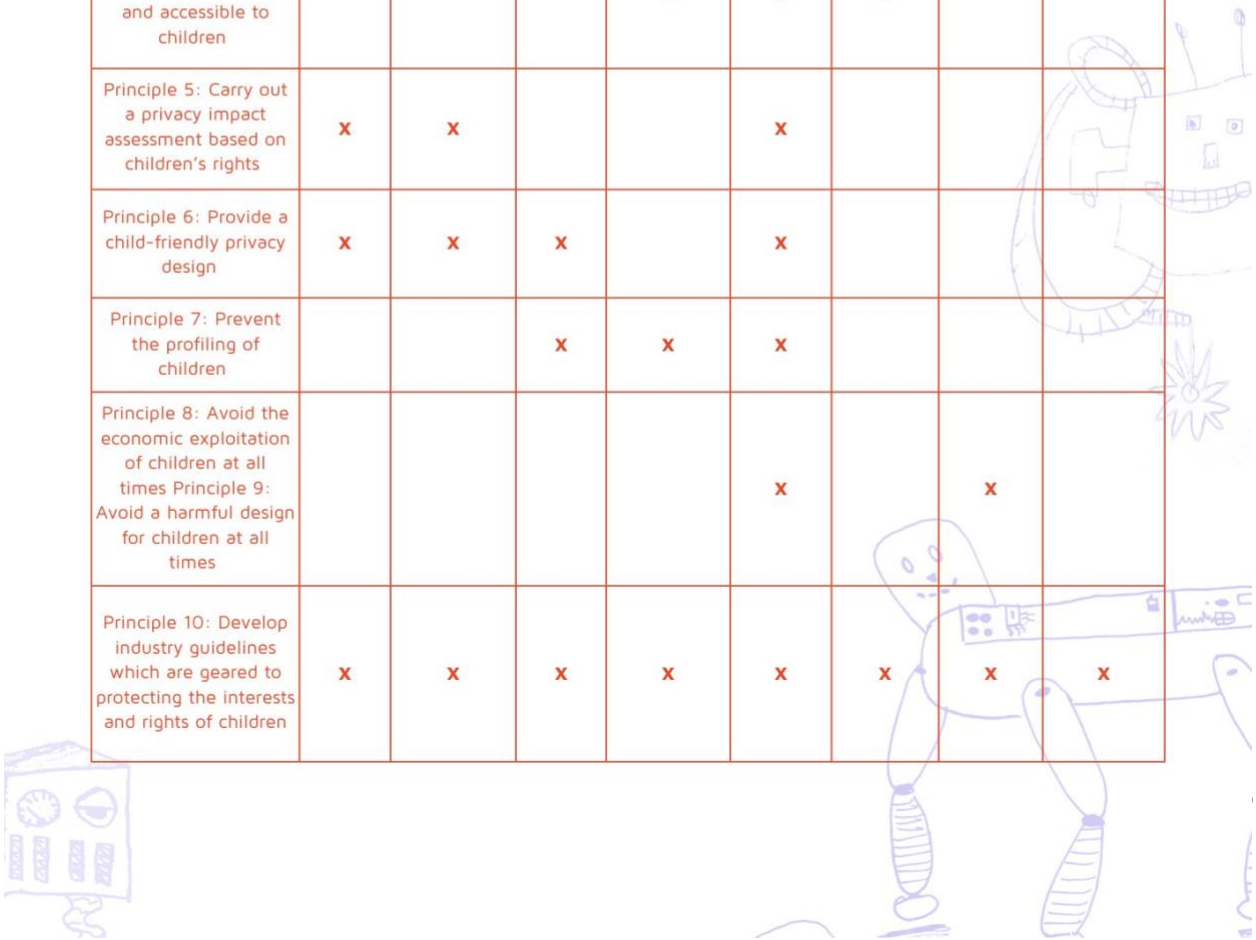
3. Dutch children's value demands informing (rights of the) United Nations Conventions on the Rights of the Child from online perspectives

	Dutch children's value demands in a society with AI							
Children's rights online(UNCRC)	Human literacy	Emotional intelligence	Love & kindness	Authenticity	Human care & protection	Autonomy	Servitude	Exuberance
Children's right to have their 'best interests' taken into consideration (Article 3)	x	x	x		x			
Children's right to reach their full potential and to develop their talents and abilities, including through education (Articles 6, 28 and 29)	x				x			
Children's right to be treated equally and fairly (Article 2)Children's right to feel safe and cared for, and to be protected from violence (Articles 19, 34 and 36)			x				x	
Children's right to share information and ideas unless it harms or offends other people (Article 13)Children's right to privacy (Article 16)					x			
Children's right to access health services (Article 24)Children's right to get information that is important for their well-being, and to be protected from harmful information (Article 17)	x				x			x
Children's right to play and to take part in cultural life and the arts (Article 31)								x



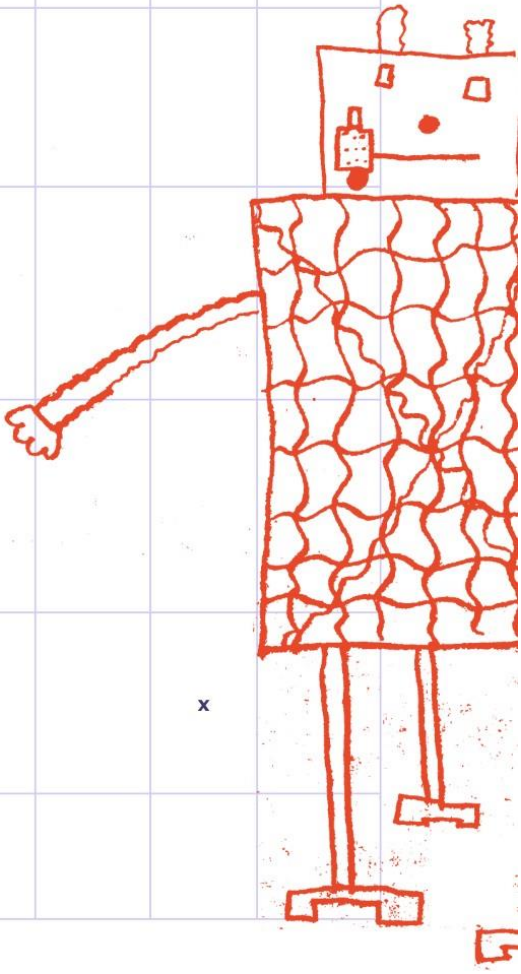
4. Dutch children's value demands informing the Dutch Code for Children's Rights

Code for Children's Rights	Dutch children's value demands in a society with AI							
	Human literacy	Emotional intelligence	Love & kindness	Authenticity	Human care & protection	Autonomy	Servitude	Exuberance
Principle 1: Make the best interests of the child the primary consideration when designing	x	x	x		x			
Principle 2: Involve children and their expectations in the design process				x		x	x	x
Principle 3: Ensure the legitimate processing of personal data of children					x			
Principle 4: Provide transparency in a way that is understandable and accessible to children				x	x	x		
Principle 5: Carry out a privacy impact assessment based on children's rights	x	x			x			
Principle 6: Provide a child-friendly privacy design	x	x	x		x			
Principle 7: Prevent the profiling of children			x	x	x			
Principle 8: Avoid the economic exploitation of children at all times Principle 9: Avoid a harmful design for children at all times					x		x	
Principle 10: Develop industry guidelines which are geared to protecting the interests and rights of children	x	x	x	x	x	x	x	x



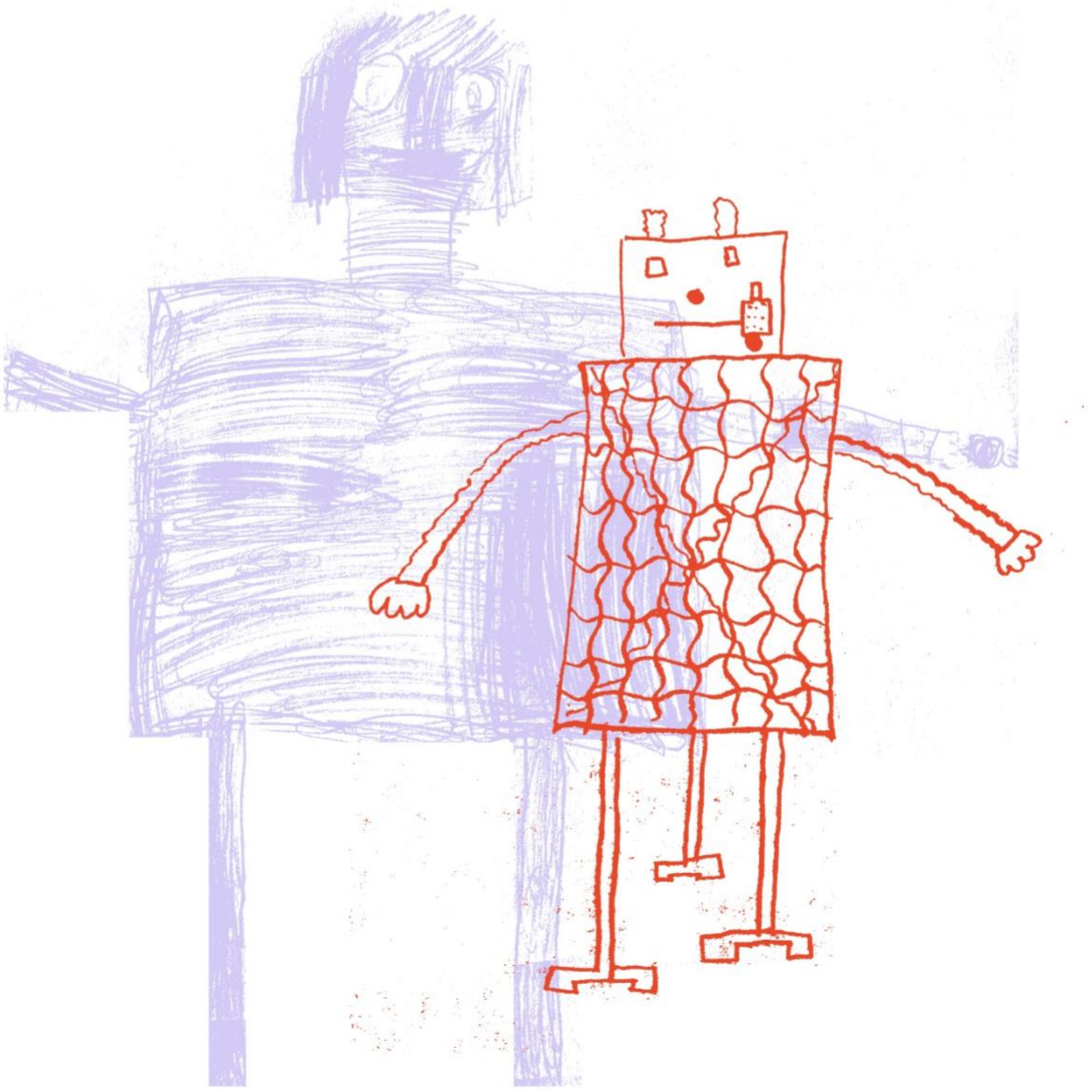
5. Dutch children's value demands informing the UNICEF's Policy Guidance on AI and Children

	Dutch children's value demands in a society with AI							
UNICEF Policy Guidance on AI and children	Human literacy	Emotional intelligence	Love & kindness	Authenticity	Human care & protection	Autonomy	AI in Servitude	Exuberance
Support children's development and well-being	x	x	x		x			
Ensure inclusion of and for children			x		x		x	
Prioritise fairness and non-discrimination for children	x	x			x			
Protect children's data and privacy	x	x	x		x			
Ensure safety for children					x			
Provide transparency, explainability, and accountability for children					x			
Empower governments and businesses with knowledge of AI and children's rights								
Prepare children for present and future developments in AI	x	x			x		x	
Create an enabling environment	x	x	x		x			



6. Dutch children's value demands informing the World Economic Forum's Artificial Intelligence for Children Toolkit

	Dutch children's value demands in a society with AI							
Artificial Intelligence for Children Toolkit (WEF, 2021)	Human literacy	Emotional intelligence	Love and kindness	Authenticity	Human care and protection	Autonomy	AI in Servitude	Exuberance
Fair	X	X		X	X			
Inclusive			X			X		X
Responsible	X	X			X			
Safe	X	X	X		X			
Transparent					X			



DesignLab

DesignLab is an ecosystem facilitating creative collaboration and knowledge transfer between researchers, societal organisations, students, and citizens, and other stakeholders, and through the DesignLab Fellows and project collaborations it is an integral part of the infrastructure of the University of Twente, The Netherlands. DesignLab values plural perspectives and expertise from individuals as well as organisations – nurturing collaborative projects that transcend disciplinary and professional domains. In DesignLab's ecosystem, anyone can become an agent of change. DesignLab's activities are shaped by the approach toward science-based innovation to design ethically for society. DesignLab puts design-thinking, Responsible Futuring, Transdisciplinary Innovation, and Citizen Science methods into practice. The societal focus domains are core pillars of the expert strategy themes of the University of Twente: Digital Society, Health Innovation, and Climate Change. This research fosters in particular the Digital Society strategy theme.

KidsRights

Children are change makers. KidsRights works together with children in a world in which children's rights are guaranteed. KidsRights is convinced that children's rights arebetter enhanced when children themselves have a say in matters that directly affect them and can take action themselves. KidsRights ensures that children are heard. Together with them, KidsRights draw worldwide attention to the power of children as change makers and to the Rights of the Child. In addition, KidsRights discovers young changemakers all over the world: children who take action themselves to improve their position. Their initiatives are sometimes small, but by supporting children and letting them speak, they can have a major effect. KidsRights offers them an international platform to share their message. They receive support to strengthen and expand their local actions. KidsRights also researches to provide them and others with insight into children's opinions about societal matters and into the status of their rights worldwide. Together with children as changemakers, KidsRights inspires a global movement for children's rights.

Karolina La Fors is a Senior Researcher in Responsible Design at the DesignLab of the University of Twente (The Netherlands). She has been listed as one of the "100 Brilliant Women in AI Ethics List 2023" by Women in AI Ethics. She is also a World Economic Forum AI Fellow. Her research focuses on evaluating the extent to which AI systems are human-centric, and account for AI ethics, children's rights, AI benefits, and children's individual and societal growth. AI innovations rapidly proliferate and set new norms and expectations in the lives of the youngest generation. Through her coordination work of the Dutch ELSALab AI4Youth and her collaboration with KidsRights, she is committed to enabling the meaningful participation of youth in a transdisciplinary research infrastructure with AI developers, NGOs, parents, pedagogues, and others. Ethnographically gathered, intergenerational knowledge on AI and society about what the norms of co-existence are and shall be with AI in society is vital for democracies. Human-centric AI requires human-centric humans. Early and broad engagement about the impact of these systems in citizens' daily lives is vital because only through co-exploring what responsible, just,

fair, and human interaction means can we achieve human-centric AI and humans. Answers shall be diverse on “What does, aspiring toward human-centric interaction require from AI design and human development?” How to remain responsible in the loop of AI systems, in the loop of each other, and of the Earth without cultivating intergenerational stories and realties to share.