Introduction:

This study investigates how children aged 10-13 perceive robots and librarians, focusing on the stereotypical characteristics children incorporate into their robot designs and how their attitudes toward robots and librarians change over time. Specifically, it seeks to answer two key questions: (1) What stereotypes do children use when designing robots? (2) How do children's perceptions of robots and librarians evolve over the course of up to four co-design sessions?

Understanding these perceptions is important because it provides insights into the beliefs and stereotypes children are exposed to regarding intelligence, competence, and professional roles. This research explores whether such perceptions persist or shift over time. Additionally, it examines how children define "smart" in the context of a librarian - whether as technical competence or literary expertise - offers opportunities to challenge limiting stereotypes. This study also aims to break down the broad concept of competence into smaller, domain-specific categories, contributing to the work of scholars like Roussos and Dunham.

To address these questions, children will participate in four co-design sessions at the Granville Library. They will design robots using a variety of stereotypical and/or non-stereotypical props (e.g., eyeglasses, bowties, hats) and features that vary by gender, age, race, class, and other dimensions. Their designs will be categorized into anthropomorphic, zoomorphic, mechanomorphic, or other emerging types. Changes in attitudes will be analyzed using deductive coding and quantitative analysis of likert-scale survey data, offering a detailed view of how children's perceptions evolve and the implications for future research and practical applications.

Related Work:

The Stereotype Content Model (SCM) provides a foundational framework for understanding how people evaluate social groups based on two dimensions: warmth and competence [2]. Warmth reflects how friendly or harmful a group appears, while competence relates to how capable or high-status a group is perceived to be. This model is central to this study's exploration of how children perceive robots and librarians, particularly how they incorporate stereotypical traits into their robot designs and associate them with warmth and competence.

The Stereotype Content Model in Social Perception

Cuddy et al. expanded the SCM to explore how warmth and competence shape perceptions of various social groups across diverse cultural contexts [2]. Their research highlights that high-status groups are often viewed as competent but not necessarily warm, while low-status groups are perceived as warm but incompetent. This work provides a broader context for understanding how stereotypes are formed but does not specifically address children aged 10-13. This gap underscores the need for further research to determine whether children in this age group associate "smart" features, such as glasses or anthropomorphic traits, with both competence and warmth in their robot designs.

The Development of Warmth and Competence in Children

Roussos and Dunham examined how children aged 5-6 and 9-10 use warmth and competence to assess social groups [4]. Their findings reveal that younger children often conflate the two dimensions, perceiving warmth and competence as interdependent. As children grow older, this dependency diminishes, and they begin to judge warmth and competence more independently,

aligning more closely with adult patterns, though warmth judgments still appear to be based on a more aggregate judgment at age 9-10. This research is particularly relevant as it suggests developmental differences in how children form stereotypes, providing a basis for investigating whether children aged 10-13 similarly conflate warmth and competence in the context of robots and librarians.

Co-Design with Children

Children are key stakeholders in the design of technologies that impact their lives, yet much prior research prioritizes adult perspectives, often focusing on elderly users. This study emphasizes the importance of engaging children as active participants in the design process, advocating for their voices to be heard. Co-design methods address the unique needs of children by creating collaborative, engaging, and child-centered research environments.

In [3], Mott et al. demonstrated the value of involving children in robot prototype development through co-design workshops. These workshops encouraged reflection on ethical concerns in child-robot interaction, fostering children's critical thinking and participatory engagement. Similarly, [1] examined children's perceptions of different robot types:

- **Anthropomorphic robots** (those that look like humans) were seen as the most competent but elicited mixed feelings of trust and distrust.
- **Zoomorphic robots** (those that look like animals) were perceived as less competent but warmer.
- **Mechanomorphic robots** (those that look like machines) were viewed as predictable and constrained to specific tasks.

These findings suggest that children are likely to associate anthropomorphic features with both cognitive and physical competence, making anthropomorphic robots more prevalent in scenarios requiring intelligence or physical interaction.

Hypotheses

This study hypothesizes that children see "smart" robots or people as warm, incorporating stereotypical features of anthropomorphic (human-like) traits such as eyeglasses, body structure, and facial structure into their designs. This research also hypothesizes that children will view librarians as more competent after the study compared to before the study. To test these hypotheses, children's designs will be analyzed to identify which characteristics are included and whether the designs are tailored to specific scenarios. This approach builds on prior research by integrating co-design methods and stereotype analysis to uncover the nuanced ways children perceive and create technology.

Method:

Participants

The study will involve children aged 10-13, who are at a critical developmental stage for understanding and forming social stereotypes. Participants will be recruited from the Granville Library, where all research activities will take place.

Procedure

Children will participate in a series of four co-design sessions designed to explore their perceptions of robots and librarians. These sessions will include activities such as designing

robot prototypes with potentially stereotypical characteristics (e.g., glasses, bowties, anthropomorphic or mechanomorphic features) and engaging in discussions to reflect on their choices. The sessions aim to capture children's initial stereotypes and track how their attitudes evolve over time.

Brief outline of schedule

The program is divided into four sessions spread across ten weeks. In Session 1 (Weeks 1–2), participants will explore librarian tasks and brainstorm how a robot could help, followed by sketching or storyboarding their designs. Activities include a warm-up, brainstorming, and a cool-down while sketches are scanned. In Session 2 (Weeks 3–4), participants will form small groups, assign roles, and start building their robot designs. They will answer design questions, refine their prototypes, and present their ideas, with videos shared with parents. Weeks 5–7 are dedicated to building a working prototype. In Session 3 (Week 8), participants will name the robot, interact with its prototype, and plan a task demonstration. Groups will design robot actions, practice, and present their interactions, with a video and personalized letter from the robot as a takeaway. Finally, in session 4 (Weeks 9–10), participants will recap the story, see a robot demo, and interact with the robot individually. They'll plan and perform a demo for parents, who will also provide feedback via surveys.

Data Collection and Analysis

Data collection and analysis for this project will involve multiple methods to capture and evaluate children's perceptions and interactions. Artefacts such as notes, sketches, photos, and videos from each session will be collected to document children's designs and interactions.

Surveys will be conducted before and after each session to assess children's attitudes toward robots and librarians, focusing on warmth and competence dimensions. The survey design ensures consistency, with participants answering the same set of questions for each entity (librarian, robot, and robot assistant) using a simple multiple-choice format supported by visual aids, such as cookie and pencil icons, to enhance clarity and engagement. Responses will be scaled from 0 to 4, reflecting either the number of cookies shared or the number of test questions answered correctly. The pretest surveys will capture baseline perceptions of librarians and robots, while the posttest surveys will include additional questions about the robot assistant librarian introduced after the intervention. This pre-and post-test design allows for a comparison of changes in perceptions.

For data analysis, qualitative methods will include organizing and analyzing session artefacts using ATLAS.ti, employing inductive coding to identify recurring themes and patterns in children's designs and reflections. Quantitative analysis will involve applying statistical tests to the survey data. Wilcoxon Tests will compare children's initial survey responses with their final results to identify significant changes in attitudes, and Spearman's Rho will measure the correlation between the number of sessions attended and changes in children's perceptions. Additionally, survey results will be visualized to highlight attitude changes over time and compare children's perceptions with those of adults. This mixed-methods approach will provide a comprehensive understanding of how children aged 10–13 perceive warmth and competence in robots and librarians and how these perceptions evolve through active engagement in co-design activities.

Expected Outcomes:

This study aims to gain insights into children's mental models by understanding how children aged 10–13 perceive robots and librarians, particularly in terms of warmth and competence, and how these perceptions differ from those of adults. It will also identify specific stereotypical characteristics that children incorporate into their robot designs, such as anthropomorphic, zoomorphic, or mechanomorphic traits. Additionally, the research will explore the impact of co-design on perceptions, investigating whether participation in the co-design process shifts children's attitudes toward robots and librarians, especially in how they evaluate competence and warmth. It will assess whether repeated engagement in interactive sessions results in measurable changes in children's mental models. Finally, this study will provide foundational data to support the expansion of this pilot into a larger-scale investigation. It will highlight the potential value of applying co-design methodologies in future research to engage children and address stereotypes in child-robot and child-librarian interactions.

References:

1. Gail Collyer-Hoar, Elisa Rubegni, Laura Malinverni, and Jason Yip. 2024. "It's kind of weird talking to a sphere": Exploring Children's Hopes and Fears on Social Robot Morphology Using Speculative Research Methods. In *Designing Interactive Systems Conference*, 276–288. https://doi.org/10.1145/3643834.3661526https://doi.org/10.1016/j.jecp.2015.08.009
2. Amy J. C. Cuddy, Susan T. Fiske, Virginia S. Y. Kwan, Peter Glick, Stéphanie Demoulin, Jacques‐Philippe Leyens, Michael Harris Bond, Jean‐Claude Croizet, Naomi Ellemers, Ed Sleebos, Tin Tin Htun, Hyun‐Jeong Kim, Greg Maio, Judi Perry, Kristina Petkova, Valery Todorov, Rosa Rodríguez‐Bailón, Elena Morales, Miguel Moya, Marisol Palacios, Vanessa Smith, Rolando Perez, Jorge Vala, and Rene Ziegler. 2009. Stereotype content model across cultures: Towards universal similarities and some differences. *British Journal of Social*

Psychology 48, 1: 1–33. https://doi.org/10.1348/014466608X314935

3. Terran Mott, Alexandra Bejarano, and Tom Williams. 2022. Robot Co-design Can Help Us Engage Child Stakeholders in Ethical Reflection. In *Proceedings of the 2022 ACM/IEEE International Conference on Human-Robot Interaction* (HRI ’22), 14–23.
4. Gina Roussos and Yarrow Dunham. 2016. The development of stereotype content: The use of warmth and competence in assessing social groups. *Journal of Experimental Child Psychology* 141: 133–144. https://doi.org/10.1016/j.jecp.2015.08.009

1. Introduction

This research aims to investigate how children and adults perceive and evaluate robots designed for specific roles, particularly in educational and library settings. The study seeks to explore the impact of combining two concepts from opposite social groups: robots, which are often perceived as mechanical, and librarians, who are commonly seen as approachable and nurturing. By merging these contrasting ideas into the design of a librarian aid robot, this research aims to observe the synergy between these concepts and the influence it has on perceptions of the robot.

Through co-design sessions with children and adults, the study seeks to tailor the robot to meet specific user needs while examining how the design process shapes participants' perceptions and attitudes. Co-design ensures that robots are not only functional but also aligned with the preferences of the study participants. In these sessions, children will actively contribute to the design process and provide feedback on robot features and designs. Data collected will include children's ratings of the final robot designs and an analysis of the design features emphasized during the co-design process.

This research will primarily use the dimensions of warmth and competence to assess social groups and their associated stereotypes. As a pilot study, it provides insights into how children and adults perceive robot characteristics and roles. Ultimately, this research will inform future co-design initiatives and contribute to the broader field of human-robot interaction by highlighting key differences in perceptions and advancing the integration of diverse social concepts in robotics.

Research Questions

This study seeks to explore how children and adults perceive and evaluate a robot designed for a specific role, such as a librarian aid.

1. How do children's ratings of the final robot compare to adults' ratings?
2. Are children's and adults' ratings consistent with or different from expectations based on stereotypical characteristics in the robot design?

As a hypothesis, children may perceive the robot they co-designed as warm, as they were actively involved in its development. In contrast, adults may evaluate the robot differently, potentially relying on preconceived stereotypes or expectations rather than personal involvement in the design process.

Importance of the Study

This study addresses critical gaps in understanding how children and adults perceive robots, particularly in the context of educational and library settings. By exploring the perceptions of both groups, the study investigates the influence of stereotypes and direct involvement in the design process. This research contributes to bridging the knowledge gap between child and adult perspectives on robots, providing insights for developing robots that are not only functional but also better aligned with the needs of the demographic.

Brief Plan

The study involves four co-design sessions with both children to explore their perceptions and contributions to the design of a librarian aid robot. During these sessions, participants will engage in shaping the robot's features. Data collection will include quantitative ratings provided by participants, assessing aspects such as warmth and competence. Additionally, qualitative analysis will focus on the specific design features emphasized by participants and whether these

features align with or challenge stereotypical characteristics traditionally associated with robots or librarians. The findings will then be compared to existing literature on stereotypes, co-design methodologies, and child development to contextualize the results and identify patterns or deviations.

2. Related Work

Stereotype Content Model

Studies show that people tend to judge others based on two main concepts: how competent (capable and smart) and how warm (friendly) they are [1]. This also applies to how people judge social groups and robots as well. Robots that seem both competent and warm tend to get positive reactions, while those that score low in both areas are often avoided or disliked. Interestingly, Mieczkowski applied the stereotype content model to robots and discovered a similar connection between perceptions of warmth and competence and how people choose to help or harm them [2].

When it comes to children, they develop these judgments differently than adults. Around ages 9 to 10, children begin to understand competence the same way adults do, but their judgments of warmth are still influenced by more general information. This implies that children may perceive robots a bit differently than adults, particularly when it comes to warmth and competence. Children's perceptions of warmth are more closely linked to their views on competence, whereas adults and teenagers are better at distinguishing between warmth and competence separately [4].

Co-design

Co-design is a participatory design method where users, in this case, children, are actively involved in the design process. This approach allows them to contribute ideas, provide

feedback, and help shape the product according to their preferences, ensuring that the final design better meets their expectations. Prior studies have shown that co-design with children enhances their understanding of the design process and encourages creativity, leading to technology that is more aligned with the users' developmental needs and preferences. For example, in the context of educational technologies or robots, co-design sessions have allowed children to contribute ideas about robot functionality, appearance, and user experience, ensuring that the designs are more relatable and accessible [3]. In other studies, co-design workshops help children think critically about robots and their ethical role in society [5].

This study builds on the observations of how children and adults view a librarian robot. The research explores how people perceive the combination of librarian traits (warmth) and robot traits (competence) and how these perceptions affect their judgment. The research also looks at how children's views of robots might be different from adults' and how stereotypes influence their thoughts on robot design [4].

3. Methods

Participants

For this study, we will recruit both children and adults from the local community in Granville. The goal is to include a group from the local library to compare different perspectives on robots and librarians. This study plans to get an approval from the IRB and all participants will be informed about the study's objectives and provide their consent to participate. This approach ensures that we capture a broad range of perceptions from both children and adults.

Location

The study will take place in the local library in Granville to ensure the context aligns with real-world applications of robots in educational and library settings.

Procedure

Each session will involve co-design activities where participants will collaborate to generate ideas, discuss, and refine robot designs. The sessions will include activities such as brainstorming, sketching, and providing feedback on different design features. Children will have the opportunity to shape the robot's look and function, while adults will be part of the discussions as well. Each session will last around 60 minutes, providing sufficient time for participants to explore the design process thoroughly. At the end of the final session, children involved in the co-design process and adults will complete a paper survey rating the final robot prototype in terms of warmth and competence (with respect to knowledge of writing and computers).

In the first session (week 1 or 2), children will be introduced to the story of designing a librarian assistant robot, brainstorm its tasks, and create initial sketches or storyboards of their ideas. In the second session (week 3 or 4), children will be divided into small groups, choose roles, and collaboratively build physical models of their robot while answering structured design questions, followed by group presentations. In the third session (week 8), children will be asked to name the prototype, interact with it up close, refine its functions, and practice acting out interactions before presenting their robot to a larger group. In the last session (week 10), children will be able to interact with the finalized robot, participate in demonstrations, take surveys, and present the robot’s capabilities to their parents, who also complete a survey.

Analysis Methods

For the quantitative analysis, the Mann-Whitney U test will be used to compare ratings between children and adults to determine if significant differences exist in how each group perceives robots and librarians. Design features of the robot will be discussed during the

co-design sessions and will be examined and categorized using ATLAS.TI, with a focus on identifying stereotypical characteristics related to warmth and competence. Deductive coding will be applied, using a predefined set of codes based on existing theories about warmth and competence in perceptions of robots and librarians. By examining the design choices and participant responses through this method, the study aims to explore how stereotypes influence the co-design process. Finally, the findings will be compared to existing research on co-design, perceptions of robots, and stereotypes in design to identify any emerging patterns.

4. **Expected Outcomes, Limitations, and Future Work**

This study expects to observe differences in how children and adults perceive robots and librarians, particularly when it comes to warmth and competence. The study will provide insights into how the co-design process might influence children's perceptions of robots. However, as this is a pilot study, we acknowledge that the small sample size may limit the generalizability of the results. In future work, we aim to expand the study by including more libraries and participants to increase the sample size and diversity. Additionally for future studies, the impact of different design features or background knowledge on participants' ratings, could provide further insights into how perceptions of robots evolve across age groups.

5. **Approximate timeline:**

May 26(M) – August 1(F) = 10 weeks

- First Session (Week 1 or 2)
- Second session (Week 3 or 4)
- Third session (larger gap between this and the second session) (Week 8)
- Fourth session, smaller groups, maybe multiple sessions (Week 10)

References

[1] Cuddy, Amy J. C., Susan T. Fiske, Virginia S. Y. Kwan, Peter Glick, Stéphanie Demoulin, Jacques-Philippe Leyens, Michael Harris Bond, et al. "Stereotype Content Model across Cultures: Towards Universal Similarities and Some Differences." *British Journal of Social Psychology* 48, no. 1 (March 2009): 1–33. https://doi.org/10.1348/014466608X314935.

[2] Mieczkowski, Hannah, Sunny Xun Liu, Jeffrey Hancock, and Byron Reeves. "Helping Not Hurting: Applying the Stereotype Content Model and BIAS Map to Social Robotics." In *2019 14th ACM/IEEE International Conference on Human-Robot Interaction (HRI)*, 222–29. Daegu, Korea (South): IEEE, 2019. https://doi.org/10.1109/HRI.2019.8673307.

[3] Mott, Terran, Alexandra Bejarano, and Tom Williams. "Robot Co-Design Can Help Us Engage Child Stakeholders in Ethical Reflection." In *Proceedings of the 2022 ACM/IEEE International Conference on Human-Robot Interaction*, 14–23. HRI '22. Sapporo, Hokkaido, Japan: IEEE Press, 2022.

[4] Roussos, Gina, and Yarrow Dunham. "The Development of Stereotype Content: The Use of Warmth and Competence in Assessing Social Groups." *Journal of Experimental Child Psychology* 141 (January 2016): 133–44. https://doi.org/10.1016/j.jecp.2015.08.009.

[5] Hourcade, Juan Pablo. 2020. *Child-Computer Interaction*. Self, Iowa City, Iowa.