BEING IN THE MINORITY: HOW GENDER (UNDER)REPRESENTATION INFLUENCES CHILDREN’S REASONING ABOUT GROUP DYNAMICS

by

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

in

THE FACULTY OF GRADUATE AND POSTDOCTORAL STUDIES

(Psychology)

THE UNIVERSITY OF BRITISH COLUMBIA

(Vancouver)

August 2023

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Being in the minority: how gender (under)representation influences children’s reasoning about group dynamics

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the degree of Master of Arts
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Abstract

The imbalanced representation of gender in Science, Technology, Engineering, and Math (STEM) disciplines functions as a barrier for women and gender equality. Prior research has identified stereotypes about gender roles, status, ability, and belongingness as some factors that hinder many STEM fields from reaching gender parity. In particular, women are perceived to be less agentic, to pursue lower-status occupations, and to lack brilliance and ability to succeed in STEM. Subsequently, women feel a lower sense of belonging than their male peers as underrepresented members. While these factors perpetuate the consequences of gender imbalance in these domains, there is also evidence of the early acquisition of gender stereotypes surrounding STEM abilities and interests in childhood. Specifically, children around age 6 make judgments about girls’ intellectual abilities and interests that are reflected in many gender-imbalanced domains. As a result, girls are discouraged from pursuing and engaging in STEM from a young age, which ultimately contribute to the pipeline problem. Nonetheless, it remains an open question whether children make similar inferences about other non-stereotyped domains. Therefore, I examine whether the gender (under)representation of groups shapes children’s inferences about the ability, inclusion, and social fit of minority members, even in STEM-neutral contexts. I also investigate whether the gender composition of groups influence how children reason about leadership. The findings suggest that 5-11-year-old children consider gender representation in groups to infer about the minority targets’ sense of belonging, to rectify gender disparity in groups, and to make leadership judgments. Taken together, this provides some initial evidence that children are sensitive to the social consequences of minority (and majority) status in groups.
Lay Summary

Women are underrepresented in Science, Technology, Engineering, and Math (STEM) domains. While the negative stereotypes about women’s competence and ability influence women’s interests and sense of belonging in many male-dominated fields, developmental research also finds children acquire similar gender stereotypes around 5-6 years of age, contributing to the pipeline problem. However, it remains an open question whether children reason about group dynamics merely based on the gender imbalance even in nonstereotyped domains, and what children intuit about being in the minority in a group. The current study offers some initial evidence that 5-11-year-old children consider gender representation in groups to infer about the minority targets’ sense of belonging, to promote gender equal representations in groups, as well as to make leadership judgments. Taken together, these findings suggest young children are sensitive to the social consequences of minority (and majority) status in groups.
Preface

This thesis is original, unpublished, independent work by the author, J. J. Lee.

The present research was approved by the University of British Columbia’s Behavioral Research Ethics Board (Title: “Social Cognitive Development Study”, Ethics ID: H10-00147-A040).
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Acknowledgements

I would like to express my sincere gratitude to my supervisor, Dr. Andrew Baron, for his guidance and mentorship. I am grateful to be part of his lab and to learn in a positive and supportive environment. I would also like to thank Dr. Susan Birch and Dr. Kiley Hamlin for serving on my committee and for their valuable feedback.

I would like to thank all the participating families for their time and the Living Lab Research Assistants for making this research possible.

I am grateful to share this academic journey with my lab twin and friend, Cameron Hall. Thank you for your support and encouragement.

My deepest thanks to my family and partner Zach Rollin for their love, encouragement, and unwavering support. Thank you for always believing in me.
Introduction

While the imbalance in gender representation in Science, Technology, Engineering, and Math (STEM) is well-documented, there also is a variation of female representation across different disciplines of STEM. In 2020, for instance, more than half of doctorate degree recipients in the United States were women in life (55.8%) and biological sciences (53.8%), whereas women only accounted for 19.0% in physics and 24.9% in mathematics and computer sciences (National Center for Science and Engineering Statistics, 2021). Although the number of women in STEM continues to increase in the U.S. and Canada (National Center for Science and Engineering Statistics, 2021; Statistics Canada, 2016), it will undoubtedly take time before we see significant changes to the proportion of women in STEM careers. In investigating the causes and consequences of this gender imbalance, prior research has much focused on the stereotypes about gender roles, status, ability, and belongingness as some of the key aspects hindering many STEM occupations from reaching gender parity.

Causes of Gender Imbalance in STEM

To begin with, social values around agency and communion provide some insight into how gender norms and stereotypes in STEM are highlighted with the gender imbalance in these fields. Agency refers to goal-achievement through competence, assertiveness, and ambition, while communion emphasizes social relationships with compassion and kindness (Sczesny et al., 2019, p. 103). These values have been deeply ingrained in cultural gender norms, where men are and should be dominant and competitive, and women are and should be kind and compassionate (Eagly et al., 2020; Sczesny et al., 2019, p. 104). Therefore, research finds women are overrepresented in careers that are “people-oriented” requiring social skills and interpersonal
interactions, whereas men are overrepresented in careers that are “things-oriented” requiring analytical and agentic skills (Eagly, 2021; Sczesny et al., 2019, p. 105). As such, the contrast between gender stereotypes about agency versus communion seems to predominantly contribute to the persistent gender imbalance in STEM.

As STEM careers are more associated with agency than communion (Stout et al., 2016; Carli et al., 2016), there is essentially a mismatch between the gender stereotypes of women and occupational stereotypes of scientists. For instance, a study investigating how people associate agentic versus communal traits with women, men, and “successful” scientists reveals a strong overlap between men and successful scientists, suggesting that men are perceived to be more similar to scientists than women (Carli et al., 2016). Similarly, agency has consistently been attributed to men throughout history, whereas communion has largely been considered a feminine trait, even increasingly so over time (Eagly et al., 2020). As long as women are perceived as communal, they continue to not be associated with science (Carli et al., 2016), because they are seen as lacking one of the main qualities to be successful in STEM occupations – agency. The incongruency between women’s gender roles and science as an agentic field therefore signals that women are not or cannot be scientists.

In addition, perceptions of different disciplines are shaped by gender proportions in these occupations. For example, Light and colleagues (2022) directly tested how the gender representation in science fields influenced whether it was considered to be “hard” or “soft” science. In the study, four disciplines in social sciences (e.g., economics, psychology, political science, and sociology) and four disciplines in engineering and physical sciences (e.g., computer science, biomedical science, earth science, and civil engineering) were described to participants as either mainly occupied by women or men. When a STEM field was described to be majority-
women, it was more likely to be categorized as a “soft” science as opposed to a “hard” science (Light et al., 2022). Likewise, the more women there are in a science field, the more communal it is perceived to be (Carli et al., 2016). Women’s representation clearly shapes how a field is perceived, further influencing women’s participation in disciplines that are considered incompatible with the gender stereotype about communion.

To discuss the causes of gender imbalance in STEM, it is also crucial to consider the other end of the spectrum – female-dominated Healthcare, Early Education, and Domestic (HEED) careers, and the key difference between the two types of fields. As noted by Eagly (2021), this horizontal segregation of the workforce is closely tied to the stereotypes around gender roles. For example, women are overrepresented in careers that require social skills and communal goals, namely HEED occupations, but men are overrepresented in fields that are competitive, and require analytical and technical skills, such as STEM. Therefore, the skillsets required in these contrasting fields directly portray the gender stereotypes that traditionally and consistently associate communion (e.g., working with and for others) with women, simultaneously linking agency (e.g., self-direction and independence) with men (Eagly et al., 2020). As such, the horizontal segregation of the workforce is perpetuated by the corresponding prerequisites for these occupations and the stereotypes around gender roles.

The idea of agency and communion can nonetheless be used to promote gender parity. For example, Stout and colleagues (2016) surveyed college students about how physical-STEM and behavioral science courses would align with their career goals of agency or communion, and tracked students’ course registrations throughout their undergraduate years. Not surprisingly, there were more male students pursuing physical-STEM courses and more female students taking behavioral science courses. However, the gender imbalance in course registrations
vanished for female students who perceived physical-STEM courses to provide opportunities for communal goals and for male students who perceived high opportunities for agency goals in behavioral science courses. In sum, while there is a strong correlation between stereotypes about gender roles and scientific fields that dissuades women specifically from partaking in STEM, those stereotypes can also be used to rectify the gender disparity in many STEM fields by capitalizing on what women see consistent with their gender roles.

**Consequences of Women’s Underrepresentation in STEM**

Research also suggests that the status perception of careers can influence the gender imbalance in STEM. In particular, male-dominated fields are valued more and seen as significantly higher status than their counterparts where women are predominant (Schmader et al., 2001; Block et al., 2019). For instance, the mere perception of increased participation of women in a STEM field is sufficient to label it as a “soft” science (as opposed to a “hard” science), which is then associated with less value and rigor, as well as less worthy of funding (Light et al., 2022). Similarly, Touhey (1974a, 1974b) finds lower ratings of prestige and desirability with increasing proportions of women in a profession, whereas higher ratings of prestige and desirability are attributed to a career with increasing proportions of men. Male-dominated careers also earn higher salaries than female-dominated careers (Block et al., 2019). This leads to a vertical segregation of the workforce where high-status positions are occupied by men (Eagly, 2021). As a result, there is stronger societal support for women to ascend to high-status careers in male-dominated fields, compared to men’s inclusion in female-dominated domains (Block et al., 2019).
While the status differences of gender are evidently reflected in the gender disparity in various STEM disciplines, it is important to note additional barriers women face in participating and succeeding in male-dominated occupations. In fact, the varying gender representation also seems to be linked to stereotypes about brilliance, such that women are underrepresented in domains where innate genius and natural talent are considered necessary to succeed (Leslie and Cimpian et al., 2015; Meyer et al., 2015). Indeed, a lack of ability is considered a significant factor in women’s underrepresentation in male-dominated domains (Block et al., 2019). As women are often stereotyped to be less brilliant than men, this gender bias therefore becomes especially problematic when women are discouraged from pursuing fields highly associated with innate brilliance (Meyer et al., 2015).

Gender stereotypes about STEM abilities and achievements also contribute to women’s lower self-efficacy in these stereotyped domains. In a study examining the relationship between social belongingness expectations, self-efficacy beliefs (i.e., believing one has the ability to succeed in a field) and interest in different majors, high school students’ expectations of belongingness in STEM majors were strongly correlated with both self-efficacy beliefs and interest levels (Tellhed et al., 2017). This suggests that students believed they would succeed and showed greater interests in a field they perceived to belong. Considering gender proportions of different majors, all participants expected greater belongingness in fields dominated by their gender ingroup. Thus, expectedly, women in the study showed significantly lower belonging, self-efficacy, and interest levels in STEM than men (Tellhed et al., 2017).

As seen above, women feel a lower sense of belongingness in STEM where women are underrepresented, which directly influences their interests and competence beliefs in those disciplines. Cheryan and colleagues (2017) outline these contributing factors to the continued
gender gap in STEM engagement as the “masculine culture of the fields”. The main consequence of the masculine culture for women revolves around social identity threat, defined as the concerns underrepresented individuals have in regard to how they are perceived in a group – whether they are stereotyped as inferior or devalued (Steele et al., 2002). Indeed, women in STEM report more identity threat following interactions with male counterparts that signal lack of acceptance and competence (Hall et al., 2015, 2019). The distinct experience leads to mental exhaustion and burnout in women who encounter daily social identity threat in their STEM workplace (Hall et al., 2015, 2019). The struggles women face in male-dominated careers and the masculine culture clearly persist beyond entry into these domains and have downstream consequences that perpetuate women’s underrepresentation.

Early Development of Gender Stereotypes in STEM

While the consequences of gender imbalance in STEM are fully present by young adulthood, it is also important to consider whether children are also impacted by the gender stereotypes and disparities in STEM. Investigating whether children have intuitions based on gender representations before they settle on academic and professional career pathways could help identify the origins and developmental trajectories of many harmful stereotypes that could limit children, especially girls, from exploring and achieving success in STEM fields. The initial timepoint in which these stereotypes develop may also help inform the creation of early interventions to attenuate future gender imbalances in STEM careers.

Indeed, developmental research finds children also have stereotypes that reflect these gender disparities (Heck et al., 2021), suggesting an early acquisition of gender stereotypes around science. Namely, a meta-analysis analyzing the development of gender-science
stereotypes using a “draw-a-scientist” task spanning from 1965 to 2015 reveals children of all ages (kindergarten to grade 12) largely associate science with (White) men (Miller et al., 2018). Although children’s drawings have become more diverse in recent years (i.e., depicting more female scientists), both girls and boys tend to draw male scientists as they get older (Miller et al., 2018). This suggests that the “science = male” stereotype is formed by 6 years of age and perhaps solidifies throughout development.

In addition, children show similar perceptions of occupational status as do adults. Specifically, occupations traditionally held by men are seen as high-status compared to those traditionally held by women. Similar to adults, 6-11-year-old children consider familiar jobs that are often occupied by men to be higher status, and by 11 years of age, children perceive novel jobs occupied by men to be higher status (Liben et al., 2001). Moreover, 5-10-year-old children rate male-dominated careers such as pilots, scientists, lawyers, and doctors as having more wealth (i.e., defined as “money” in the study) and status (i.e., defined as “power”) than female-dominated occupations such as nurses, elementary school teachers, social workers, and librarians (Weisgram et al., 2010). Therefore, children’s status beliefs of careers linked to gender representations develop around the time they start formal schooling, where men are seen as occupying higher status careers.

Furthermore, there is evidence children’s gendered beliefs about ability and brilliance are formed by 6 years of age. In a study testing when children begin to associate males and females with “being smart” (i.e., an agentic and masculine trait), children aged 5-7 were given a series of tasks where they had to pick which gender was “really, really smart” (Bian et al., 2017). The researchers found children were more likely to associate being “really, really smart” with males by 6 years of age. Surprisingly, this was driven by girls’ decreasing perceptions of own-gender
brilliance between ages 5 and 6, despite girls still believing girls were more likely to achieve higher grades in school than boys. In addition, these stereotypes about intelligence shaped children’s choices of activities when they were introduced to a novel game “for children who [were] really, really smart”. Although 5-year-old girls were equally interested in the “smart game” as 5-year-old boys, 6-7-year-old girls were less interested to try the game they associated less with their own gender (Bian et al., 2017). Therefore, not only does the stereotype about males and brilliance emerge early in development, but it also affects young children’s, especially girls’, interests in pursuing an activity that seemingly requires a quality their own gender is not afforded with.

Indeed, interest levels seem to be a key contributing factor to gender disparities in STEM engagement in childhood, insomuch that stereotypes about interest dissuade young girls from pursuing stereotypically male or male-dominated activities. For instance, when directly asked how much girls or boys would be interested in computer science and engineering, children as young as 6 respond girls are less interested in these subjects than boys (Master et al., 2021). Moreover, girls’ choices for novel activities are influenced by stereotypes about interests, where girls are significantly less likely to try the activity described as “girls are much less interested than boys” compared to the activity that is not paired with a gender stereotype (e.g., “girls and boys are equally as interested” (Master et al., 2021). These results therefore suggest that the gender-interest stereotypes about STEM fields may directly impact girls’ pursuits and engagement, where girls avoid activities or domains in which they feel a lower sense of belongingness (Master et al., 2021). In other words, stereotypes about which gender is less interested result in the said-gender indeed being less interested in pursuing an activity, potentially because of an anticipated lower belongingness and fit during engagement. Considering these gender-interest
stereotypes are endorsed throughout childhood and adolescence (Grades 1–12), they raise a critical question about the relation between gender (under)representation and perceptions of interest, belongingness and fit in childhood.

**Current Study**

In the proposed study, I seek to examine what children infer about the underrepresentation of gender, in particular, about the minority status in a group. I explore these questions in 5-11-year-old children as prior research indicates many gendered beliefs and consequences surrounding gender disparities in STEM arise between 5-6 years of age (Bian et al., 2017; Master et al., 2021; Miller et al., 2018). However, it remains an open question whether stereotypes based on the gender compositions of various domains influence children’s intuitions of who can and cannot engage in these gender-imbalanced domains. Therefore, I investigate whether the gender (under)representation itself shapes inferences about the ability, inclusion, and fit of minority members, even in STEM-neutral contexts. The broader goal of the study pertains to determining whether the intuitions children have based on gender representation function as a further barrier to gender equality.

**Hypotheses**

I hypothesize that varying gender representations will shape how children view (1) competence of target members, (2) inclusive attitudes of groups, (3) fit and belonging of target members, (4) preferences to join groups with different gender makeup, and (5) leadership judgments.
First, I hypothesize that higher ratings of competence will be attributed to the female target from the male-majority group compared to the male target from the female-majority group or the female member from the gender-balanced group, based on past research showing that a female-minority scientist in an all-male group was most likely to be perceived as smart (than hardworking) by children as young as 4 (Kumar et al., 2023).

Second, I hypothesize that children will expect members of their group to be less inclusive when a target individual is in the minority, based on research with adults on how underrepresented members often struggle with acceptance from their groups (Hall et al., 2015, 2019).

Third, I hypothesize children will attribute lower social fit and belongingness to the gender-minority targets, as there is evidence of underrepresented members expecting lower sense of belonging in social groups (Tellhed, 2017; Master et al., 2021).

Fourth, when asked to assign a new member to either the gender-balanced or -imbalanced groups, I hypothesize children will assign the new member to the gender-imbalanced group in attempt to promote gender equality in the imbalanced group, as supported by children’s tendency to rectify structurally based inequalities (Rizzo et al., 2020; Rizzo & Killen, 2020). On the other hand, I predict children will choose to join the group with more gender ingroup members when asked about their own preference, in line with young children’s tendency to prefer gender-ingroup individuals (Shutts et al., 2010).

Finally, I predict that children’s leadership judgments will change with age and be modified by children’s own gender identity. Prior research on children’s understanding of gender-based status finds while boys show an increased tendency to rate their own gender to be high-status with age, girls do not show the same pattern (Mandalaywala et al., 2020). Thus, I
predict that boys will consistently pick a gender-ingroup character to be the leader, whereas older girls especially will not favor an ingroup character for leadership.

**Method**

*Participants*

Children aged 5-11 ($N = 272; M_{age} = 8.32, SD = 2.04$) were recruited from and tested at a community-based science centre in Vancouver, BC. I tested two age group: 5-7-years-old ($N = 136; M_{age} = 6.45, SD = 0.80$), and 9-11-years-old ($N = 136; M_{age} = 10.19, SD = 0.82$), with an equal number of girls and boys in both age groups. Parents and/or legal guardians provided written consent and completed a demographic questionnaire containing children’s date of birth, language exposure, and gender and ethnic identities. The final sample included 103 White or Caucasian, 74 East Asian, 36 Multiracial, 20 South Asian, 10 Southeast Asian, 6 Latinx or Hispanic, 5 Indigenous, 4 Middle Eastern, 3 Black or African Canadian, and 1 Caribbean children, as well as 4 children whose parents indicated “other”, and 6 children whose ethnic identity was not reported. All children provided verbal assent and received a sticker for participating.

*Study Design and Procedure*

All study materials were designed in *Microsoft PowerPoint* and coded in *Inquisit V5*, which the study was run, on a Mac computer.

*Group introduction.* Before proceeding with the study, the participants were told the researcher would read a story on a computer. The participants were presented with diverse cartoon drawings of 16 children and were told these children were at a day camp. Then, the
participants were told these children wanted to play a novel game called *Toma* where they “worked in groups to create Tomas from special materials hidden throughout the camp”. The researcher told the participants that these children were assigned groups based on the order they arrived at camp to signal random assignment to groups. The two groups were labeled *Triangle* and *Circle Groups*. The *Triangle Group* depicted a gender-balanced group with 4 girls and 4 boys, and the *Circle Group* showed a gender-imbalanced group. Half of the participants saw the gender-imbalanced group with 2 girls with 6 boys, and the other half saw the gender-imbalanced group with 2 boys and 6 girls. As such, depending on the participants’ gender identity (as defined by the demographic form parents completed), half of the participants were presented with a group where their own-gender was in the minority, while the other half of our participants saw a group where their own-gender was in the majority.

*Target introduction.* The participants were randomly assigned to either girl-target or boy-target conditions. The participants were then introduced to one target agent from each group, who were gender-matched with each other, not to the participant. Thus, there were four different variations of the study: girl participants in girl-target condition, girl participants in boy-target condition, boy participants in girl-target condition, and boy participants in boy-target condition. This design allowed for analyzing whether children’s intuitions about group dynamics differed not only by their own gender identity, but also by which gender was in the minority.

*Test.* The participants were then asked a series of questions on the following domains: competence, inclusion, fit, group preferences, and leadership.

*Competence.* To measure how children reasoned about target agents’ competence, the participants were asked six questions in total. The first two items asked the participants to rate how “good” each group (presented one at a time) thought their target agent would be at the novel
game *Toma* on a 5-point Likert scale (e.g., 1 = not at all, 5 = very good). The next question showed both the gender-balanced and -imbalanced groups together and asked which of the two targets struggled to learn the rules of *Toma*, and how much the target struggled (a little versus a lot). The next item probed which target was better at helping their group re-focus on *Toma* when they feel tired, and how good the target would be (a little versus very good). Then, the participants were asked to choose which of the target members was not listened to by their group. Finally, the participants were asked whether the gender-balanced or -imbalanced group won a prize for creating more *Tomas*. These four questions were transformed into a composite score ranging from -6 to 6, where positive scores meant children perceived greater competence for the target in the gender-balanced group. On the other hand, negative scores indicated that the participants perceived the target from the gender-imbalanced group to be more competent.

**Inclusion.** To measure inclusion, children indicated whether the group would be disappointed if the target member was absent (e.g., “On the third day of camp, [the target agent] was not feeling well and stayed home. Was the Triangle/Circle Group disappointed? How disappointed?”), and whether the group would still want to engage in a group activity without the target member (e.g., “Did the Triangle/Circle Group still want to play *Toma* without [the target agent]? How much?”). The responses were coded on a 5-point Likert scale ranging from 0 to 4, with higher scores indicating more inclusion. Moreover, children were asked to choose a group would be less inclusive towards the target members in a force-choice manner (e.g., “Which group do you think forgot to invite their member to a party after camp ended?”). There were five questions total in the inclusion domain.

**Social fit – similarity.** To measure how similar children perceived the target agent to be to other members of their group, they were asked to rate the targets’ similarity to the group on a 5-
point Likert scale, ranging from 1 = not at all to 5 = very similar (e.g., “[Target] shared what she/he likes to do in her/his free time. How much do you think other people in the Triangle/Circle Group enjoy doing the same things?”). This question was asked of each group one at a time.

*Social fit – belonging.* To examine whether children had intuitions about belonging in a group, I presented the gender-balanced and -imbalanced groups side-by-side. I then asked two questions in a force-choice paradigm. First, children were instructed to choose which target member would get along well with others in their group. The responses choosing the target member from the gender-balanced group were given a score of 1, while responses choosing the target member from the gender-imbalanced group were given a score of 0. The second question asked which target member was considering switching groups. The responses were reverse-coded such that the target from the gender-balanced group was scored as 0 and the target from the gender-imbalanced group was coded as 1. These two scores were then added to create a composite score ranging from 0 to 2, where 2 meant the gender-balanced group was perceived to be where the target would feel more belongingness in the group.

*Group preferences for self.* Children were presented with the two groups side-by-side and were asked to choose whether they would prefer to join the gender-balanced or -imbalanced group (e.g., “If you were at this camp too, which group would you want to join?”). Since half of the children saw the gender-imbalanced group with 2 girls and 6 boys, and the other half saw the group with 2 boys and 6 girls, children’s responses were analyzed in terms of their preferences to join a group with more gender ingroup members. Specifically, children’s responses were given a score of 1 when they chose to join the group depicting more characters of their own gender. For example, a boy participant who chooses the gender-balanced group over the gender-imbalanced
group with 2 boys and 6 girls was given a score of 1 for preferring the group with more gender ingroup members. On the other hand, a boy participant who chose the gender-balanced group with 4 boys compared to the gender-imbalanced group of 2 girls and 6 boys was given a score of 0.

Third-party group choice. Participants were also prompted to assign a new member to one of the two groups: gender-balanced or gender-imbalanced. The participants were asked, “Mel (girl character) / Sam (boy character) arrived late to camp and has to pick a group to join. Which group do you think Mel/Sam will pick?”. The gender of the new member matched the minority gender in the gender-imbalanced group. These responses were analyzed as count data.

Leadership. To examine whether children’s leadership judgments were shaped by the gender composition of groups, they were instructed to pick an individual from each group to be a leader for their group. Children were told, “For the next round of Toma, each group has to decide who they want as their captain. Who do you think will be picked as the captain for the Triangle/Circle Group?”. The groups were presented one at a time. Children’s responses were analyzed as count data.

Results

Competence

Competence was measured in two ways. First, to measure whether children think that a minority group member will be judged as less competent (compared with a target who is from a gender-balanced group), participants were asked to rate how “good” each group thought their target member would be at the novel game Toma. A repeated-measures ANOVA with participant gender and target gender as between-subjects factors, competence of targets as a within-subjects
factor, and age as a covariate revealed a marginal effect of participant gender ($F(1, 267) = 3.60$, $p = .059$). Female participants rated the target member to be slightly more competent ($M = 3.69$, $SD = 1.00$) than did male participants ($M = 3.50$, $SD = 1.13$), regardless of targets’ gender or the group they were a part of (see Figure 1). No other main effects or interactions were observed ($F(1, 267) = 0.76$, $p = .39$) (Figure 2).

Competence was also assessed through a series of questions probing competence perception of the target members where both groups were presented together. The responses were then converted to a composite score ranging from -6 to 6 with higher absolute values indicating higher perceived competence levels. Positive composite scores meant participants rated the target character from the gender-balanced group to be more competent, while negative scores meant the target from the gender-imbalanced group (i.e., gender-minority target) was rated as more competent. An ANCOVA with target gender and participants’ gender as fixed factors and age as a covariate revealed no significant main effects or interactions ($F(1, 263) = 0.24$, $p = .62$). Overall, these data suggest that targets were perceived to be similarly competent regardless of their gender or their status as a minority (or majority) member (see Figure 3).

**Inclusion**

To measure inclusion, participants indicated whether the group would be disappointed if the target member was absent, and whether the group would still want to engage in a group activity without the target member. A repeated-measures ANOVA with participant gender and target gender as between-subjects factors, inclusion levels in targets’ groups as within-subjects factor, and age as a covariate revealed no significant main effects or interactions ($F(1, 262) = $
0.65, \( p = .49 \)). This suggested that both groups were seen as equally inclusive towards all targets (see Figure 4).

Participants were also instructed to pick a group that would be more inclusive towards the target members in a force-choice manner. A logistic regression model analyzing the relationship between participant gender, target gender, age and children’s perception of inclusion levels revealed no significant relationships between the variables (\( ps > .05 \)). Taken together, data from both measures suggest that children’s judgments of inclusions were not influenced by the gender (under)representation of group members.

**Social Fit with the Group**

**Similarity.** A repeated-measures ANOVA with participant gender and target gender as between-subjects factors, fit perception in targets’ groups as a within-subjects factor, and age as a covariate revealed a marginal effect of participant gender (\( F(1, 267) = 3.28, p = .071 \)). Female participants attributed marginally more social fit to the target (\( M = 3.60, SD = 1.07 \)) than did male participants (\( M = 3.40, SD = 1.28 \)), regardless of targets’ gender or the group they were a part of (Figure 5). There were no other significant main effects or interactions (\( F(1, 267) = 2.98, p = .12 \)). In general, children’s intuitions about the target agents’ similarity to their groups were not shaped by their status as the majority versus minority, where all targets were perceived to be equally fitting in (see Figure 6).

**Belonging.** An ANCOVA with target gender and participants’ gender as fixed factors, and age as a covariate revealed a marginal effect of target gender (\( F(1, 266) = 3.50, p = .063 \)), and a marginal effect of participant gender (\( F(1, 266) = 3.68, p = .056 \)). Female targets were seen as belonging slightly more to the gender-balanced group (\( M = 1.19, SD = 0.07 \)) compared to
male targets ($M = 1.00, SD = 0.07$) (Figure 7), and male participants perceived higher belongingness in gender-balanced group ($M = 1.19, SD = 0.07$) than female participants ($M = 0.99, SD = 0.07$) (Figure 8). Overall, children’s perceptions of belongingness did not differ drastically by the gender composition of the two groups, nor by the gender of the targets, where all targets were perceived to be equally belonging to their groups by all participants ($F(1, 266) = 0.27, p = .54$) (see Figure 9).

**Group Preferences**

*Group choice for self.* When choosing between the gender-balance group and gender-imbalance group with more own-gender characters, although not significant, children’s preference trended towards the group with 6 ingroup members (58.1% of children; $\chi^2(1, 136) = 3.56, p = .059$), regardless of their gender and age (Figure 10A). However, when presented with the group with the same number of girls and boys and the group with 2 own-gender characters, children chose both groups equally ($\chi^2(1, 136) = 1.06, p = .304$) (Figure 10B).

*Third party group choice.* Children were also asked to assign a new member to one of the groups. Whereas the new girl target was assigned equally at chance to either group ($\chi^2(1, 138) = 1.42, p = .233$) (Figure 11A), the new boy target was assigned to the gender-imbalanced group more (59.0% of the times) where he would be in the minority ($\chi^2(1, 134) = 4.30, p = .038$) (Figure 11B).

To address gender effects, I analyzed whether participants’ third-party group assignment differed by their own gender. Boy participants placed all target members to both groups at chance ($\chi^2(1, 136) = 0.47, p = .493$). However, girl participants assigned the new boy target to the gender-imbalanced group 62.7% of the times, which was significantly higher than chance.
(χ²(1, 69) = 4.31, p = .038), while assigning the new girl member to both groups at similar proportion (χ²(1, 67) = 3.26, p = .071).

Leadership

Gender biases. I first examined whether children exhibited gender biases when selecting a leader in a gender-balanced group. Overall, 70.6% of the participants chose an own-gender character for the leadership position (i.e., “captain”) when there was an equal representation of girls and boys in a group, significantly higher than chance (50%; χ²(1, 272) = 46.12, p < .001) (Figure 12B). There were no gender or age effects, such that both girls and boys chose their own-gender characters greater than chance, regardless of age (girls: χ²(1, 136) = 30.12, p < .001, boys: χ²(1, 136) = 16.94, p < .001).

When making leadership judgments for a group where their own-gender was in the minority, 53.7% of the participants chose an own-gender character higher than chance (25%; χ²(1, 136) = 59.65, p < .001) (Figure 12A). This own-gender preference differed by participants’ age and gender. Whereas boy participants showed a significant gender ingroup preference regardless of age (67.2% of the times; χ²(1, 67) = 63.53, p < .001), only 5-7-year-old girls demonstrated this same pattern (52.9% of the times; χ²(1, 34) = 14.16, p < .001). Older girls (9-11-year-olds) were at chance when choosing own- versus other-gender characters for the leadership role (χ²(1, 35) = 0.24, p = .626) (see Figure 13).

When viewing a group where their own-gender was in the majority, 81.6% of children chose their own-gender characters, which was marginally higher than chance (75%; χ²(1, 136) = 3.18, p = .075) (Figure 12C). The tendency for ingroup preference was driven by participants’ gender identity. Although boy participants consistently chose boy characters significantly higher
than chance (89.9% of the times; $\chi^2(1, 69) = 8.12, p = .004$), girl participants were at chance ($\chi^2(1, 67) = 0.12, p = .724$) (see Figure 14). In other words, when boy characters were in the majority, boys selected a gender-ingroup character for the leadership role, but girls did not show the same pattern of ingroup preference when girl characters were in the majority in a group. Therefore, children’s leadership preferences were shaped by their own gender identity, as well as the gender representation of groups.

**Discussion**

This thesis investigated whether the underrepresentation of gender influences how 5-11-year-old children reason about minority (and majority) group members. After introducing children to two fictional groups, one where gender was balanced and one where gender was imbalanced, I subsequently analyzed children’s responses in five domains: competence, inclusion, fit and belonging, group preferences, and leadership judgments.

Several interesting findings were observed. First, children overall assessed the target members in gender-balanced versus -imbalanced groups to be similarly competent, regardless of the targets’ gender or their status as a minority (or majority) member. Children’s own gender marginally impacted how the targets were perceived, where girls rated them to be more competent than did boys. While this differed from my hypothesis, it is important to note the current study used a non-stereotyped novel activity called *Toma* to introduce the gender representation in the two groups. Thus, it is possible children may not have specific inferences about targets’ competence based on gender representation in the absence of pre-existing gender stereotypes. Children may have focused more on the gender composition itself to produce a more nuanced perception of targets’ competence levels. Furthermore, the minority targets’ gender did
not always match the participating children’s gender in the current study. It is also possible children at this age do not intuit strongly about an identity not related to their own.

Nonetheless, there is some evidence of children attributing different traits to target characters based on the status of their gender as a majority or minority member in a group. Kumar and colleagues (2023) presented a highly gender-stereotyped domain of STEM to young children aged 4-6.5 to highlight the gender homogeneity or imbalance in groups. Children were then instructed to make trait judgements (i.e., smart or hardworking) of a female scientist in an all-female group, a female scientist in an all-male group, a male scientist in an all-female group, or a male scientist in an all-male group. While the minority female scientist in an all-male group was more likely to be perceived as smart than hardworking, the female scientist in an all-female group as well as the male scientist in an all-male group (i.e., gender-majority scientists) were considered to be more hardworking than smart. Interestingly, the minority male scientist in an all-female group was equally as likely to be considered smart and hardworking (Kumar et al., 2023). These results together suggest young children track and consider the gender composition of a group to some degree when inferring about individuals’ competence and making trait attributions.

To better understand children’s competence perceptions in nonstereotyped domains, future studies can explore the level and harshness of feedback target characters receive from the group. For example, young children may expect harsher feedback to be directed at a minority female target if she is seen as less competent and intelligent than her male peers because of her gender (Bian et al., 2017). In contrast, if children consider the gender imbalance in groups mainly to determine one’s ability (Kumar et al., 2023), the smart female minority target may receive less harsher feedback. Further, the feedback measure may also provide an insight into the
consequences of these competence judgments on individuals’ perception of their own social identity (Hall et al., 2015, 2019). For instance, children may expect individuals whose competence are not repeatedly questioned by majority peers feel more fulfilled and confident, and that they can succeed in fields as minority members. Overall, it would be insightful to consider how underrepresented members maintain their positions and succeed in a group especially when their competence is in question.

Next, children judged groups’ inclusive attitudes toward the target members to be similar irrespective of the gender (under)representation of group members. However, female target characters were perceived as belonging more in their groups compared to male targets. Interestingly, only male participants, especially older boys (9-11-year-olds), rated targets would feel they belonged in the gender-balanced group more than the imbalanced group. This potentially suggests boys are more sensitive to being part of a group and interpreting the gender-balanced group as where individuals would feel more fit and belonging. This finding may be explained by research on masculinity norms in adolescent boys, where boys’ peer relations are sometimes negatively impacted because of the male gender norms on ostensible lack of vulnerability and emotions (Chu, 2005). Thus, older boys in the study may have viewed the group with equal gender representation more positively, though the marginal findings should be interpreted with caution. In general, the results suggest children distinguish groups’ inclusive attitudes and members’ belonging to these, as seen from the different inferences made for each of these domains.

Still, in the context of STEM where women continue to be underrepresented, women struggle with feelings of fit and belonging (Cheryan et al., 2017, 2009). To address this, some research has focused on increasing inclusivity signals to encourage many underrepresented
groups to engage in STEM beginning in childhood. Namely, since “scientists” as an identity has been more strongly associated with men (Miller et al., 2018), pitching science activities to underrepresented children (e.g., girls, children of color, or low socioeconomic status) using terms like “scientists” may in fact be counterproductive if these children do not envision themselves as “scientists” (Lei et al., 2019). Instead, an action-based language to describe science such as “doing science” that signals more inclusivity has been shown to improve children’s interests and efficacy beliefs in science activities (Lei et al., 2019; Rhodes et al., 2020). The boost in interests and efficacy beliefs can often be seen through greater persistence on science tasks. Specifically, preschool aged girls are more likely to continue playing science games that require making predictions (e.g., smelling covered cups to guess the contents, or playing “Sink or Float game” to predict objects’ buoyancy) when these games are introduced to them as “doing” science as opposed to “being” scientists (Rhodes et al., 2019). These results demonstrate the importance of children’s, especially young girls’, internal sense of belonging in their pursuit of STEM.

In addition to increasing an internal motivation for STEM engagement, there is an external factor to inclusion that is essential in supplementing the sense of belonging and persistence for underrepresented members. To feel like they truly belong, underrepresented members also need to experience welcome and acceptance from the group. Therefore, I posit fostering allyship behavior as yet another critical factor in ensuring girls and women persevere in domains where they are in the minority and encounter various negative stereotypes. It may be particularly impactful for boys and men to support girls’ and women’s inclusion in STEM, given their position as well-represented and majority members (Steele et al., 2021). Nonetheless, as there are many levels of allyship actions (i.e., interpersonal, group-level, and organizational or institutional), interventions at various fronts would certainly yield more success in signaling
inclusion and thus, achieving gender equality in STEM fields. For example, altering some
elements in the physical space of a typical STEM environment can help women feel like they
belong. Specifically, merely removing objects that indicate male-stereotypical nature of a
workplace such as video games or science-fiction movie posters increases female students’
ambient belonging and subsequently, their interests in a highly male-dominated STEM domain
(Cheryan et al., 2009). Taken together, future research could explore what other subtle cues
beyond language used to describe science and physical objects in gender-imbalanced
environments might help foster allyship at large, especially in children.

Furthermore, children’s preference patterns differed when assigning themselves
compared to assigning a new character to one of the groups. Although children did not show a
strong gender-ingroup preference when deciding to join a group, they assigned male targets in
the gender-imbalanced group more than chance. With this new addition, the gender-imbalanced
group with 2 boys and 6 girls would now have 3 boys compared to the gender-balanced group
with 4 boys and 4 girls. This could be interpreted as children’s desire to “balance” the gender
differences between the two groups they were presented with. This may be explained by
children’s tendency to rectify resource inequities through equal distribution, as children as young
as 3 assess structurally based inequalities, compared to merit-based, to be more unfair (Rizzo et
al., 2020; Rizzo & Killen, 2020). Although gender-imbalanced representations in groups did not
relate to resource inequities in the current study, children may have interpreted the differences
between the two groups as a structurally based inequality. Thus, children may have attempted to
improve the gender underrepresentation by placing the new boy in the female-majority group.
However, as this pattern only emerged in the gender-imbalanced group where boys were in the
minority (and not in the other version where girls were in the minority), the findings are not conclusive.

While strong ingroup preferences were not displayed for group assignment, most children chose a gender-ingroup character for the leadership position “caption”. However, children’s leadership judgments were modified by their gender identities when presented with the gender-imbalanced group. When their own-gender was in the minority (2 own-gender vs. 6 other-gender), as predicted, boys showed an ingroup bias consistently throughout development, whereas only young girls (5-7-year-olds) in the current study chose a gender ingroup character for the leadership position. Children responded similarly when their own-gender was in the majority (6 own-gender vs. 2 other-gender), where boys strongly preferred a boy character to as the leader. However, girls were at chance choosing a gender ingroup even though there were more girl characters present. This pattern aligns with prior research on children’s developing understanding of social status based on gender. By 7 years of age, children start to associate various status dimensions (e.g., access to resources and decision-making power) less with girls (Mandalaywala et al., 2020). In particular, children aged 6-11 equate high-status positions (for both novel and familiar occupations) with men (Liben et al., 2001). The current study also observed a gender difference consistent with past work, where boys consistently judge their own-gender to be higher on social hierarchy, but girls do not at any point between ages 4-7 (Mandalaywala et al., 2020). Thus, 5-7-year-old girls’ representation of gender-based status aligned with that of the real-world, even in the absence of a broader social context. That is, despite the vagueness of choosing a “captain” for a novel activity, young girls’ leadership judgments reflected the broader gender-based status hierarchy, where men have more social power and occupy more highly regarded occupations.
To extend these findings, future work should also consider how children interpret “success” especially in the context of gender stereotypes and underrepresentation. As noted earlier, not only are there barriers hindering women’s pursuits of male-dominated domains, but women continuously face negative stereotypes as minority members beyond entry into these fields (Cheryan et al., 2017; Hall et al., 2015, 2018). Similarly, research also finds women experience greater imposter syndrome in academic fields that are perceived as requiring brilliance (Muradoglu et al., 2022). Thus, it would be worthwhile to consider whether children distinguish between overcoming the barrier to entry into gender-imbalanced disciplines with adjustments and belongingness in these domains after the fact. Although related, most research to date has focused on changing girls’ associations between gender and STEM to encourage girls to pursue the traditionally male-dominated domains, for example, even as the pipeline problem continues where less girls and women stay in STEM as they get older and advance in their education or careers (Steele et al., 2021). Therefore, future research should broadly investigate what children consider as “success” for traditionally underrepresented groups.

In general, intersectional identities should also be considered in future research when discussing other common under-representations in STEM. Accounting for intersectionality and incorporating diversity not only resemble the real-world better, but also reveal interesting patterns of responses in children. For instance, Jaxon, Lei, and colleagues (2019) explore how 5-6-year-old children acquire stereotypes about intelligence when presented with both race and gender identities. The study finds that children hold stereotypes across many dimensions, where (1) White men, but not Black men, are seen as brilliant, (2) Black women are considered to be more brilliant than Black men, and (3) all children associate White men with brilliance, irrespective of their own racial backgrounds (Jaxon and Lei et al., 2019). Moreover, recent
research finds racial/ethnic minority women in academia especially cope with imposter syndrome (Muradoglu et al., 2022). Clearly, there are consequences of the lack of diversity in many traditionally (White)male-dominated fields, namely, perceptions of who fits the prototype and sense of belonging. Therefore, it is important to acknowledge the diversity within “underrepresented groups” at large.

In conclusion, the current study explores children’s developing intuitions about the minority status. Specifically, I analyze whether the various gender compositions in groups shape how children reason about group dynamics. Overall, the study reveals some initial evidence that children consider gender representation when making inferences about targets’ belonging in groups, when presented with an opportunity to rectify the gender-imbalance, and when selecting leaders for each group. I also suggest several directions for future research, to gather additional evidence of young children’s growing sensitivity to group (under)representations, and to further identify and address some key aspects of the negative cycle discouraging minority individuals from engaging in many STEM fields.
Figure 1. Mean competence score by participant gender (1 = Not at all, 5 = Very good). Error bars show standard error.
Figure 2. Mean competence score of target member in each group (1 = Not at all, 5 = Very good). Error bars show standard error.
Figure 3. Competence perception of target member by participant gender. Positive values mean more competence is attributed to the gender-balanced group, negative values indicate more competence is attributed to the gender-imbalanced group. Error bars show standard error.
Figure 4. Mean inclusion score of target member in each group. Error bars show standard error.
Figure 5. Mean fit perception by participant gender (1 = Not at all, 5 = Very much).
Figure 6. Mean fit perception of target member in each group (1 = Not at all, 5 = Very much). Error bars show standard error.
Figure 7. Belonging perception of target member. Higher scores indicate more belongingness in the gender-balance group. Error bars show standard error.
Figure 8. Belonging perception by participant gender. Higher scores indicate more belongingness in the gender-balance group. Error bars show standard error.
Figure 9. Belonging perception of target member by participant gender. Higher scores indicate more belongingness in the gender-balance group. Error bars show standard error.
Figure 10. Group choice for self. Proportion of children choosing to join the group with more gender-ingroup members when presented with groups with 4 vs. 6 ingroup members (A), and when presented with groups with 2 vs. 4 ingroup members (B).
Figure 11. *Group assignment for a new third-party member.* The percentage of times the new girl target was assigned to the gender-imbalanced group (A), and the new boy target was assigned to the gender-imbalanced group (B), where they would be in the gender minority.
Figure 12. Proportion of children choosing an own-gender character for the leadership role, when their own-gender is in the minority (A), when the group is gender-balanced (B), and when their own-gender is in the majority (C). The group depictions above are from the perspective of girl participants, however, the chi-square analyses combine both girl and boy participants.
Figure 13. Proportion of children choosing an own-gender character for the leadership role when their own-gender is in the minority by participant gender and age group. Dotted line indicates chance (25%).
Figure 14. Proportion of children choosing an own-gender character for the leadership role when their own-gender is in the majority by participant gender and age group. Dotted line indicates chance (75%).
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