*Research Article*

# Walking in Her Shoes: Pretending to Be a Female Role Model Increases Young Girls' Persistence in Science

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## Abstract

Pretend play is a ubiquitous learning tool in early childhood, enabling children to explore possibilities outside of their current reality. Here, we demonstrate how pretend play can be leveraged to empower girls in scientific domains. American children ages 4 to 7 years ($N = 240$) played a challenging science activity in one of three conditions. Children in the exposure condition heard about a successful gender-matched scientist, children in the roleplay condition pretended to be that scientist, and children in the baseline condition did not receive information about the scientist. Girls in the roleplay condition, but not in the exposure condition, persisted longer in the science activity than girls in the baseline condition. Pretending to be the scientist equated girls' persistence to that of boys. These findings suggest that pretend play of role models motivates young girls in science and may help reduce gender gaps from their roots.

## Keywords

gender, STEM, role models, pretend play, persistence, open data, open materials

The best way of successfully acting a part is to be it.

—Arthur Conan Doyle (1913), *The Adventure of the Dying Detective*

Pretend play is a hallmark of child development. By donning the cape of a superhero, the dress of a princess, or the lab coat of a scientist, children temporarily disconnect from present reality to explore various "possible selves" (Lillard, 2017; Taylor et al., 2013). This transformation not only allows children to learn about the social and physical world (Sutherland & Friedman, 2013; Whitebread & O'Sullivan, 2012) but also promotes their cognitive functions (e.g., Carlson & White, 2013; White & Carlson, 2021) and helps them cope in aversive contexts (Lazarus & Abramovitz, 1962; Rubin & Livesay, 2006). The present study investigated whether pretend play can be used to empower children in the face of stereotyping and stigma (Master, 2021)—focusing on young girls in the domains of science, technology,

engineering, and mathematics (STEM). We propose that pretending to be a successful female scientist can increase girls' persistence and self-efficacy in science, nullifying gender gaps in early science engagement.

Although gender gaps in science manifest in full form during adulthood, recent research suggests that they emerge earlier in development than was previously assumed. By 6 years of age, children begin viewing scientists as White male figures (Chambers, 1983; Miller et al., 2018) and acquire stereotypes associating high levels of intellectual talent with men more than women (Bian et al., 2017). Crucially, these gender stereotypes may be detrimental for young girls' aspirations, dissuading them from many prestigious careers. For example, during the early elementary school years, girls become

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less interested in activities portrayed to require brilliance (Bian et al., 2017) and are more likely to disengage from science activities compared with boys (Rhodes et al., 2019). Girls' lower motivation in science cannot be explained by lower performance, as evident from their science grades in school, which are comparable with or even higher than boys' grades (Voyer & Voyer, 2014). Therefore, it is crucial to intervene at early stages of development to reduce gender gaps in science from their roots.

The present study focuses on the role of pretend play in promoting 4- to 7-year-old children's—especially girls'—persistence in science. Specifically, we explored whether encouraging girls and boys to pretend to be a gender-matched scientist would affect their persistence during a challenging science activity. Prior work with adults suggests that women may benefit from in-group role models (e.g., Dasgupta, 2011). Presenting STEM role models with whom women can identify effectively enhances their involvement in science (e.g., Buck et al., 2008; Stout et al., 2011). Yet women who view themselves as not sharing the characteristics of the presented science role models are likely to veer away from science (Cheryan et al., 2011, 2013). Because of this lack of identification, exposure to a science role model on its own may not suffice to empower young girls in science. However, pretend play may help girls identify with the role model and thus realize the benefits of exposure.

Pretend play is a common activity through which children experience new identities (Taylor et al., 2013). When children impersonate other people, they can flexibly integrate others' qualities within their own self-views and behave in line with these qualities (Karniol et al., 2011; White & Carlson, 2021; White et al., 2017). In a series of studies, White and Carlson (2016; White et al., 2017) found that children who pretended to be a competent fictional character (e.g., Batman) persisted longer on difficult tasks compared with children who did not pretend. The act of pretending further allows children to transcend current experiences and step away from situational distractions and obstacles, helping them cope in stressful or aversive situations (Lazarus & Abramovitz, 1962; Rubin & Livesay, 2006). Thus, in the context of our study, assuming a female scientist's identity via pretend play may increase girls' persistence in a domain in which their group is negatively stereotyped.

In sum, this study tested a novel and brief approach to promote girls' persistence in science by encouraging them to assume the identity of a successful female scientist. In addition to describing the scientist as successful, we highlighted her hardworking qualities. A growth mindset linking success to effort (rather than fixed abilities; Dweck, 2006) has been shown to

## Statement of Relevance

Women's pervasive underrepresentation in science, technology, engineering, and mathematics (STEM) is rooted in childhood. As early as the elementary school years, girls begin to shy away from science activities. The question of how to engage girls in science is of urgent practical importance, yet little research exists on ways to promote girls' participation in science before adolescence. The present study addresses this gap by testing a novel approach targeting children as young as 4 years. We encouraged girls to pretend to be a successful female scientist while playing a challenging science game and contrasted the effects of pretend play with mere exposure to the scientist. Our findings demonstrate that pretend play, but not mere exposure, increases girls' persistence in science. This research paves the way for establishing a simple and effective intervention to increase girls' involvement in STEM and reduce gender gaps as they emerge.

promote women's interest in STEM fields (e.g., Bian et al., 2018; Good et al., 2012; Smith et al., 2013). However, it is unclear from prior work whether mindset messages alone are enough to change girls' behavioral persistence or whether pretend play has benefits that go above and beyond these messages. Therefore, we contrasted children's baseline persistence in a science task (baseline condition) with their persistence during pretend play (roleplay condition) as well as with a condition in which girls were exposed to the same role model with the same growth mindset messages but were not asked to pretend (exposure condition). In a secondary outcome of interest, we assessed children's self-efficacy in science, given that self-efficacy shapes motivation (e.g., Bandura, 1993) and predicts gender gaps in representation (e.g., Bian et al., 2018). If the effects of pretending are specific to increasing motivation for science, then it should influence persistence above baseline and do so more than mere exposure to role models with growth mindset messages.

## Method

### Participants

Participants were 240 children (120 girls, 120 boys) ages 4 to 7 years ($M = 6.01$ years, $SD = 1.17$). We chose to focus on this age range because past work shows that it is a period when children acquire gender stereotypes

that steer girls away from science activities (e.g., Bian et al., 2017; Cvencek et al., 2011; Miller et al., 2018). Six participants were excluded from the sample because of an experimental mistake ($n = 3$), unwillingness to participate ($n = 2$), or technical problems with the video conferencing software ($n = 1$).

We planned to recruit 80 children per condition with an equal distribution of genders (girls, boys) and ages (4, 5, 6, 7 years). This sample size was comparable with that used in a previous study on a similar topic (Rhodes et al., 2019) and provided 80% power to detect a difference of approximately 50% in a participant's likelihood to disengage from the science activity in one condition, relative to a gender-matched participant in another condition (determined using an a priori power analysis for ratio of hazards; Chow et al., 2008). We stopped data collection when we reached the planned number of participants with valid responses. Because of an experimental error, one child participated in the baseline condition instead of the roleplay condition; thus, there were 81 children in the baseline condition, 80 in the exposure condition, and 79 in the roleplay condition.

Participants were recruited from the lab database and through advertisements in social media outlets and the Children Helping Science platform (childrenhelping-science.com). Eighty-six percent of parents provided demographic information. Of this subset, 75% identified as White, 16% as Asian, 5% as Hispanic/Latino, 3% as multiracial, 0.5% as African American, and 0.5% as another race. The median household income was $120,000, and 95% of families had at least one parent with a bachelor's degree or higher.

Participants were tested virtually over Zoom video conferencing software because of social distancing restrictions related to the COVID-19 pandemic. Families received a $5 gift card in appreciation for the child's participation. The procedure for this study was approved by Cornell University's Institutional Review Board, and written parental consent was obtained prior to testing.

## *Procedure*

Each child was randomly assigned to one of three conditions: baseline, exposure, or roleplay. Children in the baseline condition were first told that they were going to be scientists and play a science game. They received a brief explanation about what scientists do ("Scientists explore the world and discover new things. An important part of being a scientist is making predictions"; adapted from Rhodes et al., 2019). Children then proceeded to the science game measuring their persistence, followed by questions assessing their self-efficacy and motivation in science, presented in randomized order (see below).

The procedure for the exposure condition was identical to that of the baseline condition, with the exception that children were told about a gender-matched scientist before beginning the science game. We selected Marie Curie for girls and Isaac Newton for boys because both scientists were unfamiliar to most children,[1] thus minimizing the influence of prior knowledge on children's responses. Children heard a story about the scientist describing their success and persistence:

> *Dr. Marie Curie/Isaac Newton is a scientist that discovered really important stuff about the world! What is special about Dr. Marie/Isaac is that she/ he always worked really hard, even when things got tricky. And when she/he made mistakes, or her/ his predictions were wrong, she/he just kept on trying!*

Note that our manipulation involved only verbal descriptions of the role model. That is, children did not see a picture of the role model at any stage. We chose not to show children pictures of the role models because we did not want any aspect of the role models' physical appearance (e.g., skin color, hair, facial features/expression) to influence children's ability to identify with them, especially if children perceive those physical characteristics as different from their own. To ensure that children understood the crucial information presented in the story, the experimenter asked them two attention-check questions: "Does Dr. Marie/Dr. Isaac work hard, or does she/he not work hard?" and "When Dr. Marie/Dr. Isaac makes mistakes, does she/ he give up, or does she/he keep on trying?" Across these two questions, an average of 95.5% of children responded correctly.

The roleplay condition was identical to the exposure condition, except that in addition to learning about the gender-matched scientist, children were also asked to pretend to be the scientist during the science game ("For this game that we're going to play, I want you to pretend that you're the scientist Dr. Marie/Dr. Isaac. Pretending you are Dr. Marie/Dr. Isaac means that you imagine you're just like her/him!"). To facilitate the roleplay activity, we addressed children by the role model's name during the science game (e.g., "What's your prediction, Dr. Marie/Dr. Isaac?"), in contrast to the baseline and exposure conditions, in which we addressed children by their own name (e.g., "What's your prediction, [child's name]?"). Thus, throughout the science game, the only difference in script between the roleplay and exposure/baseline conditions was the use of the role model's name as opposed to the child's own name, ensuring an identical number of prompts across

conditions. To check the effectiveness of the roleplay instructions, we asked children in the roleplay condition two questions. Before beginning the science game, children in the roleplay condition were asked, "Who are you going to be in this game? Are you going to be [child's name], or are you going to be the scientist Dr. Marie/Dr. Isaac?" Seventy percent of children answered this question correctly. In addition, after participating in the science game, children in the roleplay condition were asked, "When you were playing the science game, did you feel you are the scientist Dr. Marie/Dr. Isaac?" Seventy-nine percent of children responded "yes" to this question. Thus, children's responses suggest that the roleplaying manipulation was successful for most children. In line with the recommended "intention-to-treat" approach to avoid overoptimistic estimations of an intervention's effectiveness (e.g., Gupta, 2011; Montori & Guyatt, 2001), we included all participants in the roleplay condition in our analyses.[2]

## Measures

**Persistence.** Following the introduction detailed above, children across conditions completed the science game "Sink or Float." This task has been used successfully to measure persistence in science in a previous study with children in our sample's age range (Rhodes et al., 2019). In this task, we presented children with a range of objects, one after another, and asked them to predict whether each object would sink or float when dropped in water. After each trial, children were told whether their response was correct ("Your prediction was right! It did float/sink!" followed by a green check mark) or incorrect ("Your prediction was wrong! It sank/floated!" followed by a red X). Children were relatively accurate in this task; on average, they responded correctly on 68% of trials. Analyses of the accuracy scores revealed no significant effect of gender, condition, or their interaction (see the Supplemental Material), suggesting that girls and boys were similarly accurate in the science game across conditions. After providing children with feedback, we gave them the choice to either continue to the next trial or "do something else" (procedure adapted from Rhodes et al., 2019). Children's persistence was operationalized as children's choice to keep playing the science game after each trial (as opposed to doing "something else") and could range from a minimum of one trial to a maximum of 50 trials.

Experimenters were trained to express similar levels of enthusiasm, encouragement, and engagement across conditions. This training was largely successful: Two independent coders coded the experimenters' behavior during the persistence task and found no condition differences, with the exception of higher average experimenter encouragement in the roleplay condition than in the baseline condition among boys only (see the Supplemental Material).

**Self-efficacy.** After completing the science game, children were asked two questions measuring their self-efficacy in science, presented in randomized order. One question addressed their self-efficacy in the science game ("How good are you at the science game: good, or not so good?") and the other question addressed their self-efficacy as scientists ("How good are you at being a scientist: good, or not so good?"). Following children's response to each of these questions ("good" vs. "not good"), they were presented with a child-friendly scale with three circles that increased in size and were asked, "Are you a little good/not good, good/not good, or really good/not good?" Responses could range from 0 (*really not good*) to 5 (*really good*).

**Self-reported motivation.** Children were asked, in random order, four questions adapted from the work by Bian et al. (2017) regarding their motivation in science: (a) "Do you like the science game or do you not like it?" (follow-up question: "Do you like/not like the science game a little, some, or a lot?" range = 0–5); (b) "How did playing the science game make you feel: happy or sad?" (follow-up question: "Did it make you a little happy/sad, happy/sad, or really happy/sad?" range = 0–5); (c) "Do you want to be a scientist when you grow up?" (follow-up question: "Do you want/not want to be a scientist a little, some, or a lot?" range = 0–3); and (d) "If you had a chance to do something tomorrow, would you play the science game, or would you do something else?" (score = 1 if they chose to play the game, 0 otherwise). Children's responses were standardized and averaged to create a single motivation score.

## Analytical plan

To examine the effect of condition on girls' and boys' persistence in the science game, we used survival curve analysis, with the *survival*, *survminer*, and *coxph* functions in the R programming environment (Version 4.04; R Core Team, 2021). Survival curve analysis has been used in psychological studies to examine persistence in both adult and child samples (e.g., McGuire & Kable, 2012; Rhodes et al., 2019), is suitable for data that do not follow a normal distribution (Cox & Oakes, 1984), and allows researchers to measure the probability of participants' choice to keep engaging (vs. to stop engaging) in an activity over time. In the context of our study, we used survival curve analysis to measure the probability of children choosing to continue playing the science game across 50 trials. Our model included

**Table 1.** Descriptive Statistics of Persistence Scores by Gender and Condition

| Gender | Baseline | | | Exposure | | | Roleplay | | |
|---|---|---|---|---|---|---|---|---|---|
| | *M* | *SD* | *Mdn* | *M* | *SD* | *Mdn* | *M* | *SD* | *Mdn* |
| Girls | 5.95 | 4.70 | 5 | 9.52 | 11.6 | 4 | 12.2 | 12.2 | 7 |
| Boys | 14.9 | 15.8 | 7.5 | 10.2 | 11.4 | 6 | 12.3 | 13.1 | 9 |

gender, condition, age (4–5 years vs. 6–7 years), and all their possible interactions as predictors, and overall accuracy rate (proportion of correct trials) as a control variable.[3]

We contrasted 4- to 5-year-olds with 6- to 7-year-olds because children seem to internalize and act on gender stereotypes about STEM around the age of 6 years (Bian et al., 2017; Cvencek et al., 2011). We had two competing hypotheses regarding age: Either the effect of condition would be more pronounced in older children, or children across the age span would be equally sensitive to and benefit from pretend play (e.g., White et al., 2017). To further examine the robustness of our findings, we supplemented these analyses with Wilcoxon rank-sum tests, which have been used in the past to examine persistence in young children (e.g., Leonard et al., 2021).

To probe the effect of condition on girls' and boys' self-efficacy and motivation, we ran two separate analyses of covariance (ANCOVA) for each one of these variables, with gender, condition, and their interaction as predictors, and overall accuracy rate as a control variable.

## Results

### *Persistence*

Our primary prediction was that the roleplay condition, but not the exposure condition, would increase girls' persistence in science compared with the baseline condition. The survival curve analysis revealed a significant main effect of gender on persistence in the science game; overall, girls persisted for fewer trials than boys, $\chi^2(1) = 5.08$, $p = .024$. This main effect was qualified by an interaction between gender and condition, $\chi^2(2) = 10.08$, $p = .006$. Follow-up pairwise comparisons using Tukey's honestly significant difference tests showed that, among girls, persistence in the roleplay condition ($\beta = 0.70$, 95% CI = [0.16, 1.24], $p = .006$), but not in the exposure condition ($\beta = 0.36$, 95% CI = [−0.18, 0.89], $p = .258$), was significantly higher than in the baseline condition (for descriptive statistics, see Table 1). Specifically, the roleplay condition decreased girls' likelihood to stop engaging in the science game by 51% (95% CI = [26.60%, 66.87%]). Thus, the roleplay condition,

but not the exposure condition, significantly increased girls' persistence in the science game. Persistence in the exposure condition versus the roleplay condition did not differ significantly ($\beta = 0.34$, 95% CI = [−0.19, 0.88], $p = .284$; see Fig. 1).

Among boys, persistence did not vary between the three conditions (roleplay vs. baseline: $\beta = −0.26$, 95% CI = [−0.79, 0.27], $p = .477$; exposure vs. baseline: $\beta = −0.47$, 95% CI = [−1.01, 0.07], $p = .105$; and exposure vs. roleplay: $\beta = 0.20$, 95% CI = [−0.33, 0.73], $p = .641$), presumably because boys were highly persistent in the science game to begin with (see Fig. 1).

There was also a main effect of age—older children persisted for more trials than younger children, $\chi^2(1) = 4.16$, $p = .041$—and an age-by-gender interaction, $\chi^2(1) = 4.90$, $p = .027$. Specifically, older (vs. younger) boys ($\beta = 0.56$, 95% CI = [0.20, 0.93], $p = .003$), but not older (vs. younger) girls ($\beta = −0.02$, 95% CI = [−0.39, 0.35], $p = .916$), persisted for more trials. However, there was no three-way interaction between gender, condition, and age, $\chi^2(2) = 1.70$, $p = .426$, suggesting that age did not moderate the condition effects on girls' or boys' persistence in science.

In a second step, we compared girls' persistence in each condition with boys' persistence in the baseline condition to examine whether either of the experimental conditions was successful in closing the gender gap in persistence. We applied Bonferroni correction to account for multiple comparisons. Relative to boys' baseline persistence, girls' persistence was significantly lower in the baseline condition ($\beta = −0.89$, 95% CI = [−1.35, −0.44], $p < .001$) and marginally lower in the exposure condition ($\beta = −0.53$, 95% CI = [−0.98, −0.09], $p = .059$). However, girls' persistence in the roleplay condition was statistically equivalent to boys' baseline persistence ($\beta = −0.19$, 95% CI = [−0.64, 0.26], $p = 1.00$).

The robustness of these results was confirmed using Wilcoxon rank-sum tests (all reported $p$ values are Bonferroni corrected): Compared with the baseline, girls in the roleplay condition ($W = 487.5$, $p = .008$), but not in the exposure condition ($W = 784.5$, $p = 1.00$), persisted for more trials. Girls' persistence was also marginally higher in the roleplay condition compared with the exposure condition ($W = 551$, $p = .074$). Boys' persistence did not vary across conditions (baseline vs. roleplay: $W = 840$, $p = 1.00$; baseline vs. exposure: $W = 932$,
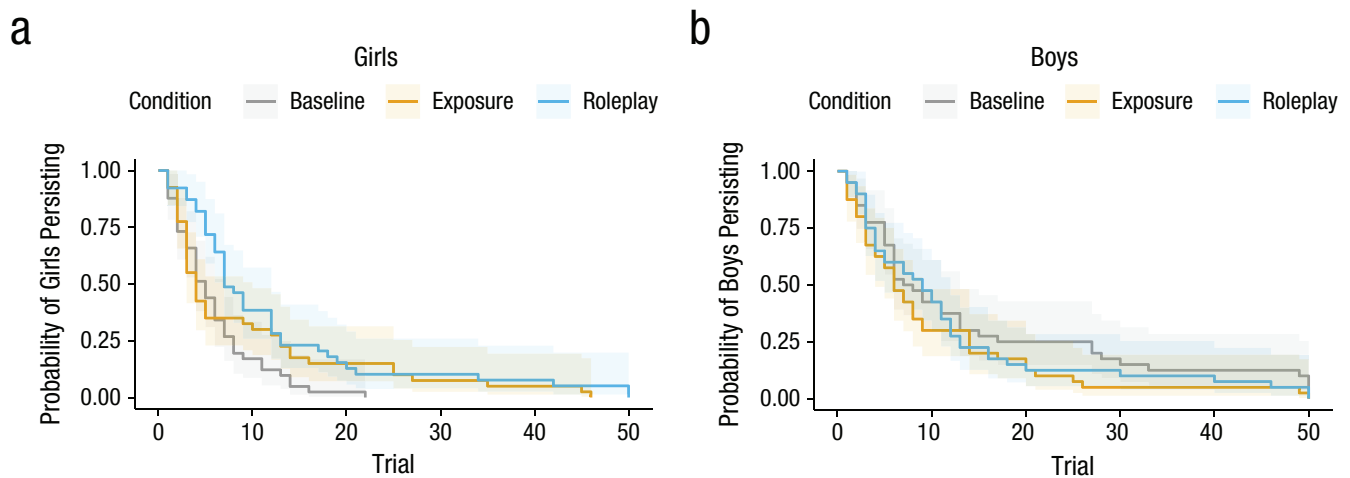
a

### Girls



b

### Boys



**Fig. 1.** Girls' (left) and boys' (right) persistence in the science game by condition. Error bands represent 95% confidence intervals.

*p* = .614; exposure vs. roleplay: *W* = 704.5, *p* = 1.00). Furthermore, relative to boys' baseline persistence, girls' persistence was lower in the baseline condition (*W* = 1106, *p* = .020) and marginally lower in the exposure condition (*W* = 1023.5, *p* = .094). However, girls' persistence in the roleplay condition was statistically indistinguishable from boys' baseline persistence (*W* = 780, *p* = 1.00).

### Self-efficacy

Next, we examined the effect of both experimental conditions on children's self-efficacy. Our exploratory analysis suggested that children responded differently to the two self-efficacy questions, "How good are you at the science game?" (self-efficacy in the science game) and "How good are you at being a scientist?" (self-efficacy as scientists; β = 0.21, 95% CI = [0.12, 0.31], *p* < .001, *d* = 0.40, 95% CI = [0.21, 0.58]). Specifically, children consistently evaluated themselves as more efficacious in the science game than in being a scientist (a pattern that did not vary by gender; β = −0.01, 95% CI = [−0.11, 0.09], *p* = .847; for descriptive statistics, see Table 2). Thus, we conducted separate ANCOVA models predicting responses to each of these questions by gender, condition, age, and their interactions as well as accuracy rate as a control variable.

With respect to children's self-efficacy in the science game, we found a significant gender-by-condition interaction, *F*(2, 227) = 4.71, *p* = .010. Pairwise comparison tests indicated that, among girls, self-efficacy in the science game was higher in both the exposure condition (β = −0.72, 95% CI = [−1.39, −0.06], *p* = .030, *d* = −0.57, 95% CI = [−1.01, −0.13]) and roleplay condition (β = −0.76, 95% CI = [−1.43, −0.09], *p* = .022, *d* = −0.60, 95% CI = [−1.05, −0.16]) compared with the baseline condition, and it did not differ between the exposure

and roleplay conditions (β = −0.04, 95% CI = [−0.71, 0.64]), *p* = .990, *d* = −0.03, 95% CI = [−0.47, 0.41]). However, boys' self-efficacy in the science game did not differ significantly across conditions (exposure vs. baseline: β = 0.38, 95% CI = [−0.29, 1.05], *p* = .381, *d* = 0.30, 95% CI = [−0.15, 0.74]; roleplay vs. baseline: β = 0.27, 95% CI = [−0.40, 0.94], *p* = .599, *d* = 0.22, 95% CI = [−0.23, 0.66]; exposure vs. roleplay: β = −0.10, 95% CI = [−0.77, 0.57], *p* = .929, *d* = −0.08, 95% CI = [−0.52, 0.36]; see Fig. 2). Thus, both experimental conditions increased girls', but not boys', self-efficacy in the science game. We did not observe a similar gender-by-condition interaction on children's self-efficacy as scientists, *F*(2, 224) = 0.71, *p* = .494.

### Self-reported motivation

There was no main effect of gender, condition, or their interaction on children's motivation score (*F*s < 1.50, *p*s > .220; for descriptive statistics, see Table 2). Because children reported their motivation shortly after having persisted in the science game, it is possible that their interest in the game was temporarily depleted. There was a main effect of age on self-reported motivation in science; older children reported lower motivation than younger ones, *F*(1, 227) = 4.15, *p* = .043. However, this effect did not vary by gender, condition, or their interaction (*F*s < 2.84, *p*s > .090).

### General Discussion

Accumulating evidence suggests that the prevalent gender gaps in STEM emerge in early childhood (e.g., Bian et al., 2017; Cvencek et al., 2011; Miller et al., 2018); however, little work has examined strategies to target these gaps at their developmental roots. The present study integrated

**Table 2.** Means and Standard Deviations of Self-Efficacy and Motivation Scores by Gender and Condition

| Variable | Gender | Baseline | | Exposure | | Roleplay | |
|---|---|---|---|---|---|---|---|
| | | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| Self-efficacy in the science game | Girls | 3.63 | 1.18 | 4.32 | 1.02 | 4.38 | 1.07 |
| | Boys | 4.03 | 1.25 | 3.68 | 1.62 | 3.78 | 1.35 |
| Self-efficacy in being a scientist | Girls | 3.61 | 1.28 | 3.85 | 1.48 | 3.53 | 1.48 |
| | Boys | 3.58 | 1.50 | 3.26 | 1.75 | 3.42 | 1.62 |
| Motivation | Girls | 0.05 | 0.58 | 0.15 | 0.52 | −0.07 | 0.78 |
| | Boys | −0.08 | 0.72 | −0.06 | 0.81 | −0.03 | 0.75 |

two bodies of literature—social psychological research on role models, and cognitive-developmental research on pretend play in childhood—to test a novel approach to increase young girls' short-term persistence in a science activity. Our findings showed that whereas 4- to 7-year-old boys overall persisted longer in the science game than girls, pretending to be a successful female scientist increased girls' persistence and helped close the gender gap—an effect that was not reliably reached with mere exposure to the female scientist. That is, only when girls assumed the role model's identity via pretend play did their persistence significantly increase beyond baseline and become equivalent to the persistence of boys. However, assuming a male role model's identity did not facilitate boys' persistence, which was relatively high to begin with. Therefore, this approach may be specifically useful in motivating girls in science. We should note that the roleplay and exposure conditions did not significantly differ from each other. Because the exposure condition

is embedded within the roleplay condition (children in the roleplay condition both were exposed to the scientist and pretended to be the scientist), the difference between these conditions may be relatively small and thus require a larger sample to detect.

Regarding self-efficacy—our secondary outcome of interest—our results suggest that both learning about and pretending to be a female scientist increased girls' self-efficacy in the science game. Therefore, merely hearing about a competent role model may suffice to alter girls' self-views, at least temporarily. However, in line with previous work (White et al., 2017), engendering behavior change may require an active adoption of the role model's identity. Interestingly, girls did not feel more self-efficacious in their identity as a scientist after being exposed to the female scientist. This may be because children's beliefs about "scientists" as a special group of people are more entrenched (Lei et al., 2019; Rhodes et al., 2019) or because identity is more abstract and
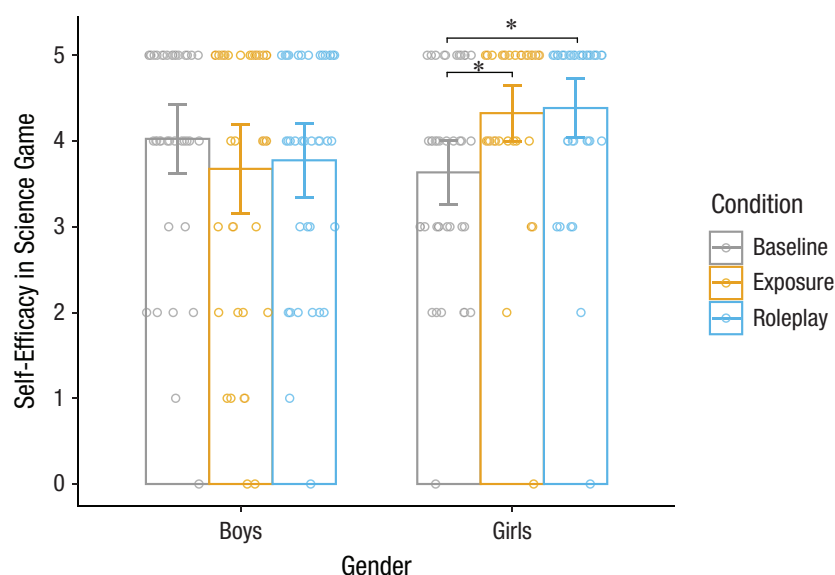


**Fig. 2.** Self-efficacy in the science game by gender and condition. Circles represent the data of individual participants. Error bars represent 95% confidence intervals. *$p < .05$.

slowly developing (Harter, 2015). Thus, a more intensive, long-term intervention may be required to change one's identification as a scientist.

One mechanism that may underlie the effectiveness of pretend play in enhancing girls' persistence in science is the strengthening of a self-scientist association. According to the "self-to-prototype" theory, one factor influencing a person's career choices is the association between their perceived self and the prototypical figure occupying such careers (Cheryan et al., 2015; McPherson et al., 2018). Assuming the identity of the role model may lead to a temporary blurring of the boundaries between the role model and the self (Karniol et al., 2011; White & Carlson, 2021; White et al., 2017), leading to a greater perceived self-scientist overlap. To further explore this mechanism, one will need to directly measure children's self-scientist associations following the role model manipulations, for example, through Implicit Association Tests (Greenwald et al., 1998). Identifying the precise mechanism through which roleplay increases girls' persistence is important in further understanding the conditions under which role models are motivating for young girls. Past work with adults has shown that learning about a role model is beneficial when people identify with the role model and can envision themselves following the role model's path (Stout et al., 2011). In contrast, learning about a role model who is very different from the self and whose success seems unattainable is demotivating (e.g., Betz & Sekaquaptewa, 2012; Cheryan et al., 2011). For children, pretend play may thus be one strategy through which identification with a role model can be successfully achieved.

Relatedly, future work should examine whether matching the gender of the role model to participants' gender is an essential ingredient in the roleplay condition. On one hand, past work has demonstrated that girls can successfully impersonate male figures (e.g., male superheroes; Karniol et al., 2011). On the other hand, other studies have suggested that women find it easier to identify with and thus envision themselves following the path of a female role model (Dasgupta, 2011). Furthermore, in the context of STEM, roleplaying a female role model may be particularly beneficial for empowering girls by counteracting negative stereotypes.

Finally, how the role model is described may moderate the effectiveness of pretend play. In our study, the role model was presented as dedicated and hardworking, in line with a growth mindset approach that highlights ability as malleable and dependent on continuous effort (Dweck, 2006). This growth-oriented presentation of role models has been found to motivate women in STEM, as opposed to a fixed mindset approach that highlights ability as innate and unchangeable (e.g., Good et al., 2012; Yeager et al., 2022). Open questions concern whether pretend play would be equally effective without a growth-oriented message. However, the finding that the exposure condition did not significantly increase girls' persistence, even though it contained an identical growth-oriented message, suggests that roleplay—in and of itself—plays a unique role.

Our study marks an exciting first step in demonstrating the power of pretend play in promoting young children's coping in the face of stereotypes. This approach is easy to implement and noncostly because it does not necessitate rich social interactions with role models and can be conducted online. Importantly, it involves only verbal descriptions of the role model without visual depictions, which may allow children from diverse backgrounds to identify with the role model and benefit from the pretend play activity. However, we acknowledge that our study was conducted in a virtual lab setting with a sample of mostly White children from high socioeconomic backgrounds; future work should use a more naturalistic measure of persistence and recruit children who are racially and socioeconomically diverse.

Taken together, our findings suggest that brief descriptions of role models can contribute to girls' self-efficacy in science as early as ages 4 to 7 years and that roleplaying—actively taking on the identity of the role model—may have benefits for persistence that are not achieved through mere exposure. The present study demonstrates the effectiveness of pretend play in promoting young girls' persistence in science and thus lays the foundation for interventions aimed at reducing gender gaps from their roots.

## Transparency

*Open Practices*

All data, analysis code, and materials have been made publicly available via the Open Science Framework and can be accessed at osf.io/qfjk9. This article has received the badges for Open Data and Open Materials. More information about the Open Practices badges can be found at http://www.psychologicalscience.org/publications/badges. This study was not preregistered.

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## Supplemental Material

Additional supporting information can be found at http://journals.sagepub.com/doi/suppl/10.1177/09567976221119393

## Notes

1. In our sample, 13% of girls reported knowing about Marie Curie, and 20% of boys reported knowing about Isaac Newton. Children's knowledge of the role model did not predict their persistence ($\beta = -0.07$, $z = -0.32$, $p = .750$).
2. Directionality and significance levels of the persistence, self-efficacy, and motivation effects remained the same after we excluded children who indicated that they did not feel like the role model in the roleplay condition.
3. Accuracy rate did not predict children's persistence in the science game ($\beta = -0.07$, $z = -0.16$, $p = .871$).

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