# The Double-Edged Sword of Role Models: A Systematic Narrative Review of the Unintended Effects of Role Model Interventions on Support for the Status Quo

Catherine Verniers[1]*, Cristina Aelenei[1], Thomas Breda[2], Joseph R. Cimpian[3], Lola Girerd[4], Emma Molina[5], Laurent Sovet[6], and Andrei Cimpian[7]*

[1] Université Paris Cité, Laboratoire de Psychologie Sociale, F-92100 Boulogne-Billancourt
[2] CNRS, Paris School of Economics, Paris
[3] Department of Applied Statistics, Social Science, and Humanities, New York University
[4] Social Mind and Behavior Lab (SMaB Lab), University of Trento
[5] Laboratoire Interdisciplinaire d'Evaluation des Politiques Publiques de Sciences Po, Paris
[6] Université Paris Cité and Université Gustave Eiffel, LaPEA, F-92100 Boulogne-Billancourt
[7] Department of Psychology, New York University

**In press, *Review of Research in Education*.**

* Email: catherine.verniers@u-paris.fr and andrei.cimpian@nyu.edu

## Author Note

This research was supported by a grant from the French National Research Agency (ANR) as part of the "Investissements d'Avenir" program LIEPP (ANR-11-LABX-0091, ANR-11-IDEX-0005- 02) and the Université de Paris IdEx (ANR-18-IDEX-0001). We thank Mark Bowker, Buju Dasgupta, Andy Elliot, Bethany Lassetter, Adam Stanaland and Siqi Zhao for insightful comments on this work and the members of the Cognitive Development Lab at New York University for helpful discussion. We have no conflict of interest to disclose.

**Abstract**

Role model interventions are often designed to foster students' pursuit of specific careers and are commonly employed in science, technology, engineering, and mathematics (STEM). Here, we drew on social-psychological theories of intergroup relations to hypothesize that role model interventions might also unintentionally shape students' beliefs and preferences concerning the broader social system—their *ideologies*. Specifically, role model interventions may lead students to view the (inequitable) status quo in STEM as natural and acceptable. A systematic narrative review (35 articles, 42 studies) examined these hypothesized side effects. This review indicated that the ideological side effects of role model interventions were rarely considered in the literature on role models. Although limited, the few relevant findings revealed both undesirable side effects of role model interventions on students' ideologies (e.g., greater endorsement of the status quo) and effects that are—from our perspective—desirable (e.g., greater awareness of gender bias in STEM). This review demonstrates that role models can be a double-edged sword and serves as a call to evaluate role model interventions based on criteria beyond motivation.

*Key words*: role models, STEM, side effects, ideology

For Peer Review

# The Double-Edged Sword of Role Models: A Systematic Narrative Review of the Unintended Effects of Role Model Interventions on Support for the Status Quo

Women's underrepresentation in science, technology, engineering, and mathematics (STEM) is of global concern (UNESCO, 2021).[1] Although girls outperform boys in school in many countries (e.g., Voyer & Voyer, 2014)—an advantage that persists at higher levels of education as well (Encinas-Martín & Cherian, 2023)—the proportion of women in STEM remains low (World Economic Forum, 2022). In 2017, the 195 member states of UNESCO—the United Nations agency that focuses on education, science, and culture—agreed to actively support the participation of women in STEM. There was consensus among member states that the most efficient way to achieve this goal is to motivate girls and young women to pursue science, and that role model interventions are a suitable tool to meet this challenge.

The present review evaluates the effectiveness of this tool. However, rather than evaluating role model interventions based on their effects on individual students' STEM self-concepts and aspirations, which is how role model interventions are typically evaluated (e.g., De Gioannis et al., 2023; Gladstone & Cimpian, 2021; Lawner et al., 2019; Olsson & Martiny, 2018), here we investigate their effects on students' *ideologies*—that is, students' beliefs and preferences concerning the broader social system they are embedded in. Our investigation is rooted in the social psychology of intergroup relations, which highlights the possibility that, above and beyond any effects on students' motivation to pursue STEM, role model interventions can substantially shape how students think about the societal status quo. Specifically, despite the positive intentions behind role model interventions, exposure to role models may inadvertently strengthen students' acceptance of existing inequities in STEM and

[1] Inequities in STEM also exist along social dimensions other than gender, including race/ethnicity (e.g., National Center for Science and Engineering Statistics, 2023). Many of the arguments here pertain to these other dimensions as well. However, space limitations prevent us from fully elaborating these arguments with respect to all relevant social dimensions. Thus, the focus on gender is motivated in part by the fact that most role model interventions in STEM to date aim to redress the gender imbalance in this domain.

For Peer Review

beyond.

After providing relevant theoretical background, we report the results of a systematic narrative review of the literature, which was guided by two research questions: First, to what extent has the research on role models so far considered their potential unintended effects on students' ideologies? Second, what do the current findings tell us about the unintended impacts of role models on these ideologies?

**Role Models as a Tool to Tackle the Gender Gap in STEM**

In line with previous work, a role model is defined here as someone who has succeeded in a domain where their social group is negatively stereotyped, as women are in STEM (Dasgupta, 2011). The role model's accomplishments are intended to demonstrate that it is possible for members of their marginalized group to succeed in that domain. For instance, female scientists can be introduced as role models to girls and young women to encourage them to consider such careers. Importantly, role models differ from mentors and sponsors in that they do not provide direct encouragement to the students or practical help; in fact, commonly discussed role models such as Marie Curie, Sally Ride, or Maryam Mirzakhani have no relationship with the students whose science motivation they are supposed to boost (Downing et al., 2005). Following previous work (e.g., Gladstone & Cimpian, 2021), the present review focused on role models defined as such, exclusive of mentors and sponsors.

To date, practice guides (Halpern et al., 2007) and systematic reviews (e.g., Gladstone & Cimpian, 2021; Lawner et al., 2019) have focused on the impact of role models on students' STEM *self-concepts* (i.e., their self-perceptions of ability in this domain) and *aspirations* to pursue STEM careers. Role model interventions are explicitly designed to have a positive impact on these outcomes. In theory, exposure to a woman who succeeded in STEM may allow female students to identify with this model, and this identification may in turn enhance these students' expectations of success in this domain, perhaps also ultimately

For Peer Review

leading them to aspire to a STEM career (Morgenroth et al., 2015, see also Bagès et al., 2016). In other words, observing an ingroup role model is often expected to function as a "social vaccine" that inoculates group members against the obstacles they might encounter pursuing a counterstereotypical career (Dasgupta, 2011).

Although it seems intuitive that exposure to role models would be motivating, cumulative evidence shows that the effectiveness of role model interventions on students' self-concepts and aspirations is somewhat limited. For example, Lawner et al. (2019) conducted a meta-analysis of 45 studies to assess the effect of using role models to improve students' performance and interest in STEM. Results indicated a positive impact—albeit a small one—of field interventions, and a non-significant overall effect among lab studies. More recently, Gladstone and Cimpian (2021) conducted a narrative systematic review of the evidence on the relation between students' exposure to role models and their STEM self-concepts and aspirations. Similar to Lawner et al. (2019), Gladstone and Cimpian concluded that these relations, while generally positive, are subtle and context-sensitive: A role model is more likely to have a positive effect on a student's self-concept and aspirations to the extent that the role model is portrayed as competent (but not too competent, such that their success feels unattainable) and as meaningfully similar to the student. Gladstone and Cimpian also suggested that role models from groups that are traditionally underrepresented in STEM may have the broadest positive effects on students' self-concepts and aspirations, regardless of the identities of the students themselves. These results indicate that role models *can* be a useful tool for making STEM more diverse and inclusive, but only under certain circumstances. We now turn to a second type of outcome of role model interventions (that is, their effects on students' ideologies), which is the focus of the present argument.

**Unintended Effects of Role Models on Students' Ideologies?**

In addition to their intended effects on students' self-concepts and aspirations, role

For Peer Review

model interventions may also influence students' *ideological beliefs and preferences* regarding the structure of their society, leading students to view the status quo in STEM and beyond as natural and acceptable. Following common usage in social psychology, we term these status-quo-defending beliefs and preferences "legitimizing myths" (Sidanius & Pratto, 1999). To elaborate, legitimizing myths are widely held values (e.g., egalitarianism), attitudes (e.g., sexism, racism), beliefs (e.g., stereotypes), and cultural ideologies (e.g., meritocracy). These myths are used either to imbue the (inequitable) status quo with legitimacy (e.g., Jost & Hunyady, 2005), reinforcing existing status and power hierarchies between groups in society, or, alternatively, to foster a more equitable society. Legitimizing myths shape individuals' behaviors, as well as the functioning of social institutions, including schools (Sidanius et al., 2004).

Based on research in social psychology, we suggest five interrelated ways in which role models might affect students' endorsement of legitimizing myths. Four of these would be, from our perspective, *undesirable* side effects of exposure to role models, insofar as they would collectively cement students' endorsement of the existing gender hierarchy in STEM and beyond: (a) strengthening endorsement of meritocratic beliefs, (b) reinforcing (some) gender stereotypes, (c) encouraging victim blaming, and (d) triggering backlash effects. In contrast to these hierarchy-enhancing side effects, role model interventions may also (e) draw attention to social injustice (i.e., gender bias), which could foster a call to action and work toward a more equitable society. This side effect of role model interventions would be, from our perspective, more *desirable*.

### *A. Role Models May Strengthen Endorsement of Meritocratic Beliefs*

Exposure to role models may reinforce the belief that STEM is a meritocracy (Manke & Cohen, 2011). To many students, the success of a competent and hardworking individual from a marginalized group (i.e., the role model) likely signals that the system is fair and

For Peer Review

rewards the most deserving—in other words, that the system is meritocratic. Seeing a member of a marginalized group who is successful in STEM makes it easy for students to conclude that the system must not be "rigged" and must instead reward individuals' skills and efforts, regardless of which group they belong to. In other words, students might reason that the role model could not have succeeded in the first place if the system was not meritocratic, so therefore it *must* be meritocratic.

In particular, exposure to role models may strengthen a core component of meritocratic ideology termed *protestant work ethic* (Madeira et al., 2019; Weber, 1958). According to the protestant work ethic ideology, people have a moral responsibility to work hard—hard work is a virtue. This ideology is prevalent in many cultures and has been linked to prejudice toward disadvantaged groups and disapproval of social policies intended to help these groups (for a review, see Rosenthal, Levy, et al., 2011). Protestant work ethic has two components, both of which are likely to be strengthened by exposure to role models. The first is a so-called *equalizer* component: Anyone who works hard can succeed, so hard work is a social equalizer. The typical narrative of a role model "pulling themselves up by their own bootstraps" despite the hardships they endured is consistent with this equalizer component and is likely to reinforce it. Protestant work ethic also encompasses a *justifier* component, according to which the work ethic of the disadvantaged explains their low status in society, making (lack of) hard work a justification for existing social hierarchies (Levy et al., 2010). Exposure to a female role model's success could reinforce this component as well, particularly as it pertains to gender inequity in STEM: Students might reason that, despite the occasional exception, perhaps the reason why women do not succeed in STEM is that they do not work enough (Rosenthal, London, et al., 2011).

By strengthening meritocratic beliefs, exposure to role models may give rise to a host of other attitudes and beliefs that reinforce the status quo. We discuss key instances of these

For Peer Review

attitudes and beliefs below (e.g., stereotypes, victim blaming) and briefly mention an additional one here: Endorsement of meritocracy makes it more likely for people—even members of disadvantaged groups—to deny the existence of discrimination. For instance, McCoy and Major (2007) demonstrated that female students experimentally primed with meritocracy (vs. neutral content) endorse gender stereotypes to a greater extent and minimize discrimination against women (see also Girerd & Bonnot, 2020). Thus, by strengthening students' belief in meritocracy, role model interventions may simultaneously strengthen a range of other legitimizing myths, which would constitute another undesirable side effect of these interventions.

***B. Role Models May Reinforce Gender Stereotypes***

If a student believes that success in STEM is primarily determined by merit, they may also reasonably conclude that those who succeed in these prestigious fields must be more competent, hardworking, or motivated than those who do not. The fact that there are many more men than women in STEM would then suggest that it must be mostly men who possess these attributes and that women are scarce in STEM because they simply do not have "what it takes." Role model interventions might inadvertently reinforce this belief system: Because these interventions understandably focus on highlighting and praising the achievements of the role models, they might suggest that the specific women serving as role models possess personal qualities that are unusual among members of their gender. The unintended implication of this message is that women *in general* lack ability in science or the ambition to succeed in this field (Krauth-Gruber et al., 2023; see also Herbaut & Barone, 2021). That is, the role model might suggest to students that there would have been more women in STEM already if more women had the qualities that the role model (and, presumably, many men) possess. It is also noteworthy that this unintended effect, if present, would be particularly disheartening because the explicit goal of many role model interventions is to foster girls'

For Peer Review

self-concepts and aspirations in STEM by *combating* stereotypes about women in STEM. If our argument is correct, these interventions instead reinforce (at least some) gender stereotypes relevant to STEM pursuit.

An experiment conducted by Ho et al. (2002) provided indirect support for this proposal. In this study, European American undergraduates watched videotaped profiles of people who overcame obstacles to attain economic success, all European American themselves. In the control group, the participants watched videotapes unrelated to this issue. Compared to the participants in this group, students who learned about individual attainments were more likely to endorse negative stereotypes of African Americans. According to the authors, information about the success of particular individuals contributed to the stereotyping of many other individuals by reinforcing the perception that opportunities in society were ample, which heightened the willingness to attribute the low status of a group to internal shortcomings. This example suggests that instances of individual social mobility may reinforce students' negative views of disadvantaged groups.

Importantly, there is also evidence that gender stereotypes are in fact legitimizing myths—that is, ideologies that justify the existing hierarchy between genders (e.g., Hoffman & Hurst, 1990; Jost & Banaji, 1994). For instance, the complementary gender stereotypes of men's competence and women's warmth have been linked to the rationalization of the status quo in several studies (e.g., Jost & Kay, 2005; Laurin et al., 2011). Similarly, greater endorsement of the complementary gender stereotypes of men's math and women's verbal abilities predicts greater likelihood of endorsing the current gender hierarchy (Bonnot & Jost, 2014; Verniers et al., 2016).

### *C. Role Models May Encourage Victim Blaming*

In addition to reinforcing gender stereotypes, instances of individual social mobility—such as successful female scientists—may lead to the perception that women as a group are

For Peer Review

somehow *to blame* for the existence and persistence of their disadvantage in STEM. The rationale for this claim is based on research on the so-called *just-world hypothesis*, according to which many people are motivated to believe that the world is essentially fair and that most individuals get what they deserve in life (e.g., Lerner, 1980). Because evidence contradicting the belief that the world is fair is threatening to many individuals' deeply ingrained worldviews, it often elicits strategies aimed at restoring faith in a just world. Blaming the victims for their fate is an effective strategy to achieve this goal (for reviews, see Hafer & Bègue, 2005; van der Bruggen & Grubb, 2014). The fact that women are underrepresented in many prestigious and lucrative careers (Block et al., 2018) may challenge the belief in a just world, leading people to blame women for their disadvantages. We propose that the presence of a role model provides a convenient opportunity to shift blame onto the rest of the group. Students exposed to a role model might reason that if one woman (the role model) can overcome obstacles, then other women should do the same, and if they cannot, they deserve their disadvantage.

In support of this claim, Kim et al. (2018) found that messages emphasizing women's ability to tackle workplace gender inequality by overcoming their own internal barriers (e.g., lack of confidence and ambition) led to perceptions that women are responsible for both creating and solving the problem of inequality (see also Georgeac & Rattan, 2019). In addition, women's empowerment messages led to a preference for interventions aimed at changing women rather than fixing the system. It is possible that female role models in STEM—and particularly those who rely on internal explanations for their success or mention internal barriers to their success (e.g., a lack of confidence)—elicit victim blaming of women generally and subsequent opposition to public policies to address gender inequalities.

It is worth noting that victim blaming overlaps with the other proposed ideological side effects of role model interventions. For instance, one way of blaming the victims in this

For Peer Review

context would be to adopt negative stereotypes about women (e.g., "women lack the ambition to succeed in STEM careers"), similar to the process described in the preceding section (section B). In addition, victim blaming might be more likely if a student believes STEM to be meritocratic (section A) and if they are unaware of discrimination against women in this domain (section E). However, the fact that some of these processes converge in particular circumstances does not mean they are indistinguishable. For example, prior research suggests that endorsement of meritocratic beliefs (section A) can arise solely from cognitive factors, without a specific *motivation* to believe in a just world (e.g., Hussak & Cimpian, 2015). In contrast, the processes underlying victim blaming (the present section) are primarily motivated—they are the byproduct of a *desire* to see the world as fair. Thus, although the ideological effects of role model interventions are interrelated and reinforce each other in many instances, they are nevertheless conceptually distinct.

***D. Role Models May Trigger Backlash Effects***

The previous sections highlighted some of the ways in which female role models' success in STEM may be "held against" *other* women, who are viewed more negatively as a result. Here, the argument is that the role models *themselves* may also be viewed negatively because their success in a male-dominated field makes them atypical for their group. Their atypicality may in turn trigger a so-called *backlash effect*, which serves to legitimize and reinforce existing gender hierarchies (Rudman, Moss-Racusin, Glick, et al., 2012). The backlash effect refers to the social (e.g., negative attitudes) and economic (e.g., negative performance reviews) penalties that women may encounter when they display traits and behaviors that are perceived as "masculine" and thus counterstereotypical for women. The underlying mechanism that prompts people to penalize counterstereotypical women resides in the motivation individuals have to defend existing gender hierarchy (Rudman, Moss-Racusin, Phelan, et al., 2012). Stereotypically masculine traits and behavior are assigned high status in

For Peer Review

society (e.g., Prentice & Carranza, 2002), so women who violate gender stereotypes by displaying these characteristics can be perceived as striving to attain power, potentially to the detriment of men, and thus possibly upsetting the traditional gender social order.

Consistent with this possibility, research in social psychology has shown that a woman candidate presenting herself in a counterstereotypical manner (i.e., self-promoting and ambitious) for a job in a male-dominated career was perceived as more dominant, less likeable, and less likely to be hired compared to a male counterpart (Rudman, Moss-Racusin, Phelan, et al., 2012). Following this line of argument, we suggest that female role models may be subject to backlash, particularly when portrayed in counterstereotypical ways. It is also possible that the backlash is not limited to just the specific role model(s) featured in an intervention but may extend more generally to women and potentially other minorities in STEM fields as well.

***E. Role Models May Increase Awareness of Gender Bias***

So far, we have proposed that role model interventions might backfire by increasing endorsement of a set of interrelated legitimizing myths, including the belief that STEM is a meritocracy or that girls and women are to blame for their disadvantage in this domain. These are arguably *undesirable* side effects of role model interventions. The present section lays out the possibility that, under specific circumstances, role model interventions might raise awareness of social injustice. In contrast to the side effects described above, this side effect might prompt a desire to increase gender equity in STEM (e.g., via collective action; Uluğ et al., 2023; van Zomeren et al., 2008, 2018) and thereby attenuate gender hierarchies. From our perspective, this would be a *desirable* side effect of role model interventions.

Given that role model interventions are in part designed to present STEM fields in a favorable light, it is rather uncommon for role models to share negative personal experiences with gender bias (e.g., being the target of sexist comments, being denied a promotion on the

For Peer Review

basis of their gender). However, when female students hear about these experiences—which likely resemble some of their own—they might as a result identify more strongly with the role models and with other women who have encountered gender bias. The more similar individuals view themselves to be with a victim, the less blame they attribute to that person (Shaver, 1970; Grubb & Harrower, 2008; van der Bruggen & Grubb, 2014). Reduction of victim blaming might in turn enhance concern with justice (Correia et al., 2007) and motivation to actually restore justice (Lerner, 1980), including support for governmental policies and organizational practices intended to prevent gender- or ethnicity-based discrimination (Crosby et al., 2006). Thus, an intervention highlighting that the role model encountered gender bias could enhance perceived similarity with the role model and with women as a disadvantaged group. In turn, such an intervention could reduce perception that women are responsible for the gender gap in STEM and, accordingly, enhance students' belief that the *system* is responsible for addressing gender inequality.[2]

**Objectives of the Systematic Narrative Review**

The present review aimed to answer two main research questions. First, to what extent has the research on role models so far considered the potential side effects of role model interventions on students' endorsement of legitimizing myths? Second, what conclusions, if any, can be drawn regarding these side effects? To answer these questions, we conducted a systematic narrative review of the literature and identified studies that included outcome variables related to legitimizing myths. The results for each outcome were then summarized to uncover which desirable and undesirable side effects can be expected from role model interventions. In particular, the review focused on the five possible side effects discussed

[2] Whereas greater awareness of gender bias in STEM might be a desirable side effect from an ideological standpoint, it may also undermine girls' and young women's pursuit of STEM—the primary intended effect of role model interventions. This tension raises the more general question of whether the ideological side effects identified here facilitate or undermine the intended effects of these interventions on self-concepts and aspirations. This issue is discussed later in the paper, in a section titled, "Reconciling the Ideological Side Effects of Role Model Interventions with Their Intended Effects on Students' STEM Self-Concepts and Aspirations."



For Peer Review

above. Due to the limited exchange of ideas between previous research on role models and social-psychological theories of intergroup relations, it was unclear a priori whether and how often these possible side effects were investigated; notably, a systematic review that documents a lack of attention to these possible side effects is valuable in and of itself.

## Method

The present review was conducted following Siddaway et al.'s (2019) recommendations and the PRISMA statement (Moher et al., 2009) for systematic reviews. The method was pre-registered prior to conducting the review. The anonymized systematic review registration form (Van den Akker et al., 2020) is available on the Open Science Framework: https://osf.io/eqgch/?view_only=eb91d835ffdc4fa7ad861c8ea411903d.

### Search Strategy

The following databases were searched to obtain relevant research studies: PsycINFO, EBSCOhost (Psychology and Behavioral Sciences Collection), ERIC, and HAL SHS. We carried out a series of exploratory searches to identify a comprehensive and effective query string. The query string used for the research was: ("role model*" OR "peer group mentor*" OR "ingroup peer*" OR "ingroup expert*") AND ("Scien*" OR "mathemat*" OR "math" OR "maths" OR "Physic*" NOT "physical" OR "Chemi*" OR "Biolog*" OR "Techno*" OR "Engineer*" OR "Computer Science*" OR "STEM"). The terms were searched in titles, abstracts, and full texts. The database search procedure was validated by checking whether it turned up five articles that were identified by recent reviews (Gladstone & Cimpian, 2021; Lawner et al., 2019) and that should be included in the search. As expected, all five articles were found using the search procedure described above; therefore, no further adjustments were made. The electronic databases were searched through February 1st, 2023. In total, 786 records were generated from the electronic database search. As preregistered, we added 248 papers identified from recent systematic reviews (Carbuccia, 2020; Gladstone & Cimpian,

For Peer Review

2021), meta-analyses (Lawner et al., 2019), and scoping reviews (De Gioannis et al., 2023) on role models. All records ($n$ = 1034) were exported into Rayyan, an AI-powered tool for systematic literature reviews (Ouzzani et al., 2016). From the 248 papers added from other systematic reviews, only 6 articles met the inclusion criteria and had not already been identified through our own search.

**Screening Process**

To be included, an article had to meet the following criteria: (a) the reported research was empirical; (b) the study included a treatment group exposed to a role model in a STEM domain and (c) a comparison group not exposed to the role model; (d) the role model was a STEM expert with whom students had no prior relationship; (e) the role model was part of a group that is underrepresented in STEM; and (f) the full text was available in English. After eliminating duplicates ($n$ = 144), one trained research assistant screened the titles and abstracts of the remaining 890 records. At this stage, records were excluded only if there was clear evidence that a criterion was *not* met. Although we first considered (and preregistered) including only experimental designs in this review, ultimately random assignment was not retained as an inclusion criterion to avoid excluding a large number of studies (e.g., observational studies, program evaluations). After this preliminary screening, 75 articles potentially fulfilled the inclusion criteria. Next, the research assistant responsible for the first screening and the first author independently screened the full text of each article to determine whether it was eligible for inclusion. Disagreements regarding the decision to include or exclude an article were resolved through discussion. This process identified for inclusion 35 articles reporting 42 separate studies (see Figure 1 for flowchart).

**Data Extraction and Synthesis**

For practical reasons, only one coder was trained to perform the initial extraction. The following information was extracted: (a) the article's metadata (e.g., title, authors, doi); (b)

For Peer Review

outcome variables; (c) role model characteristics (e.g., gender, race/ethnicity, explanations for success); (d) framing of the intervention (e.g., whether the intervention explicitly discussed the gender gap in STEM); (e) sample characteristics; and (f) summary of the results (for additional details, see the systematic review registration form on OSF). The first author then checked the accuracy of the extracted data against the articles and revised the entries accordingly. The same author then analyzed the output of the data extraction and synthesized the relevant findings for each research question into a narrative summary, with input from the other authors.

## Results

### Research Question 1: To What Extent Has the Research on Role Models Considered the Potential Effects of Role Model Interventions on Endorsement of Legitimizing Myths?

To answer the first research question, we examined which psychological constructs related to legitimizing myths were measured in the studies in our final sample. Because measuring outcomes related to group-based hierarchies does not necessarily imply that the researchers held a priori hypotheses regarding side effects of role model interventions, we also synthesized the motivations and/or hypotheses underlying the inclusion of these variables in the studies. The presentation of the results is organized in terms of the potential side effects introduced above.[3] Table 1 provides information about the 13 articles that included measures relevant to ideological side effects. The supplementary materials contain the complete list of the 35 articles included in the systematic review.

#### *A. Do Role Models Strengthen Endorsement of Meritocratic Beliefs?*

**Motivation for Including Ideology-Relevant Outcomes.** Only one study (Shin et al., 2016; see Table 1) included a measure of students' endorsement of meritocratic beliefs—

[3] Most of the papers fulfilling the inclusion criteria dealt with the gender gap in STEM and included female role models. Only one paper focused exclusively on the issue of racial/ethnic minorities in STEM, and exposed participants to a man from the minority group rather than to a woman. This paper was not considered further.



For Peer Review

specifically, protestant work ethic, which is a core component of meritocracy (Madeira et al., 2019). This measure was included as part of a manipulation check, but its status as a legitimizing myth was not an explicit part of the motivation for its inclusion.

**Results.** Findings indicated that participants exposed to the role models showed greater endorsement of the belief that hard work is a social equalizer (i.e., "anyone can succeed through hard work") relative to participants who did not see a role model. This effect might reflect the content of the intervention, which emphasized the role model's efforts, or it might result from students' efforts to explain the unexpected success of a woman in a counterstereotypical domain. However, exposure to the role model did not affect endorsement of the "justifier" component of protestant work ethic—that is, the role-model-exposed participants were not more likely to believe that unsuccessful individuals simply do not work hard enough. This result was in line with authors' expectations and the content of the role models' biographies, which emphasized their efforts but did not address failure.

### *B. Do Role Models Reinforce Gender Stereotypes?*

**Motivation for Including Ideology-Relevant Outcomes.** Only eight of the 42 studies included measures of students' endorsement of gender stereotypes (see below) and, notably, only one study explicitly considered this variable from the perspective of group-based hierarchies (Buckley et al., 2022; see Table 1). This study relied on the backlash framework (Rudman, Moss-Racusin, Glick, et al., 2012) and acknowledged that stereotypes are often social prescriptions and that stereotype violators face interpersonal penalties. Accordingly, Buckley et al. (2022) measured participants' endorsement of the stereotype that women are "nice" (which is an instantiation of the stereotypes about women's warmth and communion) following exposure to a brilliant female scientist to examine whether this exposure produced a backlash effect whereby women are seen as less "nice."

The seven other studies that also included measures of gender stereotypes failed to

For Peer Review

address the relevance of this construct to group hierarchies. For instance, in Pietri et al.'s (2021) study, the role model's perceived warmth was hypothesized to predict the participants' feeling of friendship toward the role model and interest in computer science. Breda et al. (2020) explored students' beliefs about gender differences in math aptitude and interest as potential mediators of their role model intervention's effects on students' choice of undergraduate major. In Ramsey et al. (2013), explicit and implicit STEM-gender stereotypes were considered predictors of students' STEM motivation and performance (see also Van Camp et al., 2019), whereas Stout et al. (2011) included measures of explicit and implicit gender stereotypes about math and English to demonstrate that mere exposure to a STEM role model did not influence stereotype endorsement but nevertheless inoculated women from applying these stereotypes to their own self-concept. In sum, with one exception, all these studies conceived of gender stereotypes in relation to students' self-concepts and aspirations for careers in STEM, without considering the implications of role model interventions for students' broader ideologies about the gender hierarchy in STEM.

**Results.** Among the eight studies that included measures of stereotypes, five found that exposure to role model (vs. no exposure) did not affect endorsement of gender stereotypes about STEM. This result is surprising, since—as mentioned in the Introduction—role model interventions often attempt to reduce these stereotypes in order to boost girls' self-concepts and aspirations. Null effects were observed even when the role model was intentionally framed to challenge gender stereotypes (Shin et al., 2016), and—notably—even when the intervention targeted women who were already pursuing STEM fields (Ramsey et al., 2013; Stout et al., 2011). Specifically, in four studies, female students in STEM stereotyped math as masculine, both at an implicit and an explicit level, and exposure to female scientist did not reduce these beliefs (Ramsey et al., 2013, Study 2; Stout et al., 2011, Studies 1 and 2; Van Camp et al., 2019). This result is consistent with the stereotype

For Peer Review

inoculation model, according to which occasional encounter with a female scientist may not be sufficient to change STEM stereotypes, although it may inoculate women from applying these stereotypes to their own self-concept (Stout et al., 2011). Moreover, Van Camp et al. (2019) reported the results of a role model intervention that had no effect in reducing gender stereotypes about STEM *unless* the participants also engaged in a process of reflective identification with the STEM role model (e.g., write about the ways in which they identified with the role model).

Three studies, described next, did find evidence of the intended reductions in gender stereotypes about STEM as a result of role model interventions, although even these results were somewhat mixed. First, Ashby Plant et al. (2009) found that interacting through a computer interface with a female role model reduced boys' (but not girls') endorsement of gender stereotypic beliefs about engineering. Second, Buckley et al. (2022) found that girls exposed to stories about intellectually brilliant female scientists (vs. no exposure) were significantly more likely to choose their own gender as being "really, really smart," indicating a reduction of the negative stereotype concerning female intellectual ability (Bian et al., 2017). At the same time however, the role model intervention had no effect on another widely shared gender stereotype: that women are nice. Third, Breda et al. (2020) found that, following a role model intervention, students were less likely to endorse gender stereotypes about mathematics abilities but *more* likely to endorse the belief that women do not like science. As acknowledged by the authors, this unintended negative effect might result from an effort to rationalize the gender gap in STEM.

The three studies that found the intended reduction in stereotypes about women in STEM differed in methodology (computer interface vs. short stories about women scientists vs. multimodal field intervention including video, information sessions, and in-person role models, respectively) and sample characteristics (middle-school US students vs. 7-year-old

For Peer Review

British girls vs. French students in 10th and 12th grade, respectively). Thus, no firm conclusions can be drawn regarding the conditions under which role model interventions achieve their intended goal of reducing stereotypes about women in STEM. The fact that largest of these studies (Breda et al., 2020; $N \approx 12{,}200$) also found one of the anticipated side effects, whereby the students exposed to the role models were *more* likely to believe that women do not like science, should be of concern.

### *C. Do Role Models Encourage Victim Blaming?*

No studies included outcomes related to victim blaming. Thus, we were unable to assess this hypothesized side effect of role model interventions. At the same time, the fact that little consideration has been given to the possibility that role models induce students to think that women are to blame for their underrepresentation in STEM is evidence for our claim that the potential ideological side effects of role model interventions have been overlooked.

### *D. Do Role Models Trigger Backlash Effects?*

**Motivation for Including Ideology-Relevant Outcomes.** Six studies (see below) included outcome variables capturing students' attitudes toward the role model and, more generally, toward women and racial/ethnic minorities in STEM. Negative attitudes toward women and racial/ethnic-minority scientists may reflect a hierarchy-enhancing backlash reaction—that is, a social penalty for behaving counterstereotypically (Rudman, 1998). However, only one study considered this possibility and assessed participants' attitudes toward the female role model for the express purpose of determining whether she would be disliked for being counterstereotypical (Betz & Sekaquaptewa, 2012).

Several studies included measures of attitudes toward women in science (e.g., Bamberger, 2014; Smith & Erb, 1986), but these measures were included simply as indicators of whether exposure to the role models made it more likely for girls to aspire to a career in STEM. That is, attitudes toward women in science were not discussed from the perspective of

For Peer Review

group-based hierarchies even when the items used were face-valid indicators of attitudes about these hierarchies (i.e., "Women should not have the same chances for advancement in science career as men do"; Smith & Erb, 1986). Attitudes toward the role model were also sometimes included merely as a manipulation check. For instance, Marx et al. (2013) measured attitudes toward the role model to rule out a possible confound in their experimental manipulation (see also Shin et al., 2016).

Two studies included measures of attitudes toward racial/ethnic minorities in STEM. In Shin et al. (2016), these attitudes were measured as a manipulation check in a study examining changes in students' STEM engagement after exposure to successful STEM role models who were women or men of color and who achieved their success through hard work. In Pietri et al. (2021), the participants rated the role model on warmth and competence as part of a pilot study designed to check the effectiveness of a remote Black female computer scientist as a role model.

**Results.** The effects of role model interventions on attitudes toward female role models and toward women in science more generally were inconsistent. One study reported that both boys and girls held more positive attitudes toward women scientists after exposure to a role model than in the control group (Smith & Erb, 1986). In the same vein, the high-achieving female role model in Betz and Sekaquaptewa (2012) was rated positively regardless of whether she succeeded in STEM or in a neutral domain, and Marx et al. (2013) reported that a female role model who succeeded in math was rated as equally competent and likeable as a man who succeeded in math. In contrast, another study documented an unintended negative effect of a role model intervention on attitudes toward women in science: Following the intervention, students held a less positive view of female scientists, a trend that was not found for the control group (Bamberger, 2014). According to the author, following the visits and the meetings with the women scientists, some of the girls were "frightened," and the

For Peer Review

negative change in the perceptions of women scientists reflected this fear. It is not clear whether the participants were frightened because the role models' success seemed unattainable or because they violated gender prescriptions. Notably, this effect occurred in the context of Jewish orthodoxy, in which values such as family and children's education are central. As acknowledged by the author, these values might "collide" with the intensive career of the women scientists introduced as role models (Bamberger, 2014, p. 550).

Findings on attitudes toward ethnic minorities in STEM revealed little to no evidence of backlash. In Shin et al. (2016), exposure to the role models reduced racial ingroup bias among the majority group (i.e., White participants) compared to a control condition (i.e., no intervention). In Pietri et al. (2021), pilot results indicated that there was no backlash toward the Black female scientist as compared to a Black female journalist: The perceived competence of the role model in a counterstereotypical domain did not harm her perceived warmth. It should be noted, however, that the role model's description emphasized communal goals (i.e., overseeing a summer camp for high school students), a limitation that was acknowledged by the authors, who suggested that without this information, participants may have pictured a "cold" computer scientist.

### *E. Do Role Models Increase Awareness of Gender Bias?*

**Motivation for Including Ideology-Relevant Outcomes.** Only two studies (see below) assessed students' awareness of gender bias in STEM. Awareness of bias and discrimination is a key precursor to engaging in actions to eliminate these obstacles (Radke et al., 2016; van Zomeren et al., 2008). The two studies measured this outcome for different reasons but—notably—not for the purpose of documenting whether role models reinforced group-based hierarchies. In the first study (Breda et al., 2020), awareness of gender bias was assessed with a measure of students' perceptions of (what the authors termed) "gender roles in science" (e.g., "Women face discrimination in science-related jobs"). In the second study

For Peer Review

(Pietri et al., 2018), this outcome was included to examine whether awareness of gender bias would increase female participants' identification with the role model and thus boost their STEM aspirations.

**Results.** Breda et al. (2020) found that students who received the role model intervention were more likely to report that women are discriminated against in STEM. This was an unexpected result for the authors, who suggested that perhaps the students subscribed to the idea that women face discrimination in science in an effort to explain gender gaps in this domain. Alternatively, they acknowledged that the role model might have shared personal experiences on this topic, increasing students' awareness of gender issues.

Increased awareness of gender bias in STEM was also found by Pietri et al. (2018). However, this outcome was expected and induced by the design of their study, which contrasts with Breda et al.'s (2020) study. Female participants inferred from experimental materials describing pervasive sexism in STEM that the role model had encountered similar bias, and bias awareness in turn predicted their identification with the role model. Note, however, that Pietri et al. focused on how this process promotes students' aspirations to pursue STEM; the implications of the results from the perspective of group-based hierarchies went unmentioned: Both awareness of sexism *and* identification as a member of a disadvantaged group have the potential to mobilize people to challenge the gender hierarchy (e.g., Radke et al., 2016).

**Research Question 2: What Are the Unintended Effects of Role Models on Students' Endorsement of Legitimizing Myths?**

Drawing on social-psychological theories of intergroup relations, we proposed that role model interventions might backfire by reinforcing myths (i.e., incorrect or misguided views) that legitimize the status quo in STEM and society more generally. The results suggested that, as expected, the potential side effects of role model interventions on students'

For Peer Review

endorsement of legitimizing myths have seldom been considered in the literature. Furthermore, because the focus of most studies included in this review was to document the effects of role model interventions on students' STEM self-concepts and aspirations, even the few findings that were relevant for the purposes of the present review were not interpreted and discussed as such. Notwithstanding that no strong conclusions can be drawn based on this limited evidential base, the next section tentatively summarizes and discusses the major findings from the perspective of group-based hierarchies. The potential undesirable side effects of role model interventions (i.e., side effects that imbue the unequal status quo with legitimacy) are discussed first, followed by the potential desirable side effects (i.e., side effects that make it more likely that students would challenge the inequitable status quo).

**Undesirable Side Effects of Role Model Interventions**

First, the evidence reviewed suggested that role models may strengthen meritocratic beliefs—specifically, the idea that hard work is an equalizing force in society (Shin et al., 2016). From a group-based hierarchy perspective, the possibility that role model interventions foster the idea that women's success in STEM is just a function of their efforts raises concern, as it imbues the (inequitable) status quo in this domain with legitimacy. In addition, this "equalizer" myth is related to—and may promote—a constellation of other legitimizing myths, including the belief in a just world and in individual mobility (O'Brien & Major, 2005). This myth is also associated with the tendency to make internal attributions for social ills (Christopher & Schlenker, 2005) and to exhibit intolerant attitudes toward disadvantaged groups and policies aimed at helping those groups, such as affirmative action (Rosenthal, Levy, et al., 2011).

Second, with few exceptions (discussed in the next section), the research reviewed here was rather consistent in demonstrating that gender stereotypes about STEM are deep seated and pervasive—they are not removed by an occasional role model intervention

For Peer Review

(Ramsey et al., 2013; Shin et al., 2016; Stout et al., 2011; Van Camp et al., 2019). This may be surprising to some: Several large-scale initiatives have been developed based on the idea that role models undermine gender stereotypes. For instance, the French National Center for Scientific Research developed a role model intervention intended to foster secondary school students' motivation for tech jobs. The intervention was explicitly designed to "highlight the diversity of research in digital sciences and help break down the stereotypes that discourage women from taking this path" (Institute for Information Sciences and Technologies, n.d.). Therefore, the fact that role model interventions fail to debunk gender stereotypes, and even occasionally reinforce the belief that women like science less than men (Breda et al., 2020), represents in our view an undesirable side effect.

Even more alarming is the finding that role model interventions were ineffective in changing the stereotypes held by *female* students *in STEM* (Ramsey et al., 2013; Stout et al., 2011; Van Camp et al., 2019). Social identity theory (Tajfel, 1979; Tajfel & Turner, 1986) suggests a possible explanation for this result. According to this theory, self-categorization as a member of a high-status group (e.g., "I am a STEM student") gives rise to a motivation to maintain the superiority of the ingroup over the outgroup. One way group members fulfill this motivation is by emphasizing their superiority on valued characteristics (Oldmeadow & Fiske, 2010). When a student is strongly identified with STEM, they are likely motivated to maintain the positive image of STEM by, for instance, defending the idea that brilliance is required to succeed in STEM (Leslie, Cimpian, et al., 2015; for a review, see Muradoglu et al., 2023), a characteristic associated with men more than women (Bian et al., 2017). Further empirical research is needed to examine this potential process. Regardless of what explains this finding, it seems that role model interventions fail to reduce stereotype endorsement among the very people who will likely become role models in the future, which may ultimately contribute to the perpetuation of stereotypes that are harmful to women (Carli et al., 2016).

For Peer Review

Third, although we suggested that students might penalize female role models for their success in a counterstereotypical domain, there was little to no evidence for such backlash effects. For instance, female role models who were perceived as competent were not denied warmth and likeability (Betz & Sekaquaptewa, 2012; Marx et al., 2013; Pietri et al., 2021). Similarly, exposure to role models from racial minorities did not enhance intergroup bias among majority members (Shin et al., 2016). Although the role models as *individuals* seemed to avoid backlash for behaving counterstereotypically, the picture was less clear with respect to backlash directed at women in STEM as a *group*. The two studies included in this review that assessed attitudes toward women in STEM following role model interventions showed mixed results (Bamberger, 2014; Smith & Erb, 1986), with a backlash effect present only in a cultural context that strongly encourages women to adopt traditional gender roles (Bamberger, 2014).

**Desirable Side Effects of Role Model Interventions**

Most of the desirable effects of role model interventions were expected. These effects concerned students' STEM self-concepts and aspirations. In contrast, the present review focused on desirable (but likely unintended) side effects of these interventions on students' *ideologies*. Two findings are worth noting here.

First, although role models are generally ineffective in changing gender stereotypes, there is some evidence to suggest that they can counter the gender stereotypes regarding intellectual ability (Breda et al., 2020; Buckley et al., 2022). Second, role model interventions seem to offer an opportunity to raise consciousness about gender bias in STEM (Breda et al., 2020). Female students who are aware of this bias are more likely to acknowledge that the role model may have faced discrimination, which in turn enhances their identification with the role model (Pietri et al., 2018). Provided that further research confirms this finding, it would have important implications. Indeed, it would indicate that role models have the potential to

For Peer Review

remove two main barriers to collective action: recognition of intergroup injustice and identification as a member of the disadvantaged group (Radke et al., 2016; van Zomeren et al., 2008). Thus, role model interventions could represent an asset for encouraging collective activism for gender equality.

**Reconciling the Ideological Side Effects of Role Model Interventions with Their Intended Effects on Students' STEM Self-Concepts and Aspirations**

The key takeaway of the present review is that role model interventions, although well-intended, may backfire by enhancing students' endorsement of beliefs that legitimize the gender hierarchy in STEM. However, it is important to acknowledge that role models do have a positive impact on students' self-concepts and aspirations to pursue STEM careers in some contexts (e.g., field interventions; Lawner et al., 2019) and for specific individuals (e.g., students interested in STEM prior to the intervention; Morgenroth et al., 2015). How can these seemingly contradictory effects be reconciled? We offer a few considerations below.

It is noteworthy that believing STEM is a meritocracy may in fact *encourage* students to pursue a career in this domain. In Western workplace and educational settings, the belief that outcomes such as pay or grades are allocated based on merit is an important justice principle and a motivating factor (Son Hing et al., 2011). As previously mentioned, role models signal that STEM is fair and rewards the most deserving. Therefore, role models may make STEM fields seem appealing to students. In this case, an undesirable ideological side effect might actually *enhance* the intended positive effects of role model interventions. However, perceiving STEM as meritocratic is likely beneficial only for high achievers: Female and racial/ethnic minority students who excel in this domain may be reassured that their personal merit will be considered. This differential effect of meritocratic beliefs as a function of students' achievement could explain, at least in part, why the positive effect of role model interventions on STEM enrollment is concentrated among high-achieving girls

For Peer Review

(Breda et al., 2020; see also Carrell et al., 2010).

Not all ideological side effects are beneficial for students' STEM self-concepts and aspirations. For instance, to the extent that role model interventions reinforce some negative stereotypes about women (e.g., that women don't like science; Breda et al., 2020), they might actually undermine girls' STEM pursuit. Even the side effects that seem more desirable from an ideological standpoint, such as raising awareness about the obstacles that women face in STEM, might not have desirable effects vis-à-vis girls' likelihood of pursuing STEM careers (Bamberger, 2014).

It is also important to point out that, in most circumstances, the relations between the ideological side effects of role model interventions and their intended effects are likely complex and hard to predict. This is so in part because members of stigmatized groups sometimes distance themselves from their groups in circumstances where such distancing could benefit their own upward mobility as individuals (e.g., Ellemers & Barreto, 2008; van Veelen et al., 2020). For instance, rather than being discouraged by the fact that a role model's success seems to suggest that women in general are uninterested in science, a girl might distance herself from her group (e.g., "I'm not a typical girl") in order to be able to benefit from the dose of inspiration that the role model provides. Much more research is needed to understand the ways in which the ideological side effects of role model interventions (when present) also affect students' motivation to pursue STEM careers.

**Limitations**

The conclusions of the present systematic review should be viewed with caution due to the heterogeneity in the designs and sample characteristics of the studies in our final sample. For instance, not all studies randomly assigned participants to intervention versus control conditions. In addition, most lab experiments consisted in brief exposures to role models via teleconferencing or printed materials, while field interventions included in-person

For Peer Review

role models and more extensive activities (e.g., visiting a company or lab with a female scientist). As a result, it becomes challenging to disentangle the specific contribution of the role models from the effects of other activities.

Heterogeneity in sample characteristics also limits the generalizability of the findings. Indeed, among the studies in our sample, 15% focused on elementary school students, 23% on secondary school students, 38% on university students, and 15% used participants on Amazon's Mechanical Turk platform. Although previous reviews found little evidence that age is a moderator of role models' effects (Gladstone & Cimpian, 2021), the focus was on students' STEM self-concepts and aspirations rather than on ideology-related outcomes. In addition, some authors have recently expressed doubts about the use of crowdsourcing platforms, questioning the quality of the data (Webb & Tangney, 2022).

Finally, many studies used rather small samples, which could imply low statistical power to detect the desired effects, raising questions about the reliability of the findings. Statistically underpowered studies could lead to false-positive findings in the published literature that are likely to fail later replication attempts (for a discussion, see Świątkowski & Dompnier, 2017).

**Future Directions**

Even though the studies included in this review did not provide a simple or definitive answer to the question of whether role model interventions have ideological side effects, they nonetheless open interesting perspectives. First, and in line with our theoretical argument, role model interventions might reinforce the myth that anyone can succeed if they work hard enough (Shin et al., 2016), a belief that is associated with the tendency to make internal attributions for social ills (Christopher & Schlenker, 2006). It would thus be worthwhile for future studies to examine further the impact of role models on students' endorsement of the belief in personal responsibility for success and failure. This question is critical, since prior

For Peer Review

research on role models recommends emphasizing internal, controllable explanations for role models' success, typically their efforts (e.g., Bagès et al., 2015; Gladstone & Cimpian, 2021). The possibility that role model interventions, by promoting legitimizing myths, may paradoxically enhance negative attitudes toward policies aimed at tackling the gender gap (e.g., affirmative recruitment of women in STEM, gender quotas) needs to be investigated.

Future research and interventions should also consider the cultural specificities of the contexts where role model interventions take place, particularly with regard to gender roles. The present review highlighted an unintended negative change in students' perceptions of women scientists following a role model intervention in a context marked by strong expectations about women's investment in motherhood (Bamberger, 2014). In such a context, successful female scientists might encounter backlash because they threaten the status quo. According to the status incongruity hypothesis, backlash is provoked by perceived violations of status expectations, defined as violations of the gender rules that uphold the gender status hierarchy (e.g., women's place is in the home; Rudman, Moss-Racusin, Phelan, et al., 2012). Accordingly, one can speculate that in societies strongly marked by traditional gender roles, female role models might pose a threat to the system and trigger backlash in defense of the status quo.

Finally, one implication of the present research may be that role models should aim to inspire in students a desire for social justice rather than simply commenting on their own career paths. Highlighting the challenges faced by women and racial/ethnic minorities in STEM fields might be an effective means to achieve this goal. Pointing out the absence of the necessary support systems to recruit and retain members of these groups could also help. In fact, some findings indicate that failing to provide such structural explanations for the present gender and racial/ethnic gaps in STEM likely triggers rationalization on the part of the students, a process that may actually *reinforce* gender-STEM stereotypes (Breda et al., 2020).

For Peer Review

To counter this negative side effect, we recommend that role model interventions include elements that raise awareness about structural barriers to inclusivity. This strategy may prevent students from invoking women's and minorities' internal attributes as explanations for their underrepresentation in STEM. In addition, raising awareness about structural barriers could encourage identification with women and underrepresented racial and ethnic minorities and help form a politicized identity, which is an important lever for the pursuit of social justice goals (van Zomeren et al., 2008, 2018).

**Conclusion**

In conclusion, the present work draws on social-psychological theories of intergroup relations to examine the potential side effects of role model interventions in reinforcing myths that legitimize the unequal status quo in STEM and society. To date, the literature has primarily focused on the effects of role models on students' STEM self-concepts and aspirations, overlooking potential *ideological* outcomes. The findings of our systematic review, although based on limited evidence, highlight both undesirable and desirable side effects of role model interventions on students' ideologies.

On the undesirable side, it is evident that these interventions often fail to challenge deep-seated gender stereotypes about STEM, even reinforcing the belief that women are less inclined toward science. Additionally, role model interventions may unintentionally reinforce the myth that success in STEM is solely determined by hard work. On the desirable side, some studies indicate that role model interventions can increase awareness of culturally ingrained gender bias, a key step toward potentially mobilizing students to challenge existing hierarchies. However, the limited number of studies and mixed findings suggest the need for further research to fully understand the extent and mechanisms of these ideological effects, both undesirable and desirable. Overall, this review underscores the importance of considering the potential side effects of role model interventions and encourages future

For Peer Review

research to explore these effects in more depth, contributing to the development of more effective strategies for promoting diversity and equity in STEM.

For Peer Review

## References

Ashby Plant, E., Baylor, A. L., Doerr, C. E., & Rosenberg-Kima, R. B. (2009). Changing middle-school students' attitudes and performance regarding engineering with computer-based social models. *Computers & Education*, *53*(2), 209–215. https://doi.org/10.1016/j.compedu.2009.01.013

Bagès, C., Verniers, C., & Martinot, D. (2016). Virtues of a hardworking role model to improve girls mathematics performance. *Psychology of Women Quarterly*, *40*(1), 55–64. https://doi.org/10.1177/0361684315608842

Bamberger, Y. M. (2014). Encouraging girls into science and technology with feminine role model: Does this work? *Journal of Science Education and Technology*, *23*(4), 549–561. https://doi.org/10.1007/s10956-014-9487-7

Betz, D. E., & Sekaquaptewa, D. (2012). My fair physicist? Feminine math and science role models demotivate young girls. *Social Psychological and Personality Science*, *3*(6), 738–746. https://doi.org/10.1177/1948550612440735

Bian, L., Leslie, S.-J., & Cimpian, A. (2017). Gender stereotypes about intellectual ability emerge early and influence children's interests. *Science*, *355*(6323), 389–391. https://doi.org/10.1126/science.aah6524

Block, K., Croft, A., & Schmader, T. (2018). Worth less?: Why men (and women) devalue care-oriented careers. *Frontiers in Psychology*, *9*, 1353. https://doi.org/10.3389/fpsyg.2018.01353

Bonnot, V., & Jost, J. T. (2014). Divergent effects of system justification salience on the academic self-assessments of men and women. *Group Processes & Intergroup Relations*, *17*(4), 453–464. https://doi.org/10.1177/1368430213512008

For Peer Review

Breda, T., Grenet, J., Monnet, M., & Van Effenterre, C. (2020). Do female role models reduce the gender gap in science? Evidence from French high schools. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3584926

Buckley, C., Farrell, L., & Tyndall, I. (2022). Brief stories of successful female role models in science help counter gender stereotypes regarding intellectual ability among young girls: A pilot study. *Early Education and Development*, *33*(4), 555–566. https://doi.org/10.1080/10409289.2021.1928444

Carbuccia, L. (2020). Interventions to foster academic aspirations adjustment among disadvantaged and female students—A prisma systematic review of literature. *Sciences Po LIEPP Working Paper*, *114*.

Carli, L. L., Alawa, L., Lee, Y., Zhao, B., & Kim, E. (2016). Stereotypes about gender and science: Women ≠ scientists. *Psychology of Women Quarterly*, *40*(2), 244–260. https://doi.org/10.1177/0361684315622645

Carrell, S. E., Page, M. E., & West, J. E. (2010). Sex and science: How professor gender perpetuates the gender gap. *Quarterly Journal of Economics*, *125*(3), 1101–1144. https://doi.org/10.1162/qjec.2010.125.3.1101

Christopher, A. N., & Schlenker, B. R. (2005). The protestant work ethic and attributions of responsibility: Applications of the triangle model. *Journal of Applied Social Psychology*, *35*(7), 1502–1515. https://doi.org/10.1111/j.1559-1816.2005.tb02181.x

Correia, I., Vala, J., & Aguiar, P. (2007). Victim's innocence, social categorization, and the threat to the belief in a just world. *Journal of Experimental Social Psychology*, *43*(1), 31–38. https://doi.org/10.1016/j.jesp.2005.12.010

Crosby, F. J., Iyer, A., & Sincharoen, S. (2006). Understanding affirmative action. *Annual Review of Psychology*, *57*(1), 585–611. https://doi.org/10.1146/annurev.psych.57.102904.190029

For Peer Review

Dasgupta, N. (2011). Ingroup experts and peers as social vaccines who inoculate the self-concept: The stereotype inoculation model. *Psychological Inquiry*, *22*(4), 231–246. https://doi.org/10.1080/1047840X.2011.607313

De Gioannis, E., Pasin, G. L., & Squazzoni, F. (2023). Empowering women in STEM: A scoping review of interventions with role models. *International Journal of Science Education*, 1–15. https://doi.org/10.1080/21548455.2022.2162832

Downing, R. A., Crosby, F. J., & Blake-Beard, S. (2005). The perceived importance of developmental relationships on women undergraduates' pursuit of science. *Psychology of Women Quarterly*, *29*(4), 419–426. https://doi.org/10.1111/j.1471-6402.2005.00242.x

Ellemers, N., & Barreto, M. (2008). Putting your own down: How members of disadvantaged groups unwittingly perpetuate or exacerbate their disadvantage. In A. P. Brief (Ed.), *Diversity at Work* (1st ed., pp. 202–262). Cambridge University Press. https://doi.org/10.1017/CBO9780511753725.009

Encinas-Martín, M., & Cherian, M. (2023). *Gender, education and skills: The persistence of gender gaps in education and skills*. OECD. https://doi.org/10.1787/34680dd5-en

Georgeac, O., & Rattan, A. (2019). Progress in women's representation in top leadership weakens people's disturbance with gender inequality in other domains. *Journal of Experimental Psychology: General, 148*(8), 1435–1453. https://doi.org/10.1037/xge0000561

Girerd, L., & Bonnot, V. (2020). Neoliberalism: An ideological barrier to feminist identification and collective action. *Social Justice Research*, *33*, 81–109. https://doi.org/10.1007/s11211-020-00347-8

Gladstone, J. R., & Cimpian, A. (2021). Which role models are effective for which students? A systematic review and four recommendations for maximizing the effectiveness of

For Peer Review

role models in STEM. *International Journal of STEM Education*, *8*(1), 59. https://doi.org/10.1186/s40594-021-00315-x

Grubb, A., & Harrower, J. (2008). Attribution of blame in cases of rape: An analysis of participant gender, type of rape and perceived similarity to the victim. *Aggression and Violent Behavior*, *13*(5), 396–405. https://doi.org/10.1016/j.avb.2008.06.006

Hafer, C. L., & Bègue, L. (2005). Experimental Research on Just-World Theory: Problems, Developments, and Future Challenges. *Psychological Bulletin*, *131*(1), 128–167.

Halpern, D. F., Aronson, J., Reimer, N., Simpkins, S. D., Star, J. R., & Wentzel, K. (2007). *Encouraging girls in math and science: IES practice guide*. National Center for Education Research, Institute of Education Science, U.S. Department of Education.

Herbaut, E., & Barone, C. (2021). Explaining gender segregation in higher education: Longitudinal evidence on the French case. *British Journal of Sociology of Education*, *42*(2), 260–286. https://doi.org/10.1080/01425692.2021.1875199

Ho, E. A., Sanbonmatsu, D. M., & Akimoto, S. A. (2002). The effects of comparative status on social stereotypes: How the perceived success of some persons affects the stereotypes of others. *Social Cognition*, *20*(1), 36–57. https://doi.org/10.1521/soco.20.1.36.20942

Hoffman, C., & Hurst, N. (1990). Gender stereotypes: Perception or rationalization? *Journal of Personality and Social Psychology*, *58*(2), 197–208. https://doi.org/10.1037/0022-3514.58.2.197

Hussak, L. J., & Cimpian, A. (2015). An early-emerging explanatory heuristic promotes support for the status quo. *Journal of Personality and Social Psychology*, *109*(5), 739–752. https://doi.org/10.1037/pspa0000033

Institute for Information Sciences and Technologies. (n.d.). *Les décodeuses du numérique*. Retrieved 2 May 2023, from https://www.ins2i.cnrs.fr/en/node/2559

For Peer Review

Jost, J. T., & Banaji, M. R. (1994). The role of stereotyping in system-justification and the production of false consciousness. *British Journal of Social Psychology*, *33*(1), 1–27. https://doi.org/10.1111/j.2044-8309.1994.tb01008.x

Jost, J. T., & Hunyady, O. (2005). Antecedents and consequences of system-justifying ideologies. *Current Directions in Psychological Science*, *14*(5), 260–265. https://doi.org/10.1111/j.0963-7214.2005.00377.x

Jost, J. T., & Kay, A. C. (2005). Exposure to benevolent sexism and complementary gender stereotypes: Consequences for specific and diffuse forms of system justification. *Journal of Personality and Social Psychology*, *88*(3), 498–509. https://doi.org/10.1037/0022-3514.88.3.498

Kim, J. Y., Fitzsimons, G. M., & Kay, A. C. (2018). Lean in messages increase attributions of women's responsibility for gender inequality. *Journal of Personality and Social Psychology*, *115*(6), 974–1001. https://doi.org/10.1037/pspa0000129

Krauth-Gruber, S., Yzerbyt, V., & Aelenei, C. (2023). *An intersectional approach to gender and social class stereotypes* [Manuscript in preparation].

Laurin, K., Kay, A. C., & Shepherd, S. (2011). Self-stereotyping as a route to system justification. *Social Cognition*, *29*(3), 360–375. https://doi.org/10.1521/soco.2011.29.3.360

Lawner, E. K., Quinn, D. M., Camacho, G., Johnson, B. T., & Pan-Weisz, B. (2019). Ingroup role models and underrepresented students' performance and interest in STEM: A meta-analysis of lab and field studies. *Social Psychology of Education*, *22*(5), 1169–1195. https://doi.org/10.1007/s11218-019-09518-1

Lerner, M. (1980). *The Belief in a Just World: A Fundamental Delusion*. Springer.

For Peer Review

Leslie, S.-J., Cimpian, A., Meyer, M., & Freeland, E. (2015). Expectations of brilliance underlie gender distributions across academic disciplines. *Science*, *347*(6219), 262–265. https://doi.org/10.1126/science.1261375

Levy, S. R., Freitas, A. L., Mendoza-Denton, R., Kugelmass, H., & Rosenthal, L. (2010). When sociopolitical events strike cultural beliefs: Divergent impact of hurricane Katrina on African Americans' and European Americans' endorsement of the protestant work ethic. *Basic and Applied Social Psychology*, *32*(3), 207–216. https://doi.org/10.1080/01973533.2010.495673

Madeira, A. F., Costa-Lopes, R., Dovidio, J. F., Freitas, G., & Mascarenhas, M. F. (2019). Primes and consequences: A systematic review of meritocracy in intergroup relations. *Frontiers in Psychology*, *10*, 2007. https://doi.org/10.3389/fpsyg.2019.02007

Manke, K. J., & Cohen, G. L. (2011). More than inspiration: Role models convey multiple and multifaceted messages. *Psychological Inquiry*, *22*(4), 275–279. https://doi.org/10.1080/1047840X.2011.622254

Marx, D. M., Monroe, A. H., Cole, C. E., & Gilbert, P. N. (2013). No doubt about it: When doubtful role models undermine men's and women's math performance under threat. *The Journal of Social Psychology*, *153*(5), 542–559. https://doi.org/10.1080/00224545.2013.778811

McCoy, S. K., & Major, B. (2007). Priming meritocracy and the psychological justification of inequality. *Journal of Experimental Social Psychology*, *43*(3), 341–351. https://doi.org/10.1016/j.jesp.2006.04.009

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & The PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA Statement. *PLoS Medicine*, *6*(7), e1000097. https://doi.org/10.1371/journal.pmed.1000097

For Peer Review

Morgenroth, T., Ryan, M. K., & Peters, K. (2015). The motivational theory of role modeling: How role models influence role aspirants' goals. *Review of General Psychology*, *19*(4), 465–483. https://doi.org/10.1037/gpr0000059

Muradoglu, M., Arnold, S. H., Leslie, S.-J., & Cimpian, A. (2023). "What does it take to succeed here?": The belief that success requires brilliance Is an obstacle to diversity. *Current Directions in Psychological Science*, 096372142311733. https://doi.org/10.1177/09637214231173361

National Center for Science and Engineering Statistics. (2023). *Diversity and STEM: Women, minorities, and persons with disabilities* (Special Report NSF, pp. 23–315). https://ncses.nsf.gov/wmpd

O'Brien, L. T., & Major, B. (2005). System-Justifying Beliefs and Psychological Well-Being: The Roles of Group Status and Identity. *Personality and Social Psychology Bulletin*, *31*(12), 1718–1729. https://doi.org/10.1177/0146167205278261

Oldmeadow, J. A., & Fiske, S. T. (2010). Social status and the pursuit of positive social identity: Systematic domains of intergroup differentiation and discrimination for high- and low-status groups. *Group Processes & Intergroup Relations*, *13*(4), 425–444. https://doi.org/10.1177/1368430209355650

Olsson, M., & Martiny, S. E. (2018). Does exposure to counterstereotypical role models influence girls' and women's gender stereotypes and career choices? A review of social psychological research. *Frontiers in Psychology*, *9*, 2264. https://doi.org/10.3389/fpsyg.2018.02264

Ouzzani, M., Hammady, H., Fedorowicz, Z., & Elmagarmid, A. (2016). Rayyan—A web and mobile app for systematic reviews. *Systematic Reviews*, *5*(1), 210. https://doi.org/10.1186/s13643-016-0384-4

For Peer Review

Pietri, E. S., Johnson, I. R., Majid, S., & Chu, C. (2021). Seeing what's possible: Videos are more effective than written portrayals for enhancing the relatability of scientists and promoting Black female students' interest in STEM. *Sex Roles*, *84*(1–2), 14–33. https://doi.org/10.1007/s11199-020-01153-x

Pietri, E. S., Johnson, I. R., Ozgumus, E., & Young, A. I. (2018). Maybe she is relatable: Increasing women's awareness of gender bias encourages their identification with women scientists. *Psychology of Women Quarterly*, *42*(2), 192–219. https://doi.org/10.1177/0361684317752643

Pratto, F., Sidanius, J., & Levin, S. (2006). Social dominance theory and the dynamics of intergroup relations: Taking stock and looking forward. *European Review of Social Psychology*, *17*, 271–320.

Prentice, D. A., & Carranza, E. (2002). What women and men should be, shouldn't be, are allowed to be, and don't have to be: The contents of prescriptive gender stereotypes. *Psychology of Women Quarterly*, *26*(4), 269–281. https://doi.org/10.1111/1471-6402.t01-1-00066

Radke, H. R. M., Hornsey, M. J., & Barlow, F. K. (2016). Barriers to women engaging in collective action to overcome sexism. *American Psychologist*, *71*(9), 863–874. https://doi.org/10.1037/a0040345

Ramsey, L. R., Betz, D. E., & Sekaquaptewa, D. (2013). The effects of an academic environment intervention on science identification among women in STEM. *Social Psychology of Education*, *16*(3), 377–397. https://doi.org/10.1007/s11218-013-9218-6

Rosenthal, L., Levy, S. R., & Moyer, A. (2011). Protestant work ethic's relation to intergroup and policy attitudes: A meta-analytic review: Protestant work ethic. *European Journal of Social Psychology*, *41*(7), 874–885. https://doi.org/10.1002/ejsp.832

For Peer Review

Rosenthal, L., London, B., Levy, S. R., Lobel, M., & Herrera-Alcazar, A. (2011). The relation between the protestant work ethic and undergraduate women's perceived identity compatibility in nontraditional majors: Protestant work ethic. *Analyses of Social Issues and Public Policy*, *11*(1), 241–262. https://doi.org/10.1111/j.1530-2415.2011.01264.x

Rudman, L. A. (1998). Self-promotion as a risk factor for women: The costs and benefits of counterstereotypical impression management. *Journal of Personality and Social Psychology*, *74*(3), 629–645. https://doi.org/10.1037/0022-3514.74.3.629

Rudman, L. A., Moss-Racusin, C. A., Glick, P., & Phelan, J. E. (2012). Reactions to vanguards. In *Advances in Experimental Social Psychology* (Vol. 45, pp. 167–227). Elsevier. https://doi.org/10.1016/B978-0-12-394286-9.00004-4

Rudman, L. A., Moss-Racusin, C. A., Phelan, J. E., & Nauts, S. (2012). Status incongruity and backlash effects: Defending the gender hierarchy motivates prejudice against female leaders. *Journal of Experimental Social Psychology*, *48*(1), 165–179. https://doi.org/10.1016/j.jesp.2011.10.008

Shaver, K. G. (1970). Defensive attribution: Effects of severity and relevance on the responsibility assigned for an accident. *Journal of Personality and Social Psychology*, *14*(2), 101–113. https://doi.org/10.1037/h0028777

Shin, J. E. L., Levy, S. R., & London, B. (2016). Effects of role model exposure on STEM and non-STEM student engagement. *Journal of Applied Social Psychology*, *46*(7), 410–427. https://doi.org/10.1111/jasp.12371

Sidanius, J., & Pratto, F. (1999). *Social dominance: An intergroup theory of social hierarchy and oppression.* Cambridge University Press. http://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=1999-02958-000&lang=fr&site=ehost-live

For Peer Review

Sidanius, J., Pratto, F., van Laar, C., & Levin, S. (2004). Social Dominance Theory: Its Agenda and Method. *Political Psychology*, *25*(6), 845–880.

Siddaway, A. P., Wood, A. M., & Hedges, L. V. (2019). How to do a systematic review: A best practice guide for conducting and reporting narrative reviews, meta-analyses, and meta-syntheses. *Annual Review of Psychology*, *70*(1), 747–770. https://doi.org/10.1146/annurev-psych-010418-102803

Smith, W. S., & Erb, T. O. (1986). Effect of women science career role models on early adolescents' attitudes toward scientists and women in science. *Journal of Research in Science Teaching*, *23*(8), 667–676. https://doi.org/10.1002/tea.3660230802

Son Hing, L. S., Bobocel, D. R., Zanna, M. P., Garcia, D. M., Gee, S. S., & Orazietti, K. (2011). The merit of meritocracy. *Journal of Personality and Social Psychology*, *101*(3), 433–450. https://doi.org/10.1037/a0024618

Stout, J. G., Dasgupta, N., Hunsinger, M., & McManus, M. A. (2011). STEMing the tide: Using ingroup experts to inoculate women's self-concept in science, technology, engineering, and mathematics (STEM). *Journal of Personality and Social Psychology*, *100*(2), 255–270. https://doi.org/10.1037/a0021385

Świątkowski, W., & Dompnier, B. (2017). Replicability crisis in social psychology: Looking at the past to find new pathways for the future. *International Review of Social Psychology*, *30*(1), 111. https://doi.org/10.5334/irsp.66

Tajfel, H. (1979). Individuals and groups in social psychology. *British Journal of Social and Clinical Psychology*, *18*(2), 183–190. https://doi.org/10.1111/j.2044-8260.1979.tb00324.x

Tajfel, H., & Turner, J. C. (1986). The social identity theory of intergroup behavior. In S. Worchel & W. G. Austin (Eds.), *Psychology of intergroup relations* (pp. 7–24). Nelson Hall.

For Peer Review

Uluğ, Ö. M., Chayinska, M., & Tropp, L. R. (2023). Does witnessing gender discrimination predict women's collective action intentions for gender justice? Examining the moderating role of perceived female support. *Journal of Community & Applied Social Psychology*, *33*(2), 501–518. https://doi.org/10.1002/casp.2642

UNESCO. (2021). *UNESCO science report: The race against time for smarter development* (S. Schneegans, T. Straza, & J. Lewis, Eds.; UNESCO Publishing). https://unesdoc.unesco.org/ark:/48223/pf0000377433

Van Camp, A. R., Gilbert, P. N., & O'Brien, L. T. (2019). Testing the effects of a role model intervention on women's STEM outcomes. *Social Psychology of Education*, *22*(3), 649–671. https://doi.org/10.1007/s11218-019-09498-2

Van den Akker, O., Peters, G.-J. Y., Bakker, C., Carlsson, R., Coles, N. A., Corker, K. S., Feldman, G., Mellor, D. T., Moreau, D., Nordström, T., Pfeiffer, N., Pickering, J. S., Riegelman, A., Topor, M., van Veggel, N., & Yeung, S. K. (2020). *Generalized systematic review registration form* [Preprint]. MetaArXiv. https://doi.org/10.31222/osf.io/3nbea

van der Bruggen, M., & Grubb, A. (2014). A review of the literature relating to rape victim blaming: An analysis of the impact of observer and victim characteristics on attribution of blame in rape cases. *Aggression and Violent Behavior*, *19*(5), 523–531. https://doi.org/10.1016/j.avb.2014.07.008

van Zomeren, M., Kutlaca, M., & Turner-Zwinkels, F. (2018). Integrating who "we" are with what "we" (will not) stand for: A further extension of the Social Identity Model of Collective Action. *European Review of Social Psychology*, *29*(1), 122–160. https://doi.org/10.1080/10463283.2018.1479347

van Zomeren, M., Postmes, T., & Spears, R. (2008). Toward an integrative social identity model of collective action: A quantitative research synthesis of three socio-

For Peer Review

psychological perspectives. *Psychological Bulletin*, *134*(4), 504–535. https://doi.org/10.1037/0033-2909.134.4.504

van Veelen, R., Veldman, J., Van Laar, C., & Derks, B. (2020). Distancing from a stigmatized social identity: State of the art and future research agenda on self-group distancing. *European Journal of Social Psychology*, *50*(6), 1089–1107. https://doi.org/10.1002/ejsp.2714

Verniers, C., Bonnot, V., Darnon, C., Dompnier, B., & Martinot, D. (2016). How gender stereotypes of academic abilities contribute to the maintenance of gender hierarchy in higher education. In K. Faniko, F. Lorenzi-Cioldi, O. Sarrasin, & E. Mayor (Eds.), *Gender and social hierarchies: Perspectives from social psychology* (pp. 27–38). Routledge, Taylor & Francis Group.

Voyer, D., & Voyer, S. D. (2014). Gender differences in scholastic achievement: A meta-analysis. *Psychological Bulletin*, *140*(4), 1174–1204. https://doi.org/10.1037/a0036620

Webb, M. A., & Tangney, J. P. (2022). Too good to be true: Bots and bad data from Mechanical Turk. *Perspectives on Psychological Science*, 174569162211200. https://doi.org/10.1177/17456916221120027

Weber, M. (1958). *The protestant ethic and the spirit of capitalism: A classic study of the fundamental relationships between religion and the economic and social life in modern culture*. Scribner.

World Economic Forum. (2022). *The global gender gap report 2022*. http://reports.weforum.org/global- gender-gap-report-2022

For Peer Review

**Table 1**

*Studies that Included Outcome Variables Pertaining to the Hypothesized Ideological Side Effects of Role Model Interventions*

| Study | Study design | Country | Intervention | Sample | Outcomes related to legitimizing myths |
|---|---|---|---|---|---|
| Ashby Plant et al., 2009 | Random assignment | USA | Remote RM | *N* = 106, 58% girls; 54% Caucasian, 27% African-American, 2% Asian/Asian American, 8% Hispanic/Latino, 6% multiracial, 1% other, 2% no report<br>Mean age: 13.63 | Endorsement of STEM-gender stereotype |
| Bamberger, 2014 | Quasi experimental | Israel | Multimodal: In person RM, open activity at school, visits of a tech company, summary meeting at school<br>STEM gender issue explicitly stated | *N* = 99, 100% girls<br>Mean age unspecified (9th graders) | Attitudes toward minorities in STEM—women |
| Betz & Sekaquaptewa, 2012 Study 1 | Random assignment | USA | Remote RM | *N* =144; 100% girls; 28% Black, 16% Asian, 4% Latina and 43% mixed/other<br>Mean age: 11.56 | Attitudes toward the RM |

For Peer Review

| | | | | | |
|---|---|---|---|---|---|
| Breda et al., 2020 | Random assignment | France | Multimodal: In person RM; slideshow on the STEM labor market; videos; information session on STEM careers STEM gender issue explicitly stated | *N* =19,451<br><br>10th graders: 52% girls, 6% non-French. Mean age: 15.72<br><br>12th graders: 49% girls, 5% non-French. Mean age: 17.12 | Endorsement of STEM-gender stereotype, Awareness of gender bias in STEM |
| Buckley et al., 2022 | Quasi experimental | UK | Remote RM | *N* = 40, 100% girls<br>Mean age: 7 | Endorsement of gender stereotypes—smart & nice |
| Marx et al., 2013 | Random assignment | USA | Remote RM | *N* = 120, 48% women<br>Mean age unspecified (university students) | Attitudes toward the RM |
| Pietri et al., 2021 Pilot study | Random assignment | USA | Remote RM | *N* = 399, 47% women, 8% other; 73% White, 8% Black/African American, 8% Latino/a, 8% Asian American, 6% American Indian or Alaskan Native; 12% employed in a STEM field<br>Mean age: 35 (MTurk) | Attitudes toward the RM |
| Pietri et al., 2018 Study 1a. & 1c | Random assignment | USA | Study 1a: Remote RM<br>STEM gender issue explicitly | Study 1a: *N* = 488, 100% women; 84% White, 4% African | Awareness of gender bias in STEM |

For Peer Review

| | | | | | |
|---|---|---|---|---|---|
| | | | stated<br>Study 1c: Remote RM<br>STEM gender issue explicitly stated | American, 7% Latino, 3% Asian, 1% American Indian/Alaska Native, <1% Native Hawaiian or other Pacific Islander, <1% other; 10% working in a STEM field.<br>Mean age unspecified (MTurk)<br><br>Study 1c: *N* = 515, 100% women; 80% White, 4% African American, 5% Latino, 7% Asian, <1% American Indian or Alaska Native, 3% other; 9% working in a STEM field.<br>Mean age unspecified (MTurk) | |
| Ramsey et al., 2013 Study 2 | Random assignment | USA | Remote RM | *N* = 106, 100% women STEM students; 63% Caucasian, 20% Asian American or Asian or Pacific Islander, 9% African American/Black, 1% Latina/Hispanic, 7% other.<br>Mean age: 19.07 | Endorsement of STEM-gender stereotype, including implicit stereotyping |

For Peer Review

| | | | | | |
|---|---|---|---|---|---|
| Shin et al., 2016 | Random assignment | USA | Remote RM<br>Attribution for success: Hard work | *N* = 1035, 66% women<br>Mean age: 19.92 | Endorsement of STEM-gender stereotype, Attitudes toward minorities in STEM—URM, PWE |
| Smith & Erb, 1986 | Random assignment | USA | Multimodal: In person RM; remote RM | *N* = 286, 55% girls<br>Mean age unspecified (5th to 8th graders) | Attitudes toward minorities in STEM—women |
| Stout et al., 2011 Study 1 & 2 | Random assignment | USA | Study 1: In person RM<br>Study 2: Remote RM | Study 1: *N* = 72, 100% women<br>Mean age unspecified (undergraduate STEM students)<br><br>Study 2: *N* = 101, 100% women<br>Mean age unspecified (undergraduate engineering students) | Endorsement of STEM-gender stereotype, including implicit stereotyping |
| Van Camp et al., 2019 | Random assignment | USA | Remote RM | *N* = 72, 100% women; 79% White/Caucasian, 10% Asian American, 8% biracial, 1% African American, 1% Middle Eastern. | Endorsement of STEM-gender stereotype, including implicit stereotyping |

For Peer Review

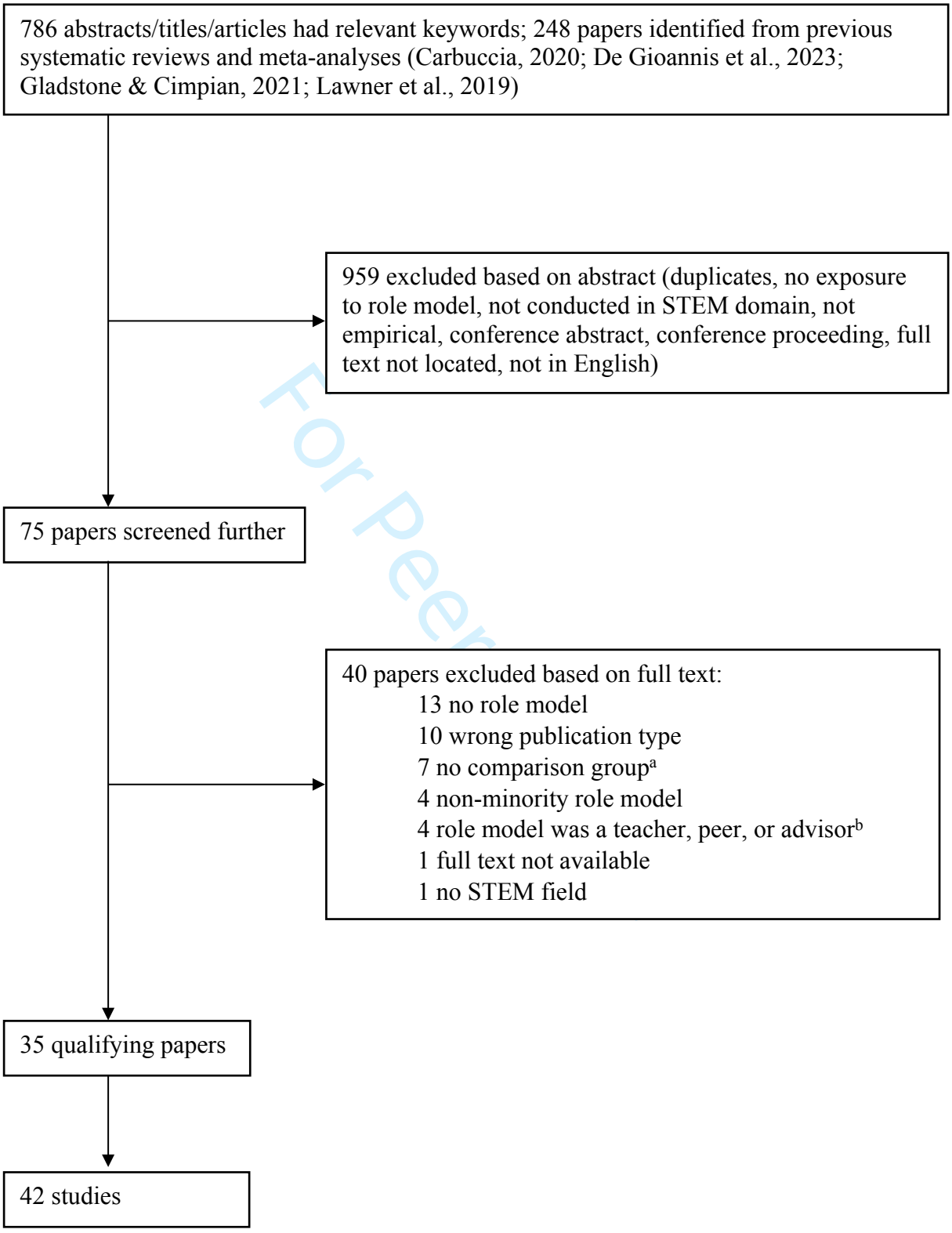
| | | |
|---|---|---|
| | | Mean age: 18.06<br>The participants had expressed interest in majoring in STEM |

*Note*. RM = role model. MTurk = Mechanical Turk. PWE = Protestant Work Ethic. URM = underrepresented minorities.

For Peer Review

**Figure 1**

*Flowchart of the Steps in the Screening Process*




[a]Even though we included studies in which participants were not randomly assigned to receive exposure to a role model (but rather self-selected into receiving this exposure), we nevertheless excluded the seven studies that did not feature a comparison, no-exposure group.

[b]The four studies in which students had a prior relationship with the role model (e.g., a teacher, a peer) were excluded because these role models did not fit the definition of role models used here.