Role Models Can Help Make the Mathematics Classroom More Inclusive

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Abstract

A decrease in student motivation in the middle grades mathematics classroom is cause for concern, especially when trying to make the mathematics environment more inclusive for typically marginalized students. One way to increase student motivation and make classrooms more inclusive is by introducing students to role models - someone who is not only successful, but inspirational, relatable, and can also be emulated. In this synthesis, we conducted a search of the literature which resulted in 48 articles related to the implementation of role models in STEM. Findings from our review demonstrate that there are at least four dimensions of role model interventions that can influence student motivation: 1) specific features of the role model (e.g., competence) that can influence students' perceptions of themselves, 2) students' perceived similarity to the role model, 3) students' perceptions of how attainable the role model's success is, and 4) features of the students themselves (e.g., degree of identification with mathematics). We also found that there are important nuances within these dimensions that could lead to unintended decreases in motivation among marginalized students. We conclude by highlighting recommendations for the implementation of role models into the mathematics classroom.

Keywords: role models, mathematics, marginalization, achievement motivation, STEM

Role Models Can Help Make the Mathematics Classroom More Inclusive

Researchers, teachers, and policy makers have sought to understand how to increase student motivation in secondary mathematics. However, in order to increase student motivation, we must first understand how to make the mathematics environment more inclusive for students who are typically marginalized. One way to help make this environment more inclusive is by introducing role models (i.e., an individual who can impact a person's achievements and motivations by acting as a successful exemplar) to students, and this is particularly true for students who are marginalized in the field. Indeed, popular news outlets have oftentimes touted role models as the solution to decreasing inequality in math and STEM more broadly (e.g., Dean, 2014; Levere, 2018). Further, in the last two decades there has been a surge in research exploring how role models can be used in mathematics and other STEM (science, technology, engineering, mathematics) fields, in order to help motivate students. The implementation of role models as an intervention to help decrease inequality is promising because the use of role models has been found to be effective in several circumstances (Bagès et al., 2016; Cheryan et al., 2011; Drury et al., 2011; Lin-Siegler et al., 2016; Lockwood, 2006; Marx & Roman, 2002; Stout et al., 2011), is relatively low cost (Herrmann et al., 2016), can be implemented in a variety of ways (Lawner et al., 2019), and has the potential to be customized to be effective for many students in the classroom (Drury et al., 2011; Morgenroth et al., 2015).

However, when implementing any sort of intervention, it is imperative that careful consideration is made when designing the treatment—in this case, the role model. One of the major goals of role model interventions is to help make an environment more inclusive by increasing positive feelings like a sense of belonging and decreasing concerns about negative stereotypes. Because the mathematics domain is a highly stereotyped domain for women and students of color (Marx & Roman, 2002; Murphy et al., 2007; Steele, 1997) it is important that a role model does not inadvertently increase feelings of not belonging or being stereotyped. Therefore, it is important to answer two questions regarding role models: what qualities of a role

model can backfire and actively perpetuate inequalities in mathematics? And what qualities of a role model can work towards making the mathematics environment more inclusive? Throughout this review, we will delve into four main dimensions of role models that can influence how effective they are in mathematics classrooms: 1) specific features of the role model (e.g., competence) that can influence students' perceptions of themselves, 2) students' perceived similarity to the role model, 3) students' perceptions of how attainable the role model's success is, and 4) features of the students themselves (e.g., degree of identification with mathematics) that matter regardless of the role model. We will next define what we mean by a "role model" and how we plan to disrupt the prototypical perception of who a role model is.

Defining Role Models

How role models are conceptualized also has a bearing on how we should implement them. In general, the term 'role model' is widely used and has been used to refer to a variety of different types of individuals. The prototypical person in a field or domain is oftentimes the easiest to picture when thinking of who a role model is. In the mathematics domain, the normative perception of who a role model can be is largely influenced by who is seen as excelling in mathematics, which is often thought of to be males (Chambers, 1983; Lee & Anderson, 2014; Steele, 2003). However, an effective role model should be more than just a person who is successful. For the purposes of this review, we define an effective role model as someone who is not only successful, but inspirational, relatable, and can also be emulated (Lockwood & Kunda, 1997; Marx & Roman, 2002; Morgenroth et al., 2015). As mentioned previously, the role model must also be perceived as being similar—physically and/or psychologically—and their success perceived to be attainable in order to facilitate a desire to be like the role model. In the following sections we will describe each of the four dimensions in turn and how these dimensions are supported by prominent theories of motivation. We will additionally discuss how these dimensions can help disrupt the normative perception of what a role model is.

Competent Role Models

When thinking about who a role model is, we generally envision someone who is competent (Lockwood & Kunda, 1997), and in mathematics the normative perception of who is good at math are males (Leslie et al., 2015). In a highly stereotyped domain like mathematics, it might be especially important to hear a similar other be described as competent and successful in mathematics. For instance, female role models that are described as being competent in mathematics may be critical for girls because they counter stereotypes about girls' perceived lower math ability. This is supported by Dasgupta's (2011) stereotype inoculation model, which posits that a perceived similar role model can help inoculate marginalized students, like females, against negative stereotypes, such as perceiving they are less competent in mathematics. Further support for why a role model's competence matters can be provided by Bandura's (1977) Social Cognitive Theory. Bandura argues that seeing or hearing about a similar peer achieve success on a task or domain could be a source of self-efficacy for students who need to overcome a barrier (e.g., stereotypes). Therefore, could the presentation of a role model described as being competent increase marginalized students' own perceptions of competence? Does the role model need to share a salient group membership with the student in order for this to be effective? Throughout this review we will explore and discuss findings regarding whether certain descriptions of the role model (i.e., that they are competent) can be a protective factor for marginalized students in mathematics. Although social comparisons with competent and successful ingroup members can be beneficial, there are other qualities of the role model that matter as well.

Similar Role Models

In addition to being described as competent in mathematics, it is also important that the role model and student share some degree of similarity. Research on social comparison demonstrates that people are most likely to seek comparisons with others who are similar to them on at least one meaningful dimension (Goethals & Darley, 1977; Lockwood et al., 2002).

One dimension of similarity that is more easily visible is a demographic similarity (e., gender, race), and it may be particularly important for marginalized students to be introduced to a successful role model that is demographically similar to themselves. The stereotype inoculation model (Dasgupta, 2011) provides support for this claim by describing how the introduction to an ingroup role model can change how a student perceives the demographic composition of the domain. For example, if a girl in mathematics is introduced to a competent female role model, this may not only help inoculate her against negative stereotypes but also help change her perception that women do belong in mathematics.

Alongside demographic similarities there are also deeper and more internal perceived similarities. While demographic similarities are typically visible on the surface, deeper similarities are similarities found at the more psychological level and include things like similar goals, interests, and struggles. Thus, it is also important to consider deeper more psychological similarities between the role model and student. An important question is whether presenting students with a demographically similar role model who is successful in mathematics is enough to help facilitate motivation. Or do students need to perceive a deeper psychological level of similarity, not just an objective or demographic similarity, in order to believe they truly belong in mathematics? For example, if the role model is perceived as being *only* demographically similar, this may lead to unintended results, such that females or other marginalized students may feel like some members of their ingroup can be successful in mathematics, but that *they themselves* cannot because of this lack of a deeper similarity. Thus, although being demographically similar is certainly important, the role model should also be perceived by the student as being similar on a deeper, more psychological level (e.g., similar goals, interests, struggles) to ensure that students feel like it is not just *other* members of their ingroup that belong in mathematics, but that they see themselves as belonging as well.

This distinction between a perceived demographic similarity and deeper psychological similarity can be supported by Expectancy-Value Theory (Eccles & Wigfield, 2002). According to

this theoretical model, role models who represent the possible through a shared sense of psychological similarity can help marginalized students' developing competence by changing the perception of external barriers (i.e., perceived discrimination) and stereotypes (Morgenroth et al., 2015). This deeper sense of similarity can help marginalized students feel seen in an environment where they are more often than not the minority. Hearing a role model describe their goals, interests or even struggles, may help create a deeper connection between the role model and the student (Marx & Roman, 2002). In this review, we will describe evidence that marginalized students who are introduced to a role model that looks like them and/or that these students perceived as being psychologically similar to them can make them feel "seen" and increase their sense of belonging.

Attainable Success of Role Models

Having a sense of similarity is important, but it is also important that this sense of similarity is followed by a feeling that the role model's success is attainable. By "attainable" we mean the degree to which students can see themselves being like the role model in the future (Morgenroth et al., 2015). Thus, a key difference between the perceived sense of similarity we discussed above and attainability, is that attainability places an emphasis on future similarity. Therefore, a perceived sense of similarity between oneself and the role model and a feeling that the role model's success is attainable should be couched together in order to more strongly send the message of "I can do this, *and so can you.*" If the role model is presented in such a way that their success seems unattainable, then despite any similarities this will likely lead to a negative social comparison and feelings of not belonging (Betz & Sekaquaptewa, 2012; Hoyt & Simon, 2011; Lockwood & Kunda, 1997; Marx & Roman, 2002; Morgenroth et al., 2015; Olsson & Martiny, 2018; Stout et al. 2011). Thus, it is important to question what happens when students do not believe they can emulate the role model's success. According to Weiner's (1979) Theory of Attribution, a role model's success is most likely to seem attainable to a student if that success seems controllable (e.g., through hard work and not innate intelligence)

and not due to other factors such as luck. In this review, we will provide evidence that the role model's success should be perceived as attainable in order to increase students' motivation in mathematics. However, it is important to keep in mind that the students' attribution of the role model's success depends not only on the portrayal of the role model, but also attributes of the students themselves.

Characteristics of the Student Matter

One particularly important characteristic of the student that matters for how they respond to a role model is their current level of math identity. Math identity is broadly defined as how students see themselves as mathematics learners, such as viewing themselves as a "math person" (Boaler, 2002; Cobb et al., 2009; Martin, 2000). Math identity is an important characteristic of the student because students with differing levels of math identity tend to perceive psychological threats of the mathematics classroom differently (Drury et al., 2011). Students who have not yet developed a strong mathematics identity are typically less concerned with negative stereotypes about their ability and more concerned with belonging than students who are strongly identified with mathematics (Cheryan & Plaut, 2010; Steele, 1997). Therefore, it is important to present different types of role models to students who have and have not developed a math identity. For students who have a strong math identity, the role model should aim to decrease concerns of negative stereotypes. For students who have not yet identified with mathematics it is more beneficial to use a role model that embodies traits compatible with how students see themselves (Cheryan et al., 2011) in order to help foster a sense of belonging which has implications for subsequent mathematics motivation and math identity development.

Disrupting the Normative Perception of What Makes a Role Model

Overall, throughout this review we will disrupt the normative perception that favors men as being the prototype of a role model because they are good at math by not just changing the idea of who can be good at math but also placing additional emphasis on other traits of the role model that can be emulated (e.g., working hard). We can help disrupt this idea by describing

qualities of the role model that matter for marginalized students and how qualities of the role model must also interplay with characteristics of the student. The presentation of more diverse role models can help students facing unequitable mathematics classroom environments develop a positive mathematics identity and sense of belonging which has consequences for their confidence and interest in mathematics. Our review of the literature thus aims to increase our understanding of how to intentionally use role models as a motivational tool to increase feelings of belonging in mathematics classrooms, rather than relying on the prototypical perception of who a role model is based on how good they are in a domain. Therefore, we will end this review with recommendations for the implementation of role models into mathematics with the goal of creating a more inclusive environment.

Methods

Selection criteria

Multiple databases were searched to obtain relevant research studies: PsycINFO, Psychology and Behavioral Sciences Collection, ERIC, and ProQuest Dissertations and Theses. The following search terms were used in this electronic database search: (“role model” or “role models”) AND (math* OR science OR “STEM”). For PsycINFO, Psychology and Behavioral Sciences Collection, ERIC, and Google Scholar, these terms could be found anywhere in the text. For ProQuest, these terms had to appear in the title or the abstract in order to be included in the more detailed scan and skim process. These electronic databases were searched through August 13, 2019 and in total 317 papers were generated from the electronic database search. Articles were immediately excluded if they only used these terms to talk about how future studies should examine role models. We additionally did a search on Google Scholar to ensure we weren’t missing anything that may not have come up in these databases. We found four more relevant articles. One from *Psychology of Women Quarterly*, one from *Contemporary Economic Policy*, one from *The Journal of Economic Education*, and one from *Journal of Research in Science Teaching*. We were also notified of a relevant meta-

analysis on August 20, 2019 that was published on August 14, 2019 in *Social Psychology of Education* titled “Ingroup role models and underrepresented students’ performance and interests in STEM: A meta-analysis of lab and field studies.” An additional 25 studies were pulled from this meta-analysis that could be used for this study. Many of these were dissertations, theses, or conference presentations. We additionally checked that they would come up in our search by conducting a new search with additional search terms that represented other terms used to describe role models (i.e., ingroup mentor, ingroup expert, ingroup peer). The following search terms were used in this new search: (“role model” or “role models” OR ingroup mentor OR ingroup expert OR ingroup peer) AND (math* OR science OR “STEM”).

To be included, (a) studies had to be conducted in a math relevant domain (e.g., STEM domain); (b) gender and/or ethnicity was discussed and comparisons made; (c) participants were exposed to a role model (in the case of experimental studies) or discussed what made a role model (in the case of qualitative and correlational studies); (d) perceived similarity between the role model and target was discussed; (e) the study examined performance, interest, ability beliefs or self-efficacy, and/or sense of belonging as outcomes after being exposed to the role model; (f) full text was available; (g) in the case of review articles, they were included if there was a discussion around the importance of role models and/or what makes a role model effective. In total 48 articles met these initial inclusion criteria.

Findings

In the next four sections, we will discuss findings from our synthesis in terms of the four dimensions of role models that we described earlier and that could influence how effective role models are in mathematics classroom. We first begin by discussing findings in relation to hearing that a role model is competent. Next, for our second finding we provide evidence that the degree of perceived similarity matters. Third, we discuss how the role model’s success must be perceived as attainable in order to have a substantial positive effect on students’ motivation.

Finally, we will discuss findings regarding how the effectiveness of a role model intervention depends in part on characteristics of the student. Together, these findings will provide a roadmap for how to effectively implement a role model intervention aimed at increasing student motivation and making the mathematics environment more inclusive for students who are typically marginalized. Further, based on the findings we will also provide recommendations for the implementation of a role model intervention.

The Effects of Competent Role Models

Our review of the literature provides evidence that a role model is typically thought of or described as being competent and the findings revealed that the level of competence being signaled has implications for students' own motivation and performance in mathematics (Betz & Sekaquaptewa, 2012; Buschor et al., 2014; Buunk et al., 2007; Drury et al., 2011; Lee & Anderson, 2014; Lockwood et al., 2005; Lockwood & Kunda, 1997; Marx & Roman, 2002; Marx et al., 2005; Master et al., 2014; Morgenroth et al., 2015). For marginalized students, hearing a relatable role model described as being competent helped buffer feelings of stereotype threat (Master et al., 2014; Marx & Roman, 2002; Schmader & Major, 1999) protected performance on a challenging math exam (Marx & Roman, 2002), and helped students' own appraisals of their math ability (Dubetz & Wilson, 2013; Lockwood et al., 2005; Marx & Goff, 2005; Marx & Roman, 2002; Marx et al., 2005; Schmader & Major, 1999). Regarding these findings, it proved to be especially important to be told that the role model was competent. For example, in a study conducted by Marx and Roman (2002), they found that it wasn't enough to protect women's math test performance by simply presenting women with a female role model with no description of their competence. The results indicated that it was the perception of the female role model's competence that buffered women's math test performance.

The finding across studies that hearing about a similar role model being successful on a math task or being described as competent in mathematics can lead to an increase in students' own ability in mathematics has important implications for helping create more inclusive

mathematics environments. Previous research has demonstrated that females are performing at the same levels as males in math, yet females still tend to report having lower beliefs about their ability in math (Gladstone et al., 2018; Wang & Degol, 2014). This could be because of concerns about stereotypes regarding one's performance in mathematics. Thus, it is promising that introducing girls and women, and other marginalized students, to similar role models who are described as being competent had a positive impact on their own perceptions of their math ability.

The Effects of Similar Role Models

Across all of the articles we reviewed, one theme consistently emerged: the importance of similarity between the student and the role model. However, our synthesis of the research also revealed that the *degree* or *type* of similarity is also an important factor to consider when implementing a role model intervention: A role model who is similar to the student at the level of demographic features often operates differently from a role model who is similar to the student on a deeper psychological level.

Demographically similar role model. Some of the articles we reviewed suggested that being presented with a demographically similar role model can have a nontrivial effect on students' motivation (Bettinger & Long, 2005; Crocker, 2011; Dennehy & Dasgupta, 2017; Dubetz & Wilson, 2013; Ferreira, 2001; Klopfenstein, 2005; Lorraine, 2017; Master et al., 2014; Milgrim, 2011; Mbanjo & Nolan, 2017; Olsson & Martiny, 2018; Rask & Bailey, 2002; Stout et al., 2011). Findings indicated that having a demographically similar teacher, as compared to having a dissimilar teacher, increased implicit attitudes (i.e., self-concept of ability, identification) in mathematics (Stout et al., 2011) and had an impact on the likelihood that a student would enroll in additional rigorous mathematics courses (Klopfenstein, 2015; Rask & Bailey, 2002). These findings are consistent with Dasgupta's (2011) stereotype inoculation model. Thus, it makes theoretical sense that being presented with a demographically similar role model can help

marginalized students develop a stronger sense of belonging and subsequent motivation in a domain where they are often the minority.

Psychologically similar role model. Our synthesis of the literature revealed that role models that are perceived similar on a variety of levels, not just demographically, have powerful effects on student motivation. This perceived similarity was found to be a stronger predictor of motivation than demographic similarity alone (Cheryan & Plaut, 2010; Cheryan et al., 2011; Drury et al., 2011; Ensher et al., 2002; Ensher & Murphy, 1997; Fuesting & Diekman, 2017; Murray et al., 2002; Selfhout et al., 2009). Dimensions of perceived similarity found across studies included degree of stereotypicality (Cheryan et al., 2011; Cheryan et al., 2012), similar goals and values (Boucher et al., 2017; Burckhard et al., 2018; Dawson et al., 2015; Diekman et al., 2010; Diekman et al., 2011; Diekman et al., 2017; Fuesting & Diekman, 2017; Gartland, 2014; Liu et al., 2014), and similar struggles (Bagès et al., 2016; Herrmann et al., 2016; Lin-Siegler et al., 2016). Role models that were described as similar demographically, as well as competent, but embodied STEM stereotypes (e.g., liking science fiction and playing video games), were found to hinder women's anticipated success in STEM compared to nonstereotypical role models (e.g., liked playing sports and hanging out with friends), regardless of whether the role models were male or female (Cheryan et al., 2011). A perceived similarity between a student's own communal goals (i.e., a desire to work with and help others) and a role model's daily activities were shown to predict more positivity toward the role model's career (Boucher et al., 2017; Dawson et al., 2015; Diekman et al., 2011). Finally, students who felt a connection between themselves and a role model who described their struggles (e.g., making mistakes, poverty, lack of parental support) had an increase in grades compared to hearing about a role model who had great success in STEM with no mention of struggles, and this effect was particularly strong for low performing students (Lin-Siegler et al., 2016). Interestingly, the positive effects of hearing about a role model's struggles was one case where the specific gender of the role model did not appear to matter. Thus, when implementing a role model

intervention, it is important to not just think about demographic similarities, but to also consider deeper similarities – such as an initial struggle with mathematics - that may be particularly important and salient to marginalized students in mathematics.

The Effects of Role Models Whose Success is Attainable vs. Unattainable

Our review of the literature also provided support for our claim that the role model's success in mathematics has to be perceived as attainable by the student in order to have a positive effect. Our synthesis revealed that it is especially important for marginalized students to hear a role model be described as hardworking (Bagès et al., 2016; Herrmann et al., 2016; Lang et al., 2015; Lin-Siegler et al., 2016) and as having qualities that are perceived as being attainable by the student (Bamberger, 2014; Betz & Sekaquaptewa, 2012; Marx & Roman, 2002; Morgenroth et al., 2015; Olsson & Martiny, 2018). For example, role models, regardless of their gender, that were described as being hardworking in math rather than gifted or innately intelligent helped increase confidence and math interest among girls (Bagès et al., 2016; Lang et al., 2015; Lin-Siegler et al., 2016). For role models to be implemented in a highly stereotyped domain like mathematics, we found that it was important that qualities of the role model appeared to be attainable in this domain. For example, Betz and Sekaquaptewa (2012) found that role models that were described as being both feminine and successful appeared to be particularly unattainable for girls who do not identify with mathematics. These role models led to significant negative effects, including reduced interest, self-efficacy, and success expectations in math among middle school girls. Finally, our findings demonstrated that, in order to be successful, role models must be a good source of information that can be used to inform a student's expectations about one's own future success (Lockwood & Kunda, 1997). That is, students need to not only be able to see themselves in their role models, but to also see the pathways to success that their role model took as being open to them as well.

Effects of Role Models Differ Based on Student Characteristics

Although characteristics of the role model clearly matter when trying to increase student motivation, our findings revealed that it is important to interpret these findings with a careful eye towards the characteristics of the specific student. We will next discuss findings of role model studies in terms of whether or not the student has already identified with mathematics.

Strong mathematics identity. Demographic similarities were found to be particularly helpful for students who have developed a strong math identity (Drury et al., 2011; Hermann et al., 2016; Lockwood, 2006; Marx & Roman, 2002; Stout et al., 2011). For marginalized students who have developed a strong mathematics identity, threats of adhering to negative stereotypes about one's ability tend to be more salient (Steele, 1997). Findings across studies revealed that compared to seeing non-demographically similar role models, demographically similar role models helped increased marginalized students' math self-efficacy (Stout et al., 2011), expectancies for success in mathematics (Lockwood, 2006), performance on a math test (Marx & Roman, 2002), and overall course grades (Herrmann et al., 2016).

Not yet identified with mathematics. Interestingly, one case where psychological – rather than demographic – similarities are particularly important are cases where students do not have a strong sense of math identity. For students, particularly marginalized students who have not yet developed a strong mathematics identity, concerns about negative stereotypes were found to be less of a barrier to participation than concerns about belonging or feeling dissimilar from other people in the mathematics domain (Cheryan & Plaut, 2010; Cheryan et al., 2009; Drury et al., 2011). For students who have not yet identified with mathematics, the role model's gender did not seem to matter for students' anticipated success and interest in mathematics (Cheryan et al., 2012; Cheryan et al., 2011; Hughes et al., 2013). Rather, what mattered most was a perceived sense of similar interests between the role model and student (e.g., hobbies, favorite T.V. shows, clothing) which helped instill a sense of belonging among the students who were not yet identified with mathematics (Cheryan et al., 2012; Cheryan et al., 2011). Thus, our synthesis of the literature revealed that when implementing role models for

students who have not yet developed a strong sense of identity, that a demographically similar role model or demographically dissimilar role model can be effective as long as they are conveying a sense of belonging through shared deeper psychological similarities. Accordingly, the evidence we presented here suggests that characteristics of the student also need to be considered when implementing a role model intervention.

Recommendations for Implementing Role Model Interventions

The use of role models to help support inclusive mathematics environments can have encouraging effects for marginalized students' motivation and mathematics identity, but they can also have backfiring effects where they unintentionally decrease student motivation. Thus, care must be taken in order to prevent any negative effects from occurring. Effective role model interventions need to focus on perceptions of role model competence, perceptions of similarity between the role model and student, perceptions of future attainability, and specific characteristics of the student, such as whether they are highly identified with math or not. We will now summarize the main takeaways and discuss implications for future interventions.

Recommendation 1. Although girls and boys are performing at the same level in math, girls are still reporting lower self-efficacy compared to their male peers (Gladstone et al., 2018; Wang & Degol, 2014). There are many structural issues in place that contribute to these differences in competence; however, we recommend that role models could be used to help counter the effects of these larger structural barriers and help increase perceptions of ability beliefs among marginalized students. When implementing role models with the explicit goal of increasing self-efficacy among marginalized students, the role model should be described as competent and should also share similarities with the student target ((Drury et al., 2011; Lockwood et al., 2005; Marx & Goff, 2005; Marx & Roman, 2002; Marx et al., 2005; Schmader & Major, 1999).

Recommendation 2. In order to make mathematics more inclusive, we must change the perception that math is an inherently "male" and "White" domain. To do this we recommend

implementing role models that are demographically similar to marginalized students. This can help change the perception of who belongs in mathematics by showing that the demographic composition of the domain isn't just restricted to males or White students (Bettinger & Long, 2005; Crocker, 2011; Dasgupta, 2011; Dennehy & Dasgupta, 2017; Ferreira, 2001; Klopfenstein, 2005; Levere, 2018; Master et al., 2014; Milgrim, 2011; Rask & Bailey, 2002; Stout et al., 2011)..

Recommendation 3. Alongside changing perceptions of the demographic majority of the mathematics classroom, it is also important that students relate to these role models on a deeper level for more sustained effects on motivation (Bagès et al., 2016; Cheryan & Plaut, 2010; Cheryan et al., 2011; Drury et al., 2011; Ensher et al., 2002; Ensher & Murphy, 1997; Herrmann et al., 2016; Murray et al., 2002; Selfhout et al., 2009). When implementing a role model intervention, we recommend that role models discuss their values and interest in mathematics. This recommendation can help students who are currently struggling to build a sense of shared identity with their role model and come to view their struggles as a means to success, rather than an obstacle to it. We also recommend that if the role model is demographically counterstereotypical (i.e., female) that one is careful to not have the role model embody other math- or STEM-related stereotypes (e.g., being a “nerd,” liking video games, preferring to be alone). When a student does not share a sense of deeper perceived similarity to the role model, it can lead to decreased motivation, which counters our goal of making the mathematics environment more inclusive (Betz & Sekaquaptewa, 2012; Marx & Roman, 2002; Morgenroth et al., 2015).

Recommendation 4. Because the mathematics domain is typically associated with innate brilliance (Leslie et al., 2015), we recommend that role models be implemented with an emphasis on their success being attainable and under their control, rather than due to innate abilities. Role models that described their struggles and how they overcame them proved to be especially effective in boosting motivation for marginalized students (Lin-Siegler et al., 2016).

Accordingly, if the role model's success does not seem attainable then the intervention can have a backfiring effect and actually decrease students' motivation (Betz & Sekaquaptewa, 2012).

Recommendation 5. Based on our review of the literature we strongly recommend that efforts should predominantly be focused on maximizing a sense of perceived similarity between the student and the role model. For students who have not yet developed a strong sense of math identity, a demographic similarity was not sufficient on its own, and it was particularly important that they felt a deeper connection (Cheryan & Plout, 2010; Cheryan et al., 2009; Drury et al., 2011). Thus, when thinking about the typical middle grade mathematics classroom where most marginalized students are still developing a math identity, a role model that can be relatable to students on a variety of levels (e.g., attitudes, interests, values) may be the most effective at increasing motivation among marginalized students.

Conclusion

The purpose of this research synthesis was to investigate how we can use role models to decrease inequality and increase inclusivity in mathematics classrooms. We claimed that four separate but interconnected dimensions of role model interventions could influence their effectiveness: 1) specific features of the role model (e.g., competence) that can influence students' perceptions of themselves, 2) students' perceived similarity to the role model, 3) students' perceptions of how attainable the role model's success is, and 4) features of the students (e.g., degree of identification with mathematics) that matter regardless of the role model. We generally found support for our claims, but there were important nuances within these dimensions that could have backfiring effects and lead to decreased motivation among marginalized students. On the whole, the strategy of bringing role models into the mathematics classroom could have potential benefits for marginalized students' motivation in mathematics and their mathematics identity, which could have long-term effects on their persistence and interest in mathematics that extend beyond the middle school years.

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