

Association for Women in Mathematics as a Place for Reimagining Gender Dynamics in
Graduate Mathematics

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This study examines gender-inclusive practices within a graduate chapter of the Association for Women in Mathematics (AWM). Using an ethnographic approach, I explore how AWM navigated their inclusive practices. Results revealed that inclusion was viewed as both a logistical necessity and a strategic move toward equity, fostering community building and identifying male allies. Additionally, tensions such as maintaining women-centered spaces and replicating gendered labor divisions also arose. AWM's efforts reflect both an aspirational reimagining of gender dynamics and the persistent realities of societal gender inequities. These findings contribute to understanding how gender-inclusive social structures can both challenge and reproduce dominant gender norms.

Keywords: graduate mathematics education, gender, student organizations

Despite improved representation at the undergraduate level, women are still underrepresented in doctoral mathematics, with only 28% of doctoral degrees awarded to women in 2018 (National Science Foundation, 2021). Beyond graduate studies, the lack of representation for women extends to academic positions, with only 24% of women occupying tenure or tenure-track positions and 11% occupying full professor positions in mathematics (American Mathematical Society, 2019). Additionally, while women who have earned PhDs in mathematics in the US have slightly lower initial unemployment rates than men, their first post-PhD jobs are less likely than men's to be at top universities, and the percentage of new women PhDs who were employed at bachelor's-only departments is much higher than for men. This discrepancy occurs despite the prestige of their PhD-granting department (Vitulli, 2018).

In addition to the inherent inequity in the underrepresentation of women in advanced mathematics, underrepresentation has been shown to be detrimental to women's experiences at the postsecondary and graduate level. Women have experienced overt prejudice (Herzig, 2010), the impact of negative stereotypes (both gendered and racialized), and experiences of invisibility (Herzig, 2002b). Furthermore, women have suffered damaging impacts because of negative gender stereotypes (Good et al., 2012), experienced a lack of belonging, reported insufficient or negative advising experiences (Herzig, 2002a, 2002b, 2004), and had to adapt their identities to minimize their gender expressions (Herzig, 2010; Rodd & Bartholomew, 2006).

Although the experiential reality of being a woman in advanced mathematics includes negative factors, much of the research in this area has positioned them as outsiders or “other” but with a right to be there” (Rodd & Bartholomew, p.42). This focus on women's negative experiences in doctoral mathematics, with little understanding of women's strengths and agency, perpetuates deficit narratives. Furthermore, some theoretical framings imply these deficits lie within the students themselves, overlooking sociopolitical themes in women's experiences (Damarin, 2008).

In addition to limited research examining the experiences of women pursuing doctoral degrees in mathematics through a critical lens, there is a dearth of literature that works to understand supports for women in advanced mathematics. Extending the research, through a critical lens, of women graduate students' experiences and their supports, this study examines the

social practices of a graduate chapter of the Association for Women in Mathematics (AWM). To investigate these areas, I answer the research question: *How does the discourse of inclusion mediate the social activity of AWM?*

Theoretical Framework

Theoretically much of the literature (e.g., Herzig 2002a, 2002b) has relied on assumptions that position women as needing to move toward an existing, static culture, framing their experiences in doctoral mathematics as an inability to integrate. To reframe women's experiences in a way that highlights their agency and impact on their local departmental culture, I leverage the figured worlds framework, with a particular emphasis on authoritative discourse (Holland et al., 1998) and refine this lens through the construct of prefiguration (Curnow, 2022).

Figured Worlds

Holland et al. (1998) define a figured world as “a socially and culturally constructed realm of interpretation in which particular characters and actors are recognized, significance is assigned to certain acts, and particular outcomes are valued over others” (p. 52). Many studies have leveraged figured worlds as contexts with their own histories and cultures that construct identities as individuals participate in them (e.g., Solomon et al., 2010; Voigt et al., 2020). However, Holland et al. (1998) emphasize that identities are co-developed *with* figured worlds. That is, identities are formed in the process of participating in the activities organized by figured worlds, *and* figured worlds are produced and reproduced through the work of participants. As such I leverage the figured worlds framework to understand how individuals, through their participation in AWM, contribute to their figured world of PhD mathematics.

Authoritative discourse. Holland et al. (1998) propose discourses as significant in mediating the construction of figured worlds. Discourses “capture the ways in which people recognize socially and historically significant identities...through well-integrated combinations of language, actions, interactions, objects, tools, technologies, beliefs, and values” (Gee, 2015, p. 1). Additionally, Holland et al. (1998) include the construct of *authoritative discourse* in their descriptions of figured worlds, which are discourses that are often accepted without question. Authoritative discourse “demands that we acknowledge it, that we make it our own” (Bakhtin, 1981, p. 342). Individuals may reject or attempt to modify an authoritative discourse, but they cannot simply ignore them. The authoritative discourse of *inclusion* has been identified as significant in education (Dune, 2009).

Inclusion “signifies a right to membership and participation, often viewed as a marker of political correctness and sensitivity...” and has been identified as an authoritative discourse in education (Dunne, 2009, p. 305). However, the unquestioned implementation of inclusive practices may lead to unintended consequences (Dunne, 2009). This includes limitations in discussing differences and relinquishment of responsibility for meaningful change by treating inclusion as a terminal act. As such, critics of unqualified inclusion encourage one to address the nuances of inclusion and answer the question “who is served by inclusion?”

While authoritative discourse via the figured worlds allows one to account for the impact of systemic and social power structures, there is a need to understand agency at the group level. One way to frame the activity of the AWM group that emphasizes their activity as one of empowerment and choice, is through the lens of *prefiguration*.

Prefiguration

Prefiguration refers to the idealized social practices of a group that reflect the aspirational or desired outcomes of the group in alignment with their political goals (Uttamchandani, 2020). Prefiguration as a theoretical lens affords the identification of “...the emergent, ongoing development of practices and philosophies of a collective...” (Curnow, 2022, p. 556). Because AWM is an inherently political organization, with the official goal of “promoting equitable opportunity and treatment of women and others of marginalized genders and gender identities across the mathematical sciences,” prefiguration allows the politicized practices of the group to be foregrounded. Lastly, using a prefigurative lens gives prominence to the agency demonstrated by AWM, by highlighting their activity as an enactment of political resistance.

Methodology

The overall methodology in answering the research question - *How does the discourse of inclusion mediate the social activity of AWM?* - was an ethnographic approach. This approach includes identifying a culture-sharing group, selecting themes to study about the group, gathering information in the group context, generating an overall interpretation of the group, and presenting patterns of the group (Cresswell & Poth, 2016). A graduate chapter of AWM was selected as the culture-sharing group, allowing the investigation of the intersection of gender and mathematics.

Context and Participants

Southwest University (SU) is a large public university in the southwest United States and is classified as a very high research activity institution. The mathematics department at SU has approximately 200 students enrolled in their doctoral program, with about 15% of students identifying as women. There are approximately 60 faculty, a minority of which are women.

Participants included five women enrolled, or recently enrolled, in the doctoral mathematics program at SU. The women were selected using a stratified purposeful sampling (Patton, 1990) with respect to years' experience in the program. This included one woman enrolled in coursework, two women in early research, one woman in advanced research, and one woman taking a leave of absence after completing coursework. Additional sampling criteria included participation in the local graduate chapter of the AWM.

The SU graduate chapter of AWM was reestablished in Fall 2019, after a ten-year period of inactivity. At the time of the study, AWM was starting its fourth year after this period of dormancy. Since coming out of dormancy, the group had initiated a variety of activities including weekly social events known as ‘Teas,’ a mentorship program, a faculty interview series, and most recently an industry panel showcasing women working professionally in STEM.

Data Corpus

Participant data included a mathematics autobiography, one episodic narrative interview (Mueller, 2019), six weeks of diary entries (Cresswell & Poth, 2016), one future-focused diary entry, and one semi-structured interview per participant (Bernard, 1998). There was also one focus group interview with all five participants (Morgan, 1997).

Observation data included two quarters (16 weeks) of observations and field notes of the AWM activities. This primarily included weekly Teas and Executive Council meetings for a total of 24 observation hours. For each observation I gathered information about the space, purpose, people, and dialogue. Additionally, the observation data included one recorded conversation with

the current AWM president about her perspective, as a representative of the group, on the inclusion of men in their events.

Analysis

In conducting this ethnography, my goal was to understand the figured world of AWM at SU. In support of this goal, I refined the ethnographic approach through thematic analysis to capture more fine-grained themes (Braun & Clarke, 2006). Analysis included reduction of the participant data to those excerpts which directly addressed the inclusion of men in AWM activities. This was followed by open coding, capturing distinct ideas related to the research question. I also open coded the observation data and the conversation with the current AWM president. After open coding, I began to look for connections among the codes, grouping them into themes. During this time, I continuously refined codes, adding new excerpts and eliminating others as well as refining the code definitions to better represent the data.

The results of the analysis revealed how the discourse of inclusion mediated the largely gender-inclusive structure of AWM. In the following sections, I present findings from the thematic analysis that detail the AWM's reasons for inclusion, the reflective ways they navigated inclusion while still serving the interests of women and other nondominant genders, and the possible consequences of their choice to include men in their events.

Results

The themes that arose as a result of the thematic analysis – *reasons for inclusion, benefits of inclusion, challenges of inclusion, navigating inclusion, and replication of domestic labor inequities* – were consistently shared among at least four of the five participants and often identified across multiple data sources (i.e., individual interviews and focus group interview). Overwhelmingly the statements about the inclusive practices of AWM were in support and often with a sense of advocacy. I first detail the reasons for gender inclusivity at AWM events.

Reasons for Inclusion

Early in my observations of the AWM Teas I asked Mariam (year 4) about her perspective on the decision to include men at the events. Her response was reflective of the group's prefiguring of gender dynamics in their department and in mathematics in general. She shared:

In an ideal world, we don't want to have an AWM because everybody's equally welcome and represented in their department. And if we want to reach that ideal state, we can't... these male colleagues are also in your program, and they're facing almost the same things, and there is a lot to gain by talking to them also. So, it's good to include them in events, I feel like, because in the future we want that. (Mariam, year 4, Interview 1)

Mariam shares her view that women and men have experiences in common in the PhD program and proposes the possibility that there is support to be gained through connections with men. Furthermore, Mariam's description of an ideal world includes equal representation and inclusion of women. Other AWM members viewed the inclusion of men as a logistic matter.

Both Ida and Lucy, the present and founding president of AWM, viewed the inclusion of men as necessary for the group to be operational due to there being few women in the PhD program. Ida discussed the need to have men initially serve as principal members because at the time AWM restarted there were not enough women to fill all the roles of the Executive Council. Ida reflected "...when we started the group, we didn't have enough women to run the group, so we needed men to volunteer to help run the group and do a lot of this important stuff" (Ida, year 6, Interview 1).

Although the principal members of the Executive Council were all women at the time of the study, the need to have men participate persisted. Lucy, the current AWM president, explained how the continued gender imbalance still necessitated the inclusion of men:

But I think for the social events, it's tricky. I think AWM wants to be known and active in our department, and because there are fewer women, I feel like sometimes if we make our events smaller, then maybe we're not as well known in the department. You need a sort of a critical mass of just people to meet your goals. (Lucy, AWM president, private conversation)

Lucy's explanation reveals the strategy of including men for the greater good of the group and to reach their goals of being recognized in the department. As evidenced by Ida and Lucy's explanations, the gender makeup of the graduate students necessitated the inclusion of men in the AWM group. Participants also discussed the benefits and of including men in AWM activities.

Benefits of Inclusion

In asking the participants directly about their reasoning for including men, they responded that events structured by inclusion benefited the department community, prevented AWM from being isolated, and benefited women. During the focus group Cindy compared her experience in her undergraduate studies to her experience in AWM at SWU. She said:

I think for AWM here, I don't know how it is at other schools, but I know, for, like in undergrad, women in STEM...there were no men involved whatsoever. And here there's like a lot of men who actively attend our events, or volunteer to help with stuff. And so, I think that overall helps contribute to a better environment in the department. (Cindy, year 2, Focus Group)

Cindy expresses the possibility of isolation in creating a group that is segregated and connects the value of community to AWM's practice of inclusion, explaining that the inclusion of men is beneficial to the department as a whole. In addition to the benefits to the department, inclusion was explicitly connected to benefiting women. For example, Ida shared:

It doesn't seem to matter so much if there are more men than women, which will happen if you have 60 people in an event in our math department because you don't have 60 women. I think it just matters that there are a lot of women to talk to and that there's a space where the women feel comfortable to talk to people and ask questions. And they're a focus. (Ida, year 6, Interview 1)

It is here that AWM's practice of inviting men into their events is distinct from a version of inclusion in which women are invited into a space in which they are marginalized. If the women being included in another, dominant group, the scenario Ida describes would structure participation in a way where women were being integrated into the dominant culture. However, because it was AWM that included the men, the social interaction is happening outside (to an extent) of a context in which men are the default. Through a prefigurative and figured worlds lens, gender inclusivity at AWM Teas facilitated the enactment of a mathematical context where women's presence was normalized.

Another reported benefit of inclusion was the potential for men to become allies to AWM as a group and women as individuals. Cindy stated "I feel like it kind of builds allies and like, oh, well if this guy comes to AWM Tea, he is probably supportive of women in math. (Cindy, year 2, Interview 1). Bringing men into the advocacy goals of the group demonstrates a prefigurative vision in which men are personally invested in the success of women. In addition to the reasons in favor of gender inclusivity in AWM, there was also evidence that the group was reflective of the potential challenges of including men in most of their activities.

Challenges of Inclusion

AWM members discussed differences between gender-inclusive and women-only events, including the times when inclusive events recreated a mathematical contexts in which women were marginalized. Cindy spoke about the differences in the AWM that were not inclusive:

So, I feel like sometimes when it's just women or gender minority focused, maybe you would say things you wouldn't say when it's just anyone's welcome. And I think that's also valuable to hear and maybe feel like you're not as alone in some experiences or also I remember I got some good advice there. (Cindy, year 2, Interview 1)

Cindy details the experience of being to share more openly struggles related to graduate school at women and gender minority events. She also describes support and camaraderie as advantages of being more vulnerable at events without men. In addition to the possible missed opportunities for support in inclusive events, Ida recalled a time when inclusion backfired and lessons the group learned from this misstep. She recalled:

I think it's important to always have women only events as well as mixed events. And in the beginning, we had a real wake up moment with this when our events started getting completely overrun with men...the men were just coming and talking about all their issues. It was coded, it was supposed to be a female space, but things were done in a way that was way more open to everyone...I think we had to be a lot more heavy handed. (Ida, year 6, Interview 1)

Ida describes early attempts to be inclusive by “coding” events as women focused. At times this implicit messaging was not enough to create an inclusive space that still centered women. She was candidly reflective that there are consequences to inclusion “I told you the reasons why we made the choices, and now I'm telling you the reasons why those choices, the costs of those choices.” (Ida, year 6, Interview 1). Acknowledgement of the sacrifices, and sometimes consequences, of inclusion implies the value AWM sees in opening their events to men. Balancing the benefits and challenges of including men was discussed by the current AWM president as she discussed the group’s plans to navigate these tensions.

Navigating Inclusion

In speaking with Lucy, the current president, about the inclusive nature of the AWM events she discussed a careful balance in their decisions to host events that included men:

So, I think that this is something maybe in our officer meetings we don't necessarily explicitly talk about a lot, but I think we all think about it a lot because it's tricky because their math being a male dominated academic field...We do make a lot of friends in our classes and things like that, especially if we're doing a more social geared event that's like, oh, well we're very close friends with a lot of the men in our department. Whereas...the industry panel that's an actual conversation that's probably going to be brought up in our meeting... are we going to restrict that to underrepresented genders because it's more of a recruiting or talking about your experiences as a woman. (Lucy, AWM president, private conversation Jan 24, 2024)

Lucy describes wanting to include men in events since due to the social relationships shared among the men and women, echoing earlier sentiments that inclusion connects women more extensively to the department. In contrast, Lucy appears more reluctant to assume the inclusion of men in the industry panel event where the focus is specific to issues relevant to women and other nondominant genders.

Replication of Domestic Labor Inequities

As I attended weekly Teas, I observed what I viewed as an inequitable division of labor. Men regularly attended the weekly Teas and often outnumbered the women. While this didn't appear to have significant impacts socially, it became apparent that women were responsible for setting up and breaking down the events. This observation was verified in a conversation with the current AWM president. Lucy explained:

If a historical or traditional idea of things are that women's jobs would be cleaning or cooking or things like that and then we have an event and if the majority of the attendees are men, but the women are the ones who are staying after and cleaning up and it's like... well who are we putting on this event for? (Lucy, private conversation, Jan 24, 2024)

Lucy is reflective of the implications of the labor division at the AWM events. Importantly, she asks the question “who are we putting on this event for?” This indicates that although the group assumes many reasons why inclusion is beneficial to their goal of supporting women, they also attend to the potential impacts of those decisions. So, while the discourse of inclusion allows the group to enact an idealized future of gender equity, there is still a tether to the reality of inequitable domestic labor among men and women.

Conclusion

AWM at SU subscribed to inclusion as an authoritative discourse that informed the structure of many of their activities. However, they navigated the complexities of inclusion by incorporating men into their events while also striving to maintain a space that supports women and gender minorities in mathematics. As such, AWM's approach to inclusion reflects both adherence to and negotiation of this discourse, as the group actively questioned who is served by inclusion but did not challenge inclusion as an assumed value to the group.

The framework of figured worlds and prefiguration highlights how AWM created alternative gender dynamics within the male-dominated space of their department. By including men in their events, AWM modeled a more integrated and aspirational environment where women were more visible and less isolated. This approach allowed for informal mentorship, allyship, and increased presence within the department, reinforcing the idea that gender inclusivity at AWM events benefits not just women but the entire academic community.

In tandem with the reported benefits of inclusion, members acknowledged the need for women-only events, recognizing that some conversations and experiences would be more accessible in a space free from dominant-group influence. Additionally, while inclusion was intended to foster an environment where women were more integrated, there were instances existing gendered power dynamics were reproduced. In this way the prefigurative enactment of gender equity in mathematics was contradicted by societal influences outside of the department.

Previous research indicates that women may significantly resist integrating their gender and mathematical identities due to the underlying bias associated with being a woman in mathematics (LaTona-Tequida, 2025, Solomon et al., 2011). This resistance reflects the need for a cultural shift in mathematics that positions women as more fully legitimate. In response, the gender inclusive practices of AWM at SU point to potential mechanisms to initiate this cultural shift. Participants expressed that spaces exclusive to women were somewhat isolating and potentially worked against their goals of being more integrated into their departmental community. The AWM activity, mediated by the discourse of inclusion, appeared successful in creating a departmental atmosphere that was beneficial to the participants.

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