STEM Identity Development for Latinas: The Role of Self- and Outside Recognition

The development of a science, technology, engineering or mathematics (STEM) identity can be thought of as a process of enhancing the way in which a student participates in the disciplinary community (Lave, 1998). This sense of identity can empower students to feel knowledgeable and comfortable in their STEM environment (Carlone & Johnson, 2007). The ability to recognize oneself as a STEM-inclined individual and feel recognized by others enhances a student's ability to persist within the discipline and transition into a related career (Carlone & Johnson, 2007). However, Latina/o students often have difficulty developing and sustaining STEM identities and recognizing themselves as potential scientists or mathematicians, despite expressing interests in related careers (Sorge, Newsom, & Hagerty, 2000). Specifically, Latinas continue to experience lower levels of STEM major declaration and persistence than their Latino male counterparts or White female peers (National Science Foundation, 2014). Latinas represent only 8% of all women who earned bachelor degrees in STEM as compared to Whites (61%), Asians (14%), African Americans, (9%), and others (7%) (National Center for Education ~~Stastitics~~Statistics, 2014). ~~Beyond~~ After college, Latinas are also less likely than Latino males to work in science and engineering occupations, even when holding a related degree (19% Latinas, 37% Latino males) (*Excelencia* in Education, 2015).

Prior research has shown identity development, specifically the elements of identity recognition, to be critical components of success in STEM fields, especially for women of color and Latina/os (Carlone & Johnson, 2007; Sorge, Newsom, & Hagerty, 2000). There is a need for Latinas to recognize themselves and be recognized by others in order to develop a salient STEM identity and be successful in their disciplines (Carlone & Johnson, 2007). Given the diversity amongst Latina/os and women of color and their experiences, it is not enough to consider Latinas

as merely members of either of these groups. Scholars must begin to disaggregate the experiences of Latinas, specifically, to avoid essentializing individual experiences and to better understand the critical gender, racial, and ethnic variations among these students (Johnson, 2011). Two primary research questions guided this study:

1. How do Latinas in college come to recognize themselves as possessing a STEM identity?
2. How does outside recognition influence the STEM identity development process of Latinas in college?

Literature Review

STEM identity is a reflection of how one understands and positions oneself within the STEM culture and the recognition one receives from others in that community. Often an amorphous concept and difficult to operationalize for research (Carlone and Johnson, 2007), STEM identity can be situated in the idea of learning as a developmental "process of coming to be" where learners "forge identities" as they develop "certain ways of participating in the world" (Lave, 1992, p. 2-4). Thus, if viewing STEM fields as specific communities of practice, identity offers a lens through which one may investigate the process of enculturation with a specific focus on how students move towards or are pushed away from the norms, culture, and practices of that community.

Sustained interest and continued persistence in the STEM disciplines is influenced by a student's sense of identity (Aschbacher, Li, & Roth, 2010; Brickhouse, Lowery, & Schultz, 2000; Carlone & Johnson, 2007). Viewing oneself as the "kind of person" who ~~takes~~ ~~part~~participates in~~does~~ STEM activities can shape this identity development (Brickhouse, Lowery, and Schultz, 2000, p. 1). In addition, students must recognize themselves and have others recognize them as STEM individuals to feel a sense of identity and belonging within the

disciplinary community (Burke & Stets, 2009; Stets & Burke, 2000; Wegner, 1998). Development of a STEM identity requires that students not only participate but are recognized by individuals within their disciplinary communities (Tonso, 2006). While early experiences with STEM concepts and communities are important, identity development during college is primarily shaped by faculty members and peers (Wenger & Cardella, 2013; Godwin, Potvin, Hazari, 2014; Strayhorn, 2010). Particularly for women, who may often be marginalized by their mostly male peers and professors, recognition as a capable member of the disciplinary community promotes a stronger identity and sense of belonging (Tonso, 1999).

Prior scholarship has shown that in science and mathematics, Latina/o students have exhibited lower levels of self-efficacy and felt a sense of disempowerment toward STEM subjects (e.g. Giguette, Lopez, & Schulte, 2006; Hazari, Sadler, & Sonnert, 2013; Leslie, McClure, & Oaxaca, 1998; Stevens, Olivarez, Lan, & Tallent-Runnels, 2004). For Latinas, and other women of color in STEM, who may simultaneously find themselves at the intersections of racism and sexism, STEM identity development experiences may be particularly complex (Carlone & Johnson, 2007). However, there is currently limited scholarship which addresses the STEM identity experiences of Latinas, independent from other racial/ethnic subgroups or Latino men.

Theoretical Framework

Carlone & Johnson's (2007) science identity development model was selected to frame the current study due to its focus on the success of women of color in science disciplines. This model posits science identity as an changing context-specific intersectional identity that interacts with racial, ethnic, and gender identities, develops over time and is composed of ~~the~~ three core, somewhat overlapping, dimensions: *competence*, *performance*, and *recognition*. This model

accounts for the way in which racial, ethnic, and gender identities influence the development of a science identity for women of color. *Competence* refers to the knowledge and understanding of disciplinary content. *Performance* examines the ways of talking and social performance of the science activities. *Recognition* refers to the way in which the individual considers herself a "science person" and how others, especially those within the discipline and those whose opinions she values, recognize her in this way.

Within this grounded model, recognition was found to be the most important element in the development of an identity for women of color in science (Carlone & Johnson, 2007). The element of recognition is~~was~~ explained in two parts: (1) recognition of the *self* as a science person and (2) recognition from meaningful *others* as a science person. *Self*-recognition ~~referred~~ refers to the way in which women of color bec~~a~~ame interested and recognize~~d~~ their talents and abilities. Within this concept, women of color have been shown to recognize~~d~~ science as a tool for altruism, resulting in an altruistic science identity, or love~~d~~ science for science's sake, resulting in a research scientist identity (Carlone & Johnson, 2007). Recognition from *meaningful others* refer~~sred~~ the way in which individuals from the science community and beyond acknowledge~~d~~ the skills and abilities of women of color. Positive recognition result~~sed~~ in a research scientist identity whereas negative recognition leads ~~to the decision of~~ students to redefine ~~redefininge~~ what it means to be a woman of color in science (leading to an altruistic science identity) or not redefine (leading to a disrupted scientist identity). Self- and outside recognition has been shown to interact~~ed~~ critically with the racial, ethnic, and gender identities of women of color within the developmental process (Carlone & Johnson, 2007). Within this model, intersectional identities influence~~d~~ the interactions and subsequent meaning-making of women of color in science, leading to identity development.

Given the prior importance of *recognition* in particular, our study focused on this final dimension to understand how Latinas in college recognized themselves as possessing a STEM identity and how outside recognition influenced their development process. To address the study's research questions, elements of both self- and outside recognition were used to analyze the experiences and meaning-making of participants within the STEM context.

Methods

~~This study interviewed 17~~Seventeen Latina undergraduate students in STEM majors were interviewed using a phenomenological approach, which allowed the researchers to explore STEM identity development while discovering hidden meanings and understanding the essence of each~~the~~ student's lived experience (Husserl, 1931; Moustakas, 1994). Participants in the study were over the age of 18, identified as Latina, identified as female, were college juniors or seniors, and were enrolled in a STEM major (see Table 1). Juniors and seniors were selected in order to gain a richer understanding of the STEM identity process over time. Participants were recruited by (1) emailing students through existing program listservs, (2) presenting participation opportunity at STEM-related student organizational meetings, and (3) employing a snowball sampling technique in which study participants identified other potential participants who met the criteria of the study and whose experiences were information rich (Miles and Huberman, 1994). Researchers had no prior relationships with participants. Institutional contacts within the university helped to connect researchers with potential participants by forwarding requests for participation through existing listservs and suggesting events at which to advertise. Participants did not receive compensation for their participation in the study.

Each student participated in two one-hour interviews. Interview questions were selected based on the recognition component (self- and outside recognition) of the chosen theoretical

framework (Carlone & Johnson, 2007). Interview one explored STEM interest and experiences and self- and outside recognition of their identity. Interview one involved questions such as: "Do you think of yourself as a STEM person? Why and how so?" (self-recognition) and "Do other people recognize you as a STEM person? Why might they have thought of you in this way?" (outside recognition). Interview two followed-up on questions from interview one and involved an artifact discussion in which participants were asked to bring five objects that related to their STEM identity development. Interview two involved questions such as: "At your first interview, you talked about how the men in your class did not recognize you as a STEM person, can you tell me more about why you feel that way? (follow-up question) and "What were the artifacts? What makes these artifacts significant to your STEM identity?" (artifact discussion). -While participants described their identity development process in reference to these objects, the researchers were able to discover the meanings that participants attached to particular objects and experiences (Glesne, 2011).

Data Analysis

To gain a comprehensive understanding of the student's STEM identity development process (phenomenon) as a whole, each interview transcript was read several times (Moustakas, 1994). Then, the researchers used a four-step data analysis process to understand the data in greater depth (Husserl, 1931; Moustakas, 1994). The first step involved reflecting upon and setting aside personal assumptions about the phenomenon (epoche) which enabled the researchers to be receptive to the meanings that students ascribed to certain experiences. The second step involved re-reading the transcripts, going beyond surface appearances, in order to gain a core understanding of the phenomenon (eidetic reduction). The third step involved the examination of meanings that students attached to their experiences and the exploration of the

phenomenon from multiple standpoints in order to determine underlying factors (imaginative variation). The fourth step involved integrating student meanings and defining the essence of the phenomenon using raw transcript data to verify the results (synthesis and verification).

Trustworthiness & Researcher Positionality

In order to establish a rigorous research study, mechanisms of trustworthiness were woven in at each stage of the study (Creswell, 2013; Lincoln & Guba, 1985). Data were systematically checked and analysis and interpretation were monitored for potential biases. Member checks were conducted with participants in order to clarify meanings and allow participants to further elaborate on previous statements. Meanings and interpretations were checked with participants in multiple ways. Participants were allowed to read the transcripts of their interviews and elaborate on their experiences as needed. The second interview served partially as a way to follow-up on any remaining questions or points of clarification from the first interview. In addition, multiple researchers were involved in the interpretation process in order to provide greater understanding of the findings and suggest multiple interpretations. Finally, throughout the process, peer-debriefing activities with two colleagues outside of the research team helped to establish trustworthiness of interpretations.

The three-person research team also sought to understand their researcher positionalities (Creswell, 2013). The first researcher, who identifies as a Latina woman, conceptualized the study, recruited participants and conducted the interviews, members checks and initial analysis. The other two members of the research team focused their efforts on later stages of analysis and conclusion drawing. One of these researchers identifies as a woman, but not a woman of color, and holds an undergraduate degree in mathematics, thus bringing a degree of perspective and some understanding of the undergraduate STEM experience as a woman. The other researcher

identifies as a White male, who has worked on previous pieces related to Latino/as in STEM and has a background in serving higher education students. His background, a bachelor's of arts in English, provided experience in the close-reading of written accounts.

Findings

Within this study, STEM identity development was influenced by the way in which Latinas in college came to recognize themselves as possessing a STEM identity and the way in which others also recognized their identities.

Self-recognition: Embodied Qualities, Qualified Self-recognition, and Risk of Identity Loss

Students based their self-recognition in how they saw qualities they associated with being a STEM person reflected in themselves. For most students, self-recognition, or reasons for self-identifying as a STEM person, was rooted in their enthusiasm for learning disciplinary concepts, ability to innovate and think critically, and their academic persistence despite struggle. Students often viewed their own struggles and persistence as a way to overcome systemic inequities for Latinas in STEM. A major concern for a student who identified as a STEM person was identity loss. These students felt like they would lose a sense of STEM identity should they not be directly involved with their discipline. Some students, however, ~~didn't~~ did not yet recognize themselves as STEM people. These students felt as though they were only in the early stages of their STEM identity development. In such cases, students focused on the qualities that they did not yet fully possess.

Self-recognition through embodied qualities. Students with strong self-recognition identified with the qualities they saw as qualities of a STEM person, including manners of thinking and patterns of action.

Enthusiasm and thinking like a scientist. For students who recognized themselves as

STEM people, enthusiasm for learning disciplinary concepts and an ability to innovate and think critically were key attributes cited as indicative of them being a STEM person. For instance, during her artifact discussion in interview two, Victoria, an engineering major, described one of the objects that she brought, an atomium replica, as representing the intrinsic nature of her science identity, saying:

> It kind of symbolizes that I am a scientist wherever I go…I feel a genuine intrigue like I want to learn. I mean, I have a lot of facts and history inside; I have a genuine curiosity…I consider myself a science person because I have a genuine interest, like when I begin to speak science with people, like, if they are not interested, their eyes glaze over. But I am very interested, so my eyes open up because I am interested in what we are talking about. I can flip to the right research papers as if it were a novel. I am like, okay, so what happened? You had this, but what happened? What did you find out? What are the next steps?

Her interests and her self-recognition as a scientist were solidified through contrastive juxtaposition with others. Similarly, another engineering major, Lydia, recognized herself as an engineer based on the way she thought about the world:

> I like knowing how things work, but just going beyond that, seeing how it works, seeing how I can improve it, and seeing how maybe what if I try this. So, innovation for me is the biggest part of it and that's why I like designing because I get to reinvent something that's already been done and maybe make it better.

Unlike Victoria, Lydia's recognition of identity was not rooted in contrast with others, rather it stemmed from a call to action.

Persistence despite struggle, acting like a scientist. Another aspect of being a scientist that students identified with in recognizing themselves as STEM people was persistence, even in the face of challenges. For Carmen, a mathematics major, her strong sense of persistence contributed to her sense of math identity:

> I am always sort of complaining about [my mathematics classes] and that like totally crushes my spirits. Sometimes discourages me, but I think I am a math person because I think it is really fulfilling when I understand certain concepts that I didn't or grasp the concept to solving problems. And, maybe, we all would appreciate that, but to keep persisting at it, that is what makes me a math person.

Carmen was not alone in the idea that continued effort made someone a STEM person. ~~. For instance,~~ Laris, a natural sciences major, also recognized herself as a science person through her resilience:

> I think that is a big part of it – the resilience of a scientist…that is also a big part of me – being resilient, just trying. I mean, sometimes it is hard to keep a positive attitude when you've failed, but I still find it easy to keep trying and not give up.

Whether named resilience or persistence, the enacted ability to continue working after failure again and again was an integral part of self-recognition as a STEM person.

Participants also articulated ~~that~~ that their persistence ~~also~~ related to larger forces of struggle for Latinas seeking to push beyond traditional norms. Students referred to elements such as "double minority," "stereotypes," and "imposter syndrome" which were larger, systematic forces to be overcome at least in part through their individual struggles. Students recognized that their resilience was in opposition to racist and sexist structures. Samantha, an engineering major, stated, "We're double minority. We're women in [and of] itself, and then we're Latinas." These students understood that their success contributed to breaking down stereotypes rooted in racism and sexism. For Maria, a biology major, these struggles related to "breaking the stereotype of being a Latina at home taking care of family…it just makes me feel more empowered doing science." When faced with the struggles of becoming a member of the STEM community, the Latina students within this study attempted to harness a sense of resilience, which they attributed to being a normal part of the STEM experience. However, students also recognized that this characteristic was problematic and representative of the oppressive structures that influenced the

success of Latinas in these disciplines.

Qualified self-recognition. While students achieved self-recognition by self-identifying with ~~qualities they perceived as qualities of a STEM person~~perceived qualities of a STEM person, at times participants viewed themselves as falling short of these qualities. This mismatch between their current perceived state and the perception of a STEM person led participants to instead identify with a qualified ~~definition~~ understanding of STEM identity often based upon what they saw as their current state in their academic or professional journey. For example, Esperanza, a natural sciences major, identified her sense of STEM identity in the following way: "I wouldn't say I'm a full-fledged awesome scientist, but I would go ahead and say I'm a budding scientist. I think I would want to add a qualification to the word scientist."

Whereas previously mentioned participants saw their STEM identities linked to innate qualities and behaviors, the feeling of not yet being complete in a STEM identity seemed to be linked to a goal orientation. For instance, Ashley, a computer science major, recognized herself as a computer science person but qualified the completeness of her identity development saying: "I still want to be more well-rounded before calling myself a scientist. I don't want to be just a computer scientist, I want to be a computer scientist that focuses on this." Ashley discusses her identity as goals for her future self and who she wants to be. Since she has not completely figured out who that is, she doesn't yet feel like she can claim the identity.

Risk of identity loss. Self-recognition of a STEM identity at either level came with a risk of identity loss in the face of challenge. Students routinely stated that they could not see themselves doing anything other than being involved with their STEM interests. For instance, Cindy, a computer science major, voiced such a concerned:

> I have to because I don't know what I'll do or what I'll be if I am not a CS major anymore. That is, what I've been doing for f***ing years – I can't see myself if I

wouldn't be doing this at the moment. Like who the hell am I?

Her investment in time had become intertwined with her sense of self to a degree that she could n't imagine herself without this now integral part of her identity.

Similarly, Victoria, engineering major, related how fragile her science/engineering identity was in the face of struggle:

> When I started to struggle in some of my classes, I was like, "who really am I?" I was like, "whoa maybe I am not good at school, maybe I am not smart." It calls into question who you really are. It is kind of like a slippery slope… I feel like it is a really good thing because gives you confidence, but it also makes you more vulnerable…If [my identity] is ever called into question where I feel that I am no longer a scientist, I feel that that could really bother me because that is who I am.

Victoria's highlighting of the dichotomous nature of having a strong STEM identity when faced with congruent and incongruent circumstances was felt by other students in the study as well. Participants consistently expressed experiencing fear of identity loss when confronted with the possibility of losing what they found central to their self-recognition of their STEM identities.

Outside Recognition: Peers, Faculty, and Family

STEM identity recognition was not limited to self-recognition. Recognition could come from outside sources as well. For participants, this recognition came primarily from STEM peers, faculty members, and, to a lesser degree, family members. Peers and faculty served as sources of recognition tied to acceptance in the STEM community while family members provided consistent sources tied more to observation than achievement.

Peer recognition encourages and complicates identity development. Participants concentrated their discussion of external recognition on gaining recognition from their STEM peers. Participants felt positively when peers could understand their interest in and excitement for their discipline and when peers trusted their intelligence and abilities. In contrast, participants felt negative effects when peers did not recognize them as STEM people, often leading

participants to feel as though they had to prove themselves in order to become a part of the disciplinary community.

When asked about recognition from peers, participants noted that their peers recognized them as STEM people due to their deep interest in STEM concepts and confidence in their pursuits. Maite related a time when she found peer recognition:

> When they said, “Oh my God, Maite’s a genius,” and they started saying the cricket thing. Today, they needed me today because I was the only one who had taken neuroscience in that class, and I knew how to read the graphs and how to put the nerve. I knew how to dissect a frog, even though I had never actually dissected a frog before. That was my first time dissecting a frog, and I did it right the first time. It’s just like a natural knack, I guess. Today people recognized it, and I felt really good.

Similar to other participants, her ~~this~~ recognition came in the context of a STEM classroom where group settings became common places for peer recognition.

While peer recognition was a positive influence for participants, a lack of this recognition, or negative peer recognition, could also motivate students. For instance, Nelly, a natural sciences major, overcame the lack of recognition she received from her peers in a positive way:

> At first, I felt like a lot of people didn’t really believe in me, but that gave me the strength to pull through and be like, “I’m gonna prove you wrong.” And now it just makes me feel like I demonstrated to some people who didn’t believe in me that I could actually make it happen…And when I came back and I told people about that, they were like oh you presented at [a prestigious national conference]? Wow. And, I feel like that’s kind of where I got a little more value. They really thought of me more as a science person.

Nelly used a lack of recognition to fuel her pursuits, leading to an internship, work as a laboratory assistant, and a presentation at a prestigious conference. Victoria, an engineering major, expressed how male peers~~,~~ in particular~~,~~ failed to recognize her abilities:

> frustrating being put in that position where you know you have the potential, and you know you can answer questions that you know you know the information, but guys think, ‘No you don't. Here’s the stuff, here’s the information.’

As can be seen here, a lack of peer recognition did not deter students from further scientific pursuits, but it did cause frustration, and, in some cases, it pushed them to continue their work and achieve more.

Outside recognition from faculty validates student efforts. Although peer recognition was important, participants also commented on how recognition from professors was key to feeling like a part of the STEM culture and community. Faculty validation often contrasted sharply with other outsider views of Latinas in STEM. As Emily, a biology major, recounted, she, similar to other Latinas in these disciplines, was generally not recognized as a member of the STEM community: "I'm kind of classified as a Hispanic, a person who doesn't do these type of careers." Even though others did not see Latina students as possible STEM community members, faculty recognition provided validation of their abilities and a sense of belonging within the discipline.

Lydia, an engineering major, considered herself an engineering person and felt that others did, too. She took faculty members talking with her about future engineering career plans and giving her opportunities to do research with them as signs that they believed in her abilities:

> It is important and you get that validation from your professors because they show you "This is what you can do with your degree and these are the possibilities and if you think this way and you think of new ideas these are things that you can do," so you get validation from your peers and your professors.

For Lydia, this validation was essential to establishing oneself in the community's norms, thought processes, and environments as faculty recognition could lead to future careers and faculty could help situate students in the field. Lydia further described the nature of faculty recognition: "Knowing that the professor trusts you and you're responsible of doing your own work and nobody's looking after you and knowing that you do the work and it is accepted or recognized by the professor."

This sense of faculty as gatekeepers was also present in the experience of Victoria, another engineering major. She related how faculty members, "can observe you from an objective point of view so they tell you, 'I notice that you like this and this, so I feel that based on my observation you would be really good at this.'" She went on to describe how one faculty member's recognition made her efforts feel worthwhile:

> I'm confident in my work, and I know it backwards and forwards, but it all kind of culminated in this moment where I gave a presentation and a faculty member that I really adored his research, came up to me and was like, "I was very impressed by your presentation." I was like, "Whoa, you just said you were impressed by me!" It was amazing; I was on cloud 9. It really validated and justified all those years of hard work.

For Victoria, faculty, as members of the STEM community aware of the culture and expected level of knowledge, could accurately assess her work and her potential. Faculty as objective disciplinary gatekeepers were some of the ultimate sources of validation and outside recognition.

Outside recognition from family develops and reinforces identity. While faculty served as unbiased disciplinary sources of recognition during one's academic journey, family could serve as some of the earliest and continuing sources of recognition. Victoria related this well saying,

> For most people, it starts with people telling you, you can be. My mom always told me I could be an engineer. I think it's because people can observe you from an objective point of view, so they tell you, "I notice you like this and this, so I feel that based on my observation you would be really good at this." Yeah, so it starts off with that.

Victoria highlighted the role of outside recognition, especially from her mother, in planting the seeds of STEM identity development. Samantha, a natural sciences major, similarly saw her mother as a source of objective outside recognition that was built through observation and report. During the artifact discussion she recounted a story about when she sent her mother a picture from her dissection:

> That is my science identity…when I sent that picture to my mom and then she was like, "Wow, you were having fun, weren't you? Can you see how happy you were with a rat?"…And I didn't look at it like that way…I just saw the details in the rat while my mom saw the details in me that I didn't even think about.

Samantha connected this moment with her mother as a significant event in her science identity development. For participants, the observations of family members could provide needed consistent perspective and recognition in the STEM identity development process.

The findings of this study indicated that multi-dimensional self-recognition and outside recognition were instrumental to the development process. Latinas who embodied certain qualities, such as thinking or persisting like a scientist, recognized themselves as STEM individuals. However, participants often chose to qualify their identities with markers of becoming a future STEM person or needing additional time to develop their knowledge and skills. Latinas gained outside recognition from peers, faculty, and family throughout the college-going process. Latinas felt as though peers and faculty members acknowledged abilities and socialized them within the community. ~~And, a~~Although family members were not part of these disciplinary communities, ~~they~~ family often encouraged the development and reinforcement of a STEM identity.

Discussion

Recognition played an important role in the STEM identity development of the study's Latinas, mirroring the importance attributed to the concept by Carlone and Johnson~~'s~~ (2007). For the students in this study, self-recognition was the result of a deep understanding and alignment with the learning of STEM concepts as well as an ability to understand one's place within the STEM community now and in the future. This s~~S~~elf-recognition in the form of understanding and

knowledge mirrors ~~findings from the prior theoretical model~~ Carlone & Johnson's (2007) *research scientist* identity. Self-recognition was also reinforced by the student's ability to persist within a STEM discipline despite ~~the~~ academic challenges ~~present~~. As students identified the elements they saw as indicative of success or of being a STEM person, their self-recognition hinged on the degree to which they identified with these characteristics. The findings also identified fear of identity loss in the future ~~can be seen~~ as an element to understanding self-recognition. In the current study, students expressed a vulnerability to identity loss and questioned how they might continue should their future divert them from their STEM endeavors. These findings parallel results of research on work identity that suggest that changes in work participation or group membership can result in loss of professional identity and difficulty with self-definition (Chreim, Williams, & Hinings, 2007; Doolin, 2002; Dutton, Roberts, & Bednar, 2010). ~~In this way, t~~The ~~current~~ present study posits that the greater the identity salience, the greater the possibility for future identity disruption ~~in the future~~.

Apart from self-recognition, outside recognition ~~recognition~~ from within the disciplinary community (faculty and peers) and to a lesser extent those beyond it (family) was also key to students developing a STEM identity, similar to previous research (e.g., Holland et al., 1998; Lave & Wenger, 1991; Packer & Goicoechea, 2000; Tonso, 2006). ~~.~~ Recognition from within the disciplinary community was particularly important as it represented a means by which ~~their~~ peers and faculty members invited them into or pushed them away from the STEM community. Students assigned differing degrees of authority to these groups and had varying levels of exposure to each.

Within this study, peer recognition held an important place in the identity development process. For the students in this study, peers recognized the participants' abilities within the field

and for their future careers. This type of recognition enabled students to feel intellectually accepted by those around them and feel as though they had met the academic standards for their discipline. This is in line with findings in previous work where recognition as a capable member of the disciplinary community has been shown to result in a stronger identity and sense of belonging for women in mostly male academic environments (Tonso, 1999, 2006). Participants found it difficult to persist without ~~that~~ peer recognition. For some students, ~~gaining recognition from peers appeared to be challenging and~~ a lack of peer recognition left ~~students~~ them doubting their abilities and questioning their place within the STEM community.

Solidification of their place in the STEM community could also be achieved through r~~R~~ecognition from faculty members. ~~emerged as~~However, such recognition was found to be less important than peer recognition, perhaps in part due to the lower frequency of such interactions. ~~Howev~~Students felt most validated by faculty members who were invested in their endeavors and supportive of their futures within STEM fields. Similar to prior research on validation in higher education (Rendón, 1994), these findings emphasize the importance of student validation by STEM institutional agents such as faculty members. ~~Faculty members,~~ T~~t~~hrough their recognition, faculty have the ability to give validation to years of academic and professional work ~~as well as~~and to act as support in ~~ers~~ ~~for~~ navigating the challenging STEM curriculum and pathway to the field.

The students in the current study found themselves simultaneously succeeding and failing in their pursuit of outside recognition. Students at times found their knowledge, skills, and experiences to be validated by their peers and faculty (i.e. during research presentations, acknowledgements from peers) and at other times questioned (i.e. not looking like a stereotypical STEM person, competence of material). Beyond these dominant groups and disciplinary insiders,

students in this study identified sources of recognition from family. To a lesser extent than Carlone and Johnson's study (2007), some of the women in this study attempted to refine those who they deemed *meaningful others*. ~~Although family might highlight and encourage early interests in STEM, family members may not be seen as *meaningful others*.~~ Although a few students highlighted family as a possible source of recognition, students in this study expressed the continued need to be recognized by their STEM community. While family might highlight and encourage early interests in STEM, family members may not be seen as *meaningful others*. ~~Thus, for students, the role of recognition from community insiders seems to be more critical to STEM identity development than alternative sourcesin the eyes of the students in this study. The focus on peer-recognition suggests that non-institutional agents can play a role in the STEM identity development proces~~ Thus, for students, the role of recognition from community insiders seems to be more critical to STEM identity development than alternative sources.

While these findings are aligned with prior research that has articulated the essential role that peers and faculty members play in the success of students (e.g., Wenger & Cardella, 2013; Godwin, Potvin, Hazari, 2014; Strayhorn, 2010), they also point to issues. Seeking such recognition from STEM peers and faculty members, most of who are White men, may be problematic. The desire by Latinas, as women of color, for recognition by peers and faculty, most of whom are White men, may perpetuate the established cultural dominance of these groups and fail to address the sexism and racism present within the STEM fields.

As such, this study also points to prior research on the importance of intersectionality on STEM experiences (e.g., Collins, 2000; Crenshaw, 1991; Malcom, Hall, and Brown, 1976; Ong,Wright, Espinosa, and Orfield, 2011). As women of color in STEM fields, Latinas may have gendered as well as racialized interactions with others which can result in unique experiences for

these students. For the participants in this study, intersectional identities shaped the way in which they interacted with the STEM community, and, in particular, with their peers. Their male peers sometimes questioned their competence and failed to recognize Latinas as valuable members of the STEM community. In addition, racial and ethnic identity, and the lack of Latinas present within the STEM disciplines, influenced the way in which faculty and members of the community overlooked Latinas as possible members of the community. As students within this study alluded to, Latinas, as women of color, experience a double bind in which they feel oppressed and marginalized based on their gender as well as their race or ethnicity, an issue commonly acknowledged in the literature (e.g., Carlone & Johnson, 2007; Malcom, Hall, and Brown, 1976; Ong, Wright, Espinosa, and Orfield, 2011).

~~For the participants in this study, intersectional identities shaped the way in which Latinas~~ they ~~interacted with the STEM community, and, in particular, with their peers. Their male peers sometimes questioned their competence and failed to recognize Latinas as valuable members of the STEM community. In addition, racial and ethnic identity, and the lack of Latinas present within the STEM disciplines, influenced the way in which faculty and members of the community overlooked Latinas as possible members of the community.~~ In turn, in order to be recognized, Latinas felt the need to persist~~,~~ despite struggles as a need to overcome assumptions and stereotypes regarding their gender, racial, and ethnic identities.

These findings align with prior research that ~~shows how~~suggests the effort to "prove others wrong" may be a method which Latinas use to critique oppression, express a desire for social justice, and drive success (Solorzano & Delgado Bernal, 2001; Yosso, 2000). The Latinas within this study critiqued the unequal representation of Latinas in STEM as well as the lower expectations of them as a result of their gender and racial/ethnic identities. From this critique, the

women weare moved to confront the negative stereotypes others placed on them and ~~motivated~~ to navigate STEM ~~for themselves~~ successfully.

Limitations

These conclusions must be interpreted in light of the study's delimitations and limitations. The sample size of 17, which allowed the researchers to delve deeply into the lived experiences of these students, is not meant to be representative of the wide range of potential differences in the lived identity development experiences of Latinas in STEM disciplines. The study took place at a tier-one, predominantly White, public research university which is also not meant to be generalizable to all contexts. Although information gathered from this study may add to the depth of knowledge regarding Latina STEM identity development, particularly for Latinas at tier-one predominantly white public research universities, results may not generalize to other types of institutions (e.g. community colleges, liberal arts colleges, regional universities, Hispanic-serving institutions (HSIs), or historically Black colleges and universities (HBCUs)).

Implications for Future Research

Although this study served as an important step towards understanding STEM identity development for Latinas, further research in this area is needed in order to more fully understand this process. In particular, future research should continue to address the intersectional nature of STEM identity development while also further examining institutional context and disaggregating by discipline ~~area~~. Disaggregating identity development by discipline may capture the nuanced ways in which Latinas experience specific contexts and curricula. The investigation of STEM identity development would also be enhanced by examining self- and

out-side recognition in a further disaggregated manner.

Recognition should be further studied to determine the progression before and through STEM degrees. Looking at development across time and degree attainment could reveal of how STEM identity development evolves over time and which elements of development are most salient at differing levels of attainment or critical junctures in the STEM pipeline. This area of research would also benefit from a greater exploration of outside recognition from faculty and peers, including a discussion of how faculty relationships with students (e.g. lecture-based, internship-based) affect recognition and how different types of peers (STEM versus non-STEM) affect outside recognition in distinct ways for Latinas in STEM disciplines. Finally, future scholarship might investigate the ways in which family influences STEM identity development. While in this study, family recognition played a limited role, findings might vary across student populations or ~~within~~ contexts. For some, ~~in which~~ parents play a more active role in their student's journey, which may in change the value placed on their recognition.

Implications for Policy and Practice

In practical terms, to encourage self-recognition of knowledge and skills, STEM faculty should provide Latina students the opportunity to reflect on assumptions regarding their field and experiences with socialization into various disciplinary communities. Through focused first-year seminars, or similar structures, students should be encouraged to explore their assumptions about the field in order to build a sense of self-recognition as a STEM individual and address racial, ethnic, and gender stereotypes around STEM. To further encourage self-recognition, institutions might require STEM students to engage in early, low-stakes experiences in which students can "see" themselves in a given field and connect with others in the disciplinary community for outside recognition.

In terms of outside recognition, institutions should focus their efforts on improving the ways in which STEM peers and faculty interact with Latina students. Peers and faculty members have the powerful potential to validate the STEM experiences of Latina students by recognizing them as valuable members of the disciplinary community. To enhance recognition, the curricula should provide opportunities for all students, at one point or another, to lead projects and highlight their abilities. Leadership opportunities in project-based learning would provide a space for which Latina students to be recognized as STEM individuals both to their peers as well as to their faculty members. To address issues of racial, ethnic, and gender bias present within the STEM fields, students and faculty should complete meaningful bias training early in their educational journeys or careers. In doing so, institutions may eliminate biases that disproportionally affect women of color in these disciplines. Finally, educational stakeholders may also encourage students to redefine whose recognition they value to include family and non-STEM peers. Despite the fact that STEM peer and faculty recognition was of great importance to the Latinas in this study, some students may find recognition along familial and non-STEM lines, rather than only within the STEM community. In order to facilitate outside recognition and create a more inviting environment, the university could invite family to STEM achievement marker events (i.e. research presentations, awards ceremonies) so that they feel a part of the STEM environment and can see their daughter's achievement within the STEM community.

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