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CENTER FOR RESEARCH ON
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RESEARCH BRIEF

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**Forming STEM Identity
in Personal Networks:**

A Quantitative Study of Social
Support for Latine STEM Students



Continuing Studies
UNIVERSITY OF WISCONSIN-MADISON



Summary

Although Latino/a/x/e (hereafter, “Latine”) students have high aspirations for achievement in Science, Technology, Engineering, and Mathematics (STEM), they remain underrepresented in the STEM workforce (Fry et al., 2021). Social support is key to STEM identity formation and sense of belonging, two important predictors of STEM persistence for historically marginalized students. Unfortunately, little research has documented the link between Latine students’ social networks, STEM identity, and sense of belonging in ways that can help researchers and educators better support their STEM success.

We used the Community Cultural Wealth framework (CCW) – a theory focused on strengths within Communities of Color (Yosso, 2005) – to design a survey of Latine STEM majors across the University of Texas System (N=408). We then measured important contours of Latine STEM students’ social networks, including (1) the features of these social networks, (2) the forms of CCW students possess in their social networks, and (3) the relationships that exist between students’ networks, STEM identity, and sense of belonging.

Key Findings:

- Latine STEM students listed an average of about five key supporters, or “alters,” within their personal, academic, and career discussion networks. On average, students report feeling close or very close to the alters they listed.
- A majority of alters were identified as Latine or of multi-racial identities that include a Latine identity. About 51% of alters were identified as cisgender women, 39% were cisgender men, and 4% were gender diverse.
- Most student networks center around alters who are friends, family members, and fellow college students. For example, 37 percent of the alters students listed are family members.
- Stronger, closer relationships to alters are positively associated with alters providing a wide variety of social supports (e.g. material aid, maintaining hopes, engaging in leisure) with the notable exception of help navigating campus.
- Alters’ status as family members is significantly associated with providing material aid, helping Latine students maintain hopes and aspirations, and modeling ways of caring, coping, or providing for members of the students’ community.
- The number of alters students listed, how close they were to these alters, and having an alter who helped navigate college life are significantly and positively related to students’ sense of belonging.
- Latine students’ STEM identity is positively associated with relationship strength, as well as having a community role model(s) ($\beta=.696$; $p=.006$).
- On the other hand, having more close-knit networks is negatively associated with STEM identity.

¹ Here, we use the expression “STEM identity” in lieu of “science identity” (Carlone & Johnson, 2007) to reflect the fact that some engineers prefer the former terminology. In our survey, we used a previously validated science identity scale (Estrada et al., 2011), but noted to respondents that they should think of “scientist” as including engineers.

Study Purpose

Although Latine students and their families maintain high aspirations for their achievement in STEM (Science, Technology, Engineering, and Mathematics) (Hernandez et al., 2016), they continue to face barriers to STEM degree completion and remain underrepresented in the STEM workforce. Latines make up 17% of employed adults, but only 8% of all STEM workers, 12% of STEM bachelor's degree recipients, and 6% of STEM research doctorates (Fry et al., 2021). Social support systems are key to STEM identity formation and sense of belonging, two important predictors of persistence and attainment in STEM, particularly among historically marginalized students (Chemers et al., 2011; Strayhorn, 2012). For this reason, documenting Latine college students' social networks – including their strengths, structure, and how they change over time – can help researchers understand career pathways in STEM.

Based on survey responses (N=408) from Latine Juniors (60-90 credit hours) majoring in STEM across seven Hispanic Serving Institutions (HSI) and emerging HSI campuses in the University of Texas System, this research brief describes a collaborative study aimed at measuring features of students' social networks in STEM. In particular, we emphasize how Community Cultural Wealth (CCW) (Yosso, 2005) moves through these networks to support students' STEM identity (Byars-Winston et al., 2016; Carlone & Johnson, 2007; Estrada et al., 2011) and sense of belonging (Johnson, 2012; Rainey et al., 2018).

Our research questions for this study are:

1. What are the features of Latine STEM students' social networks – including their size, density, and the resources they provide?
2. What forms of Community Cultural Wealth (CCW) do students possess in their social networks?
3. What is the relationship between students' network characteristics and their STEM identity and sense of belonging?

This research brief describes a collaborative study aimed at measuring features of students' social networks in STEM based on survey responses from Latine juniors across seven Hispanic Serving Institutions (HSI) and emerging-HSI campuses in the University of Texas System.

Background

Previous research shows that students' social lives have a major impact on their persistence in STEM majors. Many historically marginalized students find the impersonal and individualistic climate of STEM college classrooms off-putting (Palmer et al., 2011), are discouraged by the lack of same-race role models and mentors (Price, 2010), and face low expectations from faculty (McCoy et al., 2017). Some may leave STEM if they feel their coursework has no social relevance or potential impact on their home communities (Bonous-Hammarth, 2000). Women of Color, in particular, must do extra work to be accepted by their male and White peers, struggle with social isolation, and shoulder the daily burden of stereotypes based on their race and gender (McGee, 2016; Ong et al., 2011).

These experiences can negatively impact students' sense of belonging and STEM identity formation, to important predictors of STEM attainment and commitment for historical marginalized students (Chemers et al., 2011; Nuñez, 2009). In turn, threats to students' STEM identity and sense of belonging increase the likelihood that they will be pulled away from STEM toward non-STEM majors they perceive as more compatible with their sense of self (Thoman et al., 2014). Fortunately, STEM identity and sense of belonging for historically marginalized students are malleable and highly dependent on their social relationships in their communities of origin (Brown, 2002).

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Undergraduate students also depend on relationships developed through STEM enrichment programs (Lane, 2016), undergraduate research experiences (UREs; Frederick et al., 2021), peer study and social groups (Martin et al., 2013), and faculty mentorship (Byars-Winston & Rogers, 2019).

To date, however, little research connects STEM identity or sense of belonging to Latine STEM students' social networks, including characteristics found to be important in network research: network size (how many people one talks to about important matters), diversity (including the range of gender identities, racial identities, and education levels among one's discussants), tie strength (how close one feels to those they talk to), and network density (the degree to which one's discussants are connected to one another) (Halgin & Borgatti, 2012). As such, it is difficult to measure the benefits that accrue to students from their networks beyond the sum of their parts (Martin et al., 2020).

Similarly, most existing research linking Latine students' STEM identity to their Community Cultural Wealth – strengths from their families, cultures, communities, and experiences – is qualitative. This previous work has documented Latine students' strong family support and motivation for entering STEM (Burt & Johnson, 2018), early exposure to STEM through their family members' work (Mobley & Brawner, 2019), and desire to pay back important others by winning stable, high-paying jobs in STEM (Ayala & Contreras, 2019). Because the qualitative literature supports the notion of a link between CCW and science identity, here we are able to further explore this connection through quantitative research.

KEY TERMS

Sense of campus belonging: a student's feelings of "fit" and membership within their university campus community.

STEM identity: recognizing oneself & being recognized by others as a "science or engineering person"; performing scientific practices maintaining a longstanding and meaningful understanding of science/engineering content.

About the Networks & Cultural Assets (NCA) Project

The Networks and Cultural Assets Project (NCA) administers survey and interview instruments to measure students' Community Cultural Wealth ([Yosso, 2005](#)) and social networks, then provides results to educators for academic and career development purposes.

Historically, research and programming involving undergraduates of color focused on what students lack – an approach that not only demotivates students, but also misses opportunities to support them as they build upon their existing strengths. Community Cultural Wealth (CCW) is a framework focusing on students' assets, including skills and dispositions from their families, communities of origin, cultures, and personal experiences.

The NCA survey combines measures of different forms of CCW with personal network analysis adapted from previous work ([Burt, 1984](#); [Sablan, 2019](#)). The instrument shows how students' CCW is nurtured in their relationships both on and off campus and reveals connections between students' CCW and measures of interest to career development professionals (e.g., work volition, work values). Qualitative research, such as interviews and focus groups, rounds out the survey instrument to help the team better understand the relationships and experiences that have the greatest impact on students' CCW, career trajectories, aspirations, and resilience.

Study Methods

Data Collection

To investigate the associations between students' social networks, CCW, and STEM identity and sense of belonging, we surveyed 408 Latine students in their Junior year who declared a major in STEM at one of seven University of Texas System Campuses. Table 1 displays participant attributes.

Table 1. Demographic and Academic Characteristics

Variable ²	Frequency	Percent
Total	408	100.0%
Gender		
Cisgender Woman	210	51.5%
Cisgender Man	163	40.0%
Transgender, Non-binary, or Other Gender Identity	20	4.9%
Prefer not to reply	15	3.7%
Hispanic/Latin Origin		
Cuban	1	0.2%
Mexican, Mexican American, Chicano/a	371	90.9%
Puerto Rican	7	1.7%
Another Hispanic or Latina/o origin	25	6.1%
Multiple Hispanic or Latina/o origins	4	1.0%
First Generation College Student Status		
First Generation	211	51.7%
Major (Aggregated)		
Agriculture & Environmental Studies & Related Fields	26	6.1%
Biology and Related Fields	145	35.5%
Chemistry and Chemical Engineering	16	3.9%
Civil Engineering	20	4.9%
Computer Science and Computer Engineering	84	20.6%
Electrical/Electronic Communications Engineering	25	6.1%
Mathematics and Related Fields	11	2.7%
Mechanical Engineering	45	11.0%
Other Engineering	20	4.9%
Physics and Other Physical Science	17	4.2%
University of Texas (UT) Campus³		
UT - Arlington	8	2.0%
UT - Austin	39	9.6%
UT - Dallas	20	4.9%
UT - El Paso	101	24.8%
UT - Permian Basin	11	2.7%
UT - Rio Grande Valley	128	31.4%
UT - San Antonio	101	24.8%

Note: There are eight universities in the UT LSAMP system. Data from the eighth institution (UT-Tyler) was collected after this brief was written.

² For a full list of student attributes - including race, sexual orientation, and immigration status - please contact the research team.

³ We sampled participants based on the proportion of all UT System Latine students each campus enrolls. For example, the UT - El Paso is the home institution for approximately 20% of the Latine students enrolled across the UT System. For this reason, wanted our sample to be composed of roughly 20% UT - El Paso students.

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To assess students' social network characteristics, we used two “name generators,” a traditional social network prompt for eliciting the names of a respondent’s discussion contacts (e.g., Perry et al., 2018). We first asked students to list a maximum of 15 people (“alters”) with whom they had discussed important matters within the last 6 months (Burt, 1984). Subsequently, we asked them to mark the names of listed alters with whom they had discussed academic or career matters. A second name generator then asked respondents to list a maximum of 15 people (who were not previously listed) with whom they had discussed academic or career matters within the last 6 months.

Subsequent social network questions, referred to as “name interpreters,” asked for information on alters from each respondent. Those respondents who listed six or fewer alters in total in response to the name generators were asked to provide information on all their listed alters. If seven or more alters in total were listed, respondents were asked to provide information on six alters randomly selected from the respondent’s wider list of names (Marin & Hampton, 2007).

Name interpreters asked about each alter’s educational level, racial identity, and gender identity. They also asked about how alters were related to the participant (e.g., family member, friend, college educator, fellow college student), how close the respondent felt to each alter (referred to as “tie strength”), whether listed alters knew one another (measuring “density,” or interrelationships among alters) and the types of support that each alter provided (e.g., material aid, sharing worries, etc.). Four types of support are related to Community Cultural Wealth (Yosso, 2005), including items like “help maintain hopes or aspirations for your future” and “help oppose things you believe are wrong.”

KEY TERMS

Alter: a person with whom the respondent had discussed important matters within the last 6 months.

Tie strength: how close the respondents felt to each alter.

Tie density: whether listed alters knew one another.

STEM identity was measured by a 5-item scale (Estrada et al., 2011; $\alpha = .870$).⁴

Data Analysis

In order to examine how relationship types are associated with the CCW that students receive from their networks, we conducted Pearson’s correlation analyses between alter characteristics (e.g., tie strength, relationship type, etc.) and support provided by alters. For analysis, relationship type and support type were re-coded into binary variables that indicate whether each alter is affiliated with each category (e.g., family) or whether each alter provides each particular type of support (e.g., material aid). Therefore, results should be understood to indicate whether each type of relationship (e.g., family) is more or less related to each type of support (e.g., material support). Table 4 below shows the results of this analysis.

We used ordinary least squares (OLS) regression to understand the relationships between students’ network characteristics, STEM identity and sense of belonging. We used control variables that have been found to be related to students’ STEM identity and sense of belonging including gender, sexual orientation, transfer status, and immigration status (Strayhorn, 2012). Immigration status is particularly important in the Texas context, as Texas is the state that shares the longest border with Mexico and two participating institutions (UT-El Paso and UT-Rio Grande Valley) are located in border cities. Table 2 below summarizes the results of the regression analyses.

⁴ For a full list of items in each scale, please contact the research team.

Findings

1. What are the features of Latine STEM students' social networks?

A total of 2,077 people were listed as alters, 1,800 of whom were sampled for name interpreter questions. Table 2 summarizes the characteristics of Latine STEM students' social networks as reported by the students themselves.

Table 2. Network Characteristics

Whole Network Characteristics (N=2,077)		Range	Mean (SD)
Network Size		0-20	5.09 (2.79)
Sampled Network Characteristics (N=1,800)		Range	Mean (SD)
Network Density		0-1	0.30 (0.27)
Tie Strength		1-4	3.32 (0.54)
Sampled Alter Characteristics (N=1,800)		Frequency	Percent
Racial/ethnic identity (multichoice, aggregated; NA=2)			
American Indian or Alaska Native		21	1.17%
Asian or Asian-American		80	4.44%
Black or African American		51	2.83%
Latina/o or Hispanic		1437	79.83%
Native Hawaiian or Pacific Islander		4	0.22%
White or Caucasian		336	18.67%
Other		45	2.50%
Gender identity			
Cisgender Woman		915	50.83%
Cisgender Man		701	38.94%
Transgender Woman		7	0.39%
Transgender Man		6	0.33%
Non-binary		25	1.39%
Not listed		72	4.00%
Don't know		74	4.11%
Educational level (NA=7)			
Less than high school		112	6.22%
High school diploma or GED		708	39.33%
Associate's degree		262	14.56%
Bachelor's degree		501	27.83%
Master's or Professional degree (MA, MS, law degree, MBA)		134	7.44%
Doctorate (MD, Ph.D., Ed.D.)		76	4.22%
Relationship Type (multichoice, NA=1)			
College Educator		120	6.67%
<i>College educator at currently enrolled campus</i>		111	6.18%
College Student		468	26.00%
Coworker		104	5.78%
Family		666	37.00%
Friend		806	44.78%
Spiritual Advisor		26	1.44%
Spouse or Significant Other		136	7.56%
Other		56	3.1%
Support Provided			
Material aid in the form of money, food, clothes, etc. (Material)		724	40.22%
Help maintain hopes or aspirations for your future (Hopes)*		1,217	67.61%
Share or communicate about important problems or worries (Worries)		1,064	59.11%
Model ways of caring, coping, or providing for members of your community (Community Role Model)*		847	47.06%
Help develop skills, knowledge, or strategies for maneuvering through campus and/or the college experience (Campus)*		797	44.28%
Help oppose things you believe are wrong (Resistant)*		769	42.72%
Provide the opportunity to engage in leisure, relaxation, or a diversion from demands in your life (Leisure)		1,031	57.28%

*Denotes a form of Community Cultural Wealth.

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The number of listed people ranged from 0 to 20, with an average of 5.09 alters. This means that Latine STEM students in our study have an average of about five key supporters they speak to about personal, academic, and career development issues. The average network density was 0.30 on a 0-1 scale, the equivalent of about three connections within a social network of five people. On a 1-4 scale, where 1 is distant and 4 is very close, the average tie strength between respondents and their listed alters was 3.32, which indicates a close to very close relationship.

The overwhelming majority of listed alters (79.83%) were reported as Latine or multi-racial including Latine identity. About 51% of alters were identified as cisgender women, 39% were cisgender men, and 4% were gender diverse (transgender women, transgender men, non-binary, not listed). The most common educational level of alters was a high school diploma or GED (39.33%), followed by a bachelor's degree (28.83%). Students' networks are centered around friends (44.78%), family members (37.00%), and fellow college students (26.00%). Spouses or significant others (7.56%), college educators (6.67%), coworkers (5.78%), and spiritual advisors (1.44%) followed in proportion.

2. What forms of CCW do students possess in their social networks?

We examined correlations between tie strength, relationship type, and provided support (N=1,799; Table 3).

Table 3. Correlation Results on Tie Strength, Relationship Type, and Support

Measure	Tie Strength	Family	Coworker	College Educator	College Student	Friend	Spiritual Advisor	Spouse or Significant Other
Tie strength	1.000	.253***	-.162***	-.385***	-.051*	-.022	-.002	.220***
Material	.324***	.509***	-.126***	-.174***	-.231***	-.388***	-.033	.168***
Hopes	.339***	.075***	-.002	-.034	-.075***	-.053*	.024	.153***
Worries	.465***	.028	-.046	-.154***	.008	.042	.015	.203***
Community Role Model	.303***	.232***	-.014	-.105***	-.133***	-.151***	.054*	.067***
Campus	.012	-.118***	-.015	.170***	.116***	.043	-.005	0.037
Resistant	.315***	.045	-.070***	-.127***	-.013	.003	.055*	.161***
Leisure	.395***	-.039	-.080***	-.247***	.069***	.140***	.039	.192***

Note: + p < .10; * p < .05; ** p < .01; *** p < .001

We found that closer relationships (higher tie strength) provide a variety of supports, except for campus-related help. We also found that being a family member is significantly associated with providing material aid, helping students maintain hopes and aspirations, and modeling ways of caring, coping, or providing for members of the students' community. Family members, however, were significantly less likely to be a source of support for navigating campus or the college experience. Instead, this kind of campus-related support was more likely to be provided by college educators and other college students. Another interesting finding is that spiritual advisors showed a significant association with modeling community roles and supporting students in opposing injustice.

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3. What is the relationship between students' network characteristics and their STEM identity and sense of belonging?

Findings from the OLS regression (Table 4) suggest that multiple social network characteristics significantly associate with students' STEM identity and sense of belonging.

Table 4. Regression Results on Network Characteristics, STEM identity, and Belonging

Variable	Science Identity		Sense of Belonging	
	β (SE)	t-value	β (SE)	t-value
Intercept	3.921 (0.639)	6.137	2.728 (0.817)***	3.338
Gender (Reference: Cisgender men)				
Cisgender women	0.066 (0.131)	0.503	0.026 (0.168)	0.156
Genderqueer genders	-0.067 (0.227)	-0.294	-0.151 (0.291)	-0.520
Sexual Orientation (Reference: Straight/Heterosexual)				
LGBTQ+ or Prefer not to reply	-0.094 (0.142)	-0.665	0.159 (0.182)	0.878
Transfer Status (Reference: Non-transfer students)				
Transfer students	-0.029 (0.120)	-0.241	-0.141 (0.154)	-0.918
Changed Major (Reference: Did not change major)				
Changed major at least once	-0.294 (0.123)*	-2.398	-0.279 (0.157)+	-1.778
First generation status (Reference: Continuing generation)				
First generation	0.204 (0.120)+	1.708	0.116 (0.153)	0.757
Have disability (Reference: No or Not sure)				
Yes	0.202 (0.223)	0.907	-0.441 (0.285)	-1.550
Immigration status (Reference: Citizen)				
Non-citizen or Prefer not to reply	0.254 (0.236)	1.076	0.323 (0.302)	1.071
Network characteristics				
Network size	-0.002 (0.025)	-0.061	0.098 (0.032)**	3.031
Network density	-0.441 (0.233)+	-1.887	0.312 (0.298)	1.045
Average tie strength	0.333 (0.128)**	2.6	0.292 (0.164)+	1.786
Provided support				
Material	-0.193 (0.207)	-0.931	-0.099 (0.265)	-0.373
Hopes	-0.026 (0.441)	-0.06	-0.242 (0.564)	-0.428
Worries	0.062 (0.505)	0.122	0.934 (0.645)	1.447
Community Role Model	0.696 (0.254)**	2.745	-0.229 (0.324)	-0.705
Campus	-0.007 (0.232)	-0.031	0.628 (0.297)*	2.112
Resistant	0.220 (0.183)	1.201	-0.166 (0.234)	-0.709
Leisure	-0.283 (0.359)	-0.788	-0.220 (0.459)	-0.480

Students' STEM identity was positively associated with average tie strength and having a community role model(s). On the other hand, having denser or more close-knit networks ("network density") was negatively associated with STEM identity. Network size, average tie strength, and having an alter or alters who help navigate college life were significantly and positively related to students' sense of belonging to their campuses.

Future Directions

Preliminary results from this study indicate a connection between students' network features - including the Community Cultural Wealth passed through their social connections - and their STEM identity and sense of belonging.

Although it is too early to make recommendations based on our findings, further research should explore the idea that strong social connections with people who model caring for community can also help students see themselves as scientists. Furthermore, these findings point to the possibility of nurturing STEM identity at the peer group level – as opposed to pursuing interventions focused only on the individual. Previous social network research with college students suggests that network content matters: tight-knit social groups can support student success if they provide instrumental help, emotional support, and intellectual engagement (McCabe, 2016). Academic influence from such networks is not always positive, however, and dense networks have been shown to “intensify friends’ (positive or negative) impact” as McCabe notes (2016; p. 73). If dense social networks suppress STEM identity because of group norms inimical to science and engineering practices, could density be re-harnessed to develop pro-science group norms? As we are currently in the process of conducting follow-up interviews with a subset (N=70) of our survey respondents, future work will help explain precisely how these kinds of relationships nurture students’ STEM identity and belonging. In turn, we can offer recommendations for STEM faculty and student services professionals developing programs to foster such social supports for students who may not otherwise have them.

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