

“We Should all Help Each Other”: Latina Undergraduates’ Practices and Identities in the Figured World of Computing

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Abstract: The number of Latinas earning computing degrees and entering technical careers is stubbornly low. This study uses Holland, Lachicotte, Skinner, and Cain’s (1998) concepts of identity and figured worlds to explore the experiences of 22 Latina undergraduates in computing majors. Using semi-structured, focus group interviews, this paper describes participants’ identity production as empowered computer scientists. Results indicate that Latinas faced many cultural constraints within the landscape of computing, including isolation, marginalization and microaggressions, yet they also described practices and relationships that helped them to persist in their majors. Successful disciplinary performances and access to Latina role models were pivotal in students’ adoption of empowered identities. Study participants challenged the notion of computing as a competitive, individualistic enterprise that permeated the local and global computing communities in which they operated. Instead, they developed identities as engaged, community-oriented computer scientists and enacted these identities through their everyday practices in their departments and in the local community.

Introduction

Learning involves more than the acquisition of technical knowledge and disciplinary expertise. Though these elements are important aspects of the learning process, learning also involves identification with a discipline, profession, or community; in short, “becoming” a certain type of person. In scientific, mathematical, engineering, and mathematics (STEM) disciplines in higher education, learning encompasses an interrelated process of developing accountable disciplinary knowledge, identifying with the discipline, and navigating institutional and disciplinary contexts (Stevens et al., 2008). While undergraduate students must successfully navigate institutional and disciplinary benchmarks, such as core courses and requirements, the process of *becoming* a scientist occurs within the everyday practices, relationships, and interactions that students experience in the cultural context of their discipline.

This paper focuses on the underrepresentation of Latinas within the field of computing and explores the ways in which Latina undergraduates come to see themselves, and to be seen, as successful and empowered computer science students. The larger purpose of the study was to understand how Latinas negotiated disciplinary cultures that subordinated them as women and as individuals of Hispanic origin. Through interviews with Latina computing majors, we explored the barriers and supports they encountered in authoring competent identities in technical fields. The research questions that drove this investigation were:

- How do Latinas negotiate the figured world of academic computing, particularly in regard to their computing expertise?
- What social and cultural practices support Latinas in taking up professional identities in computing?
- How does the intersectionality of race, class, and gender influence the position of Latinas in the figured world of academic world of computing and the identities that they craft within the discipline?

Social and Cultural Barriers in STEM disciplines Faced by Women and Latino/as

Pathways in STEM fields are especially difficult for underrepresented minority students and women (Gasbarra & Johnson, 2008; Wajcman, 2010). Women are underrepresented in scientific, technology, engineering, and mathematics (STEM) careers in 121 developed and developing countries (UNESCO, 2009), within the European Union (European Commission, 2009), and in the US (National Science Board, 2012). Inequities in computing—the disciplinary site of this study—are especially grim. Only 7% of baccalaureates and less than 1% of doctorates in computer science in 2012 were granted to Hispanic US citizens (National Center for Education Statistics, 2012), though Hispanics represent 16% of the total US population, and nearly one quarter of the youth population (US Census, 2011). The National Center for Women and Information Technology (NCWIT) reported that only one percent of the information technology jobs in the US are held by women of Hispanic origin (NCWIT, 2004).

Historical-cultural views on what kind of work is appropriate for women foster gendered expectations that, in turn, profoundly affect the numbers of women in computing fields. For example, in the US, the dominant view of computing is that it is an asocial, highly technical, masculine pursuit (Barker & Aspray, 2006). A

number of processes including early socialization (Clewell & Braddock, 2000), perceptions of and actual instructor bias (Beyer, Reynes and Haller 2004), and negative departmental and classroom climates (Margolis & Fisher, 2002; Seymour & Hewitt, 1997), work in tandem with these historically and culturally engrained views to discourage women from pursuing computing degrees and careers.

In addition, Latino/as face a number of sociocultural, economic, and educational obstacles in higher education degree attainment (Hurtado, Carter, & Spuler, 1996; Oseguera, Locks, & Vega, 2009). Lack of faculty support, discomfort on the university campus, and financial struggles contribute to high attrition rates (Gloria et al. 2005; Santiago & Treindl, 2009). In STEM disciplines, cultural incongruence between minority communities and academic departments has been argued to contribute to the underrepresentation of Latino/as, African-Americans, and Native Americans in these majors (Bonous-Hammarth, 2000; Cole & Espinoza 2008). Latino/a students are less likely to have completed college-ready coursework upon high school graduation (Tyson, et al., 2007). Additionally, K-12 schools with sizeable numbers of students from non-dominant communities emphasize basic skills over higher-order thinking (Sleeter, 2005). Racial and ethnic disparities in computing education can also be attributed to the stubborn persistence of the digital divide (Margolis, 2008; Warschauer, Knobel & Stone, 2004).

Research on STEM education has elucidated historical and cultural factors that contribute to the lack of women and minorities in technical fields and identified strategies for supporting students once they have enrolled in STEM majors. However, researchers have not often focused on the ways in which specific underserved populations in STEM, such as Latinas in computing, experience intersectionality, negotiate barriers, and craft identities in fields in which they are overwhelmingly underrepresented. In this paper, we identify the life history experiences that are associated with the development of empowered identities for Latinas in computing fields.

Conceptual Framework

We use Holland, Lachicotte, Skinner, and Cain's (1998) concepts of identity and figured worlds to explore the experiences of Latinas within computing majors. Identity is formed within certain figured worlds through routine interactions, activities, and relationships. Figured worlds are socially and historically situated realms of human activity with their own sets of values, norms, and expectations. Figured worlds may be broad, such as academia, or local, such as a student club within a campus department. People enter into or are recruited into figured worlds and they "come to identify themselves as actors of more or less influence, more or less privilege, and more or less power in these worlds" (Holland et al, 1998, p.60).

Identity is a valuable construct for interpreting the experiences of actors with less privilege and power within dominant cultural contexts, such as Latinas in computing. According to Holland, et al. (1998), people may challenge taken-for granted notions and cultural constraints through the process of identity development. For example, Latinas may accept traditional, masculine notions of a computer scientist as a white or Asian male "hacker" or they may negotiate new definitions of computer scientist as activist and engaged with youth, education, or community outreach. Identities, including ways of becoming a computer scientist, are not static and fixed, nor do they spring from some "essential" characteristic such as gender or race. Instead, identities are works in progress and are formed in and through everyday practices and interactions.

Identity involves not only actively identifying oneself as an actor within a specific social and cultural field, but also being seen by others as such. While this notion of identity allows for agency within peoples' lives, individuals are not free to adopt any identity they want. Indeed, they are constrained by given social and historical conditions; but, they may also "improvise" and act creatively within those conditions. The concept of identity within figured worlds allows us to examine hierarchy, status and power within specific cultural realms of activity, such as academic departments or disciplines. This lens provides a framework for exploring the intersection of agency and structure and the ways in which individuals negotiate power within cultural domains. In this study we use the concepts of identity and figured worlds to explore how Latinas navigate oftentimes difficult academic pathways and craft identities that value the intersectionality (Crenshaw, 1991) of being Latina in the figured world of computing.

Research Design and Data Sources

We conducted semi-structured interviews to investigate—from the perspective of Latina actors in the figured world of computing—the interactions, practices and relationships that facilitated or hindered their identification with the discipline. All of our study participants were involved in the Computing Alliance of Hispanic-Serving Institutions (CAHSI), a National Science Foundation-sponsored consortium of ten Hispanic-serving Institutions (HSIs). CAHSI implements a number of pedagogical innovations that support the recruitment, retention, and advancement of Hispanics in computing. Participating institutions span the cultural and regional diversity of Latino/as in the US, from a university in Puerto Rico, to ethnically diverse urban institutions in California, to

universities in Florida with significant numbers of Cuban, Central, and South American students, and border universities in Texas and New Mexico with large populations of Mexican-American students.

Latina undergraduates are severely underrepresented in the fields of computer science and computer engineering. For example, Latinas accounted for less than one percent (only 64 out of 8977 total graduates) of bachelor's degrees in computer science or computer engineering from U.S. institutions in 2012 (NCES, 2012). CAHSI serves as a national hub for Hispanic computing students, faculty, and professionals to support and network with one another. Due to the dire underrepresentation of Latina undergraduates in computing fields, CAHSI was an ideal site through which to identify research participants.

We conducted focus group interviews with all of the female participants from CAHSI (n=22) at an academic conference for underrepresented minority students and faculty in STEM disciplines. We sought to interview all female participants at this professional meeting to not only explore Latina's experiences as computing students, but to investigate how their participation in the professional conference may have influenced their identification with the discipline. We scheduled focus groups with all 22 women from seven institutions who attended the conference. Participants met with female peers from their institution when applicable, in groups from one to six total participants. Two interviewers conducted the focus groups, with one researcher chosen beforehand to lead the discussion. Of the 22 female focus group participants, almost all were undergraduate students (81%) and self-identified as Hispanic (77%). Almost all participants were enrolled in computer science (CS) or computer engineering (CE) majors, although two students were enrolled in computer information systems (CIS) and one was a mathematics major with an emphasis in computer science. Interviews lasted 45 to 90 minutes, were digitally recorded and transcribed verbatim. Interviews focused on participant's experiences within their departments and the larger field of computing. Sample interview questions include: "How did you first become interested in computer science?" "Where do you 'fit' in your department?" "Do you see any barriers that impact you as a Hispanic woman in computing?" and "What has supported you in your pursuit of a computing degree?" All research procedures were approved by the human subjects institutional review board. Pseudonyms have been used to protect the confidentiality of participants.

Analysis Methods

Interview transcripts were coded using domain analysis (Spradley, 1980). Researchers searched for units of meaning within the data, coding interview transcripts for examples of "cover terms" within broader "domains." Taxonomies were then constructed linking coded examples to domain categories through a semantic relationship such as "is a kind of" or "is a way of doing." Domains were generated both deductively, based on our research questions and our conceptual framework, and inductively, based on emergent themes from the data. For example, some deductive domain categories from our analysis include: *Barriers in Computing*, *Supports in Computing*, and *Professional Identity*. Some inductive domain categories include: *Gendered Expectations* and *Family Influence*. Two researchers generated the initial codebook in *NVivo* qualitative software based on the research questions and conceptual framework. The researchers initially coded transcripts in tandem to identify emerging domains and to gauge inter-rater reliability. The researchers then divided the rest of the interviews and coded them separately, eventually merging them into one *NVivo* project. Throughout the coding process, the researchers met regularly to discuss emerging findings.

Results

Power and Status in the Figured World of Computing

Through the formal support provided by CAHSI and informal support fostered within peer networks, some women experienced shifts in identity similar to the Chicano activists/educators described by Urrieta (2007), who took up an activist identity with a desire to educate others and give back to their community. However, the life experiences that fostered these shifts among our study participants were different from those in Urieta's research, with the exception of the experience of oppression.

As Latinas in computing, the undergraduates described their experiences of oppression in their discipline. They discussed isolation, marginalization, and microaggressions, meaning "brief and commonplace daily verbal, behavioral, or environmental indignities" that highlight difference and power (Sue, et al., 2007 p.271). The women in this study encountered these slights in both local and global figured worlds of computing and often narrated their experiences with a focus on gender. For instance, Elisa recounted an experience at a conference where she felt ignored and invisible to a male professor, in stark contrast to the attention he gave to her male peers. This microaggression highlighted her subordinate status as a woman in the realm of computing.

When we come to other conferences or other universities, I sometimes feel like, "I'm a woman." I've run into people, like other professors at other universities, and they don't pay attention to things I have to say. I just had that experience yesterday, actually. I was really

bumped out. I had to introduce myself to a PhD professor, and I was explaining, “This is what I’m interested in.” He went on to the next student, went to the next student, and then he comes back to me and he was like, “Did you already introduce yourself? Did you already tell me about yourself?” He gave everybody information about scholarships, and I was like, “I’m the only one without a paper.” I don’t know if it was because I was female or what. Just little things... it’s not very nice.

The women also became aware of their subordinated status as women in computing through difficult interactions with male peers within the competitive landscape of undergraduate computing classes, as described by Terese and Josefina. Some male peers accepted them as computer scientists, while others held lower expectations or were dismissive of them. These interactions highlighted the devalued status of women within computing.

Josefina: One thing that I notice, in any of my CS classes, there’s a few guys that treat us maybe as equals. There’s like five guys that are like, “Yes, they can do what we can do.” But then the other ones, it seems like you have to do better. You have to study harder and you have to get better, or the same grades to be considered like, “oh, maybe they can do it.” Then sometimes it’s like, still not, they’re still just a girl.

Terese: Most of the time I do better than all of them... But at the same time, it’s this disconnect. It’s this competitiveness where they don’t want anybody being better than them, especially females. But it shouldn’t be like that. We should all help each other.

In the exchange, Josefina and Terese lament the lack of support from male peers and contrast the value that they place on community with the competitive identities of many of their male peers. In turn, they propose new ways of becoming a computer scientist within academic spaces.

In these cases, and many others recounted by our focus group participants, gender—rather than ethnicity, class or other socially constructed categories—became the salient aspect of their identity through which they initially experienced power relationships in computing. Their focus on gender subordination may result from their attendance at Hispanic-Serving Institutions (HSI) in which Hispanics comprise at least 25% of the student population. Additionally, they participated in CAHSI, an organization dedicated to creating a community of Hispanic computing students, faculty, and professionals.

Becoming Computer Scientists

Identity shifts that expanded women’s notions of what it means to “be” a computer scientist, and “who” can be a computer scientist, were often fostered by interactions with role models. Interactions with role models also led the students to a greater understanding of the intersectionality of their identity within the landscape of computing, and the complex way in which class, race, gender, and language may all play a role in subordination. Participants came to understand the role that race, ethnicity, nationality, and other factors played in conferring diminished status in the field of computing. For instance, Julia commented on how hearing role models’ stories at conferences helped her to situate herself within the field and envision that it is possible to be a successful Latina computing professional.

Julia: I think the conference is really good about exposing young females to PhDs that are also females, and have prominent positions in the universities. I think that’s really exciting. I come from a university where I’m almost the only girl in all my classes, and I’m particularly the only Hispanic girl, sometimes even the only American. It’s nice to see people that are like me, who have similar backgrounds, who have succeeded. It’s very inspiring, because you go through all these troubles, and you’re starting out with your family, and not having too much money and all that stuff. You hear their stories, and they sound the same. I came from that background. Seeing people who have accomplished that, and who have gotten a PhD, it’s very inspiring, to a lot of girls.

Emma: It’s really exciting. Sometimes you just need to see that it’s possible.

Benita: It gives you hope.

Latina role models helped the women to frame their experiences of oppression in terms of the intersectionality of race, class, and gender. Some of the women also credited the systemic support they received from CAHSI—which facilitated their involvement in disciplinary research, travel to conferences, and interactions with Latina role models—with their consciousness of underrepresentation. Dolores commented that access to the tools and practices of her discipline in her research experience had helped her successfully navigate the academic pathway. Her research mentor also raised her awareness of the underrepresentation of Latinas in computing.

I love my degree and I'm really glad that CAHSI is helping our communities because we were talking about it in the research lab a few days ago, that not only the fact that there's no women [in computing] but no Hispanics, and [my mentor] was talking about how underrepresented we are. I'm glad that CAHSI is actually helping, because it feels encouraging that we actually can get somewhere, right? Because with no help, I mean, nobody would get anywhere. I'm really thankful for the opportunity.

Thus, many of the Latina undergraduates became critically aware of social and cultural inequities within the figured world of computing. Some women attributed their persistence in the major to this process of identity production, where they became critically conscious of power within the realm of computing, yet also gained confidence that they could successfully navigate—and possibly subvert—those power relationships. Participants gained confidence through successful performance in the field and recognition, similar to the women of color in Carlone and Johnson's (2007) study of science identity development.

As the Latinas in our study displayed competence and mastery in their disciplinary knowledge through research experiences and conferences, not only did they come to see themselves differently, others began to view them differently as well. Rosa described a shift in the way that her male peers perceived the Latinas in her department. The student's engagement in professional activities had conferred status to them within the local figured world of their department and others began to see them as successful computer science students.

Some of (our male peers), they don't know us, and I guess they don't know what we're doing and, I guess they judge us. Or they have this stereotype of the girls who are not good enough. ...they treat me with respect now, *'Oh, wow, you're going to conferences, that's really cool. Wow, I've never done that before. You must be really smart, you work really hard.'*

In this way, many participants gained status within their departments, seeing themselves, and being seen, as successful computer scientists.

Crafting Empowered Identities

At four institutions, these shifts in identity sparked a more empowered stance among participants. As already noted, the women often felt isolated, disenfranchised, and disrespected by some of their male peers and in some interactions outside of their departments. As a result of their critical awareness of the intersectionality of gender and race within the figured world of computing, they began to subvert these power relationships by creating academically-oriented clubs and other supportive peer networks. Terese, one of the founders of a computing club on her campus, described its goals of creating a stronger sense of community in the department, not just for women, but for all students.

Basically the goal is to create this sense of community within the department for students to feel comfortable. We have study sessions before the meetings, so students can just come, sit together with other students, and do their homework together. It's great because within that mix there is some lower classmen and upper classmen, and so there's always help there, because everybody is friendly.

Terese reflected on her reasons for attending a conference dedicated to the advancement of underrepresented populations in scientific fields. Her motivations reflect her burgeoning understanding of the complex intersectionality of gender and ethnicity within computing. She hoped to take her new understanding of the positionality of Latinas in computing to encourage underrepresented minority girls in her local area to enter into and persist in STEM fields. Though she embraced some aspects of the traditional culture of computing, and had a professional goal of working at Google as a programmer, Terese had begun to incorporate outreach, mentoring, and local activism into her computer science identity.

What I can take back [from the conference] is getting girls and minorities [into computing]. Where we work is a HSI, Hispanic-serving institution, primarily, so since not only are women underrepresented but also minorities, what we can take from this conference is to help the students and the girls and the kids in our area. That's what I'm hoping to get out of the conference is new ideas, because it's so hard to keep using the same old ones. When you feel like they're only helping so much.

On another campus, the women negotiated a new organizational identity for their campus computer science club. Aida described how the former student president of the club was a "little iffy, and he was only wanting to do game stuff. He was like, 'We're going to have some LAN parties, and just get together and game all day.' That was all he was about. I was like, 'Yes, that would be fun to do, but we need to do other stuff.'" A group of undergraduate women, mostly Latina, assumed the leadership of the club and created a space where outreach, community service, and professional development were valued. They shifted the values of the club away from an individualistic focus on technical proficiency to a focus on community.

Last year, and this year, we have a woman president and vice president. Last year, Ana was president and I was vice president. This time around, I'm president and Sofia is vice president. We're showing a bigger appearance for women in the CS area, and wanting to do more things. But part of our club, part of our goal, is not just to help you tutor or program or something like that. We try and get all the CS people together outside of classes, and outside of school work, and socialize, get to know each other. It's been a great way to get to know people. Every year it seems like the officers seem to be getting better, and having the interests of the club members in mind. We got more involved with community service and did relay for life. Last year, we actually took charge of doing a trip for the computer science club. We were able to raise money throughout the year, and we went up to an advanced computing center.

At other institutions, students did not start formal extra-curricular clubs, but developed informal peer networks for support. Academically-inclined Latinas developed relationships with each other in the academic spaces of research groups, conferences, or classes. These networks provided personal support and encouragement. Leticia commented on an informal network of women in her computer science department.

We know that within our group, we are there for the same reasons. We need to just help each other and find support when somebody may need tutoring or something you are struggling in. Or just like a conversation, a cup of coffee, in those types of things I really find support.

In the local figured worlds of their academic departments, some women began to organize their subjectivities around the issue of underrepresentation in computing, and thus enacted identities that valued being a Latina in computing. As Holland et al. (1998) theorized, the social interactions in the localized and temporal spaces of the computing clubs and informal peer networks gave voice to the lived experiences of Latinas in computing. In this process, some women gained a deeper understanding of the cultural, political, and historical landscape of Latinas in computing, and produced identities that contested the privileging of white and Asian male "hacker" culture in computer science. Much like the role models that they accessed through conferences who helped to foster their own shifts in identity, some of the Latina undergraduates served as "significant narrators" to younger students of local figured worlds in which they participated (Urrieta, 2007). In this way, the Latinas produced identities that recognized the intersectionality of race and gender within computing, and re-defined computer scientist as someone who values community, outreach, and mentoring over individualism and competition.

Conclusion

The Latinas in our study shared several common threads in their life history experiences that facilitated shifts in their identity within the professional and academic landscape of computing. The four life experiences related to professional empowerment were: 1) experiencing discrimination and oppression, 2) gaining a critical understanding of oppression through interactions with role models from similar backgrounds, 3) engaging in successful disciplinary performances, and 4) teaching or mentoring others. The Latinas in our study recounted many instances of bias and microaggressions. Yet participants' shift away from isolation and marginalization was fostered by interactions with Latina role models who situated the student's negative experiences within inequitable social, cultural, and historical legacies in computing. Participants began to see that their struggles were not isolated or unique. The role models served as catalysts to transform the student's understanding of their own experiences and helped to re-define their professional identities as Latinas in computing. Additionally,

successful disciplinary performances in research and at conferences were pivotal in conferring status to the women within their departments and the broader landscape of computing. These two experiences—interactions with role models and successful disciplinary performance—helped the women to see themselves, and to be seen, as competent computer scientists. Finally, participants enacted their professionally empowered identities by teaching and mentoring others. These experiences represent shifts away from an individualistic, isolated experience of computing to one defined by reflection, community, and teaching.

The Latinas in this study challenged the taken-for-granted notion of computing as a competitive, individualistic enterprise that is the domain of white or Asian, male hackers. Some of the students crafted identities as engaged, community-oriented computer scientists and enacted these identities in their departments and local communities. This study provides a glimpse into the way in which interactions and practices can foster, or impede, identification with the discipline for underrepresented students in computing. The research literature in STEM education has extensively explored the positive effects of role models but has rarely examined the ability of role models to illuminate social and cultural disparities and empower novices. However, through their interactions with role models and successful disciplinary performances, participants re-defined what it means to be a computer scientist and shaped computer science identities that value community, outreach, and cooperation over individualism and competition.

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