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Education Biographies from the Science Pipeline: An Analysis of Latino/a Student Perspectives on Ethnic and Gender Identity in Higher Education

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**Education Biographies from the Science Pipeline: An Analysis of
Latino/a Student Perspectives on Ethnic and Gender Identity in Higher
Education**

by

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Dedication

This work is dedicated to Leopoldo and Sophia Lujan, and to Aurora and Fred Encinas.

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Education Biographies from the Science Pipeline: An Analysis of Latino/a Student Perspectives on Ethnic and Gender Identity in Higher Education

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This study is a qualitative narrative analysis on the importance and relevance of the ethnic and gender identities of 17 Latino/a (Hispanic) college students in the biological sciences. This research study asks the question of how one's higher education experience within the science pipeline shapes an individual's direction of study, attitudes toward science, and cultural/ethnic and gender identity development. By understanding the ideologies of these students, we are able to better comprehend the world-makings that these students bring with them to the learning process in the sciences. Informed by life history narrative analysis, this study examines Latino/as and their persisting involvement within the science pipeline in higher education and is based on qualitative observations and interviews of student perspectives on the importance of the college science experience on their ethnic identity and gender identity. The findings in this study show the multiple interrelationships from both Latino male and Latina female narratives,

separate and intersecting, to reveal the complexities of the Latino/a group experience in college science. By understanding from a student perspective how the science pipeline affects one's cultural, ethnic, or gender identity, we can create a thought-provoking discussion on why and how underrepresented student populations persist in the science pipeline in higher education. The conditions created in the science pipeline and how they affect Latino/a undergraduate pathways may further be used to understand and improve the quality of the undergraduate learning experience.

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CHAPTER 1: INTRODUCTION

1.1 Background

Individuals in our society holding a functionalist-like perspective believe that inequality is an integral part of the functioning of society, such as in positions of economics and divisions of labor (Durkheim & Coser 1997). Because skills cannot be uniformly distributed within a population, meritocracy enables individuals to become motivated to enhance their economic position and social status in society. Such a system of stratification has enough inequality to encourage success, but not enough to cause personal hardship or social disruption. Comparably, the education system serves not only to socialize individuals, but also selects individuals to be placed in the levels of the educational system based on ability - meaning opportunities exist for students to achieve mobility through educational merit. Yet, statistics on minority populations in this country do not support this perspective (Santa Ana 2002). Particularly, Latino/as, who are the largest minority population in the United States and projected to occupy more than half (52 percent) of resident college age people with all other minorities by the year 2050, face educational challenges that will have drastic economic effects on our society as a whole if we do not face the reality of what is currently happening (USDOE-NCES 2003). What is currently happening?

First, we must ask the question of where is it happening? Within science, educational opportunities for Latino/as continue to present challenges from K-12 education up through post-secondary/higher education and the corresponding workforce. For example, in 1998 looking across grades 4, 8 and 12, Latino/as showed decline through time in agreement with the statements, “I like science” and “I am good at

science” (USDOE, NCES 2003). Most recent data (USDOE, NAEP 2005) shows that these same preferences for Latino/a students in science decline over time from elementary to middle school yet increase slightly in high school. In 2005, the U.S. Department of Education found that 25 percent of Latino/a high school graduates reported biology as the highest level science course they had taken, and 37, 20, and 14 percent completed up to chemistry, physics, and advanced placement biology, respectively (USDOE, NAEP 2005). Yet, while K-12 levels are undoubtedly important levels for science access and acquisition of scientific knowledge, undergraduate enrollment of Latino/as in 2005 comprised 11 percent of all undergraduates in all institutions in the United States, with Latinas comprising less than 1 percent of all undergraduates (U.S. Census Bureau 2008). That same year, Latino/as were awarded 7 percent of all bachelor degrees in the U.S. and 7 percent of all bachelor degrees in science fields, with Latinas being awarded 4.5 percent of all bachelor degrees and 4.3 percent of all bachelor degrees in science fields (NSF 2007). These representations of Latino/as in higher education make up the lowest percentages in comparison to statistics from White, Black, and Asian-American student groups. Educational purpose, learning outcome, and achievement are central to higher education, yet research makes evident the concept that modes of acquisition and levels of achievement drastically differ across ethnicities and genders. Regarding what Solorzano and Yosso (2000) refer to as “The Chicana and Chicano educational pipeline,” these researchers conclude that given the deeply racialized and segregated educational history in the United States despite the differences in how one measures educational outcomes - Chicana and Chicano students do not perform as well as White students. Even more striking is their detailing of how out of

one hundred Chicano/a students, only twenty-four continue on to college with six of these graduating from a 4-year college while the majority remain economically disadvantaged and denied upward mobility. Low Latino/Hispanic numbers in college “is a major concern because researchers expect a college degree to be essential for success in an increasingly competitive world” (Verdugo 2006, p.8). Thus, it is socially responsible to become conscious of the academic and social environments of higher education encountered by Latino/as and to begin questioning how we can better understand the stories of Latino/a undergraduate students within the university science pipeline.

Education at all levels, particularly higher education, is more than cognitive development and achievement, as it encompasses the social and emotional aspects of the individual, as well. Learning is situated in broad socioeconomic and historical contexts and is mediated by local cultural practices and perspectives. In particular, formation of one’s identity is a central component throughout the college experience as learning is facilitated within the multiple contexts and valued practices of everyday life. Influential environmental factors and personal interactions among Latino/a college students may help to form this identity and influence thinking, values, and attitudes. It is with these behaviors, beliefs, and expressions that Latino/a college students form groups or communities that share a common bond and advance student identification. Latino/as are a subculture and community within “minority cultures” on campus with nuances of expression, codes of meaning, and cultural/language differences. Underlying the social relations and cultural practices of Latino/as are rituals, spatial and temporal maps, common sense knowledge, language expressions, mathematical understandings, and

overt cultural behaviors that may or may not allow them to gain access or react socially and culturally when within the science pipeline (Ogbu 1992).

This study attempts to look at students who have developed ways to negotiate cultural, social, and language boundaries between minority ethnic and gender cultures, and the dominant culture of scientific knowledge to succeed academically within the science pipeline. The implications of this research will provide “understanding in order to enhance the success of intervention and other efforts” (Ogbu 1992, p.7) in higher education.

1.2 Statement of the Problem

In March of 2006, the National Educational Association (NEA) and the League of United Latin American Citizens (LULAC) convened an education summit to discuss and provide strategies and recommendations for how stakeholders might improve the educational status of Latino/a students. Their recommendations for researchers were to: examine barriers to “Hispanic education” at all levels; examine gaps in student achievement; examine the “gender gap” in the Hispanic community; and, research school environments that work for Hispanic students, among others (Verdugo 2006). The research regarding the educational inequities experienced by Latino/as and other marginalized groups has traditionally identified both cultural and structural factors that impede educational attainment. These usually focus on socioeconomic status (SES), social and cultural capital, family characteristics, language background, teacher/student interaction, segregation, tracking, school financing, and high-stakes testing. These factors are related to larger issues that this population historically has had to grapple with,

including below-grade enrollment, high attrition rates, and high rates of illiteracy. All of these factors contribute to under-representation in higher education (Valdes 1997).

Student academic achievement in higher education is undoubtedly a complex accomplishment shaped by varying influences and interactive processes. Measures to improve access to higher education are only one part of the picture in understanding the academic “right of passage.” The environments of colleges and universities guide students through learning and serve students as they enter and progress through their academic years. Access rates to higher education vary depending on ethnicity, gender, and previous high school attended for students (CPEC 2007; Fry 2004). While evidence of factors such as geographic accessibility, costs, and cultural attitudes which affect entrance into higher education have been established, there is still much to be explored about the impact of such factors on the persistence of students in specific majors, such as science (Acherman-Chor et al. 2003; Treisman 1992).

It is acknowledged that with regards to Latino/a undergraduate student experience and achievement within the science pipeline, claims can be contradicting and some claims may have more merit than others based on the available research. The results of prior studies have been mixed and contradictory, as evidenced by different explanations for the achievement gap in the science pipeline among different student populations. Reports suggest that precollege experiences are important in supplying the higher education science pipeline, as the quality of science preparation in high school and science achievement at this level are the most consistent and best predictors of interest and persistence in science at postsecondary institutions (Astin & Sax 1996; Davis et al. 1996). Differences that effect these factors among ethnic and gender groups at the

secondary level rely on school related factors such as previous science coursework, grades and standardized test scores, and positive interaction with teachers and co-curricular/extracurricular science programs (Asera & Treisman 1995; Muller et al. 2001). In addition to school related factors, demographic and family background/influences also have been reported to impact science achievement in high school and consequently, postsecondary achievement in the science pipeline. For example, socioeconomic status has been shown to directly affect science achievement, with low SES contributing to lower achievement in students than high SES students (Clewell & Ginorio 2001). Other variables related to science achievement include parental education and social and cultural capital (Oakes et al. 1992).

Importantly, aspects of higher education make direct contributions to student achievement and subject interest in science (Seymour 2001). Curricular and instructional strategies that influence achievement often mirror those examined in pre-secondary education environments. These curricular and instructional strategies include technologies that may enhance courses and student learning experiences and the application of different learning strategies and academic support mechanisms such as student learning communities (Triesman 1992). Additional examples consist of the instructor's knowledge on how a particular subject can be meaningfully taught to students and the way he or she addresses the preconceptions and misconceptions that students bring to learning (Shulman 1986). Curricular and instructional strategies also include the promotion of undergraduate scientific literacy so that students develop knowledge of important scientific facts, concepts, and theories. Scientific literacy also includes an understanding of the nature of science, its connections to mathematics and technology,

and its impact on individuals – all of which help students to understand science’s role in society (NRC 2003). Indeed, the popular research by Seymour and Hewitt (1997) on why undergraduates leave the sciences indicated “poor teaching” as first among 28 other factors ranked by students about their science majors in 6 out of 7 institutions surveyed.

Individual student and instructor attitudes, identities, views/beliefs, and stereotypes have also been examined as factors that may affect undergraduate student achievement in science and mathematics (Bianchini et al. 2000; Chartard et al. 2007; Steele 1997). Aspects of the individual have been noted for the significant role they play in the participation and achievement of women and ethnic minority students in science. These aspects include the identification and construction of self, the intersection of personal identities in educational environments, views on the nature of science (to what extent do stakeholders view the field of science as gendered or raced), and beliefs related to student experiences (Eccles 1994; McGlynn 1998).

One example is Steele’s (1997) description of “stereotype threat” in which females and students of color become uneasy about being negatively judged as a female and/or student of color in advanced quantitative fields. Stereotype threat is “a situational threat – a threat in the air – that, in general form, can affect the members of any group about whom a negative stereotype exists (e.g., skateboarders, older adults, White men, gang members)” (Steele 1997, p.614). Students who belong to groups that are negatively stereotyped are likely to perform poorly in situations in which they feel uneasiness about the presence of the stereotype. Steele also suggests that the most invested students are particularly at risk, also known as the “academic vanguard” of the group (Steele 1997). Examples of these individuals include the female student in an advanced math class or

high achieving Black student in a highly selective college. Steele (1997) identifies stereotype presence as a result of social interaction, context, or even low representation of one's group. The presence of the stereotype is sufficiently distracting to affect one's academic performance, leading the individual to drop out or experience a breakdown in comprehension of subject matter.

Likewise, Seymour and Hewitt (1997) found that when women are able to experience academic success, they experience a diminished sense of competency. Additionally, another study on ethnic minorities found that they are apt to blame themselves when experiencing failure in science (as opposed to White students who have a tendency to blame institutional factors) (Bianchini et al. 2001). Further informing science studies at the institutional level, is the increasingly relevant discussion over same-sex role models and their effect on female students in science. More factors need to be explored because the mere representation of women staff in science does not increase female enrollment (Bordes & Arredondo 2005; Byne 1993).

1.3 Purpose of the Study

It is an accepted notion that scientific study is not solely for those individuals seeking to specialize in it, but for the intellectual growth of all students. Thus, bringing broader understanding to the student perspectives on the experiences and conditions faced by under-represented populations like Latino/a students in the university science classroom is a worthwhile effort. Drawing attention to the additional facets of ethnic and gender identity to the Latino/a higher education science experience explores what it means to be a "science student" and promotes a broader notion on how the science pipeline "educates" students. This becomes exceedingly relevant in terms of the

educational implications associated with current changes in demographics and globalization at both national and global levels.

This study features Latino/a student past and present day experiences through the “science pipeline,” defined as the science subject and/or career stream made by students throughout their educational lives¹. Based on the theoretical perspective of Critical Race Theory and the theory of hegemonic power structures, the purpose of this study is to explore the life stories and individual pathways of 17 Latino/a students in higher education science courses (the science pipeline); explore the educational histories of these Latino/a students in science; investigate attitudes and cultural and gender identity negotiation and transformation of these Latino/a students in higher education science courses; and to illustrate superficial and deeper discourses of the Latino/a experience through education and science. The research question is:

- What are the Latino/a life histories and how have these life histories and students’ higher education experiences within the science pipeline shaped the direction of their study, their attitudes toward science, and their cultural/ethnic and gender identity development and ideologies?

By a student-centered study of the Latino/a perspective, I refer to the student-reported concerns, questions, attitudes, knowledge, and identity forming that may or may not intersect among participants. The narrative analysis of the student life histories will focus on both superficial and deeper discourses, and social and institutional (historical and

¹ Sharon Lynch (2000) in her book, *Equity and Science Education Reform* defines the pipeline as “science courses to separate the scientifically talented from the masses, an initiation rite designed to weed out all but the most persistent and dedicated” (p.10). This definition is based on intellectual commentary to exclusionary status of science discourse.

present) bridges and barriers to better inform the intersection of culture, gender, race, and ethnicity in educational contexts. Specifically, this analysis focuses on the different perspectives of Latino/a students in biological science courses – termed as ‘successful’ or ‘promising’ at navigating the pipeline by maintaining their participation or persistence within the biological science major. The qualitative analysis of interviews will highlight perspectives on how race, gender, culture, and social class shape students' scientific thinking, learning, and various understandings of the world and the nature of science. This analysis also offers insight into the knowledge, beliefs, social relationships, and social identities that Latino/a students express throughout their everyday lives that affect students in either positive or negative ways with regards to their study of science.

1.4 Theoretical Underpinnings for the Study

This research is grounded in a theoretical framework consisting of the critical/emancipatory² paradigm (Guba & Lincoln 1998; Mertens 1998), Critical Race Theory (Delgado & Stefancic 2001; Ladson-Billings & Tate 1995), power structure theory with a focus in education and science (Apple 1990; Gramsci 1971; Harding 1991), gender in education theory (Sadker & Sadker 2002; Thorne 2002), and feminist literature (Anzaldúa 2007; Collins 1991; McRobbie 1991).

1.4.1 The Critical/Emancipatory Paradigm

This study is informed by theorizing within the critical/emancipatory paradigm. This paradigm suggests an individual's reality is shaped by social, political, cultural, economic, ethnic, and gender values (Guba & Lincoln 1998; McLaren 1998). The

² Mertens (1998) uses the term “emancipatory paradigm” as a stance against the word “critical” which is closely linked to Marxist theory.

significance of this lens, from which this research is informed, is described by Ladson-Billings & Tate (1995) and Lather (1991) as “analyzing the ideas about the causes of powerlessness, recognizing systemic oppressive forces, and acting both individually and collectively to change the conditions of our lives” (Lather 1991, p.3-4). Research within the critical paradigm highlights the interrelatedness of individual agency (via the politics of identity) and structural features (such as class, race, and gender). Additionally, the educational system and its structures are interface zones in which the individual and schooling intersect and are “frequent points of struggle between identity and structure in Western society” (Buxton 2005, p.399). This paradigm aids in the understanding of the terms and boundaries of self-negotiated ethnic and gender identity as “the self is always a product of social and cultural structures and norms...” (Ah Nee-Benham 1997, p.64). The critical lens not only explores the notion of understanding the individual as related to cultural, social, and political structures and experiences, but also the examination of historical and “subcultural” layers that may present themselves in an individual’s life history (Ladson-Billings & Tate 1995). This is to suggest that an individual maintains multiple, often contradictory accounts of the self that can be told, a term also called “manifold narrative voices,” which can applicably be used to describe the relationship between an individual and the higher education school structure, as in this study (Tierney 1993).

Guba and Lincoln (1998) describe the critical paradigm as having the following basic assumptions: 1) The critical paradigm acknowledges multiple realities constructed by social, political, cultural, economic, ethnic, gender and disability values. “Thus, what is taken to be real needs to be critically examined via an ideological critique in terms of

its role in perpetuating oppressive social structures and policies” (Mertens 1998, p.20).

2) Knowledge is socially and historically situated, and therefore, there is an understanding that researchers and their participants interact among power lines, and the researcher surrenders her control to that of the researched. The researcher has an additional obligation to examine assumptions behind theories, hypotheses, and relationships between the researcher and the participant. 3) Methods applied within this paradigm emphasize the contextual and historical as it connects to the oppressions of the participant.

Because the critical/emancipatory paradigm explores the influence of the social, political, cultural, ethnic, and gender on the construction of an individual’s reality, critics are distressed by the inclusion of socially situated knowledge into this type of research and the subsequent loss of objectivity. Expressly, by including the political, critics also regard this research as leading away from the exercise to set preconceptions and partiality aside (Mertens 1998). Responses to such criticisms explain a distinct perspective held by critical/emancipatory researchers, described by the feminist critical researcher Fine (1994) in which she states, “This does not mean that we force ‘ideological alignment.’ When we listen closely to each other and our informants, we are surprised, and our intellectual work is transformed. We keep each other honest to forces of difference, divergence, and contradiction” (pp.30-31).

1.4.2 Critical Race Theory

This study is not only informed by theorizing within the critical/emancipatory paradigm, but specifically Critical Race Theory (Delgado & Stefancic 2001; Ladson-Billings & Tate 1995). Critical Race Theory was chosen as part of the theoretical frame

for this research, because it is the theory that best supports an investigation into how race/ethnicity and power is negotiated into American consciousness. By looking at the margins, rather than the center (through the description of populations who traditionally occupy these margins), CRT describes and explains interactive ways in which race and ethnicity is socially constructed. Critical Race Theory emphasizes critical interpretation of accepted patterns or empirical patterns of representation, attainment, and achievement of underrepresented populations in science (Delgado & Stefancic 2001). This framework challenges and exposes the ontological and epistemological biases underlying existing social and institutional structures. It is acknowledged that because of the inception of the Critical Race Theory within legal matters and politics (as well as drawing on the radical feminist movement), the research lens it employs actively questions the neutral foundations of social organization (Delgado & Stefancic 2001).

One of the main tenets of Critical Race Theory is the assumption that racism is present in everyday society. Because of this expansive presence, it becomes difficult attend to less obvious modes of discrimination and inequality in our everyday practices, routines, and institutions (see related section *1.4.3 Power Structure Theories*). Another theme of Critical Race Theory is the concept of “interest convergence” (Ladson-Billings & Tate 1995). “Because racism advances the interests of both white elites (materially) and working class people (psychically), large segments of society have little incentive to eradicate it” (Delgado & Stefancic 2001, p.7). The next main tenet of CRT is “social construction” or the idea that race is socially constructed. Additionally, CRT upholds the concept of “differential racialization.” This is defined as the racialization of different minorities by the dominant society at different times in our history. Delgado and

Stefancic (2001) see differential racialization as a product of society's adaptation to needs to the labor market which in turn shape social stereotypes. Thus, the structural organization of our society and its institutions are organized to reify racist conceptions and understandings (see related section *1.4.3 Power Structures Theories*). Following on this line of thought, CRT also emphasizes that every race has its own history and origins, and therefore, there is no essential definition of a particular race. Relatedly, CRT's last tenet is the concept of "unique voice of color" (Delgado & Stefancic 2001). "Coexisting in somewhat uneasy tension with anti-essentialism, the voice-of-color thesis holds that because of their different histories and experiences with oppression, black, Indian, Asian, Latina/o writers and thinkers may be able to communicate to their white counterparts matters that the white are unlikely to know" (Delgado & Stefancic 2001, p.9).

It is these uneasy tensions that critics of CRT have addressed in their critiques and discussions of the limitations of Critical Race Theory. Critics contend that critical race theorists tend to evade the complications making CRT problematic. These complications include the view that White scholars have lower standing on critical race studies and issues as racial status serves as positive credential for theorizing within CRT.³ Additionally, critics of CRT view the concept of "interest convergence" as an overly bleak assessment of society, as well as challenge critical race theorists with the advancement of minority groups such as Asian and Jewish groups.⁴ Finally, some critics

³ Critical race theorists have responded to this criticism by stating that Critical Race Theory is simply better addressed by minorities (due to this status).

⁴ Critical race theorists have responded to this particular criticism by maintaining that each minority group has different histories and experiences that subject the groups to very different social and economic outcomes.

find CRT's association with narrative research (described below) and "voice" problematic due to the criticisms that narrative research seems anecdotal.

The use of storytelling, counter-storytelling⁵, and narrative is a principal concept within Critical Race Theory. Narrative is regarded as a useful tool in advancing the validity of minority groups within society as they serve as a bridge of understanding between different groups (Delgado & Stefancic 2001). Storytelling and narrative also allow minority individuals to name their reality. "The hope is that well-told stories describing the reality of black and brown lives can help readers bridge the gap between their worlds and those of others. Engaging stories can help us understand what life is like for others, and invite the reader into a new and unfamiliar world" (Delgado & Stefancic 2001, p.41). In this study, I use CRT as a lens to conduct a narrative analysis and to re-tell 17 Latino/a students' life histories as a way to illuminate student perspectives of this traditionally underrepresented population in science (see Chapter 3: Methodology).

Critical Race Theory serves as the foundation for this study, thus permitting an interpretation that structurally imbedded systems of inequality reinforce themselves in the manifestation of ethnic and gender identities. Drawing on this theory, I consider that these systems act as informants to student mean-making and internalization of their individual and group identities. "Critical Race Theory in education challenges the traditional claims of the educational system and its institutions to objectivity, meritocracy, color and gender blindness, race and gender neutrality, and equal opportunity" (Solorzano 1998, p.122). Critical Race Theory brings meaning to the

⁵ Counter-storytelling, specifically, is the storytelling of marginalized individuals as way to challenge and displace "embedded preconceptions that marginalize others or conceal their humanity" (Delgado & Stefancic 2001, p.42).

concept Latino/as are influenced by complex social, economic, historical and cultural factors, and maintain ideologies that underlie their social relations and cultural practices. A deeper understanding of how Latino/as gain access or react socially and culturally when within the larger culture of science can be achieved through this lens.

1.4.3 Power Structure Theories

Underpinning the Critical Race theorists' position on power and knowledge, is the notion of hegemony. Gramsci (1971) first defined hegemony as the dominant social, cultural, economic, and intellectual ideologies through which social structures and processes are created by society's dominant group(s) in its exertion of power over the subordinate group(s). Understanding hegemony allows researchers to be better equipped to understand how institutional and social structures of inequality contribute to social and individual meanings (Apple 2003). Perhaps the most important concept of hegemony is that it is "hegemonic power is constantly having to be built and rebuilt; it is contested and negotiated (Apple 2003, p.6). Thus, society's dominant and subordinate groups are in constant negotiation of power and creating new dynamic relations within society.

The production of knowledge is one way in which this negotiation of power is distributed across groups, determining who produces knowledge, organizes it, teaches it, evaluates it, and researches it (Apple 1990). Foucault (1977) states, "we should admit rather that power produces knowledge (an not simply by encouraging it because it serves power or by applying it because it is useful); that power and knowledge directly imply one another; that there is no power relation without the correlative constitution of a field of knowledge, nor any knowledge that does not presuppose and constitute at the same time power relations" (p.27). Thus, education and educational institutions are responsible

for the way knowledge is made available and the way it is circulated and distributed (Apple 1990).

Foucault's (1977) work on power structure and sub-institutional power contexts describes how knowledge is protected by communal boundaries; that is, by the regulation of who can engage in reifying this knowledge, and the recognition of participants within larger cultural and historically organized social and political worlds. Foucault (1977) goes on to describe the “regimes of truth” as the ideologies and actions of dominance that make up the power/structure of modern society. Relatedly, the hegemony and resulting structure of the education and science pipelines create socially evolved mechanisms of inequality and stratification of race, class, and gender through the offering of unequal rewards, rewards of income, power, honor, or prestige (Harding 1991). Within these pipelines, the existence of the power elite and the powerless – power being defined in multiple ways such as power of knowledge, power of politic, etc. – often allows for subcultures privy to this power to benefit from this power through the social structures of a society. This uneven systemic distribution of privileges, status, and rewards, influences all systems (from the educational to the economic).

Insofar as a particular status group controls education, it may use it to foster control within work organizations. Educational requirements for employment can serve both to select new members for elite positions who share the elite culture and, at a lower level of education, to hire lower and middle employees who have acquired a general respect for these elite values and styles. (Collins 1971, p.11)

Thus, functions of education represent powerful subcultures or groups pursuing their own interests (Harding 1991).

These relations between power and knowledge, as described by Apple (1990), Harding (1991), and Collins (1971), does not exclude the higher education science pipeline or the often described *autonomous* science pipeline, a place and field where often the view of dissemination and transmission of knowledge is thought to be equal. Science as a field has its own rules, decisions, limits, inner logic, and parameters. And, science's discourse is that which include the "rules" that govern the formation and transformation of ideas within this field, and arguably, beyond. The field of science is aligned with certain exchanges and transmissions of knowledge that may be exclusionary to certain populations because the bureaucracies of power (those who are dominant and those who are subordinate) are organized and distributed through scientific epistemology, ideology, and ontology – that which is the nature of science (Collins 2000). Applicably, educational discourses like science, are often seen as delegitimizing to the life experience and foundations of knowledge maintained by racial, ethnic, language, and gender minorities (Lather 1991; Seymour 1995; Seymour & Hewitt 1997; Steele 1997). Namenwirth (1986) suggests that "scientists believe that as long as they are not *conscious* of any bias or political agenda, they are neutral and objective, when in fact they are only unconscious" (p.29). However, utilizing power structure theories with CRT, this work can ultimately produce emancipatory knowledge, empowering the researched, "critiquing the status quo and building a more just society" (Ladson-Billings & Tate 1995; Lather 1986, p.258; Ogbu 1981; 1992).

1.4.4 Gender in Education Theory

The tenets of this study are focused not only on ethnic and cultural forms of identity for Latino/as, but also on the implications of gender identity as well; such as,

how do different genders live in the ideology of science on a day to day basis? When exploring the histories of Latino/a students in the higher education science pipeline and education pipeline in general, gender-in-schools theory helps in making sense of the experiences of students as related to learning and the classroom. Participating in a widely contested debate, some approaches contend that gender differences are socially constructed (Pollack 2002), while others contend that they are biologically constructed (Gurian 2002). While some may seem to draw upon a “deficit” based perspective, these distinctions found in the research provide illumination into the nuances of gender identity development theory and are useful in understanding gender identity development in higher education. Researchers who believe gender identity is socially constructed acknowledge that biological factors do exist that contribute to certain behavior patterns, but warn about the negative assumptions that accompany the biologically constructed identity theory. Research based on these assumptions disseminates the idea that people (e.g., teachers) are unable to affect personality, behavior, and emotional development of a person or student (Pollack 2002). For example, male development is often affected by society’s perception of what is the “norm,” also called the “Boy Code” (Pollack 2002). This often causes persons to act in ways that are usually permitted by their social environment. On the other hand, researchers who believe gender identity is biologically constructed reason that aspects of the nature of gender should be generalized and social influences put into perspective (Gurian 2002). Consequently, by shifting the dialogue to biologically constructed identity, further research is allowed to focus on perspectives that guide and structure this identity. For example, assumptions that biological properties such as increased testosterone and the increased use of the right hemisphere in the brain

in males cause males to be more aggressive, competitive, and have better spatial and abstraction skills than the average female, can be used to inform curricular decisions in schools, such as encouraging learning through visual stories, games, and/or objects that move through space (Gurian 2002). Regardless of the perspective that one takes, it must be recognized that research findings can often marginalize the opposing “other” and create a binary argument of males versus females - as other studies have found that within-gender variation is indeed greater than differences between male and female groups. In fact, gendered interactions vary by activity and context, which when carefully analyzed, examine social relations and “develop concepts that will help us grasp the diversity, overlap, contradictions, and ambiguities in the larger cultural fields in which gender relations, and the dynamics of power, are constructed” (Thorne 2002, p.143).

1.4.5 Feminist Literature and Theory

The feminist literature brings meaning to theories that Latinas negotiate their femininities (constructions of female identity) at institutions of higher education and the higher education science pipeline (Luke & Gore 1992; St. Pierre & Pillow 2000). Particularly, feminist theory is utilized to view the multiplicity of positions that racialized minority women face, as they “experience, ahead of the general population, many of the multiple struggles that subsequently become popularly expressed” (Anzaldúa 2007; Davis 1994, p.54). Within science, some feminist scholars see science as a male-dominated mechanism in which access, standards, and criteria for successful performance are pre-prescribed with masculinist orientations (Eisenhart & Finkel 1998; Harding 1991). From this perspective, science is not gender-neutral but gender-biased with masculine assumptions, and is laden with explicit and implicit experiences in which

women are disadvantaged (ie. lower pay, sexist classrooms, workplace ethic, and less academic power). Consequently, minority women use alternative pathways to create individual self-definitions and self-valuations which ultimately form unique perspectives that produce and validate knowledge. For example, women in self-described “gender-neutral” environments still have to work and adapt to the cultural forms of male professionals (Eisenhart & Finkel 1998). In fact, women are in many instances successful and attracted to science careers in which they work with scientists *and* non-scientists, with a civic-minded purpose, and with public exposure and value (Eisenhart & Finkel 1998). In addition to informing the theoretical framework upon which this research study is based, feminist theory also frames the methodological theory and framework (which is elaborated in the methodology section of Chapter 3) – as it suggests that female researchers also locate their own stories, experiences, and narratives in the questions that we ask our research participants, so that we not only “*feel* with the women we are studying,” but also interrupt the spaces between researcher and participant (McRobbie 1991,p.70; Villenas 1996).

1.5 Methodological Implications

This study examines Latino/as and their persistence in the science pipeline in higher education based upon student perspectives of the college science experience on their ethnic identity and gender identity. These perspectives will be told through collected life histories of these Latino/a undergraduate students to aid in better understanding how race, culture, and social class shape these students' thinking, learning, and various understandings of the world; the negotiations of self that affect students in either positive or negative ways; and the language of knowledge in science (Foucault

1977; Lather 1991; Ogbu 1992). Informed by life narrative analysis and inquiry, this research makes use of the idea that there are multiple interrelationships found from the underlying discourses that emerge from the narratives. These relationships not only provide context and reveal the complexities of group experience, but also create a dialectic between theory and practice through the exploration of the experiences and educational trajectories of these traditionally underrepresented students within science (Roman 1993).

The reasoning behind using this qualitative data analysis methodology for this study is that a good deal of the science education literature on student diversity and science achievement tends to categorize outcomes as discreet and unproblematic – a necessary condition for managing large data sets, however, not sufficient when the personal circumstances cross and confound the limits of such categories (Lee & Luykx 2007). Particularly, with the increasing diversity of student populations, the concept of personal circumstance will only continue to increase and obscure categorical outcomes of data which have traditionally been thought to be distinctly unyielding and rigidly defined. However, there are limitations to any qualitative design, specifically the level of subjectivity which affects the reliability, and the external and internal validity of the study. These are addressed by using different criteria and strategies for enhancing the quality of the research. In qualitative methodologies, the issue of internal validity is named credibility (Guba & Lincoln 1998). Credibility is advanced by prolonged, substantial engagement between the researcher and research participant; persistent observation; peer debriefing; negative case analysis (cases that do not fit); progressive subjectivity (self-monitoring of change in researcher conceptual constructions); member

checks; and, triangulation (checking information for convergence or nonconvergence from different sources of data (ie. interviews, observations, document review) (Mertens 1998). “A researcher should seek to use as many of these strategies as possible, because the goal is to provide evidence from a multiplicity of sources of the credibility of the research” (Mertens 1998, p.181). The notion of external validity or transferability is addressed through the usage of “extensive and careful description of the time, place, context, and culture” or thick description, and the use of multiple cases (Mertens 1998, p.183). Finally, reliability is achieved by means of researcher documentation of the research process and emerging patterns in the data that may change the focus of the research. In Chapter 3, I have addressed the particular validity issues as they relate to this research in a section titled “trustworthiness.”

What distinguishes life history and narrative analysis from other types of qualitative research is the relationship between one’s life events to social events within a defined time, place, and social culture (Hatch & Wisniewski 1995). Life history and narrative connect “the lives and stories of individuals to the understanding of larger human and social phenomena” (Hatch & Wisniewski 1995, p.113). One of the assumptions of life history and narrative analysis includes the focus on the individual through the understanding of his or her life and stories, and the central moments or critical incidents located in the narrative. Another assumption is the distinctly close and personal nature of the research process in which the researcher and research participant are involved in close relation, contact, and disclosure – often creating a greater sense of meaning for both sides. Other assumptions within life history and narrative analysis is the concept of subjectivity and its role in creating theoretical understanding from practice

and lived experience. It is through the voice of the individual that we are able to understand and make meaningful different concepts to others (Hatch & Wisniewski 1995).

Because life history researchers interact socially and personally with the research participants, the researcher becomes a part of (and active player) in the participant's world. This involvement then depends on such ethical considerations as the relationship between the researcher and the research participant and the issue of voice within the research. The personal nature of this type of analysis typically establishes an unequal relationship of power between the researcher and the research participant, with the researcher often occupying the role with most power. This then creates an environment where the research participant may not feel comfortable exposing oneself – then reflected in the narrative and subsequently, the researcher's access to the “unsaid” narrative of the participant. Researchers employing narrative analysis must always retain the notion that “people are at once products and makers of the social and cultural systems which they are lodged. He or she must also make an honest effort, at least after the materials have been collected, to address the issue of how the informant and the fieldworker were interacting, why they were drawn together, what developing concerns for (or against) each other influenced the rhythm and nature of the enterprise” (Mintz 1979, p.24). Accordingly, questions of ownership arise: “Whose story is it? What is the relationship of the researcher's story to the story told in the final text?...Whose voice is privileged? Who chooses the story to tell?” (Hatch & Wisniewski 1995, p.127).

Such issues are attended to by positionality, attention to voice, critical reflexivity, and reciprocity (Mertens 1998). The ability of the researcher to actively participate in

self-reflexivity calls for the gazing of what it is that we call scholarly practice and to question what we contribute to dominance despite our liberatory intentions (Lather 1991). When attempting to define the methodologies, terms, and validities of the life history and narrative, one must draw attention to the issues of voice and reflexivity by asking: “what is shared and why?; what do the silences tell us?; what are the authorizing assumptions, ways of knowing, and essentialist representations of others embedded within the life history approach? And how will I deal with them?” (Cary 1999). Life history and narrative researchers need to contextualize the stories and have increased awareness of multiple selves in multiple locations/times; addressing reciprocity through the constant testing of researcher-derived meanings against those of others, building consensus through including as many voices as possible, and clearly defining the position of the researcher and the interviewee as the researched, no longer claiming “universal truth or neutral translation of reality. This provides a very useful point of departure for a more situated life history as bounded to the issues of meaning, history, and power” (Cary 1999, p.416). In this particular case of looking at Latino/a college students, the positionality or authoritative text and voice of the researcher, as well as the ethnic, cultural, and gender similarities that may exist between the participant and researcher, must be acknowledged (Mertens 1998; Villenas 1996). Villenas (2000) suggests that “native ethnographers” make sense of their research through the inclusion of their own experiences, journeys, and struggles:

The ‘minority’ researcher finds herself caught within and against the colonizing nature of ethnographic research. Racialized identities are often manipulated vis-à-vis majority culture in the research field and classroom, and the woman-of-color researcher herself remain embedded in and

even reinforce the ‘colonizer/colonized’ opposition structure by traditional ethnography. (p.76).

Thus, it is with the problematizing of the similarities and inequalities of power structure between researcher and participant that researchers can simultaneously create opportunities to present additional perspectives.

1.6 Positionality

My various life stories and geographies have contributed to the conceptual framework of this research, my research questions, and approaches. Who am I? How does who I am affect my work? How do I define my work? How does my background help/hinder my relationships with my participants? Whose standards and meanings do I use in my research? To better understand these questions, I start with an autobiographical account. Autobiographical accounts within life history and narrative research, “teaches the reader or listener how to read, how to see or hear; it does not show things as literal truths, but calls upon the reader to engage in the process of meaning-making and interpretation” (Thompson 1998, p.538). My “narrative beginnings” (Clandinin et al. 2007) are based on the perspective of a former undergraduate science major, female, and Latina – which all attend to the justifications that this research hopes to change the way students and professors view underrepresented populations in university-level science, how programs are implemented, and for a greater understanding of how cultural, social, and institutional narratives (in which we are all embedded) shape identities.

In addition to providing a lens into the cultural and gendered ways of knowing of the researcher, it adds a level of “quality” of qualitative research as described by Mertens (1998) because as Patricia Hill Collins (1991) writes, “those individuals who have lived

through the experiences about which they claim to be experts are more believable and credible than those who have merely read or thought about such experiences” (p.209). Specific to this research that I have conducted as a Latina female in science, I have attempted to write accounts of individual experiences in a meaningful way and retain sensitivity to the importance of not essentializing their experiences under the notion of Latino/a identity and science education – making them into “flat” characters (Collins 1991).

When identifying myself, I have always stated that I am “Mexican,” as do most people from communities who see a very trivial line between that which is “Mexican” and that which is “Mexican-American.” I have always done so because the Mexican culture has always been a part of who I am and a culture that I have always owned. Like many Latino/as, I was raised in cities known for their minority populations – East Los Angeles, California, and El Paso, Texas, to be exact⁶. My parents were divorced when I was young, and so my older brother and I spent most of our weekdays living with my mom in a modest house next door to my maternal grandparents who predominantly spoke Spanish but would speak English to my brother and me. As such, I am fluent in speaking, writing, and reading Spanish but not because I have learned it in my home life, but instead through studying in Spanish classes from high school and college. Like many Latino/as, without trying to qualify all of us, family is the source of one’s development and values, and much of this family was comprised of my maternal and paternal grandparents throughout my life. I learned much about what it means to be a Latino/a

⁶ I attended school until the end of 4th grade in Los Angeles when my mother decided to move with my grandparents, my brother, and I to El Paso where I attended school until I completed my high school education.

from them – humility, comfort, assertion, pride. Throughout my life, they have modeled the concept of hard work, determination and perseverance in life. And so, while I am a person of color, Mexican-American born of 2nd generation⁷ Mexican-American parents, there exists another facet that lays claim to the conceptualization of my Latina identity – the color of my skin. The hue of my skin is akin to many Whites or Caucasians and because of that, I often find both ease and difficulty in assuming different roles I have encountered in life. Instead of being “different” to other ethnic groups, I am “different” to my own and it has been a constant struggle for me to come to terms with unspoken privileges that have been and continue to be awarded to me⁸. It is this difference, of my being Mexican, *invisibly* Mexican, that has affected my life, research, and teaching.

My research positionality is also derived from my experience of various successes and failures within the educational system. Specifically, as an undergraduate I enrolled as a Human Biology major having always been interested in and having excelled at science in my previous schooling. And while, overall, I excelled at most of my classes as an undergraduate, it was a shaky initiation into what it meant to be a freshman science major in college. Specifically, my introduction to college chemistry as a freshman science major left me deflated in my self-esteem, motivation, and sense of ability as a student. And while it is a harsh reality for many undergraduates in science, the experience still remains vividly etched in my memory. Ultimately, when I decided to

⁷ Here the term “second generation” refers either to a person who is U.S.-born and has at least one immigrant parent, or an immigrant who has received most of their education in the United States. As related to my personal history, this means my maternal grandmother was born in Juarez, Mexico, while my maternal grandfather was born in Jerome, Arizona. Likewise, my paternal grandmother was born in El Paso, Texas, while my paternal grandfather was born in Juarez, Mexico.

⁸ This personal realization has only occurred to me recently (within the last 6 years of my life that define my graduate education career).

pursue a graduate career in science education, this career decision was informed by my previous experiences in the science pipeline as well as having cultivated an interest in learning more about how to encourage students in the sciences.

With the understanding that everyone's realities have an influence on their life trajectories, personalities, and desires, I am able to capture the meanings of my place as a Latina female in science and hope to intuitively be able to bring different knowledge to research among members of my own community that is meaningful, insightful and informative (Anzaldua 2007). "Few Euro-America researchers, regardless of their research viewpoints, concepts, and theories, will ever be able to capture a similar insight with multifaceted meanings that come from an insider's intimate relationship to historic and contemporary individual and collective experiences" (Willis 2001, p.57). Conversely, it should be noted that an additional view exists which describes how researchers of color cannot research our own groups because we cannot and are not completely objective (Foster 1994; Stanfield 1994). It is important as a researcher to acknowledge that my personal history may bring about intersubjective understandings or engender blind spots. At the same time, "one cannot unproblematically assume commonality on the basis of class, culture, gender, or any other socio-historico-political dimensions" (Henry 2001, p.64). This research position is not meant to discount the research and work of others who do not share the same culture as their participants. As Walker (1983) explains, "the truth about any subject only comes when all the sides of the story are put together and these different meanings make one new one" (p.49).

1.7 Limitations

Qualitative approaches to social science inquiry and research are limited by particular factors. While quantitative approaches use standardized measures which make possible comparisons and statistical aggregation, qualitative approaches seek depth and detailed description. Thus, quantitative approaches to research allow for broad “generalizable” findings and qualitative approaches allow for understandings of cases and situations which inherently reduce the ability to generalize (Patton 1990). In *Scientific Research in Education* (2002), the National Research Council contended that within qualitative research of life stories, the devil lies within the details. Because independent replication of narrative inquiry is always absent, the principles of generalization and validity take on different meanings from what the authors see as “scientific inquiry”⁹. “In qualitative inquiry the researcher is the instrument” (Patton 1990, p.14). A researcher’s positionality enters into the research and analysis at all times and contributes to the loss of objectivity in this type of analysis.

Ultimately, the National Research Council (2002) concluded that narrative research and “scientific inquiry” do have “some traits in common” (p.77). These traits may be the use of a theoretical framework grounded in social science or research that uses different “form[s] of empiricism (e.g., interview)” (NRC 2002, p.76). Nevertheless, qualitative approaches to social phenomena are regarded as out of the immediate control of the researcher, making findings “always probabilistic” and “tentative” (NRC 2002, p.83). Consequently, I have attended, to the best of my ability, to the methodological

⁹ As commented in a previous section titled *1.5 Methodological Implications*, “validity” in qualitative approaches depends highly on the expertise, skill, consistency, and competence of the researcher (Guba and Lincoln 1998; Patton 1990).

criteria promoted by qualitative and narrative analysis research (see Chapter 3), while simultaneously acknowledging the limitations of this research.

1.8 Significance of the Study

The invitation that science literacy can be achieved by all leads us to opportunities where all students learn a fundamental and critical understanding of science and how the world works in a culture that is increasingly shaped by science and technology; and, where our national and global economies grow and prosper through a more educated citizenry and workforce, populated by citizens capable of analytical thought and technical expertise. Science literacy for all not only reflects the economic issues that our national and global societies face, but also social justice and the “obligation to prepare all students to participate in a postindustrial society with an equal chance at attaining the accompanying social goods – rights, liberties, and access to power” (Lynch 2000, p.16).

In the exploration of how science can be more understandable and accessible, research on equity in science is changing the way we see science as educating our students (Garcia & Baquedano-Lopez 2007; Lynch 2000). The outcomes of this research will provide further understanding to one of the most significant issues of colleges and universities regarding traditionally underrepresented populations, specifically Latino/as. These understandings may be used to extend the body of literature on ethnic and gender identity and the ways they intersect with developing college students in higher education and science. The outcomes will provide ways to build knowledge on how to better educate students in the science pipeline and inform solutions of student representation that have traditionally plagued Latino/a students in this pipeline over time. By understanding from a student perspective how the science pipeline affects one’s cultural,

ethnic, or gender identity, we can create a thought-provoking discussion on why and how underrepresented student populations persist in the science pipeline in higher education. Indeed, understanding the Latino/a student ethnic and gender issues that play a role in their achievement through the science pipeline allows higher education institutions to better serve their student body, the surrounding community, and workforce with which these students will eventually take part.

Quality education at the post-secondary/higher education level encompasses the obligation to prepare students for participation in a diverse society. By acknowledging that diversity is central to high quality, student-centered learning experiences on the whole and in science, we can move forward in focusing and improving research to incorporate these issues to help institutions improve their practice. At the post secondary level, diversity has the power to provide educational leaders with an important and vital resource for improving instruction. For science, an increasingly diverse student population helps to enable students to learn more effectively and master a sense of belonging on campuses. While it sounds imperative for the incorporation of diversity in higher education institutions, in many instances a system to effectively incorporate underrepresented student populations is still lacking, and college student bodies lack diverse science communities. We should remember that the obstacles faced by the science sub-community of Latino/as are obstacles that many minority and underrepresented student populations face throughout their college experience. It is the challenge of higher educational institutions to adapt environments and institutional structures to better include students in majors from which they have been traditionally underrepresented like

science and make the college experience an exciting and challenging endeavor; not an impossible one.

1.9 Definition of Key Terms

Discourse: Hidden and overt politics, worldviews, interpretations, and belief systems that govern the way knowledge is created in society – which directs the way a topic is talked about and the meaning it is ascribed (Foucault 1977).

Ethnic identity: A person's attitudes and self-concept in relation to their ethnic group membership. The identity is developed by conceptual and emotional influences from parents, family members, school, cultural gatherings, etc. As a social construct, it is therefore influenced by different contexts – cultural, institutional, and structural features encountered by the individual.

Ethnicity: Characteristics of an individual which may include cultural traits, customs, arts, common national origins, ancestry, religion, and language that connects and is shared by a group of people. Ethnicity is a negotiation between a shared past and culture and the culture with which one identifies him/herself.

Gender Identity: A person's attitudes and self-concept and “acting” out in relation to their gender group membership. This category is based on Butler's (1990) discussion of gender roles that is a non-static response and performance shaped by both internal and

external forces. It is a way of understanding oneself based on one's engagement and reflection upon his or her social world.

Hegemony: The dominant social, cultural, economic, and intellectual ideologies through which social structures and processes are created by society's dominant group(s) in its exertion of power over the subordinate group(s) (Foucault 1977; Gramsci 1971).

Latino/a (also commonly referred to as Hispanic): Mainly referring to persons whose origins are from Spanish-speaking countries in Latin America. Latino/as include a broad range of countries in the Central and South America diasporas – Mexico, Colombia, Peru, Ecuador, Chile, Argentina, El Salvador, Guatemala, and any other Spanish-speaking countries in Central and South America and the Caribbean. Latinos are people of Hispanic origin who identify themselves as Mexican, Puerto Rican, Cuban, or Other Spanish/Hispanic. This category can refer to ancestry, nationality group, lineage, or country of birth of the person, person's parents or ancestors before their arrival into the United States.

Minority: This term is derived from common social science vernacular and is not used as a numerical reference, but rather to social prestige, institutional privilege, and normative power. In this category, groups may be ethnic, linguistic, or cultural minorities whose current or ancestral language(s) and culture(s) are distinct from that of the majority.

Social Identity: Based on Tajfel's (1981) theory, this identity encompasses both ethnic and gender identity. Social identity is "that part of an individual's self-concept which derives from his knowledge of his membership of a social group (or groups) together with the value and emotional significance attached to that membership" (p.255).

Socioeconomic Status (SES): The characteristic of an individual or family based on economic and social standing. This characteristic is determined by parent education level, parental occupation, and family income (USDOE, NCES 2007).

CHAPTER 2: LITERATURE REVIEW

Educational Worldmaking: Context, Structure, and Identities

In understanding the educational pathways of Latino/a individuals, it is important to explore the relevant contexts that these students experience. An individual participates in different contexts as he or she forms worldviews throughout his or her life. In this study, Latino/a undergraduate students in the higher education science pipeline have experienced worldmakings from previous science-related experiences, previous education and schooling, and social and economic circumstances. Thus, by context I mean not only the physical environment but the social one as well. Theorists, Alessandro Duranti and Charles Goodwin (1992) posit that context encompasses:

the world within which he or she finds him- or herself embedded...[and] the indigenous activities that participants use to constitute the culturally and historically organized social worlds that they inhabit...Participants are situated with[in] multiple contexts which are capable of rapid and dynamic change as the events they are engaged in unfold.
(p.5)

Importantly, an understanding of the historical and present day contextual experiences of Latino/as in the educational pipeline is necessary to fully comprehend the worldmakings that many Latino/as bring with them to higher education and the science pipeline. And so, the participants in this study have both analogous and disparate contextual experiences. These Latino/a students must not be classified as one ethnic group identical to each other, a simplistic understanding of race/ethnicity. This study is an understanding of the intersections between these students' ethnicities and genders arriving at the same location within the science pipeline – as biological science majors completing their degrees. As an exploration of the gender and ethnic contextualizations, this chapter will

focus on findings reported by the growing literature on Latino/a student experiences, identities, and ideological formations on ethnicity, gender, and in science.

2.1 Within the Context of Science

The scientific foundations of knowing, learning, and instruction are widely acknowledged to include the varying modes of knowledge. Teacher knowledge and student knowledge are not solely influenced by how people learn through a cognitive science lens, but also from the curriculum they learn, the context of authority, power, and politic within which they learn, and the attitudes of individuals that facilitate learning (Clandinin & Connelly 1992; Confrey 1999; Loucks-Horsely et al. 1998). Similar to the social development theory of Vygotsky (1978) and the situated learning theory of Lave (Wenger 1998), this ideology reasons with a larger ecological perspective that knowledge acquisition occurs as a result of one's environment or background, within a social, cultural, and institutional environment (Lemke 2001; Rodriguez 1998). In educational research, meaning is derived by what we learn from our social environment, culture, and institutional environment, and creates a context for newer learning. Our social environment encompasses our friends and acquaintances, while culture is defined by cultural norms, taboos, and knowledge imparted from cultural hierarchical figures. The institutional environment includes the cultures encountered at school (micro-level) and socioeconomic structures (macro-level). Consequently, the relationship between teacher knowledge and student outcomes is much more complex than the cognitive aspects of learning, and incorporates the larger social, symbolic, and political context within both teachers and students exist.

Many students may be aware that their worldmakings (or worldview) are far removed from that of the classroom, instructor, or student-peers (Lynch 2000). An individual's worldview is the basic organization of one's thinking that influences one's norms and values, is the basis for his or her rational thought, and has a bearing on one's situated experiences. "In education, differences in students' worldviews may be called on to explain variations in science education achievement, participation, and motivation among diverse ethnic groups, social classes, and genders..." (Lynch 2000, p.68). Science as we know it today should be realized as being more compatible with certain worldviews than with others. It is a study with historical, sociological, political, and cultural constructs (Kuhn 1970).

2.2 Gendered Educational Worldmakings

Parent and school-related gender-role stereotypes take form in emotional reactions to a child's performance or play and the regulation of activities and toys of children. Through the emphasis on certain valued skills (e.g., learning and understanding specific school subjects), parents and schools influence children's "confidence in their abilities, interests in mastering various skills, and, affective reactions to participating in various activities" (Lynch 2000, p.252-253). It is suggested that these varying familial inscriptions contribute to the interest and motivation of individuals in science (Eccles 1994; Lynch 2000).

As part of the educational experience, beginning with primary school, males are regarded to be developmentally disadvantaged in comparison to females (Kindlon & Thompson 2002). This is thought to be a result of the predominantly feminine environment populated largely by women faculty and authoritative figures, as well as

biological influences that are manifested in males and often misinterpreted and mismanaged by teachers throughout this developmental stage. Male experience in this environment is mainly shaped by “the quality of his relationship with teachers” (Kindlon & Thompson 2002, p.168). Often, males are given negative attention which monopolizes teacher attention, teacher questioning the students, how the room is arranged, and where students sit. This causes gender bias to exist in the form of less quantity and quality of teacher engagement with females, different texts and material for males than females, separate curriculum, and teacher views of females as having lesser status (Sadker & Sadker 2002).

Many female students see teachers asking different kinds of questions directed to males versus females, providing a different quality of feedback or none at all to females, and having unresponsive formal rapport with females (Brown 2002). School texts and materials that portray male and female roles compound teacher behavior, as males are cast in more central, active, and various roles than females, often called “lessons of female invisibility” (Sadker & Sadker 2002). Schools create second-rate conditions for female students: as texts shape not only students’ knowledge but also their ideas, beliefs and behaviors; as female students become increasingly silent to point of doubting value of what they have to say; as males are the notables or norms of society and close off female developing ideas of self; and, as female students are subjected to a biased view of the world and themselves (Brown 2002). Females, aware of male power and privilege, possess knowledge of their class status and “feel unrecognized in their classrooms” which causes them to resist the norms of femininity valued in school and society, or embody “White middle-class femininity in ways that ensure their acceptability and yet blend them

into the amorphous backdrop of ‘nice girls,’ existing just out of their teachers’ conscious awareness” (Brown 2002, p.215).

Researchers report that many females struggle with the drastically gendered environments they encounter in schools which ultimately lead to the development of visible and invisible personas. Understanding gendered environments is important, when they affect “emotional expressiveness [which] relates positively to some measures of well-being, whereas ambivalence about such expression relates to several indexes of psychological distress” (Brown 2002, p.223). Additionally, Thorne and Michaelieu’s (1996) research suggests that self esteem in and out of school for males and females is localized in their relationships with peers. High self esteem in males is often attributed to individuation and getting ahead of others, while high esteem in females is attributed to successful relational connections with others (Thorne & Michaelieu 1996). It is notable that both males and females are subject to certain education-dismissive environments that may affect student self esteem, self-perceived competence, behavior, class participation, achievement, and academic success which many times are compounded by race and ethnicity, as well (Ladson-Billings 1995).

2.3 Ethnic-racial Educational Worldmakings

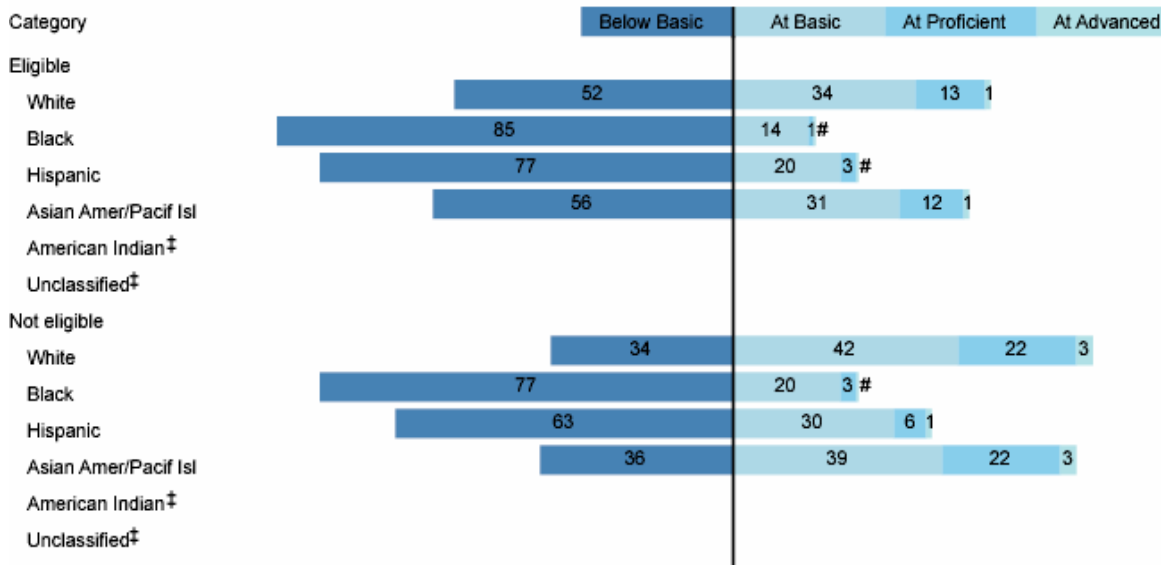
In a review of United States children under the age of 18 living in poverty, Sharon Lynch (2000) cites National Science Foundation data in which Black Americans have the highest percentage of children living in poverty, followed by Native Americans and then Latino/as. Thus, an interesting phenomenon has taken place in the United States that has had a profound impact on public schools. According to Orfield & Lee (2005),

U.S. schools are now 41 percent nonwhite and the great majority of the nonwhite students attend schools which

now show substantial segregation. Levels of segregation for Black and Latino students have been steadily increasing since the 1980s...Achievement scores are strongly linked to school racial composition and so is the presence of highly qualified and experienced teachers. The nation's shockingly high dropout problem is squarely concentrated in heavily minority high schools in big cities. The high level of poverty among children, together with many housing policies and practices that excludes poor people from most communities, mean that students in inner city schools face isolation...[as] minority children are far more likely than Whites to grow up in persistent poverty. (p.5)

These insights about the education pipeline highlight an important perception of student performance in schools and in science. There is no doubt that additional factors such as socio-economic status (SES), immigrant status, disability, religion, English language proficiency all have varying influence on an individual student. Particularly, socioeconomic status or social class is the most critical in determining the current realities and possible futures of students in the educational pipeline. However, Black, Latino/a, and American Indian ethnic groups have the highest percentage of children living at the poverty level and who attend high poverty schools as compared to White or Asian/Pacific Islander students (USDOE, NCES 2007). In Figure 2.1, it becomes apparent that SES does not exclusively describe achievement level in science as White and Asian American students who are eligible for the National School Lunch Program outperform Blacks and Hispanics (Latino/as) who are also eligible for the program.

Figure 2.1 – Percentages of students at NAEP achievement levels for science at Grade 12 by National School Lunch Program eligibility and Race/ethnicity.¹⁰



It then becomes apparent that SES and ethnicity are associated and need to be carefully interpreted and represented in the public discourse of student achievement in science and education.

For example, studies designed to assess tracking have found that higher-SES schools tend to have higher percentages of teachers with more teaching experience, as student achievement has been closely associated with this particular quality of teachers (Haycock 1998; Lynch 2000). Aside from teacher quality, the types of courses (such as advanced placement or honors courses) offered to lower-SES students are lacking. Higher-SES schools have been found to provide more access to educational opportunities, including advanced courses and more involvement with teachers and guidance counselors (Spade et al. 1997). Data has also shown that not only are students

¹⁰ # Rounds to zero.‡ Reporting standards not met. Note: Observed differences are not necessarily statistically significant. Detail may not sum to totals because of rounding. Source: (USDOE-NAEP 2005).

lacking opportunity to take advanced courses, but that the trend in taking increased vocational courses demonstrates discrepancy in opportunity and access to educational equity, as well (Oakes & Guiton 1995). In today's societies, students of different socio-economic statuses are being exposed to qualitatively different types of educational knowledge. Oakes et al. (1992) describes the concept of "curriculum differentiation" as a process by which educators "make different knowledge available to different groups of students." Curriculum differentiation is often seen as a method of tracking, differing the curriculum according to classroom dynamics and student knowledge, and the larger "societal context," recognizing the importance of students' socio-cultural constructs (Oakes et al. 1992). Perhaps, the most important factor of curriculum differentiation lies in the consequences that result from its practice. Whether deliberate or unintended, curriculum differentiation affects access to knowledge, classroom dynamics, racial and social class division, and students' academic and social success. Still, it is in the broader social and ideological ramifications that curriculum differentiation plays a part, as "most agree that curriculum differentiation has served as a stratifying function – one that largely reinforces or reproduces social and economic inequalities" (Oakes et al. 1992, p.580).

2.4 Ethnic-racial, Gendered, Intellectual Identities – Formations and Relations

Schools play an important role in the socialization of students. Because of this, it is important to understand how race and ethnicity, as a social phenomenon, is constructed "in the schoolyard" (Lewis 2003)—that is, understanding how schools as institutions are a venue in which racial/ethnic identities and meanings are negotiated (Davidson 1996; Dolby 2001; Lewis 2003; Perry 2002). Schools are embedded in the larger context of state and federal mandates that subtract from the quality of education through high-stakes

testing, in addition to the policy, ideology and hegemony that shape society as a whole. Subtractive assimilation assumes that the assimilation process within the educational system is not neutral but in fact subtracts from the cultural and ethnic identity of the student (Valenzuela 1999). Despite previous held beliefs that cultural assimilation positively impacts upward mobility, research indicates, for example, that second and third generation Mexican-American citizens are less likely to achieve educational attainments than their immigrant counterparts (Valenzuela 1999). Disparities in achievement can also occur when U.S. racial and ethnic minority groups try to assimilate into the educational system of which has dominant hegemonic foundations and ideology (Apple 1990). Thus, students are at the mercy of this subtractive process or become disenfranchised and retract participation in the system. Associated with subtractive assimilation is the notion of social capital that refers to positive social relations within a group or between groups. For example, a minority group can have increased social capital with the dominant group if they share certain social values. For countless numbers of U.S. students, primarily middle class Anglos – communities, families, and schools reinforce similar values and behaviors. These families take part in belief systems not uncommon with other social institutions. However, certain minority groups in schools, like Latino/as often lack this strong cultural capital. The groups are usually those that have been historically colonized by other dominant groups, otherwise known as involuntary minority groups (Blauner 1987; Ginorio & Huston 2002; Ogbu 1992). When family, community, and school conflict with one another in values or belief systems, students “face multiple, conflicting views of who they can and should be” (Ginorio & Huston 2002, p.544). Because the notions of identity and social capital are

central to individuals in a society and correspond to how they organize and negotiate the worlds they inhabit (Duranti & Goodwin 1992), the processes of the education pipeline undoubtedly affects the level of educational achievement these individuals can attain. This is depicted through the Valencia's (1997) "deficit-thinking paradigm" as well. The "deficit-thinking paradigm" is another example of the problematic encounters between student identity and the educational process or experience, also known as the education pipeline (Valencia 1997). Students are seen as having internal deficiencies (e.g., cognitive and/or personality traits such as motivation) or social deficiencies (e.g., familial dysfunction). This mode of thinking places the onus on the student and their family as the causal notion of failure. The belief is not that these students can be successful, but becomes an attempt to save them from themselves, their parents, and the environment in which they live¹¹ (Valencia 1997).

Olsen (1997) in *Made in America* reflects on how context, structure, and identities in society are reproduced in schools. Social reproduction is a child's inheritance of the parents' social class through the structures, processes, and institutions of society. According to Farkas & Beron (2001), social class position is reproduced in mechanisms such as spoken language, literacy and reasoning skills, and aspirations. Olsen (1997) found that students are aware of the tracking to which they are subjected, as well as the congruence of parent education level and job skill, to the types of classes the students

¹¹ In their cultural "difference" model, Fordham and Ogbu (1986) acknowledged that differences exist with respect to culture, language, and gender across groups while also asserting that one culture, language, or gender is not inherently superior or better suited to a given task than another. Cultural differences arise when groups face different historical, social, and economic conditions (such as child-rearing practices from home or the community) which ultimately lead to patterns of behavior, language use, thinking, and feeling that differs from those of other groups. For example, factors like that of SES and gender identity contribute to the interrelatedness of privilege and schooling, and complicate the relationship between the Latino/a culture and mainstream school culture.

take (Hallinan 1992). Particularly, English Language Learners (ELLs) are subject to significantly shortened academic schedules, segregation and over-placement in Special Education, and serious deficiencies in being taught by qualified teachers (Gandara et al. 2003; Olsen 1997). It is through social reproduction that social and cultural capital are lacking in lower-SES and language minority groups (which often include many Latino/as) as it is manifested in ways of talking, acting and socializing, as well as language practices, values, styles of dress and behavior that is different from the dominant hegemonic group (Ginorio & Huston 2002, p.549; MacLeod 1995). In this education-dismissive environment, the resulting gap is known as “social dualization” (Flecha 1999).

Research findings show that females of color are particularly sensitive to the presence and absence of opportunities and resources with regard to power inequalities, as race, ethnicity, and class differences are equally significant to gender differences in the formation of their identity (Erkut et al. 2002; Phinney 1990). Recognizing and understanding the relationships between academic development, personal development, moral development, and social development presents an opportunity for Latino/a students and other colonized/involuntary minorities in our education system to create what are known as resistance strategies, such as to resist the surrendering of their racial/ethnic solidarity and culture in exchange for opportunity, privilege, and economic advantage, often recorded in research as “acting White” (Ogbu 1992; Ward 2002). However, resistance strategies vary widely and take shape as “healthy (long-term, liberating) strategies” or conversely, “unhealthy (short-termed, survival oriented) strategies” (see Table 2.1).

TABLE 2.1 - Resistance Strategies

Unhealthy (Short-term, Survival Oriented) Strategies	Healthy (Long-term, Liberating) Strategies
Using silence and withdrawal as a way to avoid conflict	A belief in one's intellectual competence, knowing one's strengths and weaknesses
Succumbing to self-doubt	Setting goals high and believing in oneself
Disconnecting and disengaging from school	Resisting self-doubt and self-silencing
Emphasizing achievement in areas like sports and entertainment at the expense of academic achievement	Knowing education is essential to learning and gaining skills while maintaining the ability to critically evaluate the education one is receiving, rather than blindly submitting to the demands of a system that may be devaluing
Avoiding academic involvement and success because it is seen as "acting White"	Resisting patterns of failure and underachievement from peers
Adopting a complacent attitude – that is doing only enough to get by (pass the test, pass the class, get the diploma)	Maintaining a positive attitude toward education while maintaining one's racial/ethnic connection
Believing one is limited by bad genes	Knowing the risks of complacency: low-level education, low-level jobs, permanent low-income status for oneself, family, and community
Settling for low achievement in school	Maintaining friendships with social groups that have one's best interest in mind (which may not be all social groups of one's race/ethnicity)
Feeling victimized by inferior schooling, and internalizing notions of incompetence	Recognizes that one may face special challenges and have special needs in school, while developing the will and talent to develop intellectually despite the obstacles.
	Developing the ability to negotiate the education pipeline, while developing a strong racial/ethnic identity and sense of self.

Source: (Ward 2002)

For example, research suggests that the steadily widening ratio of low numbers of Black and Latino males to high numbers of females attending college is a consequence of parents who focus primarily on protecting males, often neglecting to push them to advance their own standards and expectations (Ward 2002). Additionally, Black and Latina females often react to prejudice and mistreatment with silence, “an example of a maladaptive resistance strategy – one that works in the short run only, to allow avoidance of immediate conflict, but it changes nothing and, if allowed to continue, can lead to depression and despair” (Ward 2002, p.519). In writing about students’ cultural and psychosocial well-being (known as “cultural competence”), Ladson-Billings (1995) studied Black high school students and the dilemma they face when negotiating academic endeavors while demonstrating and retaining cultural competence. Most academically successful students did not identify with students from other races/ethnicities. Nor did they associate with ones from their own race. This is because they felt it necessary to avoid the stigma imposed by teachers of the Black student population, which resulted in students’ academic success occurring at the expense of one’s cultural competence (Ladson-Billings 1995).

An important factor that influences and encourages academic identification and personal success for Latino/as in the educational pipeline is the notion of the family, its structures, economy, acculturation, and gender-role socialization. Latino/a family structure is undoubtedly diverse as students may live with both parents, single parents, or extended families with grandparents, adult siblings, etc. Often, the literature suggests that many of these different scenarios create an incongruity to achievement in education. Additional literature also suggests that the risks of dropping out in high school for

Latino/as are no more likely to occur in single parent homes than other family configurations, and, particularly, for low income Latino/as, any parental or familial involvement in a student's education encourages educational achievement and outcomes (Ginorio & Huston 2002). Research also suggests that Latino/as are correspondingly affected by the educational outcomes and choices of siblings. The compatibility of home/familial life and educational achievement for Latino/as, while still maintaining family roles and responsibilities, creates a powerful environment to pursue their aspirations (Asera & Treisman 1995; Valenzuela 1999). While Latino/a families often lack the cultural capital for the educational pipeline – that is, the cultural awareness, knowledge, and verbal facility to understand how the pipeline operates – it is still beneficial for Latino/as to maintain attachment to one's culture when participating in another culture's values and behaviors, as well (Valenzuela 1999).

Often times, Latino/a parents are regarded as not valuing education or encouraging their children to succeed in school. Yet, research provides us with data and examples of many Latino/a parents that embody the opposite (Ginorio & Huston 2002; Romo & Falbo 1996; Valenzuela 1999). Whereas the argument of Latino/a parents devaluing education has been discredited, there remains a disconnect in the practices of the education pipeline that still lays the onus on Latino/a familial culture and values. For example, the value system common to many Latino/a families includes a respect for authoritative figures that is demonstrated through submissive behavior in students. In the classroom, this behavior is penalized whereas individual achievement is rewarded. Many times, rewarded behavior is solely recognized through outspokenness and aggressiveness at all levels of the educational system.

Along the same lines, gendered roles commonly exhibited in Latino/a families are another important facet to understanding how Latino/as engage in the educational pipeline. For example, research suggests that for Latinas, traditional gender roles hinder the attendance and persistence of these females through high education (Cardoza 1991). Conversely, a longitudinal study by Peng (1995) reported parents of color were more prone to have expectations of female children attending college than male children. In general, however, Latino/a family values and support are factors that should equate attainment of success for the educational pipeline. Research interviewing Latina female doctoral students found that the common thread of many of their stories included familial support and the successful negotiation of familial expectations at home and the demands of school as influential factors to their success (McGlynn 1998). “Thus for many Latinas, possible selves imagined for postsecondary years must include some integration of those conflicting expectations, or they will be forced to choose between education or loyalty to family” (Ginorio & Huston 2002, p.556).

Peer groups also play a role in the development of Latino/a student identity, as peer culture and school culture intersect within the education pipeline. For Latino/as, peer groups emerge as either an advantage or hindrance to academic accomplishment. Females, particularly, use peer groups to further shape their identity and sense of self. While one individual peer group may be influential and encourage one’s engagement in school, another peer group may resent such decisions to engage in school activities and studies. Latinas who choose among these different roles are not only choosing from their own preferences but are also influenced by the educational setting and environment with which they are learning (Ginorio & Huston 2002). Latinas in a largely Latino/a

populated school will make distinctly different choices with regards to peer groups than Latinas in schools where Latino/as are the minority. “The perception of achievement as ‘White’ is probably more pronounced in schools whose environment is perceived as assimilationist or dismissive of minority cultures. Often, this leads to a bifurcation of academic and Latina identity, making it difficult for a young woman to craft an identity that is both Latina and academically successful” (Ginorio & Huston 2002, p.563).

2.5 Identity

There is no doubt that educational environments can exert powerful influences on student development. Latino/a students come to college with socio-historical, economic, and political backgrounds and encounter many more types of experiences and environments within the pipeline. Because of this dynamic, both psychosocial theories of identity and more nuanced contextually-specific identity theories can be useful as descriptive tools to guide further understanding of the development of student identity within the education pipeline (Evans et al. 1998; Goode 1998). However, it must be noted that identity theories contain both benefits and limitations to understanding the broader worldmakings of an individual. In speaking of the dissolution of authoritative knowledge, Lather (1991) discusses the idea that research participants may not always fit into discrete categories, but at the same time one may use them to understand certain phenomena. For example, the discussion of identity development has historically focused on White male individuals. Contemporary theories include gender, racial, cultural, and sexual preference as important factors and indicators for identity development. Particularly, in describing Latino/a college student gender and ethnic identity development, it can be helpful to understand those theories that focus on college

education and identity (Chickering & Reisser 1993); relatedly, transition theory (Schlossberg et al. 1995); identity development of women (Josselson 1973; 1987); and, ethnic identity development (Lopez 2003; Padilla & Perez 2003; Phinney 1990). In this study, identity will be defined as how Latino/a students view themselves and their place in U.S. society (Tafoya 2004). These theoretical positions help to frame the social and historical formation of self and identity in the context of cultural production for Latino/as in this research.

2.5.1 Transition Theory

Even before the development of a student's identity within the higher education environment, students take part in a transition of environments from secondary education to higher education. Specifically for Latino/as, we see that high school to college transition rates have fluctuated over time (USDOE, NCES 2007). Additionally, immediate enrollment of high school graduates into college continues to be significantly lower for low-SES families than for high-SES families. The meaning ascribed to this transition is influenced by a myriad of personal factors which include an individual's demographic and psychological resources in dealing with the transition (as will be described later). Transitions can also occur within higher education environments, such as a declaring a science major or more commonly noted, failing an introductory science course.

Schlossberg et al. (1995) describe a transition as “any event, or non-event, that results in changed relationships, routines, assumptions, and roles” (p.27). In Schlossberg et al.'s (1995) transition theory, transitions take on meaning based on the type of transition it is – whether or not it is an anticipated transition or nonevent (in which the

individual may anticipate an event, but it does not occur). Meaning is also created by the context, or one's relationship to the transition, the setting in which the transition occurs, and the impact of the transition on an individual's daily life. An individual copes with a transition by a process that occurs over time, from a space of preoccupation to integration. Schlossberg et al. (1995) define this transition process as consisting of three phases: moving in, moving through, and moving out. Individuals vary with regards to the coping mechanisms they employ for transitions, as the coping process is influenced by the resources that an individual may or may not have – Schlossberg et al. (1995) calls these resources “assets and liabilities.” An individual draws on resources from four distinct areas (to cope with change and devise a plan when in transition): (a) the situation; (b) oneself; (c) support; and, (d) strategies.

(a) Assessment of the situation includes what triggered the transition, the social timing during which the transition is occurring, the degree of perceived control over the situation, whether or not role change is involved, the duration of the transition, previous experience with a similar transition, concurrent sources of stress that may subtract coping resources, and who or what is perceived to be the cause of the transition.

(b) Individuals coping with transition also rely on one's personal and demographic characteristics, and psychological resources. An individual's psychological resources include optimism maintenance, view of self-efficacy, and values. Personal and demographic characteristics include one's socioeconomic status, gender, ethnicity, and psychological, social, and functional age. For example, students from high-SES families are known to more likely expect to earn a bachelor's degree than students from low-SES families (USDOE, NCES 2007).

(c) The third aspect that is essential in coping with transition is the assessment of social support, exemplified through intimate relationships, family, networks of friends and communities.

(d) Finally, the fourth coping relation involves the employment of strategies. Such strategies are divided into those that modify the situation, those that control the meaning of the transition, and those that aid in the management of stress in the outcome. Individuals may choose to utilize different strategies, such as direct action, no action, information seeking, or reflection.

Schlossberg et al. (1995) suggest that, in order to fully understand transitions in the lives of individuals, not only must there be an understanding of the individual, but also family, historical time, cultural age norms, and cultural age constraints.

2.5.2 College Student Development Theory

After an individual makes the transition from high school to college, traversing the college terrain becomes another set of complex experiences and environments that a student must cope with. Chickering and Reisser (1993) describe development in college as consisting of seven vectors: (1) developing competence; (2) managing emotions; (3) moving through autonomy toward interdependence; (4) developing mature interpersonal relationships; (5) establishing identity; (6) developing purpose; and, (7) developing integrity. These vectors are meant to describe the emotional, interpersonal, ethical, and intellectual encounters that post secondary students experience. Chickering and Reisser (1993) indicate that the vectors vary in complexity for each student and that they should be seen as interacting incremental pathways.

(1) In describing the development of competence, Chickering and Reisser (1993) outlined three different types of competence students build: intellectual competence associated with knowing and learning; physical competence associated with health and wellness; and, interpersonal competence associated with communicating and working successfully with others. (2) Students subsequently develop the ability to manage emotions by recognizing, accepting, and appropriately expressing them. This vector is also associated with the third vector, moving through autonomy toward interdependence. (3) This period of identity development involves competency building of emotional independence, self-direction, problem-solving, and mobility. Additionally, students acknowledge the significance of being connected to others in social, emotional, and non-emotional ways. (4) The next developmental aspect is the development of mature interpersonal relationships. This phase involves a student's ability to accept and respect individual differences and appreciate commonalities. (5) Consequently, students then have the tools to establish one's own identity through the acceptance and comfort of one's own appearance, gender, sexual orientation, lifestyle, cultural heritage, and social background (Chickering & Reisser 1993). The final stages of college student development are the development of a life purpose (6) through meaningful decision-making and commitments in which family influences often affect such decision- and goal-making processes, and the development of integrity (7) through the establishment of value systems and a sense of social responsibility.

Importantly, with regards to ethnic-racial groups, college student development may increasingly favor certain vectors. The establishment of identity described above in vector five appears as an oversimplification by Chickering and Reisser (1993). Their

position does not recognize the diverse responses that ethnic-racial groups may have to the process of development and shifts responsibility solely to the individual rather than a process of academic socialization where these groups encounter measures of racial isolation at institutions. For example, 25 percent of Latino/as attend higher education institutions where they are the majority, and 44 percent of Latino/as attend institutions where they make up less than 20 percent of the enrollment (with half of these students attending institutions where they make up less than 10 percent) (USDOE, NCES 2007). Additionally, the literature written on the applicability of Chickering and Reisser's (1993) theory to women's identity development indicates that collegiate women develop mature interpersonal relationships at an earlier stage than Chickering and Reisser suggest – stage four (Evans et al. 1998). Minority women, specifically, tend to develop these types of relationships earlier and score higher on assessments for autonomy and the development of a life purpose than their male counterparts (Evans et al. 1998). This is consistent with the findings by other theorists who postulate that the stages or phases of identity development are not necessarily progressive (sequential) or permanent as Chickering and Reisser (1993) state them to be, but that a person's identity status is dynamic through time (Evans et al. 1998). Still, other theorists of identity development try to focus on and explain the identity resolution process briefly described in stages five and six by Chickering and Reisser (1993), such as Marcia (1980) and specifically, on how this process relates to women (Josselson 1973; 1987).

2.5.3 College Women Development

Josselson's theory (1973; 1987) builds upon Marcia's (1980) four identity states in order to explore identity formation of women in depth. Phinney's (1990) theory on

ethnic identity development also draws on Marcia's identity states. Marcia (1980) describes these four identity states (not to be confused with stages, as they are not incremental) as:

1. Foreclosure – Individuals do not question the formation of an identity, and passively accept parental values. They are seen as “cooperative or conforming.”
2. Diffusion – Individuals refuse or are unable to commit to the formation of an identity. They are seen as “carefree or careless.”
3. Moratorium – Individuals actively question parental values (seen as a crisis) in order to form their identity. They are seen as “sensitive, highly ethical, or flexible.”
4. Achievement – Individuals experience a crisis in which clear choices are realized and strong commitments are made. They are seen as “strong, self-directed, and highly adaptive.”

(p.161)

Josselson (1973; 1987) subsequently describes college women “Foreclosures” as women whose childhood assumptions and identifications (often reflecting parental beliefs and standards) serve as the direction for their lives. They have a high level of determination and graduate from higher education without doubt or hesitation of their life purpose and direction. Josselson (1973; 1987) suggests that “Foreclosures” are grounded in identification with family and relationships with others rather than individuation, even when successful with their careers. “Diffusion” women are described as unable to form healthy identities. This may be due to early life emotional scars and/or feelings of

powerlessness that incapacitate them to organize and constructively integrate experiences. Some “Diffusion” women may experience crises and thus, cannot make definitive choices in their lives, while others remain disoriented about their lives, unable to become independent. “Moratorium” women spend time searching and experimenting with identities. In Josselson’s (1973; 1987) findings, “Moratoriums” often experience themselves in relation to others. With little investment in personal achievement, “Moratoriums” define and differentiate themselves through the emotional ties to and validation from others. Last of all, “Achievement” women interrupt childhood identifications and form distinct identities. The formation of these identities occurs with the negotiation and reshaping of previous aspects of self and who they want to become in the future. They are seen to value their own confidence and self worth, and also maintain balance among elements in their lives. Interestingly, “Achievement” women are often found enrolled in more “difficult” college majors such as math and science (Evans et al. 1998).

2.5.4 Phinney’s Psychological Framework of Ethnic Identity

Using Tafoya’s (2004) general definition of identity as how students view themselves and their place in society, research on Latino/a students in higher education and the science pipeline should most importantly reflect the examination of these students’ ethnic identities. Chickering and Reisser (1993), Schlossberg et al. (1995), Marcia (1980), and Josselson (1973; 1987) all recognized the importance of ethnicity in their development theories. However, early women’s and race/ethnic studies looked at the achievement levels of these populations without culture as the central or specific contextual variable, and behavior was misidentified. Traditionally, cultural aspects of an

individual have been regarded as “a nuisance variable,” something that impedes individual attainment and thus, controlled for or as a statistically manipulated in studies. Current research demands itself to be knowledgeable in ways in which ethnic life experiences influence and shape life experiences. Phinney’s (1990) review of research on ethnic identity in adolescents and adults defines ethnic identity as part of the individual’s self concept that is a result from one’s knowledge, value, emotional significance, common origin, and shared activities with a larger society.

The individual psychological framework on ethnic identity formation emphasizes the extent to which ethnic identity is maintained and the psychological effects of culture conflicts. Phinney (1990) addresses the actual formation of identity with her theory derived from Marcia’s (1980) four stages of identity states. Phinney’s (1990) theory is a three stage development model based on the progression from Diffusion-Foreclosure to Moratorium to Identity Achievement (from an unexamined identity to an exploration period to an achieved/committed identity). Phinney (1990) describes Diffusion-Foreclosure as individuals that have not explored feelings about their own identity. This may be due to lack of interest or having given it little thought (Diffusion). These reactions may be acquired from attitudes of others – in childhood from significant others or a reaction to the internalization of negative attitudes from the dominant culture (Foreclosure). Stage two is the Moratorium stage exemplified by the exploration or examination of the significance of one’s ethnic identity. This may be a result of a particular experience (usually, negative in nature) or a gradual recognition of being perceived as “less” by the dominant culture (Phinney 1990). This stage may involve emotional intensity displayed through anger, guilt, or embarrassment. The third and last

stage is identity achievement which is characterized by the resolution of an individual's identity conflicts and the coming to terms with ethnic and racial issues, such as cultural differences between one's culture and the dominant culture or the disparaged status of their ethnic group in society. It is also noted that identity achievement may not always result in a high ethnic involvement. This concept is salient with Latino/as whose ethnic self-identification may be negatively correlated to preference for ethnic involvement or group behavior.

2.5.5 Ethnic Classification and Cultural Commitment

Ethnic identity may also include prejudices, pressures, or problems faced from conflict or disparagement by the majority culture or dominant group. Phinney and Alipuria (1990) report that ethnic identity is multi-faceted, and seminal to the positive self-concept or self-esteem formed by minority adolescents and college students. Ethnic identity may be developed from shared culture, religion, geography, knowledge of group history, and/or language and many times research is focused on what individuals learn from family and communities.

Family ecologies influence one's personal and social identity as family affects gender socialization, interaction patterns, cultural-ethnic identity formation, and cultural identity conceptualization. Family and "home spaces" impart meanings and expectations of femaleness and maleness as gender related behaviors are learned in the home as well as from larger discourses in school and society (Lopez 2003). Culture such as symbols, meanings and cultural norms begin in home spaces as well. These distinctions are defined as cultural symbols (signs, artifacts, words or language that that is meaningful to a group), meanings (or interpretations attached to a particular symbol), and cultural

norms (collective interpretations or proper or improper behavior). Group membership to a particular ethnic group varies among different levels as the emotional significance or affiliation strength one attaches to one's ethnic-culture is not shared across all members. For example, the Latino/a ethnic-cultural group are a distinct sociological group with identifiable characteristics that can be specified or described, however, heterogeneity exists within the community as well. Yet, this group shares some commonalities due to their social locations, their experiences, their histories, and their cultural practices¹².

For Latino/as and minority groups, deep-level cultural cues encompass traditions, beliefs, and values – culturally shared traditions include myths, legends, ceremonies, and rituals passed on from one generation to the next; culturally shared beliefs are fundamental assumptions or worldviews held dearly without question; and, cultural values are priorities that guide “good” or “bad” behavior, “desirable” or “undesirable” practices, and “fair” or “unfair” actions. The importance of family (or the ideology of the collective) is another deep-level cultural value for Latino/as (Garcia 2003). Often times this definition of family extends beyond the nuclear family and encompasses large family networks. For Latino/as, family needs may often take precedence over individual needs. Selflessness is also thought to be proper behavior, especially of women (Anzaldua 2007; Garcia 2003). For example, family-formed “racialized” gender identities may shape educational behaviors. Phinney (1990) claims that females may often be more subjected by racial stereotypes than gender-related stereotypes in identity formation. Gender and ethnic identity do intersect “in those cultures in which men are more likely to

¹² While it is evident that there are implicit understandings of these commonly shared values among Latino/a individuals, it should be noted that there is no homogeneous Latino experience.

get jobs in the mainstream culture while the women remain at home. There may also be differential cultural expectations for men and women, such as the assumption that women are the carriers of ethnic traditions” as the literature asserts that women are more involved in the ethnicity identification when compared to men (Phinney 1990, p.509).

From the female perspective of 2nd generation Latina-Caribbean immigrant women living in New York, Lopez (2003) asserts that women fashion the concept of educational emancipation through and against the hardship narratives of their working-class mothers. Lopez (2003) calls this phenomenon the “dual frame of reference” because these women contrast their own life-educational stories with their parents’ stories of leaving a home country. “An intense feeling of guilt and obligation toward a sacrificing mother, along with the dream of ending family hardship, led these young people to emphasize academic success as a means of bringing honor to their families” (Lopez 2003, p.120). “Racialized” women also report high degrees of family ties and intimacy yet also vehemently criticize the double standard of male and female roles at home. As a consequence, females are more likely to define future goals of family responsibility and weigh decisions that ultimately produce their own definition of self-determination and autonomy through the pursuit of education. From the male perspective, Lopez (2003) reports that males are not expected to assume an active role in family or domestic responsibilities and spend much time outside the home (due to indirect socioeconomic factors) and highly participate in sports-related activities (Barajas & Pierce 2001). Weak family ties cause males to “disidentify” with parental stories and struggles, which in turn make them to more likely to engage in the development of their masculinity outside and apart from education.

Religion is another common culturally shared belief among Latino/as. Catholicism, specifically, has been the predominant religious belief system for Latino/as living in the U.S – which also embodies paternalistic and fatalistic ideologies (Garcia 2003). It is thought that Catholicism’s prevalent historical practice among this ethnic-cultural group has caused an ideological fusion of beliefs and values that may no longer be separated from each other. Another aspect of religious beliefs among Latino/as includes worldviews and assumptions that reflect spiritual realities outside of a person – that may or may not include a Catholic ideological foundation (Anzaldúa 2007). Language is also an important cultural theme for Latino/as (Garcia 2003). The Spanish language used within the Latino/a ethnic-culture is not only used as a way of basic communication, but also in ways to pass heritage/cultural meaning, and incite group identity – a way to classify ingroup and outgroup membership status. Additional studies on ethnic group identification of individuals include chief indicators such as: maintaining ingroup friends or ingroup dating; religious affiliation; participation in structured ethnic groups such as ethnic societies, clubs, or organizations; involvement in political activities on behalf of one’s ethnic group; residence in ingroup communities or neighborhoods; miscellaneous activities (music, song, dance, food, cooking, traditional celebrations, interest in homeland, opposition to mixed marriages, knowledge of history, etc); and, language (Phinney 1990).

The conceptual frameworks for studying identity involve three main perspectives: social identity; acculturation and culture conflict; and social stigma. Social identity postulates that individuals should sustain a strong sense of group identification. Yet, while membership may contribute to positive self-concept, many ethnic groups by

relation to a dominant group often face negative or low self-concept and social identity – social stigma. Members belonging to low status social groups (like Latino/as) can react through different levels of acculturation: leaving the group or rejecting identity (Rodriguez 1982; Steele 1990); trying to “pass” as individuals from the dominant group (Moraga & Anzaldua 1984); engaging in “boundary crossing” (Goode 1998); choosing between the conflicting identities (sometimes seen as resistance or “counter culture”) (Foley 1990; Willis 1981); or, establish an adaptive bicultural or situational or “negotiated” ethnic identity (Anzaldua 2007). The resulting strong and weak ethnic identifications produce four different “degrees” of identification based on one’s own ethnic group and the dominant/majority group:

TABLE 2.2 – Four Orientations of Ethnic Identity based on the Two-Dimensional Culture Exchange

Identification with majority group	Identification with Ethnic group	
	<i>Strong</i>	<i>Weak</i>
<i>Strong</i>	Acculturated Integrated Bicultural	Assimilated
<i>Weak</i>	Ethnically identified Ethnically embedded Separated Dissociated	Marginal

Source: (Phinney 1990)

Thus, acculturation is a selective process where individuals can decide what aspects he or she would like to retain from one’s ethnic culture and what aspects he or she would like to take up from the new culture (Padilla & Perez 2003). Factors that influence the ways in which people acculturate are related to family structure, religious beliefs and values, gender, age, and power structures between dominant and minority groups. When

individuals come from the same educational, socioeconomic, generational and familial backgrounds, explanations for acculturation may lie in “personality characteristics, such as assertiveness, likeability, sociability, extraversion, and ego control” (Padilla & Perez 2003, p.40-41).

Empirical findings on Latino/a ethnic identity reveal that strong identification with certain Latino sub-group ethnicities promote a positive self-concept (Matute-Bianchi 1991). These findings and others support Marcia’s (1980) original concept of higher self-esteem in individuals with achieved ethnic identity. Higher self-esteem is thought to positively contribute to higher self-evaluation, sense of mastery in subjects, family relations, and social relations (Phinney 1990; Phinney & Alipuria 1990). However, in the qualitative study on Mexican-American adolescents in high school by Matute-Bianchi (1991), students demonstrating varying modes of acculturation were related to academic achievement. The results did not necessarily impart a linear relationship of assimilation or acculturation to academic achievement. Instead, students with more caste-like embedded ethnic identities were the least successful academically. Achievement was differentiated by contexts involving minority status, incorporation into U.S. society, and experiences with discrimination and subordination (Matute-Bianchi 1991). Additional research findings claim that ethnic identity is also positively connected to the ethnic density of the neighborhood in which one lives, and negatively associated to the occupational and/or residential mobility of an individual¹³ (Phinney 1990).

¹³ However, Phinney and Alipuria (1990) report that with college students, there are no connections between the stages of ethnic identity and social class.

In another example, Goode (1998) describes situationally complex boundary crossing of immigrant identities and suggests that construction of a “pluralistic mosaic” identity occurs between different ethnic-racial groups who share similar class histories. In one neighborhood, poorer Korean immigrants, aspiring middle class Puerto Ricans, and middle class Blacks and Whites all live in an environment Goode frames as residentially unsegregated. The ethnic-racial groups have engaged in a process of “boundary crossing” due mainly in part to “women’s roles in social reproduction, child rearing, and neighboring [that] have begun to structure the relationships of intimacy and trust across the boundaries of nationality and language...” (Goode 1998, p.48). These identities are situationally complex because groups may contest the “pluralistic mosaic” and form “alternative collective identities.” These alternative collective identities are formed in opposition to economic and political power structures within these neighborhoods. One illustration of this in Goode’s research are the collective identities formed between Korean and Puerto Rican groups based on shared immigrant and “peasant” status, which differed from the shared collective identity between White and Black groups based on similar contemporary cultural understandings and historical precedence in occupying the area.

Foley (1990) and Willis (1981) also explore social class inequities and class consciousness as factors influencing identity. Situated in the context of schooling this time, both men believe that schools culturally reproduce unequal social structures and therefore provoke resistance from working class students. “Working class people construct their own distinct, rewarding, honorable ways of life” (Foley 1990, p.163). Willis (1981) contends that working class boys (“lads”) in England construct a “counter-

culture” as a method to find dignity in an oppressive hegemonic environment. Further extending this discussion of ideological struggle and consciousness to ethnic-racial groups, Anzaldua (2007) discusses the struggle of the Latina/Chicana “Mestiza” cultural-feminist identity rooted in resistance and alienation. The ideological struggle of the Mestiza is the occupation of borderlands – at once alienated from one’s native culture and language, and living alienated within a new space/culture where a new self is created. The Mestiza is living between the spaces. Anzaldua (2007) also describes the consciousness of alienation and oppression through the notion of “la facultad” possessed by the Mestiza and others. “La facultad” is a capability developed by marginalized groups to sense deeper discourses and realities that one encounters in daily life (e.g., sensing welcoming or hostile emotions when walking into a room). “Those who are pounced on the most have it strongest – the females, the homosexuals of all races, the darkskinned, the outcast, the persecuted, the marginalized, the foreign” (Anzaldua 2007, p.60). Anzaldua (2007) affirms that individuals think, feel, and act as members of collective groups and cultures while simultaneously learning abilities to function in new types of spaces.

This meaning is directly connected to the psycho-social concept of acculturation. Acculturation is defined as the changes in attitudes, values, and behaviors resulting from the exchange of two cultures. Acculturation and exchange between two cultures is written in the literature as either occurring in a linear fashion or two-dimensionally (Phinney 1990). Linear cultural exchanges occur when an individual has strong connections to one culture (ie. ethnic) and weak ties to another (ie. mainstream). This view maintains that “a strong identity is not possible among those who become involved

in the mainstream society, and acculturation is inevitably accompanied by a weakening of ethnic identity” (Phinney 1990, p.501). Conversely, the two dimensional exchange between cultures declares that an individual may have independent relationships to one’s ethnic culture and the dominant culture. “Minority group members can have either strong or weak identifications with both their own and the mainstream cultures” and strong ethnic-cultural knowledge does not necessarily imply a strong relationship or involvement with the one’s culture (Phinney 1990, p.501). For example, in a study of Mexican heritage, Arbona et al. (1995) noted that while cultural knowledge decreased from 1st to 4th generations, high ethnic loyalty (maintaining ethnic group friends, etc.) was maintained across generations.

The construction of an ethnic identity involves the process of resolving conflicts, such as stereotyping and prejudices on part of the majority group, which for example, may pose threats to the development of self-concept in minority group individuals (Chartard et al. 2007; Evans et al. 1998; Steele 1997). Because of this, individuals will go through cultural changes due to political, social, or economic pressures that make cultural adaptation advantageous (Marin 1993). These individuals sensitive to the negative encounters and feedback from others due to discrimination are called “stigmatized individuals” (Padilla & Perez 2003). “For instance, immigrants who see themselves as negatively stigmatized because of their darker skin color or accented English speech may be less willing to acculturate...” (Padilla & Perez 2003, p.43). Padilla and Perez (2003) believe that acculturation is increasingly difficult for persons who are more distinct from the hegemonic culture – skin color, religious practices, gender, homosexuality, etc. The stigma is the central schema through which others make

assumptions about a person. An example of this is Santa Ana's (2002) interpretation of the public immigrant schema or script that stigmatize the social identities of all Latino/as. He posits that because a U.S. citizen is culturally defined as speaking English, having Anglo-centric cultural orientation, and complying to U.S. dominant ideology, many Latino/as (because of shared physical characteristics¹⁴) are assigned the immigrant status – regardless of being one or not. As such, individuals with a “concealable” or invisible stigma may pass their identity as part of the dominant group. “But they are aware they could be stigmatized if their devaluing attribute is discovered” (Padilla & Perez 2003, p.45). Moraga in Moraga and Anzaldúa (1984) highlights the meaning ascribed to skin color and the “passing” of her own self, a fair-skinned Latina, as a White – “white was right. Period. I could pass. If I got educated enough, there would never be any telling” (p.31). Both Santa Ana (2002) and Moraga and Anzaldúa (1984) frame the idea that social locations of identity are culturally mediated through the relations and schemas of those located outside the group. That is, the subordinate position (dark skin color, Spanish language) is subordinate because of its inherent relation to the dominant (White or light color, English).

Another prevailing theory of stigmatized individuals is that they do not attribute negative encounters or outcomes to discrimination, prejudice, or negative stereotypes (whether warranted or not), as this has consequences on their self-esteem. This is also seen in a study of Black, Latino/a, and Asian students who were less likely to perceive ethnic group discrimination towards one's group based in part to a prevailing belief in

¹⁴ Rodriguez (1982) is also a key example of the cultural practice of looking and the observations and examinations made of each other as part of daily practice.

American meritocracy (e.g., social mobility is achieved through hard work) (Major et al. 2002). Stigmatized individuals will also protect self-esteem by limiting social comparisons only to other groups that have stigmas, because it is less threatening to their ethnic-social identity (Jones et al. 1984). In other words, comparisons made to the dominant group would be deleterious to self-esteem because they would reinforce the negative identity of the stigmatized individual. Yet, despite these coping strategies, stigmatized individuals nevertheless react to negative stereotypes. Steele's (1997) study on the math performance and ethnic/gender stigmatization of African-American females indicates that females fulfill the stigmatization schema or stereotype through underperformance. He contends that the underperformance is not due to the individual's internalization of the threat, but from the anxiety that she will conform to the negative stereotype. If the stereotype threat exists long enough, the individual will eventually react through disidentification – by dropping out of the situation altogether and withholding internalization of goals and values. “Disidentification offers the retreat of not caring about the domain in relation to the self. But as it protects in this way, it can undermine sustained motivation in the domain, an adaptation that can be costly when the domain is as important as schooling” (Steele 1997, p.614).

2.6 The K-12 Science Pipeline

Because Latino/as are a population that has historically and continues to be underrepresented in the Science, Technology, Engineering and Mathematics (STEM) fields, evaluating the performance of Latino/a student access, persistence, and completion in these fields and the education fields that feed them (the STEM pipeline) helps to identify the factors and difficulties that these students face. Explicitly with regards to the

focus of this study, marginalized populations such as Latino/as face complexities that exist at all levels within the K-12 science pipeline (the postsecondary level will be discussed in a later section).

From kindergarten to third grade, lower social class parent expectations for performing well in mathematics are higher for girls than for boys, while opposite was true for middle class parents (Clewell & Ginorio 2002). In a study of British working class children, for both males and females in mathematics, test scores were related to the mother's educational achievement and the occurrence of teaching in the home (Blatchford et al. 1985). It is widely researched that the middle school grades (grades four through eight) are most crucial and influential to student performance and achievement in science and mathematics. In this section of the pipeline, students develop capacities that affect how they learn and build the skills for attainment of science and mathematics achievement. And while gender differences in performance occur by eighth or ninth grade for White males and females, ethnic and racial differences in student performance occur even earlier (Catsambis 1995). Further research indicates that below grade-level performance and achievement from students often puts them in a situation where they are ultimately unable to close the gap. This is markedly true for Black and Latino/a students as NAEP data show us that Black and Latino/a student test scores at fourth, eighth, and twelfth grade are below the average scores of White students (Grigg et al. 2006). Males also continue to outscore females at all of the three grade levels (fourth, eighth, and twelfth grade) of the NAEP assessment (Grigg et al. 2006).

Student performance and participation on assessment measures is affected by many factors including instructional practice, educational environments, learning styles,

attitudes, and perceptions. For underrepresented students within the STEM pipeline, influential factors affecting performance and participation include different characteristics that these learners bring with them to the learning process. Particularly, Black and Latino/a student attitudes and perceptions of mathematics and science are influenced by subject enjoyment, perceptions of the subject's utility to one's life, ideas or beliefs that the subjects are White/male dominated, and confidence in one's own intellectual ability.

Research suggests that positive attitudes and perceptions of mathematics and science begin to decline in middle school and continue to decline through high school, with the greatest decline occurring in grades six and seven (Fennema et al. 1996). Disaggregated by gender, male and female attitudes and perceptions towards mathematics and science at the elementary school level are similar, but by high school, male student attitudes become significantly more positive (Jones et al. 1992). Additionally, among male and female students who perceive science in positive ways, males will often develop a higher level of proficiency in the subject.

NAEP data (USDOE 2005) on science attitudes showed that Latina females, at 4th, 8th, and 12th grade, have less positive attitudes toward science than Latino males. This is consistent with White and Black females who at these ages, like Latinas, decline in student self-confidence in science. Among all racial/ethnic classifications, the number of male students at all three grade levels are more likely to report positive attitudes toward science than girls. NAEP (USDOE 2005) data also suggests that between White, Black, and Latino/a 4th, 8th, and 12th graders, at all levels girls are less likely than boys to answer "Yes" when asked, "Do you like science?" and "Are you good at science?"

Overall, across both genders, Latino/a student preferences for science decline over time from elementary to middle school, and increase slightly in high school (USDOE, NAEP 2005).

Additional research on student attitudes and perceptions suggests that male students are more perceptive to the science and math male-dominated stereotype than females, while other research suggests that “students of all groups also absorb racial stereotypes of mathematics and science as White fields” (Clewell & Ginorio 2002, p.620; Steele 1997). The more students endorse a particular stereotype, the more likely they adopt stereotype-consistent thought, which can even affect memories and generate biases of past achievement (Chartard et al. 2007). In a study of French high school students, Chartard et al. (2007) found that when students have unqualified theories of gender stereotypes (e.g., that math is a stereotypically masculine domain), they are more likely to reconstruct past math achievement and report math grades that are stereotype-consistent. Chartard et al. (2007) found this process of assuming the stereotype to be automatic, without attention or awareness. Further, “it is possible that women are less likely to embrace scientific careers than men because gender stereotypes lead them to underestimate their past achievement” (Chartard et al. 2007, p.1023).

Student attitudes and perceptions of science and mathematics may also be affected by their admitted self-confidence and the level of importance and usefulness they ascribe to these subjects. This pattern is relatively equal for both males and females in third and seventh grade (Jones et al. 1992). However, by high school, female perceptions of the utility of science drops a little over ten percent, and female interest in science careers decreases by eleventh grade (Jones et al. 1992). Research suggests that

significant predictors for female achievement in science are related to factors such as classroom teaching strategies (ie. cooperative learning and inquiry based learning), whereas for males achievement predictors such as individual and socio-cultural factors (ie. peer influence and environmental influence) were significant, particularly with males students of color (Kahle et al. 1993). Overall, the research highlights that middle school females of all ethnic and racial groups lack positive attitudes toward science, participate in fewer science-related extracurricular activities, and aspire less to science careers than their male counterparts. This change in gender attitudes is most apparent among Latino/as, as Latinas start out liking science more than Latinos at age nine, but with Latinos showing greater preference by age thirteen (Catsambis 1995). And, while most research suggests that positive attitudes for science positively affect participation and performance, studies have shown that Black and Latino/a students share positive attitudes that may equal or exceed those attitudes of White students, yet still have lower science achievement scores (Catsambis 1995; Clewell & Ginorio 2002; Kahle et al. 1993).

During the middle school grades, home and other societal factors may influence participation, performance, and attitudes toward mathematics and science. For example, parental gender-stereotypes towards children are vital to self-conceptualization and achievement, as parental expectations can be key predictors for mathematics attainment and problem-solving ability (Fennema et al. 1996). Latino/a parents, predominantly Mexican-American parents, were found to be more supportive than their White counterparts, but often lacked the educational experience and information necessary to assist in their children's learning. NAEP data highlights aspects such as parental education, home assistance with learning and homework, participation in science-related

activities, the amount and nature of reading materials in the home, and familial television viewing habits as factors affecting student achievement and attitudes toward mathematics and science. This data suggests a correlation between home assistance with student learning, parental education level, and student proficiency in science subjects (USDOE, NAEP 2005). Additionally, for English language learners (ELLs), language not only plays an important role in maintaining ethnic identity, but as a factor in science achievement as well (Gandara et al. 2003). With regards to the linguistic aspects of the science classroom – science requires vernacular skills of high-level academic English literacy, often times leaving ELL students at a disadvantage when learning and understanding advanced scientific concepts or having equitable access to college track science and math courses (Gandara 2006; Garcia & Baquedano-Lopez 2007).

At the high school level, achievement and performance in science and mathematics may be related to school-related factors, course enrollment and participation, and career aspirations (Clewell & Ginorio 2002). In the NAEP 2005 assessment, Black and Latina girls performed lower in science than White female students, with female students lagging behind male students at all grades (USDOE, NAEP 2005). This data is supported by research that suggests that in each racial and ethnic category, male students outperform females over time, with the largest gap at grade twelve (Jones et al. 1992; USDOE, NAEP 2005). One school-related factor often cited is the exposure of students to role models in the classroom. Evans (1992) studied role-model effects in high school students and proposed findings that did not suggest gender-based role-model influences, but did, however, suggest race/ethnicity-based influences. His findings revealed that Black teachers generated almost a 19 percent

improvement in achievement level for both male and female Black students whose mothers lacked college educations (Evans 1992). Course enrollment is another factor that may relate to attainment, as shown by students who take advanced level mathematics and science courses are likely to demonstrate have higher achievement (Clewell & Ginorio 2002; Jones et al. 1992). Typically, females and students of color enroll less frequently in mathematics electives and advanced courses in mathematics than White male students, and the proportion of students of color decreases progressively for each advanced course (Fenemma et al. 1996). Research on NAEP data findings also suggests that more coursework in a content area like science may be related to higher proficiency in that area and higher proficiency overall (Jones et al. 1992). This research also indicates that male students tend to take more Physics courses than female students, and that White and Asian-American students are proportionately more likely than African-American, Latino/a and Native-American students. Moreover, female students tend to take a larger proportion of Biology, Chemistry, and Earth Science courses.

Consequently, it is clear that the K-12 education pipeline is ripe with opportunities for students to improve attitudes, performance, and participation in science under the appropriate conditions. Interestingly, examining the perspectives behind these attitudes and the resulting choices of students of color (particularly Latino/as who persist within the science pipeline to higher education) may be an important facet informing the larger discussion of the educational paths selected by Latino/as and students of color in the larger K-16 science pipeline and the higher education pipeline.

2.7 Latino/as and Higher Education

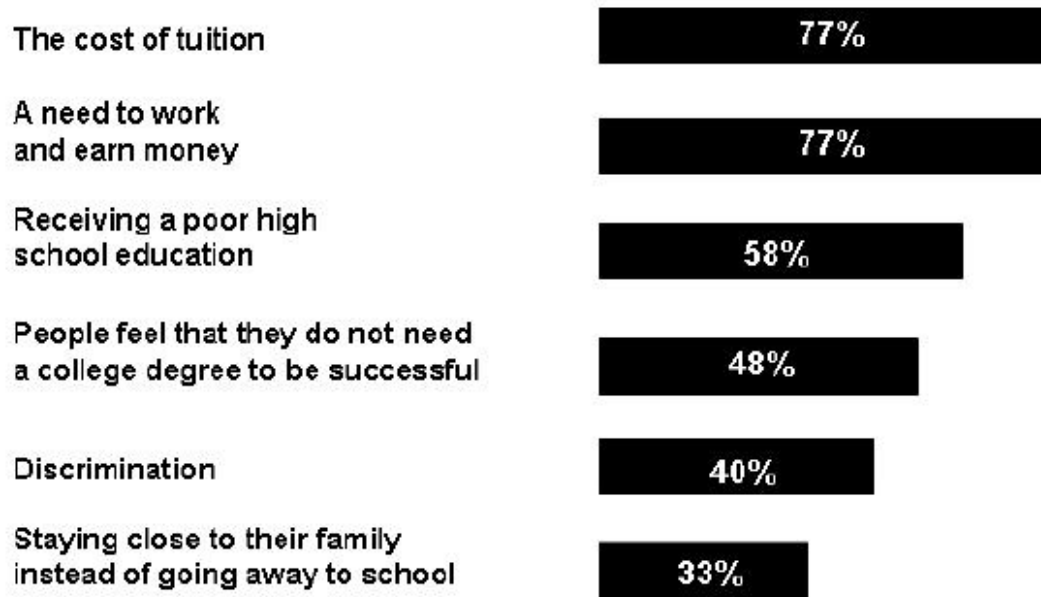
Delpit (1993) declares that equity in education must address the explicit education that students receive in the “culture of power.” For example, higher education institutions reinscribe systems of knowledge that have cultural and social components. Within these cultural and social components, the sorting exclusion or inclusion of certain individuals takes place as knowledge is neither randomly nor equitably distributed across groups. In the discussion of Latino/a students in higher education, this is driven by processes of admission, access, academic environments (such as STEM enrollments and persistence), and social environments. For example, some scholars believe that the admissions processes of colleges and higher education institutions promote and maintain a class stratified system as top institutions set criteria for admissions that typically give access to the top quarter of the national income bracket (Bowen et al. 2005; Stevens 2007).

Beginning with graduation from high school many Latino/a students typically face disadvantages. In fact, statistics show that the students who transition immediately from high school to college are more likely to complete their postsecondary education sooner (Adelman 1999). Those Latino/a students with the opportunity to make this transition typically find that there are significant demands and consequences to this decision. Specifically, there are new responsibilities associated with college readiness, such as financial aid and mental preparedness to leave home (Ginorio & Huston 2002; Tinto 1993). For example, studies report that extended families, particularly mothers and grandmothers, can be pivotal by encouraging and motivating female students of color. Alternatively, other studies state that the extended family (the foundation of affirmation

and security) may have demands that interfere with academic work (Lopez 2003). This pattern can be seen in young Latino/a adults who are participating in the labor force, which often is seen as a necessity, contributing and alleviating family household expenses (Fry 2002). Fry (2002) also claims that this commitment to the workforce and/or household responsibilities does not necessarily prevent Latino/as from attending higher education, but when linked with low socioeconomic status, helps explain the lack of enrollment in full-time higher education institutions. Currently, Latino/a students are more likely to attend 2-year colleges as Latino attendance to 2-year colleges has increased at a rate higher than 4-year institutions (Chapa & De La Rosa 2006). Additionally, selection is biased towards less expensive and/or less selective postsecondary institutions; and, they are less likely to inquire about and apply for financial aid (Fry 2002; Ginorio & Huston 2002). Latinas expressly tend to have difficulties negotiating the family and peer group ties at home and the attraction of a school that may be far away from home. If these students haven't already made the decision to attend a smaller community college because it is close to their home life, those that move away may return home before completing their studies at a 4-year institution (Ginorio & Huston 2002). Moreover, community colleges are increasingly found to be the first step for Latino/as into the higher education pipeline (as well as the science pipeline). In fact, 25 percent of Ph.D. degree holding Latino/as originate from 2-year colleges (Solorzano et al. 2005).

In a national survey of Latino/as, Fry (2002) finds that there are common obstacles obstructing Latino/a students access to higher education and/or the completion of higher education. In general, these factors are:

Figure 2.2 – Pew Hispanic Center *National Survey of Latinos*: Obstacles to Higher Education



In a later study, Fry (2004) also finds that Latino/a pathways through completion of a bachelor's degree are impacted by certain factors that are specific to Latino/as. These factors are living with family while attending college, delayed enrollment into college, and financial responsibility to family dependents. And, while Latino/a students enroll in college at the same rate as their White peers, one in three enroll in community colleges, and maintain the highest college drop-out rate of any major ethnic group (Zalaquett 2005). Additional barriers include minimal adult guidance in the application processes as many Latino/a students are first generation college attendees and/or have parents who have limited proficiency in English (though parents still support students' aspirations). Terenzini et al. (1996) believe that first generation college students are at a particularly high risk of missing post-secondary educational opportunities because of misinformation and poorly informed choices.

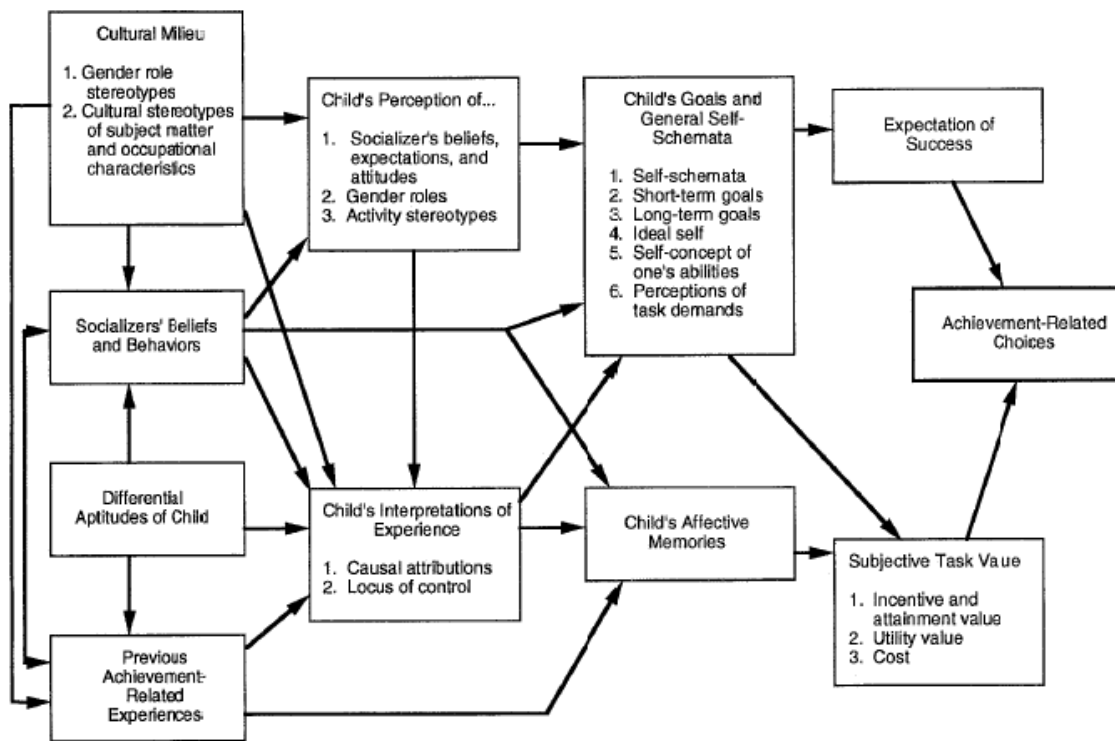
Asera and Treisman (1995) assert that the academically successful trajectories of African-American, Latino/a, and Native-American college mathematics students include positive family attitudes toward education and family lives that are organized in ways to support students to succeed academically. Students and family members also “consciously share” common goals toward education. This is consistent with other studies of Latino/as in higher education reporting strong family support helps college success (Zalaquett 2005). While “the research literature indicates poverty, low levels of education, migrant farmworker status, and immigrant status strongly influence the nature and levels of parent support in school achievement,” (despite low parental levels of cultural capital within the education system), students still attribute success to family relationships and encouragement (Zalaquett 2005, p.40).

The Asera and Treisman (1995) study also highlights similarities in the stories of mathematics college students’ pre-college experiences as important subject-related impressions are made between the 7th and 12th grade as stated previously in the section titled *The K-12 Pipeline*. African-American, Latino/a, and Native-American college students academically successful in mathematics participate in subject recreation (clubs or teams) at the middle and high school levels, enroll in college preparatory and advanced classes, and are nurtured teachers with a special affection for the subject. Peer socialization also sets the tone for daily school life. Students may tend to study alone but socialize at school with the “smart kids” if there is socialization between peer groups at school and a different peer group at home in the community – this is also consistent with the two-dimensional model of acculturation in ethnic identity development (Phinney 1990). And while accomplishments are found to be greater when peer groups and family

have the same values, negative peer effects such as discouragement of achievement may not override the drive for academic accomplishment.

(Eccles 1994) also suggests family, friends, mentors, and one’s community may shape career aspirations and personal expectations more strongly than school experiences (Eccles 1994). This is seen in Figure 2.3 of Eccles et al.’s model of achievement related choices. However, it should be noted that while this model is celebrated for receiving strong empirical support, some scholars believe the Eccles model to be inherently flawed when applying the model to students of color as factors affecting success and achievement may not always be a product of choice (Lynch 2000)¹⁵.

Figure 2.3 – Eccles et al. Model of Achievement-Related Choices



Source: (Eccles 1994)

¹⁵ However, it is my contention that the achievement-related choices of the Eccles model are made only after they have been mediated through identities formed from indirect influences and interpretations constituted by relations of power.

In this model, how the self is construed is heavily influenced by external factors, such as cultural values of gender roles and occupations, peer and parental influences, and previous achievement experiences. Looking at the model in Figure 2.2, one sees that cultural influences and gender role influences are interpreted through one's experiences and perceptions of one's abilities. These constructs then mediate effects of past achievement and socialization experiences into expectations for success and values attributed to success and goals. For example, this model can be used to study college student persistence in a specific major such as science, as expectations for success (e.g., graduation from college) and the value of this success (while indirectly influenced by preceding variables) influence choices that bring a student closer to this outcome.

At the ecological level of colleges and universities, conditions on predominantly White campuses reveal interesting notions of minority student identity and engagement. Student feelings of isolation are based from small numbers of minorities on campus, the lacking presence of role-models and inadequate services directed solely towards minorities (Brown 1994; Thomas et al. 1992). These feelings of isolation and alienation among minority students towards campus culture are also origins that can affect academic performance (Chartard et al. 2007; Seymour & Hewitt 1997). In particular, Latino/as who attend high schools where the Latino/a community is dominant are often alienated on campuses that lack significant representation of these students¹⁶. While existing literature shows that peer connections are important to college retention and success, the lack of congruence presented within existing literature demonstrates the complexity of

¹⁶ It should be noted that extensive differences in the ethnic classification of what makes a "Hispanic" or "Latino/a" have been studied and findings suggest that over-generalizing of this student population also leads to cultural clashes and lack of cohesiveness in college environments (Seymour & Hewitt 1997).

this topic. Seymour and Hewitt (1997) state, “students experienced doubt that they belonged, wondered if others judged them as incompetent, held back from seeking help or asking questions, and were miserably lonely without a peer group with whom to share their experiences” (p.362). Hurtado and Ponjuan (2005) report findings showing that student experiences on college campuses seem to play a more significant role than student background characteristics (e.g., ability, gender, SES, generational status) in student sense of belonging. Likewise, “the positive quality of interaction with diverse peers among Latino students not only resulted in a higher sense of belonging in college but also increases in confidence and skills that reflect a pluralistic orientation—their capacity to manage differences and function in a diverse workplace” (Hurtado & Ponjuan 2005, p.248). As a caveat, within traditionally White institutions (similar to The University of Texas at Austin), Hispanics report that they are more likely to stay in college when they maintain ties to the Hispanic community on campus (Hernandez 2000). Specific to science, without significant representation in their major, students of color often lack ethnic peer connections to discuss things such as academic difficulties. This is important as most Latino/a students report positive peer connections and interpersonal friendships as helping to facilitate achievement in college (Zalaquett 2005).

2.7.1. Latino/as and Higher Education Science

“Science *knowledge* includes an understanding of a system of shared meaning that requires access to social knowledge (e.g., where to go to school and with whom to study, how to write and speak convincingly to other scientists, and so on) that facilitates access to scientific knowledge” (Lynch 2000, p.16). And, retention and graduation of African-American, Latino/a, and Native American students in the life science majors continues to

be low. Between freshman and senior years of college, SME majors are lost at a rate of 40 percent and mostly within the first two years (Seymour 2001). The biological sciences in particular lose students at a rate of 50 percent in comparison to physics and engineering at rates of 20 percent and 40 percent, respectively, with male students enrolled in mathematics and science majors persisting at higher rates than female students. Seymour and Hewitt's (1997) study on why undergraduates leave the sciences report that students of color leave the science or math majors at a rate of 65 percent (compared to 37 percent of White students) with half of this population switching to another major and half dropping out altogether. Astin and Astin (1993) report that for Latino/as, two-thirds leave their science, mathematics, and engineering majors.

Students cite that interests fade due to poor quality of teaching in science courses, difficulties in university science courses, and the attraction of non-scientific disciplines (Seymour 2001). "A particularly serious problem is that such minority students often enter college with little exposure to the culture of science and find it difficult to see the relevance of their science courses to their future careers" (NRC 2003, p.99). Collea (1990) makes sense of this assertion through the finding that minority groups have notably less access to information about careers in the sciences pre-college, but also desire classes and faculty in college to apply scientific theories to practical problems associated with future student science careers. In addition, Seymour and Hewitt (1997) find that male students of color and all women find that they must "alter" or "override" personal values to achieve success in college science. In other words, Latino/a student groups exhibit non-assertive and self-abasing behaviors in the sciences. When encountering problems in science studies, this group is also less likely to take the

initiative when they need it. For instance, because many Latino/as do not grow up with White middle class values that are socially reproduced through education and science, often times they are less likely to question or dispute college grade marks.

Students of color are also thought to be socialized throughout the K-12 pipeline to value and over-depend on relationships with teachers, and thus expect this relationship in college. To Latino/as, the traditional curriculum of college science through lecture seems unfeeling and impersonal. Conversely, Latino/a students increase their likelihood of retention in college when they maintain quality faculty relationships that care for the students and encourage them to work harder (Hernandez 2000; Lundberg & Schreiner 2004). Expanding on this idea of relationships in college science, Grandy's (1998) study indicates that science ambition in college for minority students heavily depends on the level of "minority support" they receive. In other words, these students have minority role models in college, as well as receive advice and support from advanced students of one's same ethnicity. This support in turn allows minority students to feel that it is "important to them to make scientific or technological contributions, to discover new frontiers in science or technology or to contribute to basic scientific theory" (Grandy 1998, p.602). Though "minority support" has negligible effect on grades, these students report a positive relation to scientific ambition, attitudes, enjoyment, and willingness to make science career commitments.

Seymour (2001) suggests that concerns on the under-representation of certain student populations should criticize the quality and character of the SME science pipeline and how it actually participates in this under-representation. For example, Treisman (1992) found that faculty stereotypes incorrectly attribute student of color attrition to a

lack of motivation in addition to lack of financial resources and academic resources in high school. In their study comparing White and non-White (students of color) STEM major “switchers,” Seymour and Hewitt (1997) found racial and ethnic groups to report factors that attribute switching to student-centered failure rather than White students who were more likely to blame faculty and institutional factors. For students of color “the decision to leave an S.M.E. major is often preceded by loss of confidence in the ability to do science” and feelings of inadequacy, shame and failure (Seymour & Hewitt 1997, p.324). Additional stereotypes exist that define Latino/as are lazy, unintelligent and unmotivated, and there is a prevailing assumption that college admissions regularly lower requirements for these populations.

Whether affirmative action guidelines on college campuses do or do not lower the admission criteria for particular students is, in this context, *irrelevant*. It is the stereotypes itself that damages inter-racial/ethnic relationships, *not* the particular policy that is in force. More significantly, this stereotype damages the self-concept of Black and Hispanic students by undermining their confidence to persist, regardless of their actual level of ability or preparation. (Seymour & Hewitt 1997, p.355)

In reaction to stereotypes, students of color and minority groups may respond in different ways – either by unconsciously fulfilling the stereotype through the inability to act in ways that dismiss the stereotype (Chartard et al. 2007; Steele 1997) or in countering the stereotype in effort to prove others wrong (Barajas & Pierce 2001; Seymour & Hewitt 1997).

Accordingly, Latino/as in higher education environments bring with them understandings and consciousness of their identities across multiple communities. In other words, a Latino/a student in the science education pipeline at a college or university

is subject to influences, identities and memberships that exist on the periphery of traditional science education. Thus, in order to improve the quality of the undergraduate learning experience for Latinos and Latinas, we must think about these conditions that are created in the science pipeline, how these conditions may affect their individual perspectives, and what approaches best explore and attempt to understand the meanings of science through its socio-cultural and socio-historical legacies.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

Using theoretical perspectives of Critical Race Theory, power structures, gender in education, and feminist literature, the purpose of this study is to explore the pathways of Latino/a students in higher education science courses (the science pipeline) through the exploration of their educational experiences. Within these experiences, attitudes on cultural and gender identity negotiation and transformation begin to emerge as these students describe the realities through which they experience education and science. The aim of this research is to examine science discourse through the student perspectives and present the varying understandings that relate science as couched within the idea of neutrality yet disseminates social hierarchies of dominance and subordination. The displacement of certain racial, economic, and language groups makes science a context where marginal discourses are carefully uncovered and represented (Kuh & Andreas 1991). In this chapter, I detail how an understanding based on life history and narrative analysis methodology helps to uncover how social difference is constructed. Founded in the critical theory¹⁷/emancipatory paradigm, this methodology reveals the inherent social relations and language that permeate the dominant discourse that is science.

3.2 Overview of Research Question

The student-centered nature of this study (from the Latino/a perspective) highlights the concerns, questions, attitudes, knowledge, and identity forming of the research participants. The narrative analysis employed in this study focuses on social and

¹⁷ Some scholars believe that life history narrative analysis and inquiry is inherently imbedded within poststructural theory, as it posits knowledge as partial, identity as subjective, and power as structured (Hatch & Wisniewski 1995).

institutional bridges and barriers as individuals negotiate across distances of gender, ethnicity, and cultural space. Specifically, the analysis focuses on the different perspectives of Latino/a students in biological science courses – termed ‘successful’ or ‘promising’ at navigating the pipeline by maintaining their participation or persistence within a biological science major. The resulting student narratives highlight ways in which ethnic and gender factors shape students' scientific thinking, learning, and various understandings of the world and the nature of science. These narratives offer insight to the influences that affect student ethnic and gendered understandings in the science pipeline, and the ideologies, social relationships, and social identities within education and science that are expressed in their everyday lives. As a review, this study poses the following research question:

- What are the Latino/a life histories and how have these life histories and students’ higher education experiences within the science pipeline shaped the direction of their study, their attitudes toward science, and their cultural/ethnic and gender identity development and ideologies?

3.3 Research Design and Methodology

Life history and narrative offer exciting alternatives for connecting the lives and stories of individuals to the understanding of larger human and social phenomena. (Hatch & Wisniewski 1995, p.113)

In this study, life history and narrative inquiry/analysis will attempt to illuminate the social, economic, historical, and cultural factors significant to the science pipeline from the perspective of the students. It will describe the ways in which Latino/a undergraduate science majors maintain identities successful to science while simultaneously incorporating their own ethnic-cultural and gender identities. Life history

and narrative inquiry allows researchers to ask: in what ways are these identities negotiated and what is the echo of discourse that has been left by these students? Thinking about discourse as it is reified out of social practice (constituted through participation in different social relations), the language of the narrative is not only a communicative tool but also an expression of “consciousness.”

This study adopts Bloom and Munro’s (1995) definition of life history (the phenomena that is being collected and analyzed) that begins with the personal reconstruction of experience within context but is then elaborated to include oral history, informal narrative, personal narrative, and life story. I use this definition in conjunction with Connelly and Clandinin’s (2006) definition from which the methodology of narrative analysis is based. It is

a view of human experience in which humans, individually and socially, lead storied lives. People shape their daily lives by stories of who they and others are and as they interpret their past in terms of these stories. (p.477)

Connelly and Clandinin’s (2006) view of life history and narrative analysis/inquiry is also based on the premise that life is education, a concept that has historical significance dating back to John Dewey. Through narrative analysis, the personal life being narrated is in every way connected to the educational life that is narrated. In narrative analysis and inquiry, the researcher is served with the task of describing the individual within the larger cultural context (often viewed as the elements or features of the culture, such as a traditional set of beliefs and behaviors within a particular society that can be traced historically and/or referenced to the past). The researcher must also describe that which is socially constructed, viewed as the social makeup and maneuvering of a particular group and the different ways individuals within this group vary at an explicit point in

time. “In getting at the life profiles of others by collecting data on their experiences, we may examine, within limits, the extent to which such profiles are isomorphic with each other, or with some aggregate profile of the culture as a whole – if we know enough about the culture to make such comparisons possible” (Mintz 1979, p.25). The foundation of narrative analysis lies within the way individuals make meaning out of their lives. Thus, within the cultural production of science, students develop relevant meanings out of everyday disciplinary practice (in science) and one’s perceived place in society.

Though it may seem intuitive, Connelly and Clandinin (2006) make explicit three qualities of narrative inquiry and analysis which they term “commonplaces.” In their description, narrative inquiry involves the parallel exploration of temporality, sociality, and place. Temporality involves the study of people, places, and events through time and thus, always in temporal transition. Sociality explores individual personal states (e.g., feelings, emotions, morals, hopes) and social conditions (e.g., environments, people, surrounding forces). Sociality also encompasses the researcher-participant relationship and the resulting personal and social conditions that are constituted as a result (Connelly & Clandinin 1990). Finally, the third commonplace is the notion of place – the actual physical location where events take place and in which the individual is located. It is helpful to think of these commonplaces as further informing the context through which the research is located and performed. Thus, the individual self is in constant flux with the surrounding context, also known as “subjectivity.” In this study, Latino/a student life histories and narratives not only reveal the relationships between the participant and society. These narratives also establish how participants negotiate “exceptional” group

status (e.g., gender status, ethnic status, etc.), and make associations of subjectivity to the development of their identity (Bloom & Munro 1995). Narrative inquiry and analysis permits the examination and exploration of such subjective identities or “nonunitary selves” (Bloom & Munro 1995).

Often times with marginalized groups, the subjective identities are non-monolithic, and contradictory (e.g., both resistant and redemptive) (Chow 1993). “Ethnicity signifies the social experience which is not completed once and for all but which is constituted by a continual, often conflictual, working-out of its grounds” (Chow 1993, p.143). With Latino/as, there exists the notion of negotiating identity, trying on identities, and/or the repositioning of one’s self-designation (Guerra 2004; Ogbu 1992; Visweswaran 1994). However, the “notion of ‘trying on identities,’...obscures the fact that identities, no matter how strategically deployed, are not always chosen, but are in fact constituted by relations of power always historically determined” (Visweswaran 1994, p.8). These multiple identities and participant experiences are constructs of contextual locations and times. They are “authorized at specific moments in history by complex negotiations of community, identity, and accountability” (Visweswaran 1994, p.15). Hence, this study considers science to be culturally located in dominant discourse and consequently focuses on the identities and subjectivities of a culturally and linguistically diverse group within science. Life history and narrative analysis/inquiry searches to better understand how these Latino/a self-representations are used to enhance movement through internally complex gendered and ethnic communities and contexts within science.

3.4 Population Sample and Context

Choosing a specific sampling strategy gives direction to the study and enables the researcher to maximize what we presently understand and what there is left to learn (Stake 1995). For this reason, purposeful sampling was the selection strategy employed within this study (Patton 1990). Merriam (1998) states that the researcher who chooses to conduct purposeful sampling selects a sample that can inform the area of research the most. “The logic and power of purposeful sampling lies in selecting information rich cases for study in depth. Information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the research...” (Patton 1990, p.169). Specifically, the *stratified* type of purposeful sampling approach was conducted in this study. Stratified purposeful sampling, as described by Mertens (1998), is the selection of a group using specific criteria (in this case ethnicity and college major or Latino/as in the biological sciences). Subgroups are then selected within this broader classification (this being the gender breakdown of Latino/a biological science majors).

Research participants were sampled from a pool of Latino/a biological science majors at The University of Texas at Austin, a large research university in Austin, Texas. The students were sampled to elucidate phenomena on how these students have developed ways to cross socio-cultural and gendered boundaries between minority and dominant cultures to succeed academically in the science pipeline (NRC 2002). The identifying characteristics I chose for my participant sample were the following:

1. Undergraduate students in their 3rd year or higher to represent persistence in college and their college major. “...Given the multiple disadvantages that Latino

- students face, it can be argued that it is most important to examine the profiles of Latino students who rise to the top of their own group” (Gandara 2005, p.9).
2. Biological science majors – Biological science majors were categorized as Biology, Human Biology, Biochemistry/Biophysics, Botany, Marine Science, Microbiology, Molecular Biology, and Zoology (Seymour & Hewitt 1997).
 3. Latino/a ethnicity – Also commonly referred to as Hispanic, but mainly referring to persons whose origins are from Spanish-speaking countries in Latin America. Latino/as include a broad range of countries in the Central and South America diasporas – Mexico, Colombia, Peru, Ecuador, Chile, Argentina, El Salvador, Guatemala, and any other Spanish-speaking countries in Central and South America and the Caribbean.
 4. Both males and female genders – Consistent with the framework of representing narrative inquiry (Clandinin et al. 2007), this study used multiple narratives (female and male) as a way to offer different viewpoints on the shaping of identities within college science and the broader discourse of science.
 5. Over 18 years of age – Though typically undergraduate students in their 3rd year or higher are over 18 years of age, the minimal age restriction ensured that informed consent could be supplied by the participant, him/herself. There were no upper-limit age restrictions.

Notably, a description of demographic statistics at The University of Texas at Austin can further elucidate the context from which these students were recruited and selected (UT-Austin 2008). In the most recent statistical data for the Fall of 2007, The

University of Texas at Austin had a total of 37,459 enrolled undergraduate students. Of these students, 6662 undergraduates (or 17.7%) were of Hispanic ethnicity. Additionally, 1585 of these Hispanic undergraduates were natural science majors (the broad college that encompasses biological science majors). That is, 23.7% of Hispanic undergraduate students at The University of Texas at Austin were enrolled as natural science majors. Hispanic undergraduate natural science majors, in particular, made up 18.2% of the total natural science undergraduate population with Hispanic females slightly outnumbering Hispanic males (roughly 54% to 46%, respectively). And while this study does not specifically focus on graduate studies in the sciences¹⁸, it seems appropriate to note that in 2007, the natural sciences enrolled a total of 13 Hispanic master's students, and 26 Hispanic doctoral students (2.8% of all natural science master's students and 2.6% of all natural science doctoral students). That same year, the College of Natural Sciences conferred a total of 184 Hispanic bachelor degrees, roughly 12.6% of all the bachelor degrees conferred within the college – again, with females slightly outnumbering males, 55% to 45%.

It is important to acknowledge that gaining access was intentionally and situationally/contextually determined. I chose to access this group of students by targeting undergraduates enrolled at the same university of which I was a graduate student, and from a course from which I was one of 16 teaching assistants. Having taught this course as a teaching assistant for 3 years at the start of the study, I was very close to the supervisor of the course. Glesne (1999) calls this person the “gatekeeper” or “the

¹⁸ Chapa and De La Rosa (2006) call the demographic trends of Latino participation in STEM graduate studies the “problematic pipeline.”

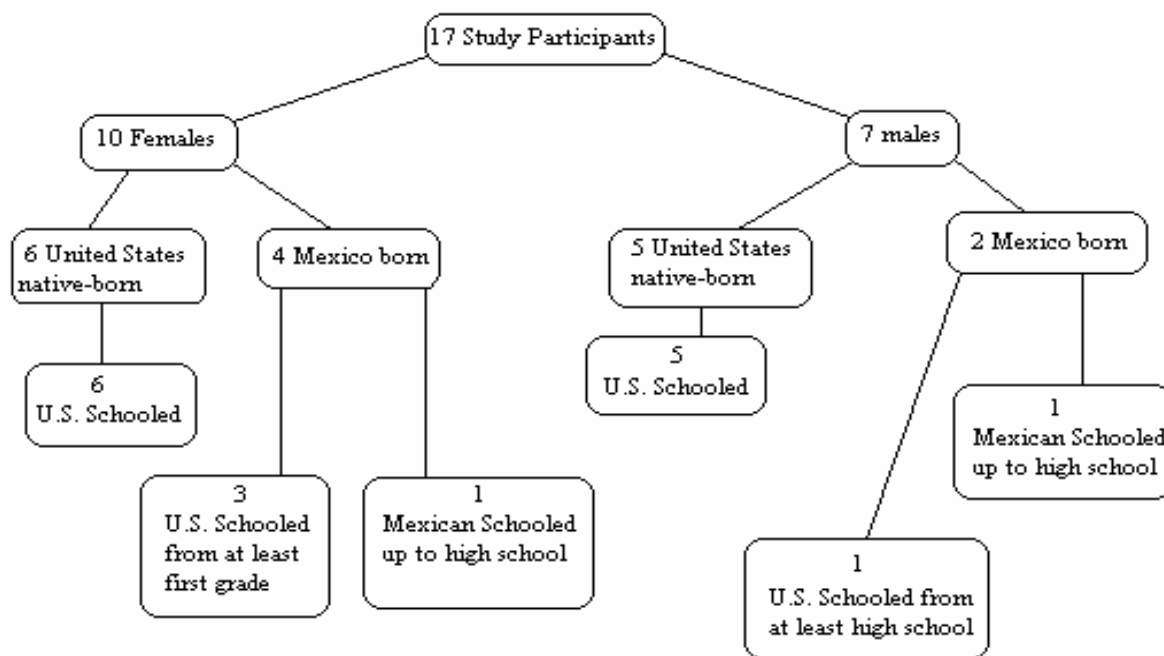
person or persons who must give their consent before you may enter a research setting, and with whom you must negotiate the conditions of access” (p.39). Thus, I was able to attend the remaining 15 other laboratory sections which I was not supervising to make an announcement inviting any Latino/a students interested in participating in my investigation. By not having participating students enrolled in my particular laboratory section, subjection to conflict of interest or enticement to participate due to the possibility of grade inflation was minimized. I specifically chose the upper-level laboratory course at The University of Texas at Austin not only because of the ease in access attained by the researcher, but also because it was representative of the participant criteria constraints directing the study.

It should be made transparent that I attained insider privilege because I was familiar with the setting of the classroom, curricular structure of the course, and other teaching assistants. At first this may be considered a study limitation because of the underlying message that was presented to the students, as I was in some way affiliated with the course in which they were enrolled. Regardless, obtaining the participation of the respondents was a difficult task. Many times, students responded positively to the invitation to participate at the time of the announcement in class, but after permission was given to me to contact them through email (where I further elaborated on the reasons for the study, the purpose of the interviews, and the time commitment), students lost interest. The recruitment period lasted continually from May 2007 to October 2007. During this time I actively recruited students enrolled in the laboratory course for the Spring 2007 semester, Summer 2007 semester, and Fall 2007 semester. In the first two semesters, I received very limited interest in the study from students and felt dispirited. However, in

the Fall 2007 semester, the study attracted more students. The speculations for this occurrence draw on the idea that the initial recruitment happened at the cusp of the Spring semester ending and beginning of summer. Perhaps students were more likely to be away from campus; the Summer semester (as it often does) had limited enrollments of students, as well as during this time, the laboratory course becomes very labor intensive; and/or, the Fall semester provided enough temporal space to increase the incidence of positively recruiting potential participants.

Ultimately, I received positive interest and from seventeen participants who were all of Mexican or Mexican-American, Latino descent. Two participants from the Spring 2007 semester completed the study, one participant was drawn from the Summer 2007 semester, and the remaining fourteen participants were retrieved from the Fall 2007 semester. Active written consent was obtained from all of the study participants (see attached consent form – Appendix IV). In total, ten of the seventeen participants were females and seven participants were males. The participants' biological science majors included Biology, Human Biology, Biochemistry, Marine Science, and Molecular Biology. Though it was not the intent to have a representative sample of participants that reflected the overall gender breakdown of natural science majors at The University of Texas at Austin, this standard was almost achieved in which 41% of my sample were males and 59% were females. Additionally, of these ten females and seven males, six females and five males were native U.S. born (with four females and two males born in Mexico). The following diagram in Figure 3.1 further describes the broad categorical differences of the participants:

Figure 3.1 – Broad Personalizing Categories of Latino/a Student Research Participants



In the end, the sample size was meant to draw as many meaningful perspectives and representations with the ultimate purpose of “continu[ing] to develop rich portraits...if we are to genuinely construct science for all” (Barton & Yang 2000, p.886).

3.5 Data

3.5.1 Data Sources

In narrative inquiry and analysis, data collection and analysis begins with a period of discovery in which themes, stories, and discourses emerge, followed by a verification process in which these themes, stories, and discourses begin to form patterns (Guba 1978). In life history and narrative analysis/inquiry, it is through the data collection of “field texts” that researchers then analyze to ultimately learn how people reflect directly on behavior, circumstances, identity, and events against terms set by socio-cultural

factors (Connelly & Clandinin 1990; Clandinin et al. 2007). In this study, the field texts are represented by three sources: interviews; researcher dialogical journal writing; and, participant observations and/or documents – of which none of these are mutually exclusive in the collection process. The practice of relying on multiple sources or measures is called triangulation and contributes to the trustworthiness of the data (Lincoln & Guba 1985). Triangulation among data sources, methods, and theories may bring about unification or even divergence between these units (Lather 1986). It is through choosing multiple sources of data that various understandings are gained of the phenomena in question, the overall purposes of the inquiry are satisfied, and resources, such as time available for data collection, are efficiently used (Glesne 1999; Patton 1990).

The first and primary source of data from which this study attempts to understand the influence of contextual relationships on student mean-making in science was the semi-structured interviews (Merriam & Associates 2002). This interview protocol was “semi-structured” in that the participants were asked to tell their life story in the initial informal type interview with a series of open-ended prompts to ensure that a basic structure was achieved across all participants. Open-ended interviews allow the participant to respond on his or her own terms (Patton 1990). Subsequent interviews, with more moderately and highly structured questions, probed more deeply into views of schooling, science, ethnicity, gender, and worldviews. (See attached copies of sample topics and questions for the semi-structured interviews in Appendix V). Each research participant took part in a total of three individual interviews (each lasting approximately one to two hours) throughout the duration of the study. All interviews and informal

participant observations (the second source of data) were conducted on The University of Texas at Austin campus, and the interviews were arranged at a mutually agreed time and place by the participant and the researcher. During all of the interviews, the participant and researcher were the only persons at the designated location – always at the office of the researcher on the university campus, as this location was locked and restricted to the public, consequently taking into account researcher-participant confidentiality and reciprocity. Thus, each participant provided approximately 4 ½ hours of face to face interviews that served to draw out their detailed life histories as one of the bases of analysis for this study.

The interviews and observations were also iterative over a 2-4 month period to elicit engagement of the participants in deeper discourses and to develop the necessary relationship of trust, rapport, and reciprocal self-exposure (Lather 1986). To understand each participant's ethnic and gender identities and subjectivities within the legacy of science, a set of questions and/or prompts concerning life history were given on childhood, family, schooling, science education, worldviews, personal identity, morals/values, and ethnicity and gender (both in general and with regards to the context of science). During this time, researcher-generated documents were prepared in the form of journaling – the third type of data source in the study. While the purpose of the semi-structured interviews was to gather comprehensive, systematic, and in-depth information about the participants and their social world (Patton 1990), the researcher journaling aided in the interpretation of the participant views and researcher views of the information within the interviews (Merriam & Associates 2002). In the end, the researcher transcribed the full life histories of ten participants and outsourced seven to a

professional transcription company. With “cleaned-up” prose, which Nesper and Barber (1995) see as “artifacts of interview practice” as opposed to the distortion of data, all seventeen life histories were considered “full transcriptions” – “the most desirable data to obtain” (Patton 1990, p.349).

3.5.2 Data Collection

Participant observations occurred once a week in the same laboratory course from which the participants were originally recruited. “Field records collected through participant observation in a shared practical setting is one the primary tools of narrative inquiry work” (Connelly & Clandinin 1990, p.5). The observation method used was consistent with Connelly and Clandinin’s (1990) concept of “active recording”¹⁹. That is, the researcher took notes which were an active reconstruction of the events with the researcher’s practical interpretation of the events. The observations provided data on participant identity associated with one’s academic environment and the understanding of participant involvement and membership within his or her community of science learners, such as the participation and interaction with other students in the science class. Because the participant observations were limited in the study, it should be noted that Connelly and Clandinin (1990) recognize other such narrative data sources that were additionally represented in this study. For example, story telling which participants use to “describe their work and explain their actions” (p.6). Letter writing, autobiographical/biographical writing, documents, picturing, metaphors, and personal philosophies are all various

¹⁹ “Active recording” as defined by Connelly and Clandinin (1990) is not to be confused with observation that occurs through “active participation” as specified by Mertens (1998). “Active participation” defines the researcher as not only observing but selectively participating in some but not all activities of the participants. “Active recording” is the method employed by the researcher when documenting the observations.

sources of data in narrative inquiry and analysis. In this particular study, personal philosophies were obtained as well as document sharing by some of the participants.

Privacy of each participant was protected by ensuring that the participant was comfortable with the location of the interview. The participant was encouraged to disclose information, ensuring that the time allotment given to the interview could be modified (shortened/lengthened) according to the wishes of the participant as long as he or she felt that the interview responses were as complete as the participant deemed possible. Confidentiality was maintained by assuring the participant that the disclosed information would not be divulged in a way that was inconsistent with the stipulations of the study. Because it was the case that this research data would be published in the form of a dissertation thesis, the participant was also reassured that any identifying information connecting the participant to his/her real identity would be changed.

3.6 Data Analysis

Life history and narrative inquiry/analysis aims to bring meaning by describing routines, problematic moments, and meanings in individuals' lives. This study examines understanding at the individual level so as to understand and sort what we know about the sampled Latino/a individuals before relating the complexities at the sociocultural levels of college and science. Polkinghorne (1995) states that "a storied narrative is the linguistic form that preserves the complexity of human action with its interrelationship of temporal sequence, human motivation, chance happenings, and changing interpersonal contexts" (p.7). When investigating science as a context, narrative inquiry and analysis is an appropriate methodology because of this creation of meaning between contexts and players – what Connelly and Clandinin (2006) call "the landscape of practice."

Some theorists believe that qualitative methodologies like narrative inquiry and analysis introduce evidence that is overly influenced by personal criteria. While quantitative methodologies are seen as “representative” or used as “diagnostic” statistical evidence where ideologies remain unquestioned, the personal circumstances found in life history and narrative research often confound limits of such categories and premises (Mertens 1998). Personal circumstances obscure categorical outcomes. Nonetheless, the use of life history and narrative inquiry/analysis in this study is to suggest that a reasoned argument can be achieved through the telling and representation of personal histories and conditions. As we try to understand “the complex matrix of variables that impinge upon and affect student learning...[m]ethods of qualitative research can assist the practitioner and the learner to understand the nuances and the complexity of individual differences and consider the impact of the social context” (Newton & Smith 1996, p. 31).

Connelly and Clandinin (2006) assert that there are five essential qualities of narrative inquiry and analysis. 1) Experience: Narrative analysis is an experiential inquiry. Stake (1995) defines this as capturing and describing the complexity of the participant through real-life events with an emphasis on nuance and the sequentiality of happenings in context. 2) Time: The context of time is not only important in presenting experiential data, but also in actually gathering participant stories. The interpretability of the analysis is positively related to the time spent gathering these stories. 3) Intensity of dialogue between researcher and participant: Within the dialogue, past, present, and future contexts and relations should all be explored. 4) Collaboration between researcher and participant: Collaboration enables both parties to engage in a reciprocal relationship. This relationship, Polkinghorne (1988) states, should form a text to be interpreted by

others. 5) Researcher insight and reflexivity: The flexibility of narrative story telling (or analysis) allows the data to present itself in a myriad of ways to the reader. Ultimately, “the search is for data that will reveal uniqueness of the individual case or bounded system and provide an understanding of its idiosyncrasy and particular complexity” (Hatch & Wisniewski 1995, p.15).

In this study, the narratives created a cultural and psychic platform through which the individual’s gender, class, and ethnic identities were analyzed (Barone 1995). The meaning of science and its dominant discourse were inseparable from the notions of cultural, ethnic, gender, and linguistic minority, by way of their intersection and negotiation in education and society. For my participants, challenging the socio-historical meaning of science was difficult, as participants came to the interviews with certain notions and preconceptions of what they envisioned the study to be about – some championing the research, while others questioning the relevance. The “spaces of possibility,” spaces that broadened the meaning of science and scientist were not only confounded by the students’ beliefs and stories, but also may have been influenced and produced from my reinforcement of cultural validity in science – imparted simply through the practice of my research (Carlone 2003). It is my belief, however, that the ways in which the students’ talked openly about science should be seen as demonstrations of legitimacy and the broadening of boundaries within the discourse.

The analysis of narratives performed in this study was an adaptation of Connelly and Clandinin’s (1990) concepts of broadening, burrowing, and restorying – where restorying was further developed by interruption and deconstruction of the texts. Many different scholars have described similar analyses so I will compare Connelly and

Clandinin's (1990) concepts with that of Wolcott's (1994) means of data transformation/analysis or what he calls description, analysis, and interpretation as a way to fully depict the analysis. The narrative analysis was achieved through multiple readings of the transcripts and the subsequent codings that occurred through each phase of reading. Segments of data were compared *within* each participant narrative and then themes/concepts compared *across* narratives (Merriam & Associates 2002). Theoretical saturation was achieved when no new themes could be identified by the researcher. Finally, the texts were interrupted and deconstructed through a critical paradigmatic lens, a tool which provided a way to make sense out of the experiences of this marginalized group. Though not meant to be a comprehensive depiction of deconstruction strategies, the methods employed encompassed the questioning of dichotomous comparisons, examining silences and contradictions, analyzing metaphors and biases, and the calling of attention to the things the participants viewed as alien as a way to uncover meanings (Czarniawski 2004).

Connelly and Clandinin (1990) maintain that broadening reveals the overall picture of the participant, his or her character, way of life, and values. Wolcott (1994) sees this as description or letting the data "speak for themselves" (p.10). Yet, even before this point, Patton (1990) suggests that the transcription process should be the first re-introduction into the information generated by the narratives. In this case, I was only able to achieve this for the transcriptions that I, personally, transcribed. To Connelly and Clandinin (1990), the next phase of burrowing focuses on the emotional and moral origins that are associated with particular events and why. Similarly, Wolcott's (1994) analysis is defined through the identification of the seminal factors and the relationships

and interactions between them. “In general, the reduction of experience to variables can yield insights, but it also needs to be understood that it is the whole from which the variables are extracted and reduced that is the context for making meaning of...educational experience” (Xu et al. 2007, p.412). Finally, restorying is the re-shaping of the life story into a collaborative construction between researcher and participant. In a word, as the researcher investigates participant reasonings and explanations, the researcher may use supporting theory, impart personal experience, or present the data in alternative forms. For Wolcott (1994), interpretation is the effort made by the researcher to go beyond the “factual data and cautious analysis and begin to probe into what is to be made of them” (p.36). The researcher communicates the data on his or her own conditions and terms (Czarniawska 2004). For example, Reissman (1993) suggests that the researcher highlight elements such as intertextuality (or variation of the participant’s voice within the discourse – e.g., different tense or different stance), embedding of a story within another, and passive voice. All of these are indications of power differentials that must be further complicated and interrupted by the analysis.

Most scholars believe that the researcher should organize descriptions and/or themes either in chronological order, day-in-the-life, or by critical events (Czarniawski 2004). Still, others like Hatch and Wisniewski (1995) believe that there are specific types of narrative analyses that determine how the organization and presentation of the narrative is produced. As stated before, this research attempts to hybridize narrative analysis. This is achieved by synthesizing events into an explanation of translations/representations of cultural difference and the subjectivities produced out of

nuanced understandings of the participants, but also by relating common themes among the narratives.

3.7 Trustworthiness

Because life history and narratives are ongoing as people live across temporal, social, and physical spaces, it "...suggests that, in a different time, in a different social situation, and for different purposes, a different research text might be written" ²⁰ (Clandinin et al. 2007, p.32). Nevertheless, efforts at achieving a level of authenticity, adequacy, and plausibility should be maintained (Clandinin et al. 2007). Authenticity is often regarded as the characteristic of the research to present a balanced perspective. That is, the researcher should attempt to actively document and present participant construct development and any changes that may occur in participant constructs. "Conflicts and value differences should be displayed" (Mertens 1998, p.185). Lincoln and Guba (1985) discuss ways in which a researcher can increase trustworthiness of study findings. Because the issue of trustworthiness and/or validity has already been detailed in the introduction to this study, I will briefly outline the procedures employed in this study that were used to augment trustworthiness.

- Prolonged engagement allowed the researcher and participant to develop a relationship of trust and allowed some participants to be receptive and unguarded with personal experiences.
- Triangulation was used through multiple data sources and increased the likelihood of clarifying incongruent findings.

²⁰ This does not exempt data collected by quantitative methods as these types of "space changes" may also affect responses and data sources to be analyzed quantitatively.

- Negative case analysis happened when the researcher actively searched for negative cases and unconfirming evidence, experiences, or stories in order to further refine working themes or findings.
- Subjectivity and intersubjectivity was attended to through the understanding, recognition, and representation of researcher perceptions and values that shaped the research. (Intersubjectivity, specifically, is the interaction and connection between researcher and participant that ultimately informs the analysis of the data.)
- Member checking in the form of sharing researcher analytical thoughts with the participant confirmed the representation of the lives, experiences, and views of the participant were recorded and analyzed accurately.
- Rich, thick description was used through the depiction and representation of temporal, personal, social, and physical contexts in the analysis. Mertens (1998) posits that rich, thick description of time, place, context, and culture contributes to the “transferability” of the research to similar contexts.
- The use of multiple cases was another procedure that aided in the “transferability” of the research.
- Finally, discussion of limitations (see Chapter One) helped to provide readers with a relative frame with which to read and interpret the study.

Mertens (1998) and Lincoln (1995) also outline procedures that are useful in maintaining the trustworthiness of research that is carried out from the emancipatory or critical paradigm, the framework that primarily informed the research described in this thesis. The quality of research is judged by

- Positionality. This when the researcher recognizes the contextuality of the research. (For this study, please refer to Chapter One).
- Community. The researcher should not only know the community from which he or she gathers data, but also apply findings positively to the community.
- Attention to voice. “The researcher must seek out those who are silent and must involve those who are marginalized” (Mertens 1998, p.186).
- Critical reflexivity. The researcher is aware of his or her own thinking, the roles that are played in the knowledge construction process, and aware of how meaning is created.
- Reciprocity. The researcher acknowledges that an environment of trust, mutuality, and confidentiality is to be maintained.
- Sharing prerequisites of privilege. The researcher recognizes the contribution of the participant(s).

Life history and narrative inquiry/analysis is characterized by researcher-participant relationships, issues of voice, issues of credibility and trustworthiness, and issues of representation. Lather (1986; 1991) describes these aspects as forming “praxis-oriented research” – the dialectic or fluidity of theory that informs the understanding of experience and experience that informs theory as a mode to keep preconceptions from falsifying the logic within the evidence. Reciprocity from Lather’s (1986; 1991) perspective is gained from interviews that employ an interactive component in which the researcher is involved in self-disclosure or negotiation with the connection to the

respondent, sequential interviews of individuals and small groups, negotiation of meaning through the “recycling of description” back to the respondent, and researcher-respondent discussion of respondent false consciousness. Reciprocity is used to provide analysis of the connections of structure, processes, and people, by creating intimacy and mutuality for the self-exposure between researcher and respondent (Roman 1993). Additionally, the channels for gaining and maintaining reciprocity are explored further in the praxis-oriented research component of validation. Validation of this type of research is accomplished by the teasing out of culturally-specific, tacit understandings from both the researcher and research participant. Polanyi (1968; 1969) describes this understanding as the contributions to scientific or objective thought that are actually acts of personal judgment. The researcher’s own tacit knowledge should be situated throughout the collection, analysis, and writing of the data obtained from interviews and participant observation. The conditions under which the researcher operates, such as her own theoretical and political ideologies, discursive codes and cultural practices, all inform the research being conducted (Roman 1993). These understandings ultimately inform how researcher self-representations are used to enhance movement in and out of the complex researcher-participant relationship that researchers themselves have created in this construction of academic research (Cary 1999). Clandinin et al. (2007) call this researcher awareness and insight, “wakefulness.”

3.8 Conclusion

In the following chapter, the construction of the participants’ stories and reconstruction of narrative plots is first presented in what is termed a “narrative sketch” (Connelly & Clandinin 1990). The brief “narrative sketch” in this case is first, a broad

overview of the participant familial background and second, an introduction into spaces, selected events in science education that are important to the study, and seminal characters of the participant's life history. As I present these stories, I acknowledge that these stories and lives of my participants are valued not only because my participants and I shared mutual moments of emotion, but also that I have come to recognize that each life and narrative resonates with a particular aspect or experience in mine. Noddings (1992) calls this an "ethic of care" as researcher and participant engage in the sharing of life stories, and the ensuing trust and commitments that can be formed. This becomes evident in the candidness of the participants' responses and, many times, the sharing of intimate details of their thoughts and lives. Following the narrative sketches of each participant is a thematic analysis of the participant life histories in which I uncover the knowledge, beliefs, attitudes, and insights on ethnicity and gender that these Latino/a students have created in the science pipeline. This is seen as a way of thinking narratively about the phenomenon of identity shaping – "a narrative view extended over time, shaped by personal and social conditions, and situated, correspondingly in a multiplicity of places" (Clandinin et al. 2007, p.26).

CHAPTER 4: ANALYSIS OF DATA AND RESULTS

The following chapter will provide an analysis of the student participant life histories presented through actual narrative accompanied by textual analysis. In the primary section, participants will be presented in a broad demographic or “narrative sketch.” In the concluding section, thematic findings will be presented with narrative excerpts from varying participants. Through the presentation of life histories and narrative analysis, this research highlights how these 17 Latino/a undergraduate students make sense of their cultural-ethnic and gender identities, and illuminates the knowledge, attitudes, and beliefs that are shaped through their experiences within the science pipeline.

4.1 Presentation and Descriptive Characteristics of Participants

Paulina

Paulina is a 21 year old college senior who was born in a south-eastern city of Texas.

I’m only half Hispanic. My mom is White. She was born in Indiana [and] grew up in New England. My grandpa was a physics professor. My dad, he came from a migrant farmer background and he’s a physician now. He was born...I think it was San Antonio.

Although she was highly interested in the subjects of History and English, Paulina chose to major in Biology following a strong push from her father for the pre-med science track.

He pushed for it...So for a long time too, I struggled with, “Am I doing this because my dad wants me to do it or am I doing it because I want to do it?”...for the first couple of years, I struggled with whether or not I picked the correct major. I didn’t do that well and I was seriously thinking, “Am I too stupid for college? What’s going on? I don’t understand.” So that was a big issue with me for a very long time.

Paulina came to the resolution that she ultimately liked biology and attributed persisting in the major to the motivation she received through academic gratification.

Well, this is the first thing that I can honestly say that I remember trying to do and then not seeing improvement right away. And I think that if I hadn't improved as much as I did, then I would've dropped my major and figured something else out. I remember I was really struggling in general chemistry and I pulled my way up from a D to a B. And by the end of the semester, I was like, "Yeah, I can do this." If I hadn't of seen anything, then I would have thought, "Jeez, maybe I should think about changing my major to something a little easier."

At the conclusion of the interviews with Paulina, she was preparing to take the MCAT for the possibility of a career in the medical professions "working with underprivileged populations."

Juliana

Juliana is a 21 year old college senior who was born in Texas, and later raised in the Rio Grande Valley²¹ in Texas.

My parents are both from Texas and they were born in the Valley²², which is [Valley City], which is south. My mom is an elementary school teacher and my dad is in real estate. They both came to U.T. My mother's father is from Spain, but he came over when he was very young. My dad's parents are both Hispanic and they were born in Texas. They were born down in the Valley and so was my mother's mother. My dad grew up poor...my grandfather was a construction worker and my grandmother worked at a department store. My mother's father came here to U.T...and my mother's mother graduated from here also...the Galveston branch and she's a nurse. He's an accountant.

Juliana's long-term goals and career aspirations are to become a medical doctor.

Growing up, as far as I can remember, I always wanted to be a doctor. And I have a couple of uncles who are doctors and I guess they influenced me. I always knew I wanted to go to college. So not coming was never an option. I think it had a lot to do with the fact that my parents went to college. And a lot of people in my family are very well educated. And I always wanted to be a doctor, so I knew that I would have to go to school after high school. I just thought that having biology as a major would prepare me better for medical school.

²¹ The Rio Grande Valley is the southern region of Texas that lies along the border of Texas and Mexico.

²² Participants often refer to "the Valley" – a connotation of the Rio Grande Valley in the southern region of Texas.

Rocio

Rocio is a 20 year old college senior from a town in the central region of Texas. She was born in Mexico, and came to Texas when she was 4 years old.

I was born in _____, Mexico. My parents are from there. My whole family practically lives over there. My mother went to school over there. My father also. My mom went to nursing school and my dad made it to his first year of college and then had to drop out because there wasn't enough money to pay for it.

Did she work as a nurse in Mexico?

For a while, until we came here. The language barrier just doesn't...no. [Here] my dad has always worked, my mom has always stayed home. He's the only one working...as a waiter. He hasn't stopped working since the day we got here.

When Rocio was asked if there was ever a point she didn't want to attend college, her response was "No. Never. Purposes for attending college: career; education; better life. Just those are the main reasons." Rocio's dream career is to become a pharmacist and at the time of the interviews, she was applying to the doctor of pharmacy programs in Texas. "The final factor that made me realize I wanted to do pharmacy and really be in that kind of field was just family, stability of just being able to do a 9 to 5..."

Imelda

Imelda is a 20 year old college junior from northern Mexico, who transferred to The University of Texas at Austin after her first year at a small college in United States.

Imelda acquired her pre-college schooling in Mexico and her parents still reside there.

[My dad], when he graduated from college, he got a scholarship (a national scholarship) to go study in France – his master's and Ph.D. At the same time, he was with my mom...She did her master's and Ph.D. in France also...My grandparents on my father's side, I don't know exactly what level of education they got to, probably high school and that's it. But, they own a ranch in my state so that's how they do their living...My mother's parents...they got their college degrees. They are professors. They were high school and college professors.

Imelda's interests in attaining a U.S. college education and interest in a graduate career in science was sparked by the influence of her parents.

I was always thinking that I was going to come to the U.S. for college. And my parents also put that idea into me since I was in junior high school. They're both scientists, also. They do research in engineering and metallurgics. And they always had, they taught me so many things about science. Since they did their Ph.D.'s and they went all the way over there, it's also something that I always thought I was going to do. But for myself, I saw biology as really interesting...the fact that the study of biology is life itself. There's some philosophical stuff about it and I really like that idea.

Ultimately, Imelda wants to pursue a career in conservation science.

Teresa

Teresa is a 20 year old college junior who was born in the Rio Grande Valley in Texas. Both of her parents were also born there and reside there. Her father is an electrician and her mother stays at home. Teresa's father attended a university for two years before dropping out due to lack of financial resources, and her mother acquired some community college education. Both her maternal and paternal grandparents were born and raised in the Rio Grande Valley or "the Valley."

They were from different little towns. But, we've been in the United States – like my great, great, great grandparents have been here. We've been here for a long time. I don't know many of my relatives who have come from Mexico.

My mom's dad...he graduated high school, but my grandma and other grandpas, none of them graduated high school.

From her earliest memories, Teresa wanted to attend college and be a doctor and consequently, chose the biology major because of that (while expressing that she also enjoyed the subject).

Because they had just said, "Oh pre-med? Do bio." It's always been, even that's what I thought. And then I kind of thought, "Hey, you know I can." Because if

I'm doing something, I might as well make some money. I mean I know doctors are not supposed to think like that, but it's always something I've wanted to do.

Martha

Martha is a 20 year old college junior from a state in central Mexico. She moved to Texas, at the age of 6 and immediately entered 1st grade. Martha's parents were both born in Mexico.

When we lived in Mexico, he [my father] had very odd jobs. He was a priest for a while and then he was a policeman for a while. And then when we came over here, he sort of worked for a tire company...When my parents separated...she started working again and she got her own apartment.

Both of Martha's parents, despite their lack of more than a middle school education, stressed the importance of education and attending college.

I'm not really coming to make money, just a comfortable sort of life. But also, definitely seeing my parents in a job that they didn't like and not really getting fulfillment out of a job. It was a job, not a career. And I don't want that, even if it's a high paying job. My own purposes were, I did want to do the whole broaden your horizons.

Martha ultimately chose to major in biology due to her general interest and is thinking about pursuing a career in public health or attending physician's assistant school after graduating.

Elena

Elena is a 20 year old college junior born in the central-west region of Texas, and raised in a small town to the north east of the town where she was born. Elena's parents are college-educated and her mother is a teacher, while her father is a school principal.

They grew up on a ranch and they would just grow all their own food and stuff. My mom's side...And my dad just lived a more typical life. But, both of them have some of the same experiences growing up. Neither of them had very much money...and, well, both of my parents went to segregated schools before college. I think my dad's dad was a janitor and his mom was a teacher's aid...My dad's

parents were born in Texas...And then my mom's mom didn't really work much just because they had the ranch...They were actually also born in Texas, but I think they lived in Mexico for a little but then came back and just lived on the ranch.

For Elena, attending college and majoring in biology was heavily influenced by her family.

My parents, it was never really a question, "Are you going to college?" It was, "What college are you going to?"

Well, I chose to pick a science major because I wanted to be some kind of doctor or dentist...Well, I was just always interested in the topic. And, it probably influenced me a lot that my sister had already done it...and she liked it. And she knew that I had been interested in the science fields

Carmen

Carmen is a 20 year old college junior from central Mexico, and moved when she was 2 years old to central Texas, where she was raised. Both of Carmen's parents were also born in central Mexico, as well.

Well, my dad had been living in the U.S. since he was like fifteen...He used to live in California doing agriculture and then I think he moved to [Texas] because of the welding industry in [Texas]. I think that's why we're there...He's still a welder...my dad's the supporter and my mom's the housewife...I think the highest [education] my mom did was 5th grade. And my dad, he did up to 9th grade...School's very important to them. I think because they didn't have an opportunity to go to school, and so now that we can, it's very important to them.

Carmen chose to major in Biology to pursue her career goal of becoming a pediatrician.

She realized this goal during her sophomore year of high school while volunteering at a hospital.

I had always wanted to go into the medical field and so I figured that science would be a good way to go. And when I came here and they talked about, "you don't have to be a science major to go on to medical school." And, so I considered changing to another major, but I really like it and I like learning about the material...My parents were never very stern or firm on what they wanted me to do. I know a lot of students have that pressure from their parents of maybe

their parents are doctors and expected that the children are going to be doctors also. But I never had that from my parents.

Fernanda

Fernanda is a 22 year old college senior born and raised in the Rio Grande Valley in Texas.

Well, my dad was born across by default because they were going to shop over there, so he had dual-citizenship. And my mom was born here...She was raised in [the Rio Grande Valley]...My dad was born into a wealthy family, to a rancher family, so he had more of an educational opportunity to go to U.T. [University of Texas at Austin]...My mom was one of six, so she went to community college...She never graduated from college...They are very proud of being Mexican, and my dad always talks about how he's Aztec and I don't know what, and how there's this rumor that our grandfather was actually an Indian found by a Mexican rancher... My maternal grandparents were born here and I think it goes until my great, great grandparents. They were born in Mexico...[Paternal], they were born here.

Fernanda's father is retired from a state public employee position and her mother is a secretary. Fernanda stated that it was a "natural step" for her to follow in her dad's footsteps of going to college at U.T. Yet, she expressed uncertainty in her future and career due to "branching ideal goals" as graduation loomed the same semester she was interviewed. "I love biology and my goal [is] to be happy whether I be a doctor or a biologist."

Monica

Monica is a 20 year old college junior from the Rio Grande Valley in Texas, where her mother was born and raised. Her father was born and raised in the Midwest.

My dad is a lawyer and he went to the University of Texas Law School and my mom is an English professor...She taught at a community college but she stopped teaching...My grandma and my grandpa on my mom's side were both from the U.S., and my grandma from my dad's side was born in Mexico...And, my grandpa was born here in America.

For Monica, attending college was always a goal from a very young age.

Because of pageants, the judges ask you questions and you have to have your priorities straight. And even when I wished upon a star, I didn't wish for candy or anything. I was just like, "I want to go to college."

Monica originally enrolled at U.T. as a chemistry major, but switched to biology.

I'd have to take analytical chemistry and all these calculus [classes] and it just wasn't for me. So I switched to biology. Plus, its more interesting...So science is interesting to me, on a scale of one to ten, I guess a six...I mean I like how I can apply it to everyday life, and I like stuff that distinguishes me from other people, I guess.

And while her ideal career is to become a doctor, she is leaving open options for graduate school or to become a physician's assistant.

Lucio

Lucio is a 21 year old, fourth year college senior with two more years left at U.T., because he transferred after his sophomore year from a university in west Texas, where his parents currently live.

I was born in Mexico and both of my parents are from different parts of the northern Mexico border with the U.S...My dad studied at the University of Mexico City...studied in economy...and then worked there his whole life...And my mom, I think she got up to high school and then she didn't finish any other degree. She opened a little business and worked on that most of the time.

Lucio wanted to attend college in the United States at a very young age because of his brother who took that path. Lucio was interested in biology but initially encountered resistance from his parents. Later, when applying to college he chose biology as a major and his goal is to receive his Ph.D. in a biomedical science field.

I really, really wanted to – biology in particular. And I told my mom once and being from where we come from, she told me, "No. You shouldn't study that." She wasn't forbidding me from it, but she just advised, "You shouldn't study that because you're not going to make any money. You're going to end up as a high school professor or something like that." And I was like, "Yeah, maybe you're right." But then, after changing my mind a couple of times, I came back to, I told my parents I wanted to study genetics.

Fabian

Fabian is a 19 year old college junior from the south-eastern region of Texas, where both of his parents and grandparents were born and lived all of their lives.

I was born and my mom was very young. She never went to college or anything. She was nineteen at the time so we lived with my grandmother for a while and her and my father were never married. So that was always something that was a big part of my life...I guess my great grandparents came here from Mexico. So it's been a few generations, but I still feel very close to that. It's a big part of my life definitely. I'm proud and everything of being Hispanic...

Fabian's decision to major in biology and his interest in a medical career stemmed from his stepfather's fight and death from cancer.

My first stepdad actually died of cancer so that was actually one of the things that kind of gave me the idea of a doctor. And the kind of the doctor he went to was sort of somebody I was looking at. He was a research doctor but he was trying this new study and he had his patients and my stepdad was one of those. And it was where I felt you could do the most good because you have your patients but you were also working in the lab, which I am. It's kind of the cutting edge if you make that discovery. Eventually its got to be tested on people, so that's kind of where I want to go in a sense, but if I make it to be a doctor.

Macario

Macario is a 21 year old college junior who was born in central Mexico. Macario came to Texas when he was fifteen years old.

I started high school in freshman year. But in high school, they put me one year behind, because I didn't have my grades with me.

Macario is the first person in his family to attend college and his high school experience with a "caring" science teacher incited his interest in biology.

My mom and dad, they know I'm at college but they don't know what I'm doing here. They care about, but they just don't know. They've got limited knowledge because they didn't have much education. They don't know what I'm doing. Even if I tell them what I'm doing, they won't be able to understand.

I think the way they approached me or the subject and the way they talked to me, the information they taught to me is what informs me to even decide my major or my future career...And I was, well I still am a biology major. But third semester I kind of doubted. I didn't think I still wanted to do biology because it was getting tough...But I decided to stay with it. I think that the better things are the ones that really cost you, so you won't really see when something is really good.

Macario talked about the security that comes from an education, and his career aspirations centered around becoming a doctor and being able to give back to his community back in central Mexico.

During the summer in high school, I would work with my brother and we would usually work in the fields during the hot sun or winter during the cold...I realized that wasn't the thing I wanted to do all my life and I wanted to have a secure future for myself and for my family...I expect for me, giving back as much as possible to the community that shaped what I am...there's lots of kids there that need attention, so hopefully going back there.

Isaac

Isaac is a 25 year old college senior who was born in California.

I was the only one in my family to be born in the states. My parents came over and just had me, from Mexico, and then went back...My mom [was born] in [Mexico] and my dad, [Mexico]...My mom dropped out of school once she married my dad...I think she did two years of high school...He was an M.D...And then he got his master's in public health, as well as a toxicology degree, and he's working on his Ph.D. now for toxicology.

Isaac moved back to California at the age of ten, and his family finally settled in Texas starting his freshman year of high school. Isaac initially came to U.T. declared as a mechanical engineering major due to his interest in design.

I almost figured out right away, I just didn't switch out right away – that I didn't want to do that because I realized it's not alive.

After his junior year, he withdrew from school for two years to travel abroad during which he decided he was specifically interested in marine science and returned to U.T.

I basically, I don't know, I guess you could say I was a little depressed at the time. I wasn't going to class, I wasn't dropping the class, and I also wasn't taking the tests.

When I was traveling, that's when I started kind of forming what I wanted to do...I saw marine science as one that could offer me more of what I want – being outdoors a little more.

Isaac hopes to find a career in marine science working with fisheries abroad.

Reuben

Reuben is a 22 year old college senior who was born in western Texas before moving to the south-eastern region of Texas, at the age of thirteen when his parents separated.

So my dad was actually born in Juarez [Mexico], but he was raised in El Paso. She [mother] was born in [west Texas]...So my mom got her degree from [the university] in communications, and my dad finished high school and proceeded to work as a contractor...She works as an account coordinator...My [maternal] grandmother, she started working, she worked for a corporation for the longest time. My maternal grandfather, he worked...On my dad's side, my grandmother, she was a homemaker. My grandfather, they're from Juarez, Mexico, and when my grandfather was really young, fourteen or fifteen, he would cross the U.S.-Mexican border to El Paso and he'd work in construction.

Reuben blindly attended a university in northern Texas (due to a cousin's recommendation) for his freshman year before transferring to U.T. Originally, Reuben aspired to be a physical therapist but later changed his mind to become a physician.

I was going to college, that's how it was put to me when I was younger, because I had the grades to go...My brother is a different story, he didn't really care about school. And I would always say, "Well, why doesn't he have to go to school?"

What were your purposes of choosing a biology major?

One, I was always good at it...I like that it was something that made me stand out because I was always good at it...Two, I wanted to do physical therapy and the prerequisites for that overlap for science...But now, I'm interested in taking classes that I don't necessarily need [and] I want to be a physician.

Alberto

Alberto is a 20 year old college junior from a city in the central region of Texas.

My dad was born in [the Rio Grande Valley in] Texas, and my mom was born in [central] Texas. My parents have a high school education and they maybe have a couple hours of college...it was community colleges. My dad came from the same background as my mom: lower class family. My dad was doing civil service down...because he got laid off at [his previous job]...And my mom works at an insurance company.

Alberto attended The University of Texas at Austin due to its institutional prestige. It was in high school that he first decided to go into the medical field, after shadowing a doctor and observing some surgical procedures at a hospital his junior year.

My purpose for attending college was to get an education in the sciences so that I can go on to the medical field. And I got that probably from influence, like my brother, but also from me just going to some medical forums and seeing stuff, like shadowing.

After college, Alberto would like to pursue a career as a physician's assistant.

Marcelo

Marcelo is a 20 year old college junior from the northern region of Texas.

I just found myself there having a tumultuous background, very inconsistent, very, very uncertain...She [mother] had me when she was 18, but by the time she had me, her and my biological father were separated. She grew up in Mexico but she was born here. She's a medical assistant...She was married twice. She wasn't married to my sister's dad. She was married again, and we grew up with our step-dad. They've been married for ten years now, and so he's sticking around and they're making that work.

Marcelo hardly saw his father while growing up and still has very limited contact with him.

He of course was born in Mexico and so were his parents. He's just been a disappointment.

It was a very loose family structure. My freshman year, I actually had a pregnancy scare with my first girlfriend. That night, I was literally on my knees praying to be spared out of this, to get out somehow. I didn't have a good spiritual connection with God. I prayed and swore to God, "I will do the best with what you gave me if you just get me out of this. I won't be lazy and all of that."

The night before I told my parents that something was wrong, my girlfriend called me and told me everything was fine.

Marcelo excelled at school after this turning point and decided to attend college.

I was the first person to go to college. I knew college came after high school. I knew I wasn't going to quit after high school like the other Mexicans do. My mom always told me you're not going to be like the other Mexicans.

He ultimately chose to major in biology because he liked the subject in high school and had a nurturing relationship with his A.P. biology teacher. At the time of the interview, Marcelo was still undecided about his career options.

4.2 Analysis of Data and Discussion of Thematic Findings

The analyses of the students' life histories and narratives are guided by the original research questions on student-based perspectives and meaning-making of ethnic-cultural and gender identities. These questions ask how the conceptualizations of identity influence the climate of the university science pipeline and how they shape the educational trajectories of these students. Although many more narrative themes were gleaned from the analyses of the participants' life histories, presented here is a focus specifically on those emerging discourses on ethnic identity in higher education and those on ethnic and gender identity in higher education science. The presentation is focused on the common thematic findings across all study participants and findings separated by gender in science. At the end of this chapter is a discussion of other factors that delineate the participants and how these factors intersect within the analyses.

The themes that surfaced in these stories and narratives should lead to further discussion on how we are to answer questions about the ways interpretations of identity are acted upon at the collegiate level and in college science. What are the elements that

we allow to separate us and what are the aspects that separate us that we are not aware of? These are fundamental questions that speak to universality and difference, strategies to combat stereotypes, and hybridities of nationalism and indigeneity within the lives of Latino/a students and underrepresented populations in higher education and science. The following is an outline of the theme titles that will be followed in the discussion of the analytic findings:

- I. Ethnic Identity and Higher Education
 - a. Physicality and the Culture of “Looking”
 - b. Ethnic-cultural Bond *and* Negotiation of Otherness
 - c. The Politics of Stereotype: Acknowledgement, Subscription, Internalization, and Threat
 - d. The Allegory of David and Goliath: A “Subaltern” Narrative
- II. Science Pipeline
 - a. Latino/as in Science: Representation, Expectations, and Perseverance
 - b. Latina Female Narratives:
 - i. Stereotypes, Perceptions, and Resistance
 - ii. Juxtapositions of Ethnicity and Gender
 - c. Latino Male Narratives:
 - i. Pressures and Societal Expectations
 - ii. Female Emotional Advantage: The Return of the “Tracherous Woman”
 - iii. Science: The Gender Equalizer
 - d. Science: The Cultural Equalizer (A Conflictual Narrative)

4.2.1 Ethnic Identity and Higher Education

4.2.1.a: Physicality and the Culture of “Looking”

Beginning with a general analysis of Latino/a perspectives on ethnic identity, the first narrative that study participants reflected on was the physicality of being Latino/a. Both males and females spoke of physicality, framing this notion with respect to the examination of visual perceptions by others and the resulting impacts in relation to their subjectivity (Bhabha 1993). For example, students were quick to point out the importance of skin color as a definition of their ethnic identification or non-identification.

My dad's Hispanic and my mom is not. But when I'm around members of my father's family, they always say, "Oh, you're the White kid."
For them [mother's family], I'm very Hispanic. I look very Hispanic, I sound Hispanic. (Paulina)

People see “Oh, he has brown skin color, so he must be Latino.” (Macario)

Both Macario and Paulina are conscious of the ways observation of skin color are attached to images of what it means to be Latino/a and the implications of shifting contexts that relate ethnic authenticity. Butler (1990) describes this concept of physicality and observation/looking as a political relationship between the surveyor and the surveyed and a way in which the surveyed respond to the meanings that are being ascribed to him or herself. This concept of contextual Latino/a identity through physicality is also evident in the more socially and psychologically entrenched experiences of Teresa and Monica who both regard themselves as light-skinned.

I'm always like, “Stupid Mexicans.” I'll make comments too. But it's, I always thought I was more White, especially in high school. I don't work, my parents don't work in the farm. I always thought we were a little bit better. And coming here with some people, I'm like “I'm not even close to thinking I was White.” I'm tan and I'm white up here (*motioning to her shoulder covered by her shirt*), but I'm getting tan and my arms have never gotten this dark. So it's like “Whoa, I'm really Mexican.” And I know that sounds weird, but it's like, it's kind of

strange, but I feel more, more identified with being Hispanic being here amongst other groups than just being just around Hispanics by ourselves. (Teresa)

People will always find it so crazy that I look how I do, but I'm Hispanic. And they have that stereotype in their mind... Sometimes I think it's easier for me – being the way I look and the way I talk and stuff – to move up. Because I kind of just blend in. I can blend in and then I can distinguish myself. And it really gets me upset when I see dark Mexican people trying to blend in. I don't know why that bothers me. What gets me is they put down the Mexican race and our culture and that we're ghetto and the Valley is ghetto and stuff, and, “Oh, I heard this and this.” I'm like, “Why are you putting us down? You're the one who can't run away from being stereotyped, so why don't you just embrace them?” So I mean it gets me upset when they try to blend in. But I guess – I mean I don't ever put anything down, but sometimes I'm jealous of them that they are distinguished all the time, whereas I'm not. And, I'm kind of criticized for that. (Monica)

Teresa's story supports the concept of contextual authenticity, but she also uses this physical characteristic to complicate the balance of ethnic allegiance and group belonging. In her home town, Teresa shifts allegiance to a more distant and removed Latina identity, whereas in the context of the university, an institution with over half of its student body who are White, Teresa reclaims her ethnic identification – all of which occurs through physical appearance. Monica, on the other hand, considers herself light enough to “blend in” or “pass,” but responds to the alliance of color by which many Latino/as can include themselves and for which she is a cultural outsider (with little capital) (Moraga & Anzaldúa 1984). Interestingly, Monica also shows an absence of conceptualizing the privilege and cultural capital that “blending in” with the dominant culture implies, and she consequently projects disdain for those Latino/as she sees as attempting to “blend in.”

Other participants like Rocio and Isaac examine the relationship of “gazing” or “looking” as a process for creating subjugated spaces fashioned from dominance. Within the “culture of looking,” identity is defined by the physical body which produces a dialectic between observation of the body and consciousness of the mind. Santa Ana

(2002) discusses how these schemas or scripts can stigmatize the social identities of all Latino/as. Often, Latino/as are assigned immigrant status (aside from actually being one or not) based on shared physical characteristics and a socio-cultural orientation of observation/“looking.” Rocio and Isaac’s narratives demonstrate student recognition of the discourses of cultural dissent and social antagonism (Bhabha 1993). These discourses of rejection are realized and perceived through what Anzaldua (2007) terms, “la facultad.”

I think it affects the college life in the fact that we're not taken seriously. Like when I was working at a restaurant when I was in high school, I'm pretty sure people thought that that was it. I'm just, by appearance or whatever or when I speak Spanish, I just think we're automatically judged. (Rocio)

You know sometimes I have felt awkward in certain situations – that I was outnumbered, basically. Awkward as in I didn’t have enough people that I associated with, as myself. Like body language – the way everyone kind of reacts to you. You know if you have a whole group of people, if they react to you? It could be very subtle. (Isaac)

Many different scholars have recorded the culture of “looking” within their research. Feagin and Sikes (1994) talk about the “hate stares” that students experience and emphasize the “racialized” nature of the culture of “looking.” Lopez (2003) also states, “Glances that African Americans are subjected to on a daily basis from strangers are not merely inconvenient; they have a significant psychological impact on the worldviews of African Americans as individuals, as well as the community at large. These incidents reverberate and accumulate to form part of the life perspectives of African Americans” (p.31).

Accordingly, student observations and their organization of images within social and college environments have the capacity to take on meaning when making sense of one’s individual self in the world. The process of observation may happen below the

threshold of consciousness, produced through social and psychological interplay, or through the attachment to symbols and images. These images are “visual perceptions, conceptualizations and representations of race, ethnicity or even racism played out in their everyday lives and [have] evolved into our adult attitudes and identifications” (Phinney 1993, p.63). In his memoir, writer Richard Rodriguez (1982) also spoke about the influence of observation and examination of skin color – “that is to say that my complexion assumes its significance from the context of my life” (p.137). Thus, Rocio and Isaac come to understand alienation and oppression as members of the collective Latino culture through “gazing” and “looking,” while simultaneously learning how to function in the new spaces of, as Isaac puts it: “awkwardness.”

4.2.1.b: Ethnic-cultural Bond and Negotiation of Otherness

The experiences of the students in the context of higher education bring about narratives on the ethnic-cultural bond or connection among collegiate Latino/as. Concurrently, students also reflect on ethnic identities of “otherness” and negotiate between insider-outsider ethnic group identification. For example, the following students describe the cultural bond of “Latinidad” and the practice of belonging.

I guess we all have in common that we – I don’t want to say stick together – but you just, I don’t know how to explain it, but you know when you meet other, especially with me, meeting other Hispanic people here at U.T. I mean there is so little of us, so you kind of get excited. You just assume that they grew up the same and that you have those weird things in common that your culture does. (Juliana)

With Latinos, we kind of have certain things in common. Because it’s a shared experience. And, I guess with other groups, it isn’t like you feel alienation, but it’s, whereas you feel that like instant connections with other Latin[o]s, you sometimes feel a little disparity. (Fabian)

The ethnic-cultural bond and connectedness felt by Juliana and Fabian is a concept based on sharing something “intrinsic” that is at times hard to define, yet always part of an

undercurrent of deeper understanding and common connection. Similarly, Arbona et al. (1995) show data in which ethnic loyalty and connection are maintained across different generational status of Mexican-American college students. Arbona et al. (1995) define ethnic loyalty as “the individual’s sense of pride in Mexican culture, preference for being with others of Mexican descent, and perception of discrimination against people of Mexican descent” (p.613).

I think it's just a matter of you want to feel in a comfort zone and most people tend to think that they're part of that comfort zone with people of their own race or their own ethnicity. (Carmen)

It gives you a sense of belonging. (Martha)

For example, right now I have a TA that’s also Mexican. So you kind of relate to them. If you have something in common with someone, you always try and talk more and stuff like that. I think you are more prone to ask for help, because you kind of already established that common thing. So, it’s just easier to talk to them and comment on something. It helps. (Lucio)

Carmen, Martha, and Lucio continue to affirm the sense of belonging and comfort that is felt with other Latino/a students. Lucio, specifically, applies the notion of ethnic-cultural bond to how one actively interacts within a classroom setting. According to Lucio, the concept of ethnic bond and connection influences the way he participates cognitively in academic subjects.

Additionally, the participants oppositionally discuss the concept of feeling removed or negotiating the boundary of identification and otherness. At different points in their narration, these same students intimate bond and connection with their ethnic group. Here, multiple identities converge on the negotiation of what it means to be a Latino/a and the ways in which the shared experience of higher education calls for this delicate negotiation (Visweswaran 1994). Academic identity and social identity are balanced by the allegiances to educational life and the higher education environment.

Often times a direct result of working so hard to debunk negative stereotypes of Latino/as, the posturing they employ to distance themselves from the collective ethnic identity allows them to create “successful” identities. For example, Marcelo and Alberto distance themselves from an ethnic identity defined by lower-working class individuals. Marcelo specifically highlights the difference between himself, pursuing education, to the Latino men working construction on campus.

Basically like the guys lined up on a wall during lunch time who are building the stadium. That’s what I see, like that’s what I think is typical [Latino]. (Marcelo)

I guess I don’t really have the ethnic background as maybe somebody else. And then if I’m seen by someone else, then they automatically assume that I do, maybe. I just won’t identify myself as being Hispanic or maybe I just don’t fit the stereotypes. But I sometimes, I feel that I don’t fit. Hispanic lifestyle is seen more as like the middle class and working. Yeah, I guess working class. But I guess I associate myself with upper class. (Alberto)

Another student, Macario, distances himself from an alternate definition of Latino/a ethnicity – defined by social deviance. Macario tries to resist this social stereotype but ultimately succumbs to his need to position himself outside the collective.

I don’t say that I consider myself a member of my ethnic group all the time because I mean, sometimes I see Latinos acting deviant – like doing stuff that they shouldn’t be doing or begging on the street. And I refuse to believe that some Latinos are like that. So sometimes I don’t want to be, myself, related to those people. (Macario)

Lastly, Isaac is a student who is unsuccessful in naming the collective ethnic definition he feels he is able to associate with. His ethnic identity is defined as neither here nor there, in a self-described state of “limbo” and negotiation by which it means to be a Mexican and what it means to be an American.

There are times where I feel like I don’t have a place either here or there. Because, I’m kind of in limbo. Its like I got part of my life is there, and then part of my life is here, and then there again, and then here again. I don’t remember what kind of situations bring that about – there has been situations when I have

felt that way where it's like "Well, I'm not fully Mexican and I'm not fully American. Not sure where I fit in." (Isaac)

Maira (2002) discusses these hybrid-like identities as "embedded in the dialectic between the presumably divergent pathways of assimilation and ethnic authenticity" (p.16). The students are caught in a society where the construction and politicization of the social identities and cultural symbols of "Latino/a" are defined as "deviant." In sum, the students live academic lives that are in constant discourse-dialogue between these conflicting heterogeneities of ethnic-cultural bond and negotiation of otherness.

4.2.1.c: The Politics of Stereotype: Acknowledgement, Subscription, Internalization, and Threat

In this theme, participants intimated different ways in which they respond to racialized stereotypes that undermine and marginalize their Latino/a culture. Their narrations reveal the rhetoric of stereotypes from which all participants acknowledge. Thus, the politics of ethnicity and ethnic identity form an "ethnoscape" (Appadurai 1993) to which individuals subscribe to such stereotypes, internalize the stereotypes into a form of oppression, or translate the stereotypes into a threat – from which they define their very existence in higher education. Appadurai (1993) defines an ethnoscape as "deeply perspectival constructs, inflected very much by the historical, linguistic and political situatedness of different sorts of actors: nation states, multinationals, diasporic communities, as well as sub-national groupings and movements...and even intimate face-to-face groups, such as villages, neighborhoods, and families" (p.222). For example, student participants noted the public ethnoscape of social antagonisms that pervade social discourse and that are enacted, sustained, and legitimated into present student realities.

I think that's another of the misconceptions – that people or other groups, such as the American society – that Latinos are just, that we are, there are a lot of Latinos

here, that they think that we are the troublemakers just because we are Latinos, that we are deviant because we are Latino. (Macario)

Mexicans, specifically with all the immigrant issues, they are being very discriminated. And all the stereotypes formed, I really despise them. For instance, I hate all those, I don't like all those jokes about Latinos being field workers or maid service or hotel service. I really hate that, because that stereotype is really marked. (Lucio)

While Lucio and Macario communicate the marginalization and inferiority of such stereotypes (stereotypes where Latino/as are seen as unproductive members of society), students such as Fabian and Marcelo describe such marginalized ideologies from the scrutiny by both the ethnic-cultural community of peers and outsiders.

Well I guess jokes, especially from my friends, because my family from where we are now, we're in a rich White suburb, you know. And, they give me a hard time sometimes about, "Oh, you're not really – you know, you're a White. You moved out there." The joke has been coconut – brown on the outside and White on the inside. But, I mean, I've always – I'm glad that I've kind of retained my culture and stuff. And, that's why I hope that I will translate that to my kids and that my – the rest of my family stays that way, you know, because it seems to always be associated with whether you're living in the ghetto or the bayou in order to being Hispanic. (Fabian)

People would say, "Yeah, you're not like the other Hispanics. You're excelling," or, "You're going to college," or this and that, just basically it was the good – the successful qualities that pushed me from the typical group. (Marcelo)

Both Fabian and Marcelo formalize and reconstitute conceptualizations of the stereotypes in different ways. Whereas Fabian tries to resist the scrutiny of his Latino peers by asserting his cultural affection, Marcelo seems to tacitly accept the idea that most Latino/as (or "Hispanics") are academically unsuccessful. These understandings ultimately inform how individuals use ethnic stereotypes for the emphasis or de-emphasis of their own ethnic identities.

In the exploration and clarification of their conceptualizations, beliefs, and attitudes on Latino/a stereotypes, the participants uncovered anti-ethnic self ideologies and narratives. Through the edification and subscription to stereotypes and inherent

recognition of social capital, the students reveal feelings of oppression and rejection of cultural identity. The resulting stories expose the discriminations and self-restrictions imposed by these stigmatized individuals (Padilla & Perez 2003).

I didn't want to be a loser. I think where I grew up I think it had a lot to do with the fact that I am in college. And the fact of where my dad worked, also - you know he purposely would take me in. And he would tell me, "Do you want to end up like these girls?" So I think that had to do a lot with it. The neighborhood I grew up in. The people I was surrounded by. Just my whole social world I think had a lot to do with it. And like the kind of friends I made in high school and the high school I went to. And like how much of our population was represented and what I guess the Chicanos, Mexican Americans, would achieve in high school. As an observer you can see the difference you know between their story and you know an American girl, a White person's story. You see a huge difference. And all of my friends in high school were White. All of them. (Rocio)

I think that is where many Hispanic kids think what am I doing – learning about like Shakespeare and Sophocles – what does that have anything to do with getting a nice truck? And, so they see that dropping out and getting a job is a lot closer to getting a nice truck than – they don't have the perspective. (Marcelo)

Sometimes when I see Hispanics with a bunch of children and the father's real cholo or ghetto looking, or I guess lower-class looking, I kind of don't associate myself with them. Back down where I live, we're like, "Yeah, ghetto." Or whenever we see them we're like, "Chunt." We have different slang words for them. And that's when I don't consider myself Hispanic because I don't want to be part of a stereotype like that. Kind of like chuntaro [*"wetback" or uncultured, low-class Mexican*] or cholo [*Mexican gangster*]. You never heard chunt? I also say "Sus," like sucio [*"dirty Mexican"*]. (Monica)

These three narratives tell a story of individual posturing to, once again, distance the hegemonic ideology of "Latinidad" from the individual narrative and ethnic identity of the stigmatized participants (as is seen in the theme: *Physicality and the Culture of "Looking"*). The negotiation is a discursive shift that makes possible the suspension of group identification but also reinscribes the dominant discourse into the identity of the individual. Thus, the individual remains marginalized and internally oppressed, within a "process of simultaneous institutional engagement and oppression" (Lopez 2003, p.15).

In the same way, these negotiations and verifications by the participants are related to what Spivak (1993) calls “internal colonization” – the “patterns of exploitation and domination of disenfranchised groups within the United States” (p.187). In this explanation, the “culture” of Rocio, Marcelo, and Monica are strategies of survival between ideology and individuation.

Finally, the pressures of ethnic-cultural stereotypes are normalized and rationalized through the adopted view that it is easier to advance within higher education when identified as a Latino/a. In other words, the students falsify the belief of the education system as a meritocracy and shift to belief in a system that unequally favors minority cultures and Latino/as.

It’s easier to be Hispanic – people set the bar so low. (Teresa)

When I applied to U.T., I wasn’t in the top-ten percent. I was in the top eleven percent and I was in a Texas school. And I don’t think I did that great on my SATs. And I knew that from the previous year, basically U.T. only accepted people that were in the top-ten because there’s too many people applying and they only accept people in the top-ten. So I applied anyway. But then I got a letter back saying I was accepted. So maybe, maybe they accepted me because I was Hispanic and they said “well...” No, I don’t really think that. But sometimes, I think maybe. Maybe that’s why. (Isaac)

Teresa and Isaac not only subscribe to prevailing thought on systemic advantages for minority groups, but link the past histories of such legislations to the present traditions of higher education and make them universal (in their mind), at the same time relegating their academic identities to subjugation, domination, and displacement.

Conversely, Carmen and Juliana confront and challenge the totalizing concept that Latino/a success in school and presence in higher education is an abnormality.

I think for Latina, Latinos in higher education, it seemed more of an abnormality – it’s not as expected for you to be here and it’s not as expected for you to complete. I think it’s when individuals complete, it’s not looked down upon us harshly. I think that people expect “Oh you’re just not going to cut it” because

people try – I assume, people try to take into consideration the background you've had with in terms of schooling and it's just a common thing that in Latino communities the schooling is always a little bit below the level of others. And I think more in relation to school, I think people treat it as more of an abnormality. If you don't do well, it's more excused, but if you do well, it's like I don't. You would say, "A Latino student graduated from..." You wouldn't just say, "A student graduated." (Carmen)

Because, a lot of people think that the Asians, and the Indians are also very very smart. And I think a lot of people think that Hispanic people and Black people (here at U.T.) are here because of top ten percent, or affirmative action, things like that. I think a lot of people don't think that we actually earned our grades. And we're ABLE to come here because of our grades and not because of our race. (Juliana)

Both Carmen and Juliana contest the "Latino success as abnormality" narrative by upholding the belief in one's intellectual competence and by being able to critically evaluate the education they are receiving, instead of ambivalently acquiescing to a devaluing system or prevailing set of beliefs (Ward 2002).

Steele et al. (1993) discuss the idea of self-image resilience (or maintaining a general image of self-integrity) as a psychological "end goal." They posit that an individual does not have to dismiss each stereotype threat that presents itself, but instead can utilize different strategies to maintain the self-integrity of the individual. An individual can let a threat remain "unrationalized" by accepting the threat without opposition, or affirm another aspect of the self that supports another aspect of "self-adequacy" (as we see in Fabian's narrative). Vulnerability, on the other hand, requires an individual "to have knowledge of the stereotypes linked to their stigmatized social identities and the knowledge that they risk being personally reduced to those stereotypes in a given situation" (Davies et al. 2005, p.277). As we see here in this theme, and later in the Latina female themes, Latino/a students devise complex strategies to cope with

stereotypes, whether they exhibit vulnerabilities or find an aspect of self that maintains their self-integrity.

4.2.1.d: The Allegory of David and Goliath: A “Subaltern” Narrative

The allegory of David and Goliath is a narrative that permeates all themes and participants in this study. It is a story of struggle and of carving out successful trajectories amongst expectations of failure and negative stereotypes (Gurin & Epps 1975; Gurin & Nagda 2006). It is a narrative that defines the participants through a collective, despite negotiations of physical difference and difference in consciousness. The David and Goliath narrative is fashioned from the need to break judgments imposed on Latino/as through successful example. Lopez (2003) suggests that both males and females are more likely to produce these types of definitions of self-determination and autonomy through the pursuit of education, though females are thought to define these goals through a sense of family responsibility. In the analysis of the student narratives within this research thesis, these narratives suggest that *both* Latinos and Latinas convey feelings of obligation and sense of struggle for the family. More broadly, the male and female narratives below suggest both genders identify with the struggles against social inequalities imposed on their Latino/a ethnic identities.²³

I believe that I, being Hispanic and being Latina and coming from an immigrant family I just, I feel like I want it more than other people. You know like I have some Caucasian friends, and I just feel like I want it twice as much as they do.
(Rocio)

Rocio emphasizes feelings of difference to her non-Latino/a college peers. Focusing on this point, Rocio asserts this difference is based on the amount of desire Latino/as have

²³ I have included extensive samples of narratives for this theme because of the very latitude that this narrative carries throughout the participants’ stories. The David and Goliath narrative not only connects all

for improving their education. In Rocio's larger narrative, it is clear this desire is built upon family economic betterment and the effort to expose the fraudulence of totalizing stereotypes against Latino/as. Elena, Lucio, Macario, and Marcelo extend this idea of pushing against stereotypes and rectifying Latino/a ethnic social status.

I just feel people expect me to just go to a technical school, or something like that. And, I can actually accomplish something else, but maybe they'll look at me different. (Elena)

I think it's an opportunity to break the mold. (Marcelo)

I guess somehow on an unconscious level – you try to demonstrate otherwise. Of course we can. We're just as capable of either something as hard as science or something as competitive as business or stuff like that. We're as capable as anyone else. But, you unconsciously try to prove that always. (Lucio)

People, like American society, believes that the Latino population is just like the workers. Like, they're not professionals – they can't hold any professional jobs. They are just here to do the labor. I think seeing those misconceptions or those type of – not racism – but prejudice, I think keeps pushing me to prove. That we're not achieving something but maybe we're expected or that they think that we're not capable of – so that pushes me to attain the highest level that I can get in the professional field. (Macario)

Additionally, Carmen and Fabian are examples of how the David and Goliath allegory is culturally instilled within Latino/a values of family-instilled pride and resoluteness in their labor towards success in higher education.

Hispanic people, are very hard-working, and that's really stressed – like nothing should really come too easy because otherwise it's not worth it. Or, also like pushing through, I think a lot of these people who came here with nothing – that it had to be stressed in them in order for their survival. And so I think that as generations past come across, the parents still try to instill that and you have to continue. And then if it gets kind of rough on you, and even if you're down and under, you still have to push forward. (Carmen)

Definitely. I always wanted to make a difference. You know, it's like what my family stressed too is that they always said the same thing, you know – to make a – I guess, you know, we all were very proud. We're a very proud group. And, to help – to make a name for one of us, you know, and to give a role – to give an example for others who you hope will also do better. And just to that way better

other themes within the higher education pipeline, it also is prevalent in the student narratives and negotiations of ethnic and gender identity in the science pipeline.

ourselves as a whole group of people and really show people, anyone else who says that you're just the lazy Mexican or something – that's not true. (Fabian)

Carmen talks about resoluteness as a cultural-evolutionary trait held by Latino/as. Like David's resolve in fighting Goliath, Carmen asserts Latino/a parents instill in their children to "push forward." Fabian, on the other hand, brings the concept to a more personal level, talking specifically about his own family instillation of self-pride and determination. This individual purpose promotes a vision for educational success, individually and collectively (as a role model). It is the strength of mind and commitment to fight against stereotypes and stigmas of Latino/as in the higher education pipeline.

Student perceptions of the stereotypes of Latino/a presence and success in higher education, and the negative influences of social stigma are detrimental to Latino/a self-identities by deflating their sense of confidence and capability (Seymour & Hewitt 1997). Yet, in the fulfillment of the David and Goliath narrative, these students counter such stereotypes and perceptions in an effort to prove others wrong. Likewise, Barajas and Pierce's (2001) research suggests "Latino students construct paths through the terrain of discrimination and prejudice they encounter in schools in much more complex and varied ways" than simply giving up on one's ethnic culture and assimilating to the dominant one (p.860). Their research saw Latina females navigating ethnic and gender stereotypes through supportive connections with other Latinas. Latino males created masculine identities, but "paid a psychological price for their conformity to these norms. The majority had strongly ambivalent feelings about their racial ethnic identities, and although they often associated with other Latinos on campus, they had less social support and shared understanding of being 'different'" (p.873). On the contrary, the Latino/a

narratives within this research study see both Latino males and Latina females earnestly sharing perspectives about their ethnic identities and understandings on being “different.” It is this difference that causes both genders to carve out the emancipatory narrative of David and Goliath.

The David and Goliath narrative is also a “subaltern” narrative²⁴ – subaltern, meaning those who are subjugated through hegemonic/dominant discourse and structure (as previously discussed in the literature review). According to Spivak (1988), individuals within the subaltern group conceive identities that are fragmented among multiple alliances. The subaltern narrative encompasses the conception of an identity that ultimately seeks to surmount the subaltern subordinate position, but in creating this identity of possibility, enforces the dominant position from which the relationship of resistance and opposition is inscribed (between dominant and subordinate). Nevertheless, the subaltern consciousness is not passive or ineffectual. Because the subaltern’s subjectivity is based on dependence and alienation, its consciousness and reflexive knowledge can also translate into racialized and gendered agency. Thus, the subaltern are able to emerge when they recognize the presence of the hegemonic discourse and utilize ways (like many of these narrative themes represent) to create consciousness and emergent pathways. Within these student narratives, we see that these Latino/a students experience a form of agency to resist the hegemonic discourse and stereotypes imposed

²⁴ The concept of the “subaltern” narrative is a complicated moment, but as a researcher, I wanted to incorporate this concept to expand on the notion that Latino/as are considered a “colonized” or “caste-like” minority (Matute-Bianchi 1991). The concept of the “subaltern,” first proposed by Gramsci (1971) and later complexified by Spivak (1988), is a way to deconstruct and critique differentiated experiences and meanings established through dominant practices on such populations. Hence, the “subaltern” narrative acknowledges this domination and reasons that dominated individuals translate their experiences into nuanced understandings and identities.

on the Latino/a culture. Yet, according to Spivak (1988), the true David versus Goliath narrative can only be achieved through a critical consciousness of this dominant discourse – by “breaking of the mold” (Marcelo).

4.2.2 Science Pipeline

The science pipeline is a cultural encapsulating structure in which the participants engage in a process of simultaneous institutional engagement, contestation, and boundary crossing (Carlone 2003). From these narratives it is evident that the student participants have created situational identities that draw not only from the general themes of ethnic identity formation in higher education described previously, but also have created different adaptation schemas particular to the science pipeline. Based on the acknowledgement that power differentials exist in science, at times these student schemas call for social mobilization. Conversely, these student schemas are also found to reject the dichotomous status of dominance-subordination, causing students to subscribe to a true meritocracy that is the symbol of the science pipeline.

4.2.2.a: Latino/as in Science: Representation, Expectations, and Perseverance

The Latino/a student narratives of their ethnicity are responses to certain neo-racist discourses they have encountered within the science pipeline. They suggest the presence of embedded and invisible negative expectations, void of explicit terminology, projected towards cultures and nationalities, like Latino/as. In response, participants like Rocio, Elena, and Carmen, speak of the legacy of science as an exclusionary setting – one in which Latino/a representation is low and expectations congruent with representation. The three Latinas create an experience of anti-complacency and empowerment within an environment of loneliness and attrition.

In science? I still don't think we're taken seriously, because...I mean, a lot of Hispanic students come in and I noticed it right off the bat and they, they drop out after their first semester, because they can't handle it. Students dubbed it as, "Oh, I guess they weren't as smart as they thought they were." "Oh reality sets in" and you know, just stuff like that. But I think that us that have stuck around to third year are taken a lot more seriously. (Rocio)

In science, I wouldn't say that necessarily the actual science would affect the way I interact. Maybe I might be more motivated though to try to do my best just because, I don't know, sometimes I feel maybe some people stereotype me. They think – "Oh, because your last name's____, you might not be as smart," or something. (Elena)

Because you're one of the few, so it gives you that sense of wow, out of all these people, I was able to make it. Whereas, if you came from like the majority, you're really not one of a few or it's understood or much more common for this to happen. So it [being of the few] would make you feel much more empowered. (Carmen)

Concordantly, Seymour and Hewitt's (1997) research on undergraduates in the sciences reports that students of color doubted their sense of belonging in college environments that lacked significant representation of these students, like science. Further, they relayed feelings of loneliness and questioned whether individuals were suspicious and disbelieving of their academic competencies and abilities. The concept of representation and loneliness is important because studies report positive ethnic peer connections and interpersonal friendships help to facilitate academic achievement in college for Latino/a students (Zalaquett 2005). Without significant representation, many Latino/a students lack the ability to make ethnic peer connections that are important in moving beyond the difficulties of academic life.

Due to this lack of representation in the sciences, the Latino/a participants also create a sense of collective identity. In opposition to the prevailing stereotypes in which their culture is under-minded, participants create a collective and redemptive narrative.

This narrative is decidedly connected to the “David and Goliath” narrative seen in the thematic findings for ethnic identity in higher education.

I had a Hispanic friend who was in one of my science classes. We would just talk and be, “Feels like we’re the only ones in here that are Hispanic.” And it just felt like we went through the same thing with the difficulty of the courses. (Alberto)

Alberto makes sense of what it feels like to be in science with very few other Latino/a students. Alberto and his Latina classmate find themselves in a science class where Latino/as are underrepresented and create a shared experience as they undergo “the same thing” together as Latino/a college science students. Another student, Reuben, applies his understanding of shared experience to an explanation of why he joined the campus organization for Latino/as interested in health professions. It is a narrative of communal perseverance founded in exclusion and disenfranchisement that ultimately brings this science pipeline experience to a place of possibility and inspired ethnic union.

I felt like we are all doing the same thing – we are all coming from the same background. It’s just we have a connection that’s why. It’s that we’re all doing something that - the majority of us – that our families have never done before. So it’s sort of “we’re in this together” kind of thing. It’s hard to describe. But those other organizations, they’re just doing this to – they understand the drill. And we’re new to the drill – and so we’re going to do the drill together. (Reuben)

Relatedly, out of the “David and Goliath” (and/or emergence-type narrative) a role-model narrative materializes. It is a materialization out of the struggle to debunk existent stereotypes for, amongst, and against the Latino/a community in science. This narrative encourages individual success which is translated into recognition for the collective – where an individual feels like he or she has to create a path that defines success for the larger ethnic group and it’s future generations²⁵.

²⁵ Steele (1997) further describes this notion as individuals working at the “frontier” of their abilities – a place where working to dispel “stereotype threat through performance probably increases with the

I think it's a job given to me. I think that it's a responsibility given to me, because I think we're presenting what could be the future of this country. I think we're presenting opportunity. I think other people – I mean, other Hispanics that see us think that they can get that far. So I think we represent opportunity and just chances, for advancement or something. (Rocio)

I think it makes me want to try harder because its like I said, I don't think people perceive Hispanics to be very smart and when you tell them, "Hey, I'm a biology major. I'm taking calculus too." They're just like, "Wow. Are you getting tutored? How are you doing?" And I think it really impresses people. It impresses people like, "Hey, I'm a Hispanic in college," but when you tell them, "I'm doing science, I'm doing math, I'm doing this," I think they think, "Wow, if she can do it, I'm sure my children can do it too." (Teresa)

Rocio and Teresa are examples of conscious resistance and determination. Personal honor and success in science is the legacy they bring to the Latino/a community as they transform their effort into a space of educational reinvention for their ethnic-culture.

Thus, both male and female Latino/a science undergraduates communicate observations of underrepresentation in the science pipeline, coupled with feelings of social and cultural expectations, and implications for personal perseverance. As the participants share in identities against the propagation of destructive labels of Latino/as in science, each gender uniquely devises their own narratives of ethnicity and gender identity preservation.

4.2.2.b(i): Latina Female Narrative – Stereotypes, Perceptions, Resistance

Latina females create identities in science that strive to debunk the traditional gender roles of not only their ethnic culture, but broader society as well. Despite these female students being subjected to a biased view of the world and themselves, they find ways to resist the norms of femininity valued in family, school, and society (Brown 1998). Within these identities, they create a narrative of personal agency in which they

difficulty of work in the domain, and whatever exemption is gained has to be rewon at the next new proving ground" (p.618).

see themselves “carving out” roles of independence, resistant to the gender traditions imposed by society and the science pipeline. For instance, Imelda, Elena, and Fernanda speak about how they embody conscious decisions (through the pursuit of a field not traditionally seen as female populated) to debunk gender stereotypes such as family dependence and early female pregnancy.

I really don't see myself with a family at some point. I know that it has to happen eventually, but for now, as long as you dedicate what you do to your work, and are really really dedicated – that for me is really successful. (Imelda)

I don't think too traditionally about things. [*Talking about herself and her sisters*] We're all independent. And all of us wanted to pursue jobs that maybe primarily weren't mostly women. (Elena)

Today, I was thinking [about] one of my friends from high school: She got pregnant during her sophomore year. And a lot of people from my town and – it's not culturally driven, but it's a stigma that lies along the border or with our ethnicity or ethnic group – that we don't continue college or we don't get there because either we meet someone or we get pregnant or we already have kids and we can't get that education. And I was thinking that she went home and then one of my friends went home that was also from Laredo, just an hour away. They got pregnant here and they didn't finish...And my two friends from back home who went to other colleges. So it's just, you kind of see my friends perpetuating a stereotype and it's really hard. And by the time I'm a senior, and I don't have a belly, I'm like, “Whew! Lucked out on that one.” Last year, when I had a boyfriend I was like, “Oh my God. Don't get pregnant or you're just going to perpetuate...And it's just not going to be good. And, what will other people say? So it was just really, really scary being in that situation or having the risk of that situation. And so I dumped him – I had to push through, and it's scary having that vulnerability. (Fernanda)

Within these female narratives, Imelda, Elena, and Fernanda negotiate their femininities and use alternative pathways to locate their own identities among gender labels in school and in science. Steele (1997) suggests that individual perceptions of stereotypes are dangerous in that those individuals that experience stereotype threat (or anxiety over stereotype conformity) may end up dropping out of science altogether. For Fernanda, she actively attempts to make life choices and curtail tendencies to become like her ethnic

peers back home. Thus, Imelda, Elena, and Fernanda create resistance strategies with individual self-definitions and self-valuations to continue studying and participating in science (Eisenhart & Finkel 1998).

Also included in this narrative is Juliana's story about encounters with male college students and her dispassionate reaction to encountered stereotypes. Juliana and others talk about the recognition of such instances when around other science majors and the desensitization they feel to perceptions and stereotypes.

When I did that preceptor-ship, my partner and I were both female. And I felt that some of the guys that came to our session didn't really feel we were as smart as we really were. It came off that they seemed like, "These girls don't know what they're talking about." And then, they didn't come back. (Juliana)

When telling her story, Juliana ambivalently remarks with a sense of normalcy that the males in the tutoring group never returned. It is a coping strategy in which females commonly struggle in gendered environments through the development of visible and invisible personas (Brown 2002). The female student perspectives validate complacency and are marked by desensitization to the stereotypes and perceptions of others. Yet, despite this need for desensitization in moving toward success, over time, consistent academic success in science may still cause these females to feel a diminished sense of competency (Seymour & Hewitt 1997).

4.2.2.b(ii): Latina Female Narrative – Juxtapositions of Ethnicity and Gender

Research by Erkut et al. (2002) describes females of color as having an acute sensitivity towards the available resources and opportunities within power structures. Further, Erkut et al. (2002) find females of color experience power differentials within race, ethnicity, class and gender as equally significant, where Phinney (1990) claims that

females are more subjected by racial stereotypes than gender stereotypes²⁶. For the Latina female participants described here through this research, there is compounding marginalization based on their ethnic and gender status in society and in science. That is, the Latina females face discrimination effects – a “double jeopardy” based on the subordinate status that both their ethnicity and gender occupy. In the narratives of Martha, Fernanda, and Carmen, the observations of representation, public reaction, and interactions in science are reflections of both Latino/a and female factors coupled together.

You don't really see a lot of Hispanic women in science. (Martha)

In science, I think it actually is different from just being outside in the world because you're not really – Latinas aren't usually associated with science or scientists or discovering something. (Fernanda)

I think if I was White, it would be more – it wouldn't be as big of a shocker if I made it. I think it's more like – it's understood that these people go into these fields and do well and they graduate. But it's not as seen, that for Hispanic people, especially for Hispanic women, to go through and actually succeed all the way through. And so I think people go “Wow, she's Latina *and* she made it”...there is always that factor. (Carmen)

Martha, Fernanda, and Carmen express that Latinas are neither seen nor expected to succeed in science. Likewise in Monica's narrative, another aspect of ethnic and gender identity juxtaposition is exhibited – that of the nihilistic tendencies of colonized or stigmatized groups to cope with the exclusionary settings of society, like science (Brown 1998).

Like when I tutor people, they'll ask me what my last name is and they'll be like, “Wow.” Or my Black friends and I will just poke fun at each other because we're both minorities. But it's prevalent. Sometimes when I don't know the person real well and they say jokes like that, it's not really funny. But at least three times a

²⁶ The female undergraduate students in my study were asked to explain which was more apparent to them in science classes: their ethnicity or gender. The majority of the females stated ethnicity. This finding is supported by Phinney's (1990) claim that females are more subjected by racial stereotypes.

week it comes up that I'm Hispanic and Hispanics usually aren't that smart, especially girls. (Monica)

Because both Monica and her Black friends occupy these “outside spaces” of the discourse of science, they re-appropriate and re-inscribe their own subordinate frameworks through their “jokes” (as they are shaped by the exclusionary thinking that dominates science today). Consequently, Martha, Fernanda, Carmen, and Monica face different realities of who they should be and who they actualize themselves to be.

Additionally, the Latina students expound on the importance of leadership roles that are subsumed and embraced by the Latina females in science. This is congruent with the role model narrative that was described for all of the Latino/a college students who participated in this study. The role model narrative is a secondary aspect of the “David and Goliath” narrative or “emergence” mentality, where students perceive low Latina student representation and use this factor as a basis for motivational feelings.

I think it's a very, very unique role to be in because there's not that many Latinas in science and it kind of puts pressure on you to do something good so that you can be a role model for someone else going into science. (Fernanda)

I mean it's a very powerful thing to be female. Because I mean you're just opening new doors for other females behind you. And I just think that you become a leader. So I think it's important. Especially being Hispanic. (Rocio)

Fernanda and Rocio present their female narratives as commitments to teach other Latina females that they can achieve success in science. Rocio even speaks of the ethnic and gender “power” that is contained within their individual examples. Both Rocio and Fernanda frame the notions of ethnic and gender identity as they intersect along experiences of exploitation and displacement in the science pipeline.

In sum, the Latina theme of ethnic and gender juxtapositioning in science undoubtedly exhibits Latina female students as experiencing a myriad of identities that

are both resistant and redemptive (Chow 1993). These are non-monolithic identities that are conceptualized into “successful” identities, academically, though not always “successful,” psychologically.

4.2.2.c(i): Latino Male Narrative – Pressures and Societal Expectations

The Latino male narratives are just as complex and strategic within the science pipeline, and vary from inwardly reflective narratives to those outwardly projected towards Latina females. In the narrative described in this section, Latino males talk about male gender pressures that they experience which have significant influence on their motivations and academically successful trajectories. The pressures discussed within these reflections originate in Latino familial culture and are affected by society’s perceptions. Consequently, these males act in ways and assume traditional gendered roles in college and in science.

I would say the only way that it’s affected me being male, especially being the only male in my family – I only have two younger sisters – I think a lot of focus of success was put on me, especially by my father. And my mother, it’s never really been brought out and spoken but I just get the feeling like, “You’re the oldest, and you’re a male on top of that. So you have to succeed. You have to be the first one to succeed in this family and whatnot. Get your education. Get a good job.” (Isaac)

I believe that a man is put into a position to be assertive and to lead, to be head of household. So he has to be mentally more decisive and more ambitious...That has definitely had a direct impact on my motivation and academic success. Being male, I think society expects, I just feel like it expects a lot more ambition and there’s a higher pressure to succeed, I think, as a man. (Marcelo)

I think society expects males to be the scientists and just for the fact of being male in science gives you that extra pressure on you that you have to do well on those classes and science. And just for the fact of being male has given more pressure for myself to do well in the classes. (Macario)

Isaac’s story highlights the role of familial gender pressures to achieve academic success.

He describes these pressures as both overt and hidden within the discourse of his parents.

For Isaac, the gender role pressures stem from his mother and father while Marcelo reacts to more general societal expectations for males. Marcelo and Macario both emphasize the role of social gender pressures on the academic success of males and in science. Specifically, Macario's narrative relates these pressures of societal expectations as they have inscribed themselves psychologically and therefore contribute to his motivation to do well in science.

Lynch (2000) talks about the influences of parental and school-related gender role stereotypes that a student receives throughout his life. Males perceive the emotional reactions of family and schools, which ultimately inform their interest in a particular educational subject and confidence in their success. Because family is a deep-level cultural value for Latino/as, they help to set the priorities that guide "desirable" and "undesirable" behavior (Garcia 2003). Interestingly, within this narrative, the Latino male students have rearranged the female notion of negative social pressure in science into a construction where positive social pressure has the propensity for negative outcome. Thus, males personally adopt both dominant and subordinate positions within the discourse of science.

4.2.2.c(ii): Latino Male Narrative – Female Emotional Advantage: The Return of the “Treacherous Woman”

The second male thematic result within this study is the concept of female emotional advantage. During the interviews, a peculiar theme emerged from the male life stories and experiences in science – that of females using their emotions and gender as a negotiating factor for success in science and higher education. Below, Fabian expresses his views on female negotiations of their femininities in the classroom and beyond.

Well, I think girls can be more convincing sometimes. I think of a guy and a girl pitching the same argument to the professor: The girl just might be that much more convincing. Not necessarily that there was a discrimination – that they might pull it off better.

What do you mean by convincing?

Ok. Here's a good example – a girl gets pulled over or a guy will get pulled over. Like how if a girl cries, she's more - I've heard plenty of, "I got out of it by crying." Things like that. (Fabian)

Macario echoes this sentiment except that his narrative places the origin of action on professors and teaching assistants that subscribe to the notion that females need to be given extra advantage. Nevertheless, Macario's narrative is laden with discourse on the unmerited and iniquitous advantage of females in academic settings.

They [*professors and TAs*] might be softer on girls and may be a little bit harsh on guys. (Macario)

Finally, Isaac produces a female emotional advantage narrative and specifically directs this understanding and conceptualization of female gain to the field of science. While distally acknowledging the dominance of men to women in science, Isaac returns his narrative to the unwarrantable profiteering of females through their emotions and feminine embodiment.

I mean, if I wanted to see it in advantages and if I really wanted to succeed, then it would be an advantage to be female. Because I mean, this is really cold-hearted but if you were a female and you're going into a science major that's mainly dominated by men, you can get by a lot faster, a lot quicker, a lot easier. Because if you wanted to do that, you could – you could go up and bawl, start crying in front of a male professor and he's got to be pretty hard to not feel something, especially if he's male – naturally, he's going to feel something. I've heard of girls using their tears to get a grade basically. I mean, no guy's going to walk in – and even if they do – walk in and cry in front of a professor, the professor's not going to be like "Oh." They'll be like "Weirdo, get out." (Isaac)

This narrative is titled *The Female Emotional Advantage: the Return of the "Tracherous" Woman* because within the masculine narratives of the Latino culture, the concepts of female emotions, feminine embodiments, and violations of confidence

intersect beyond mere observations and have inculcated themselves into the very fabric of historical heritage and folklore. For example, Peña (1991) discusses the prevalence of “la mujer traicionera” or “the treacherous woman” in twentieth century Mexican folklore and the “canción ranchera” of Mexican working class males. These males use these songs and stories for the debasement of women through stereotype. This stereotype legitimizes the oppression of Latina females as males engage in a “conscious ideological manipulation,” and “the woman is singled out for a special, if ignominious role in the folklore of machismo” (Peña 1991, p.33). Itself, a complex mechanism, the machismo ideology is regarded by some scholars as originating from historically shaped conditions of the Mexican culture – that of “extreme economic exploitation and its attendant deprivation and alienation” (Peña 1991, p.31).

A more classic version of the faithless and disloyal Latina female is that of La Malinche, the famous indigenous translator and mistress of the Spanish explorer, Hernán Cortés. “Malinche is viewed as the original translator to her race, who through the use of her body, in essence ‘allowed’ the conquest to occur” (Mallon 1996, p.175). It is through her story that she is regarded by Mexican and Latin American historians as informing the “gender subtext” of modern Mexican-American studies. Her identity is both negatively and positively viewed upon – “in the former case, Malinche was seen as a traitor. In the latter, she was the precursor of true Mexican nationality” (Mallon 1996, p.176). Thus, the treacherous woman of “canción ranchera” and the historical figure of La Malinche are ways in which Latino males, like the students in this study, create and shape their masculine identities in relation to Latina females “corporealities.” These outward

projections towards Latina females are conceived from feelings of cultural difference and subordination, and defined by the imagery and language of power.

4.2.2.c(iii): *Latino Male Narrative – Science: The Gender Equalizer*

The final Latino male narrative is that of conceptualizing the field of science as a gender equalizer. Whereas females parlay a sense of gender disparity and inequity, the common narrative among the male participants is that science “evens the playing field.” The female gendered narrative of science is that of a male-dominated mechanism where access, standards, and criteria for success is male-oriented (Eisenhart & Finkel 1998). Moreover, females tell of explicit and implicit experiences of disadvantage that are simply lacking in the males narratives. Science as a subject, career, and academic identity is seen as gender-neutral by these Latino males, as they contend science is objective, not subjective.

The subject there is the same one and you just talk about that and try to be as objective as possible. I don't think that gender makes any difference in what you're talking about or how you're talking about it. (Lucio)

I think in terms of sciences it's the same. Again, it's more being just a student. I try to kind of look at everything colorblind and gender blind and everything. It's just you're just another person and your scientific interactions regardless of male, female, race. (Fabian)

Lucio and Fabian's narratives outline science as a field where gender issues do not have a place in explaining how individuals interact within or talk about science. It is a field where the language and discourse occurs only through scientific experimentation and “interactions.” Additionally, Reuben and Alberto relate success in science as gender-neutral and as “just being a student.” Science is seen as a gender equalizer by the Latino males where the exclusion and displacement of different genders is invalidated.

It doesn't mean anything – as compared to a female? Nothing different. We have the same opportunities to succeed. Everybody has to do the same thing to

succeed. It doesn't matter what gender you are...it's like being any other student at U.T. Just being a student. (Reuben)

I think both genders have an equal opportunity to succeed. (Alberto)

Interestingly, Latino males view the interplay of ethnic-cultural forces in science, yet do not regard science as having masculinist ideologies of exclusion. The notion of the male dominant "in-group" evoked in these discussions upholds the stabilizing traditions of science (Harding 1991). However, the male undergraduate students do acknowledge the historical legacy and numerical discrepancy of women in science. Significantly, it is only an observation made to the "changing nature of science" towards the equality of genders. Consequently, these male narratives are reifications of the dominant position – a form of "blind-spot" held by the dominant group that does not feel the objectification and "genderizing" nature of science.

4.2.2.d: Science – The Cultural Equalizer (A Conflictual Narrative)

The concept of science discourse as a cultural equalizer is a conflicting narrative to the *Latino/as in Science: Representation, Expectations, and Perseverance* narrative. It is an attempt by the student participants to give hegemonic "normality" to the already acknowledged subjugations and displacements of Latino/as in science.

We're all students first and everything else is secondary to that. (Paulina)

I feel like I'm just a science student just like everybody else. (Imelda)

In science, I haven't found that it makes a difference. I don't think that there's that much, especially because you communicate the same things in that case. (Lucio)

I think every student, every classmate, is the same to me. (Reuben)

The male and female narratives of Paulina, Imelda, Lucio, and Reuben indicate ethnicity as obverse to science and science discourse. Through the understandings of these students, individuals in science are "students first," and the ways in which individuals

communicate science and the knowledge they communicate are equivalently and unaffectedly exchanged. Fabian's narrative likens science and the college academic environment to a "bubble," but intriguingly acknowledges that this bubble is not completely impervious. In the same way, Marcelo recognizes that he "implicitly" represents his Latino culture: It is embedded within his individuality, even as a student in science.

You're looking at the science and not to your common bond, you know. It [ethnicity] doesn't have as big of impact if you're focusing on something else...I mean, you kind of have this little bubble going on here. Not that we're completely sheltered or anything, but, I mean, you know, the nice thing about being at a university, you're kind of – you're supposed to be able to put all that away, and just come here to learn and everything. (Fabian)

I'm just another part of the student body rather than the Hispanic community. I figure maybe I represent implicitly the Hispanic community. (Marcelo)

By subscribing to this narrative, students adopt the view that scientific knowledge and the act of studying and talking about science is "race neutral" (Fries-Britt & Turner 2002). In their research, Fries-Britt and Turner (2002) describe Black students enrolled in traditionally White institutions (TWIs) "felt at ease" in their science classroom despite feelings of alienation in other more opinion-laden classes, like political science. However, at the time of the study, the school had implemented large scale recruitment and retention programs for minority students in math, science, and engineering. Hence, the students also spoke about the large number of other Black students in their science classes – a characteristic from which the Latino/a student narratives in this present research explicitly suggest otherwise.

For the Latino/a student participants in this study, the view of science as a cultural equalizer or neutralizing force acts as a type of social, cultural, and symbolic capital – resources that help to improve an individual's position or status through connections,

educational credentials, and symbols of prestige and legitimacy, respectively (O'Connor et al. 2007). To suggest otherwise, these students would be contesting their social affiliations in the sciences. Consequently, they create “interruptive” identities or “manifold narrative voices” (multiple and often, contradictory) within the relationship between the discourse of ethnicity and the discourse of science (Tierney 1993).

4.3 Categorization of Issues

In accordance with the authorizing assumptions that occur in qualitative research, particularly life history and narrative analysis, this section is dedicated to the silences and additional narrative representations of the student participants (Cary 1999). For example, consistent with the literature on Latino/as and college students, many of the students did relate experiences of drawing on their resources in coping with different transitions in the education and science pipelines, such as the importance of intimate relationships with family and networks of friends (Schlossberg et al. 1995; Valenzuela 1999). Additionally, across study participants, the themes presented in the thematic analysis spanned all levels of parental education level, from professional school to less than high school. Despite the lack of cultural capital of those participant families whose parents' education was less than college-level, this finding upholds research on the importance of familial support and positive family attitudes towards education, regardless of parental education level (Asera & Treisman 1995; Zalaquett 2005).

The factor of socioeconomic status is important because it has been shown in studies to directly affect science achievement and success (Clewel & Ginorio 2002). This research informs the discussion of ethnic, gender, and academic identity intersection designated by socioeconomic status in that the student participants and their families

varied across socioeconomic distinctions, yet still held common knowledge, beliefs and attitudes on ethnic and gender identity within the higher education and science pipeline. Likewise, the gender identity thematic representations within each gender classification were similar despite socioeconomic differences within a particular gender. Perhaps the most interesting factor regarding the socioeconomic variables within this study is the link participants make between conceptualizing Latino/a culture and the connection it has to a particular social or economic class (regardless of the actual socioeconomic status of the participant). Both Latinos and Latinas of varying socioeconomic backgrounds conceptualized “Latinidad” (Latino/a ethnicity) as lower or “working” class. As mentioned earlier in the thematic discussion of *Ethnic-cultural Bond and Connection vs. Otherness and Negotiation*, the concept of “otherness” and “ethnic distancing,” at times, occurred at the sake of this class distinction. Nevertheless, both ethnicity and socioeconomic status remain important factors in analysis of science achievement and success throughout the science pipeline.

4.3.1 Additional Narrative Representations

The male narrative of Reuben was the outlier narrative in which his responses and life history was a multiple, contradictory story of refusal and negation strategies on how his ethnic and gender identities intersect in science. While at certain moments he acknowledged the importance of ethnic identity in making up an individual’s character and shared many of the same views and themes listed in this study (at times producing profound thoughts included within the thematic analysis), at other times, he seemed to create an identity where he blocked all personal realization of previously described hegemonic structures and powers. His incitement of group ethnic identity by serving as

president of the “Hispanic Health Organization” was inconsistent with his views on general institutional power and privilege issues. In her discussion of *Giving an Account of Oneself*, Butler (2005) discusses an individual’s capacity to reflect on oneself:

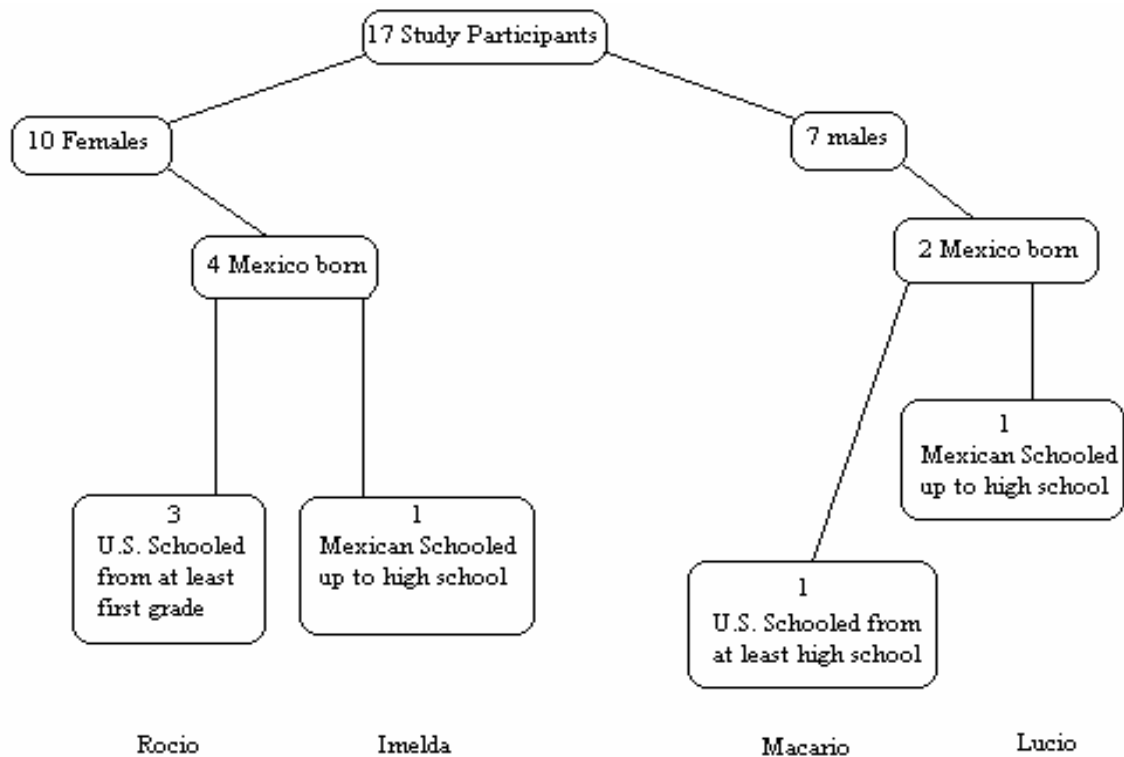
...It seems, there is a price for telling the truth about oneself, precisely because what constitutes the truth will be framed by norms and by specific modes of rationality that emerge historically and are, in that sense, contingent. Insofar as we do tell the truth, we conform to a criterion of truth, and we accept that criterion as binding upon us...So telling the truth about oneself comes at a price... (p.121)

The incorporation of Butler’s (2005) discussion with Reuben’s narrative asks for the consideration of Reuben’s “manifold narrative” as a negotiation of his personal account and the conformity to subordinate status within science. In telling his narrative, Reuben’s story opens up the spaces where more critical analysis can be achieved. These spaces are informed by the identities Reuben inhabits and his existence that ultimately depends on the negation of his ethnic status. Further analysis should produce insights into the reasoning behind Latino/a students creating such drastically conflicting narratives and understanding different representations of identity preserving strategies.

Student achievement and success in higher education and science is undoubtedly a complex mechanism. Consequently, it is necessary to discuss the intersection of participant demographics and thematic analysis of this research. For instance, the narratives and thematic understandings on the ethnic identities of the Latino/a U.S. native-born citizens and Latino/a early-youth immigrants (those who came to the U.S. at an early age) were strikingly similar. However, ethnic identity maintenance between early-youth Mexican immigrants and later-youth immigrants (those who came to the U.S.

at the start of high school) is a topic that should be looked at for further analysis and study.

Figure 4.1 – Latino/a Student Immigrant Identities



For example, the life histories and narratives of Rocio (an early-youth Latina immigrant) and Imelda (who immigrated to the U.S. only to attend college) were in contrast, between Rocio’s “assimilated” ethnic identity and Imelda’s “international” or “alternative collective” identity of feeling a strong association with her Mexican-ness and dissociation from all U.S. culture (Goode 1998; Rodriguez 1982; Phinney 1990). This finding is consistent with Suarez-Orozco’s (1989) research on Latin-American immigrant identity and Mexican-American identity. Similarly, the life histories and narratives of Macario (a later-youth immigrant) and Lucio (who immigrated to the U.S. just before his freshman

year of college) were in contrast, between Macario's "bicultural" ethnic identity and Lucio's "international"/"alternative collective" identity (Goode 1998; Phinney 1990). However, when you compare Rocio's early-youth immigrant story of assimilation to Macario's later-youth immigrant story of biculturalism, an interesting relationship begins to appear. Referring to Figure 4.1, Rocio, Imelda, Macario, and Lucio are all immigrant narratives, but the temporal contrast between the "border stories" of Rocio and Macario are defined by difference. Rocio's early "border story" defines her ethnic identity much differently than Macario's later one. Thus, the topic of Rocio's early-youth immigrant ethnic identity and Macario's later-youth immigrant identity is a rich aspect of immigrant ethnic identity negotiation to be explored.

CHAPTER 5: FINDINGS, CONCLUSIONS, AND IMPLICATIONS

5.1 Summary of the Study

The seventeen life histories and narratives discussed within this thesis demonstrate that Latino/a college students find elaborate and intricate ways to understand their ethnic and gender identities. Indeed, the college environment may not be the “postethnic” space that many administrators, faculty, and students believe it to be²⁷ (Hollinger 2008). Perhaps, the immediately recognizable response to this statement is: to whom are higher education and science void of the dominant and subordinate relationships where identity politics are informed by choice rather than by ascription? After meticulous analysis of the emotions and interpersonal conflict presented by the student narratives here, it is evident these students move forward through the higher education and science pipelines with much more than a sense of void. Together, they present Latinos who feel the gendered pressures of family and society, projecting feelings of gendered angst against Latinas, who in turn feel oppressive forces of overlapping social, cultural, and female stereotypes. These characters produce vivid confirmations of the hegemonic forces on ethnicity and gender within higher education and science.

It is also clear that these Latino/a students carry these racialized and gendered “knapsacks” through the science pipeline, complicating their definition of the social apotheosis of the college science student. Though their ethnic and gender identities play

²⁷ Hollinger (2008) describes a “postethnic” social order as one that “encourages individuals to devote as much – or as little – of their energies as they wished to their community of descent. Hence to be postethnic is not to be anti-ethnic, but to reject the idea that descent is destiny” (p.B7). Hollinger’s argument is based on individual strategies that choose the level of association with one’s ethnic identity. The Latino/a students in this study show that they do in fact develop such strategies, but the strategies do not exist in social vacuum. “Descent” may actually mean “destiny” to students who internalize and self-ascribe negative hegemonic social perceptions.

a crucial role in creating successful trajectories in science on a personal level, there are obvious differences and spaces of negotiation between how the discourse of science informs their personal definition of what it is to be a science student and the common notion of who science students really are. The experiences of these Latino/a students constitute a specific “reality” within the science pipeline. While it cannot be conclusively stated that this “reality” has any influence on students’ problem-solving or critical thinking skills in science, it certainly does influence the peripheral aspects of science learning. The Latino/a student life histories and narratives suggest quite clearly students’ experiences within the science pipeline shape motivations, perceptions, and attitudes about themselves as science majors. The thematic patterns of these students are research outcomes promoting a broader notion of what science education is, and how the science pipeline “educates” students. It teaches scholars and educators at all levels to not overlook the education of science that is not always tangible through curricular aspects and cognitive outcomes.

5.2 Findings and Conclusion

This thesis originated in the search for knowledge and voice of Latino/a students within the university science pipeline and featured perspectival interactions between understandings of ethnic identity and gender identity. Through the methodology of narrative inquiry/analysis, both female and male undergraduate life histories were analyzed for thematic qualities. Not exclusive to individual social and psychological displays of compartmentalization, the themes crossed boundaries as emergent socio-cultural conceptualizations within science were found in some instances to be conflicting. The thematic findings presented in this study were grouped by broad contextual

definitions of higher education and higher education science (or science pipeline). Under the heading of higher education, both genders were grouped together to produce narratives based solely on their ethnic identity. This was done because the students mainly talked about gender as it was associated with ethnicity or as it pertained to the science pipeline (the second larger context from which the themes are grouped).

The findings of this study contribute and extend existing knowledge in four ways.

- 1) This study contributes to the theoretical framework of Critical Race Theory by affirming the ways an individual complicates his/her position with regards to social, cultural, and scientific norms (Ladson-Billings & Tate 1995). Additionally, the results of this study inform the critical paradigm as students have independently created their own critical consciousness for understanding hidden power relationships in higher education and science.
- 2) The findings contribute to the methodological significance of narrative inquiry and analysis by demonstrating that students do in fact have “non-unitary selves” when they negotiate their group statuses (e.g., gender and ethnic) (Bloom & Munro 1995). Further, the findings demonstrate the capacity of life profiles to be grouped together for comparison when the data presents itself in a way that allows the researcher to do so – when sociality, temporality, and physical space come together to inform the context in which the research is located (Connelly & Clandinin 1990; Mintz 1979).
- 3) The results refine and extend existing knowledge on the science pipeline and higher education by framing the notion that the field of science is in fact an environment that influences student attitudes and ideologies about science not only through the interaction of students within the scientific community, but through the less tangible discourses that make up the “air” or “climate” of science.
- 4) Finally, the results bring additional meaning

to research within the social contexts in education, helping to further extend critical examination of race, ethnicity, class, and gender within the social contexts of learning and development.

5.2.1 Applications to Theory

The results enhance the theoretical framework from which this research is based by challenging and exposing the subtle biases underrepresented students experience in higher education. These thematic findings from the student narratives were organized into four categories: physicality and the culture of “looking,” ethnic bond and otherness, politics of stereotype, and the allegory of David and Goliath. The first theme of physicality and the culture of “looking” described the notions of physical embodiment as an “authentic” Latino/a and the public ritual of “looking” that preserves the “culture of domination” on and off campus (hooks 1993). The second theme on ethnic identity informing the critical paradigm drew on the ethnic bond or otherness that Latino/as felt as members of the Latino/a cultural community. While students discussed feelings and psychosocial attractions they experienced with other Latino/as on a college campus, they also made vivid distinctions for whom they did not feel this bond. These distinctions were made in an effort to define their own ethnic standard of acceptance – at once, both culturally preserving and ‘successful’. The third theme depicted the various stereotypes and discriminations the Latino/a undergraduates encountered and the different ways in which they related to these stereotypes on a daily basis. The nuanced strategies and approaches employed by the students varied from defiance to submission. Students even reflected on the doubts such stereotypes placed on their rank and status in college. They movingly questioned whether they had been fairly admitted to the university through

internalized stereotypes suggesting Latino/as and other minority populations receive unfair treatment in admissions to higher education institutions. Lastly, the final theme described the culmination of the three previous themes into the emancipatory narrative of David and Goliath. Like the allegory, the students formed the essence of struggle into a transformative power. Within this struggle, the students like David, withstood the doubts of the “masses” (socially) and at times their families. They constructed themselves in “student-hero” narratives where they saw themselves conquering the unconquerable like the boy-hero, David.

5.2.2 Methodological Connections

Methodologically is the second means by which the research findings supplement existing knowledge. The use of narrative inquiry and analysis helped to define the multiple relationships found within the narratives. Through these multiple relationships, the research findings demonstrated overlapping natures of the participants perspectives and themes. For example, the theme of “David and Goliath” was an emancipatory narrative derived from the emergent culture of “looking” in which the Latino/a students felt critical, evaluating, and opinionated stares based on their physical makeup. If a student did not speak about “looks” directed at him or her, the student most definitely acknowledged the self-concept of physical difference-similarity to the more indigenous qualities of many Latino/as. Though the definition of exactly what a Latino/a looks like is more malleable than that of dark skin and dark hair, the students inserted a dichotomy of “dark versus light” into the description of “Latino/a versus non-Latino/a,” respectively. With this dichotomous classification in mind, the students focused their attention to personal feelings of common identification and connection to their culture and,

alternatively, to feelings of otherness. It was these very feelings that, in turn, further established themselves into the students' lives by ubiquitous public stereotypes. Acknowledgment, threat, internalization, and subscription by Latino/as to such stereotypes were brought together, making up the "air" of college environment and science. Coming conceptually full circle, this "air" of college and science produced a narrative where students struggled to unfetter themselves from the constraints of dominant discourse – as seen in the narrative of David and Goliath. As we see in these themes, Bloom and Munro (1995) call the overlapping boundaries of individual identity, "non-unitary selves."

Another notable example of multiple, contradictory selves is the theme of *Science – The Cultural Equalizer (A Conflictual Narrative)*. It is a contradicting textual representation within both the Latina and Latino narratives. Methodologically, this thematic finding constituted a negative case that needed to be analyzed in order to draw on the constituted spaces spoken by the participants. The negative case or "conflictual narrative" depicted the field of science as a "cultural equalizer" or culturally neutral. At different points within the student narratives, some of the students discussed science as a context where students live in a theoretical "bubble" and where communication is disciplined solely to science content. Interestingly, despite these individual reasons, some students intervened to state that science is uncontainable – that "implicit" meanings of ethnic identity can puncture a seemingly impregnable system like science. This last narrative finding is seen as a technique by students to stylize science in such a way that allows them to accept its values while rejecting and emancipating themselves from its threats to their ethnic identities.

Hatch and Wisniewski (1995) assert that life history and narrative analysis “offer exciting alternatives” for connecting individuals to social phenomena. The Latino/a student participants within this research demonstrated such an “alternative” where tacit alliances organized themselves into complex webs of understanding identity. Drawing on this alternative for understanding, the identity development theories used for students in college today (talked about in the literature review on college student development) do not necessarily respond to the conditions surrounding ethnic emergent-emancipatory identities found here. Leaving theoretical difficulties aside, perhaps ethnic identity theory and college student development theory can transcend particular interests and merge into a common dialogue for college student development – something it has traditionally resisted. An initiative like this would bridge the acceptance that underrepresented populations create alternative points of view, instead of treating ethnic identity and underrepresentation as dynamics outside of college student development “monoculture.”

5.2.3 Contributions to Science Pipeline Research

The results refine and extend existing knowledge about the science pipeline by capturing undergraduate perspectives that frame the field of science as an environment that influences student attitudes and ideologies about the subject. Much of the scholarly research on science, technology, engineering, and math or STEM-related college contexts explore topics of student attrition, major-switching, and reasons for persistence – only superficially acknowledging racial-ethnic populations. The field is ripe with opportunity to explore the nuanced details of the climate of science for these student populations. In the theme titled *Latino/as in Science: Representation, Expectations, and Perseverance*,

student observations of low Latino representation in science are coupled with pervasive social expectations of failure, bringing this orientation into the life practices of these students. The symbolisms of low representation and expectation within the science pipeline are repositioned to the front of the students' striving, helping them to aspire and emerge from these classifications. The research findings of this study, therefore, present an example of possibility to reach new corners of exploration for the science pipeline. In another example, Latina females collectively expressed their resistance to gendered stereotypes as these stereotypes intersected with their ethnicity in science. The Latina students recognized these stereotypes as belonging to a traditional set of social and cultural stereotypes of women. These included ideologies broken down into discrete messages based on the family caretaker role of females, female dependency, and early pregnancy in school. The Latina science students revised these roles through their science education and thought of science as a means to produce non-traditional gender identities. Other Latina female narratives described how both ethnicity and gender couple together to make Latina students feel doubly marginalized (a "double jeopardy") when competing in science. Dominant social values were internalized through this identification from which the Latina students conceived new meanings from socio-cultural products and power relations. The females organized around the concept of resistance through academic success in science and articulated their own identities as role models for other Latina females.

The Latino male narratives highlight the social and cultural pressures which legitimized their current place in the science pipeline. Unlike the Latina females who experienced minimal expectations for them to succeed, the Latino males described great

expectations directed towards them by family and society, alike. These expectations originated from both their family culture and social pressures. Instead of creating resistant identities like the Latinas, the Latinos accepted these pressures as part of their trajectory towards academic success in science. Latino students also related another experience that was discussed in a different thematic finding across males. The students asserted that, at different instances within the science pipeline, females were known to use their femininity to reach academic success and better grades. In this narrative, Latinos reconciled themselves to the subordinate status in science because they felt Latina females unfairly and shrewdly manipulated their academic positions. This finding also demonstrated the complexity of the Latino/a culture and the multiple ways gender roles have been positioned in history and folklore. Finally, the last male narrative discussed the field of science as a “gender equalizer.” The Latino males regarded science as an equal playing field where both males and females have equal chances and possibilities to succeed. The Latinos saw this theme informed by what and how knowledge is communicated in science – factors that are not biased or structured by dominant-subordinate relations. Surprisingly, the Latino males spent the majority of their narratives characterizing science as a field suffused by power relations when speaking about their ethnic identities. Yet, as commented in the discussion and analysis of this narrative in Chapter 4, the males resisted against science’s dominant ethnic code, not its gender code – hybridizing their narratives around the different hegemonic forms of science.

5.2.4 Explorations of Social Construction

The results of this study augment fields seeking to explore the social contexts and constructions within education. As discussed in sections *4.3 Categorization of Issues* and *4.3.1 Additional Narrative Representations*, scholars need to give more attention to the surprising ways in which demographic characteristics are captured and related in educational research. For instance, the notion that the Latino/a student participants varied across socioeconomic statuses, yet were still able to parallel attitudes within and across genders, generates a productive moment in education scholarship. Just like the once binary literature on the negative-positive influence of family culture on a student's educational achievement, the arguments of socioeconomic status versus ethnicity scholarship should instead involve two-way transmission and help to further inform research on the achievement of different student populations. In this study, the theme of socioeconomic status is still important. It does, however, inscribe its influence on achievement *through* identity and is not a factor being compared *against* it. For example, the participants essentialized Latino/a ethnic identity as lower class and associated ethnic embodiments and cultural-class markers together as negative (e.g., The typical Latino was defined as low class, working construction, or “gangster”).

Another illustration of demographic representation were the identities of Latino/a “international,” “late-youth,” and “early-youth” immigrants. These identities surfaced among the immigrant student participants when talking about the social and cultural meanings of being a Mexican immigrant. Unexpectedly, these students held apparent distinctions on their immigrant status. The two participants (one male and one female) who came to the U.S. at the beginning of college, enacted what I called “international” or

“alternative collective identities.” As separate narratives, they relayed to me a sense of the collective they represented and their social peer preference. These “international” student narratives disdainfully questioned the cultural practices of Mexican-American students, and culturally affirmed a collective ethnic identity with other “internationals” (Imelda). Conversely, the “late-youth” and “early-youth” notions of immigrant identity presented the intractable differences related to the “border stories” of immigrant narratives as they occur at a particular time in a person’s life. The “early-youth” immigrant narratives in this study were more likely to demonstrate assimilationist notions of ethnic identity, where the “late-youth” narrative remained more bicultural (Phinney 1990). The immigrant narratives and the ethnic identity formations they represent are improvisations of identities centered around fault lines and borders. They are examples of another demographic characteristic by which narratives represent spaces for understanding and critically examining race, ethnicity, class, and gender within the social contexts of learning and development.

At a more local narrative level, noting the narrative of Reuben was an examination of methodological “silence” and attention to voice (Mertens 1998). Reuben was a negative case analysis among all the other sixteen student narratives. Reuben’s narrative, however, also exhibited “idiosyncrasy” by producing and telling insightful stories and narratives consistent with the other students. I purposefully included these insightful narratives by Reuben to present them as demonstrations of intuitive and discerning spaces for understanding (Lather 1991). In our time together, I attempted to tease out his culturally-specific and tacit understandings, yet he remained many times obstinate to divulging reasons for the negations of his ethnic status. Thus, Reuben is a

narrative through which critical examinations of race and ethnicity can further produce discoveries into understanding conflicting narratives and how they may symbolize sophisticated figures of identity preservation.

In conclusion, the results of this study illustrate how we must take seriously the education of Latino/a students in science and look with renewed interest at the surrounding factors and influences that make up science instruction in higher education. The Latino/a participants speak of their higher education and science experience and provide “not simply a confessional and self-analytical perspective which bears witness to experiences but also a practical will for change...” (During 1993, p.233).

5.3 Implications and Suggestions for Future Research

The research findings presented in this thesis help to disseminate understandings of the cultural implications for exchanges of knowledge in science. Scholarly research on science and the culture of its students is not meant to produce ambivalent or threatening remarks toward either field. Nor are findings meant to be reduced to simple cultural differences. These are simplistic notions of sabotage that often face the production of academic knowledge on the education of science. Realized from these narratives is the idea Latino/as form complex ethnic-collective and gender identities. Thus, we should carefully examine what it means for students to recognize equality and difference within settings that promote certain cultural understandings, like science. The Latino/a students here exhibit strategies to deal with such antagonisms and have constructively transformed the culturally exclusionary definition of the science pipeline into one that they can navigate. They act upon the pipeline and in doing so, promote a vision how we can better assist underrepresented populations of students in the sciences.

For example, understanding how Latino/a student ethnic and gender issues play a role in their achievement through the science pipeline allow college administrations to better serve their student body and the surrounding scientific community with which these students will eventually be a part. By acknowledging that diversity is central to college student bodies and their learning experiences, we may move forward in helping college administrations and departments focus and improve their practice. At the higher education level, understanding diversity provides educational leaders with an important and vital resource for improving science instruction. Continued research on the diverse identities of college students specific to science may assist professors in teaching to their increasingly diverse student populations more effectively, master the specialized types of knowledge they may lack about these issues, and meet student learning needs.

Noting that calls for cultural diversity have saturated educational discourse, bell hooks (1993) addresses the intersection of diversity and education initiative:

Some folks think that everyone who supports cultural diversity wants to replace one dictatorship of knowing with another, changing one way of thinking for another. This is perhaps the gravest misperception of cultural diversity...All of us in the academy and in the culture as a whole are called to renew our minds if we are transform educational institutions – and society – so that the way we live, teach, and work can reflect our joy in cultural diversity, our passion for justice, and our love of freedom. (hooks 1993, p.239).

Her call is for the development of strategies to maintain engagement in the production of scholarly knowledge, as the ethnic, racial, gender, and cultural are defined by temporal space – in constant flux, changing with time, and existing with insatiable hunger for new perspectives.

The results of this study not only encourage the continuation of constant scholarly research on this area, but informs ways in which the “gatekeepers” of scientific discourse and culture in higher education influence the culture of the classroom. No longer can we shirk at the responsibility of promoting cultural inclusion in science, and we should be careful to easily dismiss the methods of science as a modernizing effect of uniformity. Thus, it seems fitting of this research to respond to “the bromide that science serves truth and not society” (an interpretation of its objectivity), by championing Ross (1993) in his “Challenge of Science.”

It should be seen as the kind of argument that exposes the way in which technical elites protect their privileges in a society where the most valued forms of knowledge are well nigh inaccessible to most of the population. Indeed, the use of technical expertise as a criterion to intimidate, exclude and disenfranchise is a primary exercise of power in the knowledge society we now inhabit. (p.304)

As we relate cultural and gendered notions to that of science, as is demonstrated in this study, we are encouraged to take notice of the means in which students have the possibility to think of science and themselves in less-restrictive ways while always remaining mindful of science’s more-disenfranchising directions.

APPENDIX

I. Office of Research and Compliance Approval Form



OFFICE OF RESEARCH SUPPORT & COMPLIANCE

THE UNIVERSITY OF TEXAS AT AUSTIN

P.O. Box 7426, Austin, Texas 78713 (512) 471-8871 - FAX (512) 471-8873
North Office Building A, Suite 5.200 (Mail code A3200)

FWA # 00002030

Date: 11/07/06

PI(s): Vanessa B Lujan

Department & Mail Code: ***PAYROLL USE ONLY***

Z9999

Dear: Vanessa B Lujan

IRB APPROVAL – IRB Protocol # 2006-10-0005

Title: **A Critical Analysis on Constructs of Latino Student
Ethnic and Gender Identity in Higher Education: Education**

In accordance with Federal Regulations for review of research protocols, the Institutional Review Board has reviewed the above referenced protocol and found that it met approval under an Expedited category for the following period of time: **11/07/2006 - 11/06/2007**

Expedited category of approval:

___(1) Clinical studies of drugs and medical devices only when condition (a) or (b) is met. (a) Research on drugs for which an investigational new drug application (21 CFR Part 312) is not required. (Note: Research on marketed drugs that significantly increases the risks or decreases the acceptability of the risks associated with the use of the product is not eligible for expedited review). (b) Research on medical devices for which (i) an investigational device exemption application (21 CFR Part 812) is not required; or (ii) the medical device is cleared/approved for marketing and the medical device is being used in accordance with its cleared/approved labeling.

___(2) Collection of blood samples by finger stick, heel stick, ear stick, or venipuncture as follows: (a) from healthy, non-pregnant adults who weigh at least 110 pounds. For these subjects, the amounts drawn may not exceed 550 ml in an 8 week period and collection may not occur more frequently than 2 times per week; or (b) from other adults and children, considering the age, weight, and health of the subjects, the collection procedure, the amount of blood to be collected, and the frequency with which it will be collected. For these subjects, the amount drawn may not exceed the lesser of 50 ml or 3 ml per kg in an 8 week period and collection may not occur more frequently than 2 times per week.

___(3) Prospective collection of biological specimens for research purposes by Non-invasive means.

Examples:

- (a) hair and nail clippings in a non-disfiguring manner;
- (b) deciduous teeth at time of exfoliation or if routine patient care indicates a need for extraction;
- (c) permanent teeth if routine patient care indicates a need for extraction;
- (d) excreta and external secretions (including sweat);
- (e) uncannulated saliva collected either in an un-stimulated fashion or stimulated by chewing gumbase or wax or by applying a dilute citric solution to the tongue;
- (f) placenta removed at delivery;
- (g) amniotic fluid obtained at the time of rupture of the membrane prior to or during labor;
- (h) supra- and subgingival dental plaque and calculus, provided the collection procedure is not more invasive than routine prophylactic scaling of the teeth and the Process is accomplished in accordance with accepted prophylactic techniques;
- (i) mucosal and skin cells collected by buccal scraping or swab, skin swab, or mouth washings;
- (j) sputum collected after saline mist nebulization.

(4) Collection of data through noninvasive procedures (not involving general anesthesia or sedation) routinely employed in clinical practice, excluding procedures involving x-rays or microwaves. Where medical devices are employed, they must be cleared/approved for marketing. (Studies intended to evaluate the safety and effectiveness of the medical device are not generally eligible for expedited review, including studies of cleared medical devices for new indications). Examples:

- (a) physical sensors that are applied either to the surface of the body or at a distance and do not involve input of significant amounts of energy into the subject or an invasion of the subject's privacy;
- (b) weighing or testing sensory acuity;
- (c) magnetic resonance imaging;
- (d) electrocardiography, electroencephalography, thermography, detection of naturally occurring radioactivity, electroretinography, ultrasound, diagnostic infrared imaging, doppler blood flow, and echocardiography;
- (e) moderate exercise, muscular strength testing, body composition assessment, and flexibility testing where appropriate given the age, weight, and health of the individual.

(5) Research involving materials (data, documents, records, or specimens) that have been collected, or will be collected solely for non-research purposes (such as medical treatment or diagnosis). (NOTE: Some research in this category may be exempt from the HHS regulations for the protection of human subjects. 45 CFR 46.101(b)(4). This listing refers only to research that is not exempt).

(6) Collection of data from voice, video, digital, or image recordings made for research purposes.

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies. (NOTE: Some research in this category may be exempt from the HHS regulations for the protection of human subjects. 45 CFR 46.101(b)(2) and (b)(3). This listing refers only to research that is not exempt).

Please use the attached approved informed consent

You have been granted Waiver of Documentation of Consent

According to 45 CFR 46.117, an IRB may waive the requirement for the investigator to obtain a signed consent form for some or all subjects if it finds either:

- The research presents no more than minimal risk
AND
- The research involves procedures that do not require written consent when performed outside of a research setting
<OR>
- The principal risks are those associated with a breach of confidentiality concerning the subject's participation in the research
AND
- The consent document is the only record linking the subject with the research
AND
- This study is not FDA regulated (45 CFR 46.117)
AND
- Each participant will be asked whether the participant wishes documentation linking the participant with the research, and the participants wishes will govern.

You have been granted Waiver of Informed Consent

According to 45 CFR 46.116(d), an IRB may waive or alter some or all of the requirements for Informed consent if:

- The research presents no more than minimal risk to subjects;
- The waiver will not adversely affect the rights and welfare of subjects;
- The research could not practicably be carried out without the waiver; and
- Whenever appropriate, the subjects will be provided with additional pertinent information they have participated in the study.

___ This study is not FDA regulated (45 CFR 46.117)

RESPONSIBILITIES OF PRINCIPAL INVESTIGATOR FOR ONGOING PROTOCOLS:

- (1) Report **immediately** to the IRB any unanticipated problems.
- (2) Proposed changes in approved research during the period for which IRB approval cannot be initiated without IRB review and approval, except when necessary to eliminate apparent immediate hazards to the participant. Changes in approved research initiated without IRB review and approval initiated to eliminate apparent immediate hazards to the participant must be promptly reported to the IRB, and reviewed under the unanticipated problems policy to determine whether the change was consistent with ensuring the participants continued welfare.
- (3) Report any significant findings that become known in the course of the research that might affect the willingness of subjects to continue to take part.
- (4) Insure that only persons formally approved by the IRB enroll subjects.
- (5) Use **only** a currently approved consent form (remember approval periods are for 12 months or less).
- (6) **Protect the confidentiality of all persons and personally identifiable data, and train your staff and collaborators on policies and procedures for ensuring the privacy and confidentiality of participants and information.**
- (7) Submit for review and approval by the IRB all modifications to the protocol or consent form(s) prior to the implementation of the change.
- (8) Submit a **Continuing Review Report** for continuing review by the IRB. Federal regulations require **IRB review of on-going projects no less than once a year** (a Continuing Review Report form and a reminder letter will be sent to you 2 months before your expiration date). Please note however, that if you do not receive a reminder from this office about your upcoming continuing review, it is the primary responsibility of the PI not to exceed the expiration date in collection of any information. Finally, it is the responsibility of the PI to submit the Continuing Review Report before the expiration period.
- (9) Notify the IRB when the study has been completed and complete the Final Report Form.
- (10) Please help us help you by including the above protocol number on all future correspondence relating to this protocol.

Thank you for your help in this matter.

Sincerely,

Lisa Leiden, Ph.D., Chair
Institutional Review Board

Protocol # Approval dates: - 2006-10-0005

11/07/2006

11/06/2007

II. Office of Research and Compliance Renewal Approval Form



OFFICE OF RESEARCH SUPPORT & COMPLIANCE

THE UNIVERSITY OF TEXAS AT AUSTIN

P.O. Box 7426, Austin, Texas 78713 (512) 471-8871 - FAX (512) 471-8873
North Office Building A, Suite 5.200 (Mail code A3200)

FWA # 00002030

Date: 10/30/07

PI(s): Vanessa B Lujan

Department & Mail Code: ***PAYROLL USE ONLY***

Z9999

Dear: Vanessa B Lujan

IRB APPROVAL - IRB Protocol # 2006-10-0005

Title: **Education Biographies from the Biological Science Pipeline:
An Analysis of Latino Student Perspectives on Ethnic and Gender Identity in Higher Education**

In accordance with Federal Regulations for review of research protocols, the research study listed above has been re-approved for the following period of time:

Your research study has been re-approved from 10/30/2007 - 10/28/2008

RESPONSIBILITIES OF PRINCIPAL INVESTIGATOR FOR ONGOING PROTOCOLS:

- (1) Report immediately to the IRB any unanticipated problems.
- (2) Proposed changes in approved research during the period for which IRB approval cannot be initiated without IRB review and approval, except when necessary to eliminate apparent immediate hazards to the participant. Changes in approved research initiated without IRB review and approval initiated to eliminate apparent immediate hazards to the participant must be promptly reported to the IRB, and reviewed under the unanticipated problems policy to determine whether the change was consistent with ensuring the participants continued welfare.
- (3) Report any significant findings that become known in the course of the research that might affect the willingness of subjects to continue to take part.
- (4) Insure that only persons formally approved by the IRB enroll subjects.
- (5) Use only a currently approved consent form (remember approval periods are for 12 months or less).
- (6) Protect the confidentiality of all persons and personally identifiable data, and train your staff and collaborators on policies and procedures for ensuring the privacy and confidentiality of participants and information.
- (7) Submit for review and approval by the IRB all modifications to the protocol or consent form(s) prior to the implementation of the change.

Protocol # Approval dates:

2006-10-0005

10/30/2007 - 10/28/2008

(8) Submit a **Continuing Review Report** for continuing review by the IRB. Federal regulations require IRB review of on-going projects no less than once a year (a Continuing Review Report form and a reminder letter will be sent to you 2 months before your expiration date). Please note however, that if you do not receive a reminder from this office about your upcoming continuing review, it is the primary responsibility of the PI not to exceed the expiration date in collection of any information. Finally, it is the responsibility of the PI to submit the Continuing Review Report before the expiration period.

(9) Notify the IRB when the study has been completed and complete the Final Report Form.

(10) Please help us help you by including the above protocol number on all future correspondence relating to this protocol.

Thank you for your help in this matter.

Sincerely,



Jody Jensen, Ph.D., IRB Chair

Protocol # Approval dates:
2006-10-0005 10/30/2007 - 10/28/2008

III. Office of Research and Compliance Amendment Form



OFFICE OF RESEARCH SUPPORT & COMPLIANCE
THE UNIVERSITY OF TEXAS AT AUSTIN

P.O. Box 7426, Austin, TX 78713 (512) 471-8871 - FAX (512) 471-8873
North Office Building A, Suite 5.200 (Mail Code A3200)

FWA # 00002030

Date: 10/30/07

PI(s): **Vanessa B Lujan**

Department & Mail Code: *****PAYROLL USE ONLY*****

Dear: **Vanessa B Lujan**

IRB APPROVAL - IRB Protocol # 2006-10-0005

Title: **Education Biographies from the Biological Science Pipeline:
An Analysis of Latino Student Perspectives on Ethnic and Gender Identity in Higher Education**

In accordance with Federal Regulations for review of research protocols, the Institutional Review Board has reviewed the above referenced protocol and found that it met approval for the following period of time:

Your amendment has been approved from 10/30/2007 - 10/28/2008

The following requested changes have been approved:

adding incentive
title change

Please use the attached approved informed consent
You have been granted waiver of documentation of informed consent in lieu
of verbal consent
You have been granted waiver of informed consent

RESPONSIBILITIES OF PRINCIPAL INVESTIGATOR FOR ONGOING PROTOCOLS:

- (1) Report immediately to the IRB any unanticipated problems.
- (2) Proposed changes in approved research during the period for which IRB approval cannot be initiated without IRB review and approval, except when necessary to eliminate apparent immediate hazards to the participant. Changes in approved research initiated without IRB review and approval initiated to eliminate apparent immediate hazards to the participant must be promptly reported to the IRB, and reviewed under the unanticipated problems policy to determine whether the change was consistent with ensuring the participants continued welfare.
- (3) Report any significant findings that become known in the course of the research that might affect the willingness of subjects to continue to take part.
- (4) Insure that only persons formally approved by the IRB enroll subjects.
- (5) Use only a currently approved consent form (remember approval periods are for 12 months or less).
- (6) Protect the confidentiality of all persons and personally identifiable data, and train your staff

Protocol # 2006-10-0005

Approved from: 10/30/2007 - 10/28/2008

and collaborators on policies and procedures for ensuring the privacy and confidentiality of participants and information.

- (7) Submit for review and approval by the IRB all modifications to the protocol or consent form(s) prior to the implementation of the change.*
- (8) Submit a Continuing Review Report for continuing review by the IRB. Federal regulations require IRB review of on-going projects no less than once a year (a Continuing Review Report form and a reminder letter will be sent to you 2 months before your expiration date). Please note however, that if you do not receive a reminder from this office about your upcoming continuing review, it is the primary responsibility of the PI not to exceed the expiration date in collection of any information. Finally, it is the responsibility of the PI to submit the Continuing Review Report before the expiration period.*
- (9) Notify the IRB when the study has been completed and complete the Final Report Form.*
- (10) Please help us help you by including the above protocol number on all future correspondence relating to this protocol. Thank you for your help in this matter.*

Sincerely,



Jody L. Jensen, Ph.D., IRB Chair
Department of Kinesiology & Health Education
University of Texas Austin
Phone: 512-232-2685
Fax: 512-471-8914
E-Mail: JLJ@mail.utexas.edu

IV. Office of Research and Compliance Informed Consent Form

IRB# 2006-10-0005

INFORMED CONSENT TO PARTICIPATE IN RESEARCH

The University of Texas at Austin

You are being asked to participate in a research study. This form provides you with information about the study. The Principal Investigator (the person in charge of this research) or his/her representative will provide you with a copy of this form to keep for your reference, and will also describe this study to you and answer all of your questions. Please read the information below and ask questions about anything you don't understand before deciding whether or not to take part. Your participation is entirely voluntary and you can refuse to participate without penalty or loss of benefits to which you are otherwise entitled.

Title of Research Study: An Analysis of Latino Student Perspectives on Ethnic and Gender Identity in Higher Education: Education Biographies from the Science Pipeline

Principal Investigator(s) (include faculty sponsor), UT affiliation, and Telephone Number(s):

Principal Investigator:

Vanessa B. Lujan, Science Education, vlujan@mail.utexas.edu, 512-471-7068

Dissertation Advisor:

Richard H. Richardson, Integrative Biology, d.richardson@mail.utexas.edu, 512-471-4128

Funding source: Not Applicable.

What is the purpose of this study?

The purpose of this study is to: explore the life stories of Latino students in higher education biological science courses; explore the educational histories of Latino students in Science; investigate attitudes, personal histories, and cultural histories that each Latino student brings to the Science classroom; and to understand how past experiences and histories (previous to current Science classroom experiences) have affected direction of study, attitudes toward science, and identity construction for students. The anticipated number of subjects for the duration of the study is approximately 10 students.

What will be done if you take part in this research study?

If you take part in this study, you will be interviewed about your past and current experiences with science education. You will also be asked about your personal and cultural histories and if you feel this has influenced your experiences, thoughts, and

aspirations in any way as related to Science education. You will be asked to elaborate on your studying habits, the formations of these habits, and what it means to be “successful” or “unsuccessful” in Science. This study involves participant observation which will include student observation in the science classroom, as well as activities related to the science course, such as study groups, etc.

The Project Duration is: The duration of this research study will last 3-6 months.

What are the possible discomforts and risks?

Potential discomforts and risks may include mild psychological or emotional stress associated with the interview questions. The risk is low and treatment will not be provided. If you wish to discuss the information above or any other risks you may experience, you may ask questions now or contact the Principal Investigator listed on the front page of this form. Participants can also contact Counseling and Mental Health Services at 471-CALL.

What are the possible benefits to you or to others?

The potential benefits of this study to the participants may include deeper understanding of one’s cultural and ethnic development, and one’s academic histories.

If you choose to take part in this study, will it cost you anything? No.

Will you receive compensation for your participation in this study? No.

What if you are injured because of the study? This study does not involve physical risk.

If you do not want to take part in this study, what other options are available to you?

Your participation in this study is entirely voluntary. You are free to refuse to be in the study, and your refusal will not influence current or future relationships with The University of Texas at Austin.

How can you withdraw from this research study and who should you call if you have questions?

You may discontinue participation at any time without penalty or loss of benefits to which you are entitled.

If you wish to stop your participation in this research study for any reason, you should contact the principal investigator: Vanessa Lujan at (512) 471- 7068. You should also call the principal investigator for any questions, concerns, or complaints about the research. You are free to withdraw your consent and stop participation in this research study at any time without penalty or loss of benefits for which you may

be entitled. Throughout the study, the researchers will notify you of new information that may become available and that might affect your decision to remain in the study.

In addition, if you have questions about your rights as a research participant, or if you have complaints, concerns, or questions about the research, please contact Lisa Leiden, Ph.D., Chair, The University of Texas at Austin Institutional Review Board for the Protection of Human Subjects, or the Office of Research Compliance and Support at (512) 471-8871.

How will your privacy and the confidentiality of your research records be protected?

Privacy and confidentiality will be maintained by keeping all research materials, audiotapes, notes, and transcripts in a locked file cabinet of the principal investigator. The principal investigator will have sole access to the tapes, and no other person will handle, transcribe, or listen to them. The tapes will not be destroyed after they have been transcribed or the information on it has been coded. In the case that the research will need to refer back to the tapes at a later date, the tapes will be retained after the study is completed and after they have been analyzed.

If in the unlikely event it becomes necessary for the Institutional Review Board to review your research records, then the University of Texas at Austin will protect the confidentiality of those records to the extent permitted by law. Your research records will not be released without your consent unless required by law or a court order. The data resulting from your participation may be made available to other researchers in the future for research purposes not detailed within this consent form. In these cases, the data will contain no identifying information that could associate you with it, or with your participation in any study.

All interviews will be audio-taped; the cassettes will be coded so that no personally identifying information is visible on them; they will be kept in the locked file cabinet of the principal investigator; they will be heard only for the research purposes by the principal investigator; and they will be retained for possible future analysis. If the results of this research are published or presented at scientific meetings, your identity will not be disclosed.

Will the researchers benefit from your participation in this study?

Understanding the relationship of personal and cultural histories that each student brings to the Science classroom.

Signatures:

As a representative of this study, I have explained the purpose, the procedures, the benefits, and the risks that are involved in this research study:

Signature and printed name of person obtaining consent

Date

You have been informed about this study's purpose, procedures, possible benefits and risks, and you have received a copy of this form. You have been given the opportunity to ask questions before you sign, and you have been told that you can ask other questions at any time. You voluntarily agree to participate in this study. By signing this form, you are not waiving any of your legal rights.

Printed Name of Subject

Date

Signature of Subject

Date

Signature of Principal Investigator

Date

V. Sample Overview of Interview Protocol Questions

General Background

Briefly give me a sense of the following. You don't need to go into detail here because we will be going into more detail later and in subsequent interviews.

Name, Age, Gender

Degree program

Minor area of study

Current Classes

Internships, Awards, etc.

Personal Interests

Previous work experience

Describe to me who you are – (personality, likes, dislikes).

Take me through a day in your life as it exists as a college student. As you do, highlight people and events which have the most meaning for you at this time.

General Life History

Describe your life history, in a nutshell. As you do this, recall some significant events in your life as a way to give more information about your life history. Keep in mind to explain what you consider to be the main influences that helped you shape your view of the world.

Prompts:

Family life, family values and influences, gender roles

Cultural heritage and background

Neighborhood raised

Family make-up (values and influences)

Educational background (you and family)

Where did you attend school – public/private?

Human nature beliefs

Gender roles

Changes in value orientation

Authority figures

Identification figures

Lets review for a moment. Your mother was born where? ___ Your father: ___ and you consider yourself...Mexican, Hispanic, Latino, Mexican American, etc

Choose from the following areas which ones are most significant and influential to you:

Social background

Political orientation

Cultural background

Religious background
Other

How are these areas influential and significant? As you consider this recall people, places, and events that you encountered that shaped your view of the world in these areas.

In your words, what would be the signs and symbols of leading a successful life? Do you believe that this path is available to everyone? Do you believe that this path is available to you? Do you believe you are on this path?

Does everyone have equal opportunity to achieve this path?
How is this possible or impossible?

Ethnicity

What does ethnic identity mean to you?

How do think it developed?

What role does your family play in the development of your ethnic identity development?

What does it mean to be Latino/a? How would you describe this to others?

Were you raised in a Latino/a - dominant neighborhood or non-Latino/a neighborhood?

What cultural group and ethnic group do you identify with?

Do you see similarities and/or differences between your ethnic group and other ethnic groups? What are they and with which groups?

How often during the week is being “Latino/a” salient for you in social or group situations? (not at all, five times a week, etc)

How do you understand the experience of being and living as a Latino/a? and in science?

Are there any cultural practices or behaviors that you engage in on a regular basis that allow you to express you ethnic identity?

What characteristics of your ethnic group make you feel like a part of this group? Examples of these characteristics are values, history, language, customs, belief, and traditions.

Gender

How do you understand the experience of being and living as a female/male? As a female/male in science?

Are there any cultural practices or behaviors that you engage in on a regular basis that allow you to express your gender identity?

What characteristics of your gender group make you feel like a part of this group? Examples of these characteristics are values, history, language, customs, belief, and traditions.

How does being female/male impact how you experience and reflect upon social interactions with groups – in science?

What does it mean to you to be a female/male in the United States today?

Please reflect on the dynamic of gender prejudice in this country. Who is the dominant group? Where do females/males fit? In dominant group, subordinate group, someplace else?

Have there ever been times in which you understood your gender place as dominant? Subordinate? Someplace else? When? Describe. In science?

Do you think your gender affects how your science professors/TAs interact with you?

Are all gender groups in school treated equally?

Worldview

I'm going to list some of the major societal problems we face today. As I do, consider which ones you see as most serious. Which ones do you consider most serious and why?

Problems in Society:

Crime

Unemployment

Poverty / Hunger

High cost of living

Fear of war / International tensions

Excess of governmental spending

Budget deficits

The economy in general

Moral, religious decline

Racism

Violence

Family breakdown

Welfare payments

Others?

Are there any other problems not mentioned which you see as serious and if so, what solutions do you suggest?

In a nutshell, what is your worldview? What do you see as the key influences in your life?

What do you believe are/were the most important influences that shape your beliefs?

If you were asked to list the most fundamental or strongest beliefs by which you live, what would you say?

What does the future hold for you? Give me an idea of your goals and expectations in the short and long term.

In what ways do you think your world view could affect your learning or being successful at science?

Closing

What have you discovered about yourself that you did not know before the interviews?

Did you find the questions used in the interviews suitable? Easy to answer? Did they make you think? Do you have any other questions in mind that I could have included?

Were you comfortable with the in-depth interviewing approach? In what ways could it have been improved?

Did you find the whole process effective in that it helped you to uncover your world view and belief systems?

Did you enjoy going through this process or did you find it more of a chore?

What other things would you like to say to add to what you have already said?

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