

## Broadening Conceptualization of Native Identity as Foundational for Success among Native Americans in STEM

Janet Page-Reeves<sup>1\*</sup>, Ananda Marin<sup>2</sup>, Kathy DeerInWater<sup>3</sup> and Douglas Medin<sup>4</sup>

<sup>1</sup>Office for Community Health in the Department of Family and Community Medicine, University of New Mexico, Albuquerque, New Mexico, USA

<sup>2</sup>Graduate School of Education and Information Studies, University of California Los Angeles (UCLA), Los Angeles, California, USA

<sup>3</sup>Directorate of Research, American Indian Science and Engineering Society (AISES), Albuquerque, New Mexico, USA

<sup>4</sup>Department of Psychology and the School of Education and Social Policy at Northwestern University, Chicago, Illinois, USA

### Abstract

This study explores success among Native Americans in science, technology, engineering, and mathematics (STEM) disciplines and careers. We investigate how identities are negotiated as individuals navigate educational, professional, and community landscapes, as well as the historical legacy of the detrimental way that Western science has positioned Native culture. We conducted interviews with Native STEM professionals and we found that a common factor in their experience is the strength of their self-identity as Native people. Contradicting both mainstream beliefs that STEM expertise requires a Western sensibility and common attitudes in Native communities that pursuing a career in STEM is antithetical to Native cultural affiliation, it is the depth of their Native identity that gives interviewees a platform for success in science.

**Keywords:** Identity; Science; STEM; Native American; Indigenous

### Introduction

#### Broadening conceptualization of Native identity as foundational for success among Native Americans in STEM

*Acts of inclusion are powerful acts of affirmation of our shared humanity that do not require homogenization, standardization, or flattening of cultural vitality and distinctiveness (p. 355) [1].*

*This is where I come from, and this is where I'm going, and this is why I have to be who I have to be [quote from a Native STEM professional].*

#### STEM and the continuing challenge of participation

The number of Native American students attending college, graduating, and pursuing graduate degrees has increased over the past 25 years and yet proportional underrepresentation persists [2]. According to the National Science Foundation (NSF) Science and Engineering Indicators, only 30% of Native American freshman intended to major in science and engineering in 2014, and intention to major in a STEM field has not improved since 1998 when 28.5% of Native American freshman intended to major in STEM [3]. Native American students are the only racial and ethnic group not to see improvement in STEM participation, and interest in STEM among Native Americans appears to be lower than all other racial and ethnic groups [4]. Patterns of college enrollment, college graduation, workforce participation, rates of employment and academic employment in STEM fields in the United States show a continuing underrepresentation among three racial/ethnic communities (defined as Blacks, Hispanics, and American Indians) [5]. Over the past ten years, Native people have represented an average 0.63% of the total number of bachelor's degrees and an average of 0.48% of the doctorates awarded in Science and Engineering [3]. In the 2010 U.S. Census, a little over 1.7% of the US population identified themselves as Native [6]. Given these statistics, Native people are therefore under-represented by a factor of more than three at the doctoral level. In light of this continuing under-representation, there is currently a move to develop a better understanding of the dynamics of the experience of Native Americans with STEM education and careers.

### Overview of this paper

In considering how to investigate underrepresentation of Native Americans in STEM, we follow guidance from Indigenous scholars [7-10] in our decision to reject approaches that emphasize individual failure and weakness. We also reject comparative perspectives that hold white middle-class values and practices as "the normal." Such approaches often lead to explanations that situate "cultural failure" as the problem. The focus of this paper is on understanding the identities that successful Native science professionals bring to their educational, career, and practical experience. We believe that an assets-based framework exploring the factors that lead to success and illuminating experiences that demonstrate strength has the potential to offer valuable instruction for developing strategies for inclusion and fosters a more respectful depiction of the lives of Native people. We present findings from interviews with Native STEM professionals and a structured dialogue group with a subset of the interviewees. We investigate how identities are (co-)constructed and negotiated as individuals navigate multiple and at times competing cultural practices across educational, professional, and community landscapes.

### Cultural Identity and Hegemonic Narratives

Weaver [11] discusses the challenge that Native Americans face in agentively constructing and defining their own cultural identities. Although academic conceptualizations may recognize the fluid and contingent nature of culture and identity as theoretical constructs, popular understanding continues to see both as constant, even static.

**\*Corresponding author:** Janet Page-Reeves, Research Assistant Professor, Office for Community Health in the Department of Family and Community Medicine, University of New Mexico, MSC09 5065, 1 Albuquerque, New Mexico, USA, Tel: 505-306-3041; Fax: 505-272-3764; E-mail: JPage-Reeves@salud.unm.edu

**Received:** July 20, 2017; **Accepted:** September 08, 2017; **Published:** September 13, 2017

**Citation:** Page-Reeves J, Marin A, DeerInWater K, Medin D (2017) Broadening Conceptualization of Native Identity as Foundational for Success among Native Americans in STEM. *Anthropol* 5: 187. doi:10.4172/2332-0915.1000187

**Copyright:** © 2017 Page-Reeves J, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

This means that Native Americans are often confined to a narrow imaginary of what others assume they should “be” based on historicized or caricatured cultural visions—the timeless Indian. Weaver [12] calls attention to the fact that in reality, Native “identities are always fragmented, multiply constructed, and intersected in a constantly changing, sometimes conflicting array” (p. 240). However, this multi-dimensional and fluid nature of identity is regularly lost in discussions of cultural interface that are commonly employed in relation to Native Americans. There is a propensity to present Native cultural identity as simple and one-dimensional, and therefore easily understood in counter-distinction to a similarly simplified caricature of non-Indigenous identity. The well-worn phrase, “walking in two worlds” that is commonplace in discussing the experience of Native Americans captures this abbreviated binary.

There is also a tendency to underappreciate the extent to which Native people are capable of having co-occurring identities or multiple and complex cultural affiliations in a manner that is healthy and happy. Having roots or experiences in different cultures and contexts is commonly construed as challenging, problematic, or even psychologically damaging for Native people. Lomawaima [13] sees this as a mythic discourse, a consequence of settler hegemony and white privilege that pathologizes Native Americans as incapable and victimized, and their culture as rigid and unchanging. She points out that we all have identities that involve simultaneous multiple selves, and that in middle- and upper-class American culture there is a tradition regarding cultivation of the ability to operate fluidly in other cultural contexts as a celebrated marker of elite status (e.g., speaking French or listening to Italian opera). Yet the hegemonic power of the pathology myth means that the stereotypical Native American is seen as traumatized and immutable when confronted with negotiating distinct Native and non-Native cultural landscapes, with the best hope for recovery or transcendence inevitably framed as assimilation.

Saranillio [14] discusses this predisposition to “imagine Natives through colonial tropes of ‘primitivism, technological incompetence, physical distance, and cultural difference,’ [as undergirding] colonial expectations of Indigenous peoples” (p. 637). Reardon and TallBear [15] identify damaging and negatively constructed imaginaries of Native Americans as part of a “long-standing property regime in favor of whiteness” (p. S241) that operates ideologically, both explicitly and implicitly, to confer rights and privileges to settler power structures that justify controlling the lives and destinies of Native people and the taking of Native lands and resources. Such ideological frames with colonial roots shape a “geography of expectation” that limits sanctioned spaces and activities for Native Americans and influences Native identities [16] (p. 139). As Brayboy [17] evinces in his article, aptly entitled “Hiding in the Ivy,” the resulting social and physical geography makes it seem incongruous or unexpected for Native Americans to be on a college campus, whether as students or as faculty. Weaver [12] believes that “non-Indigenous people do not want to see aspects of Native people that do not support their own ideas and beliefs, thus leading to a perpetuation of stereotypes,” and that, importantly, “these external perceptions may influence how indigenous people view themselves” (p. 247). This dynamic has obvious negative implications for thinking about academic and social outcomes for Native Americans. At the same time, Brayboy [18] reminds us that Native peoples have continuously engaged in acts of survivance by blending cultural, academic, Indigenous and European, knowledges.

### The power of agentive identity construction

Garcia [19] explores ways to undo these types of negative hegemonic

narratives and dynamics. He sees cultural identity as an agentive arena that can operate to re-center Indigenous cultural knowledge and values in a way that has potential to empower Native people to negotiate their own “positionality” within structures of privilege and entitlement, and to promote notions of sovereignty and self-determination. Contemporary conceptualization of identity as fluid rather than fixed demonstrates the extent to which individuals are involved in the creation of personal identities that reflect individual experience and choices [20-22].

But of course, people are not entirely free to construct their own reality. Levi and Maybury-Lewis [23] suggest that Native people “represent a particular position or subjectivity vis-à-vis fields of power” (p. 6). Historical residues and contemporary structures impinge upon people’s everyday lives and life courses. Writing about the experience of people with multi-racial heritage, Houston and Hogan [24] propose that identity is “embedded within a socio-political context [that] occurs across the lifespan” (p. 148). Individuals and groups must negotiate from within that context. They have the capacity to challenge externally imposed boundaries and actively redefine the demarcation of borders that circumscribe their lives. Even within imposed boundaries, people find ways to have multiple options. They manage contradictions, claim or re-claim meanings, and construct their identities while negotiating their position vis-à-vis dominant groups and individuals, and within structures of power. Culture is a fulcrum that individuals use for creating power and value in their lives. This process is complicated, contradictory, and often challenges the way we think about ourselves and others. But at the same time, it is clear that the autonomy of individuals to self-construct is never unconditional. Boundaries can be re-drawn, but they can rarely be erased [25,26].

Halliday [27] describes the complexity of this social reality as a dialogue between personal life trajectories and structural forces. He argues that culture is an “emergent and expressive” arena (p. 175) where people live within rather than between worlds, and that people can agentively construct their position within this arena by claiming “ownership and capacity to expand culturally into different [but simultaneous] domains” (p. 175). Within this powered landscape, such acts of “claiming” have been identified as key to expanding Native self-determination [28]. Below we explore how these processes are played out in the identities, experiences, and perspectives of Native STEM professionals we interviewed in this study.

### Identity as a lens for thinking about college success and STEM participation

It is clear from published works that identity is a key issue for understanding academic success and STEM participation for underrepresented minorities [29,30]. One study found that although structural barriers and academic preparation issues were important, identity was the single biggest predictor of grades [31]. Still another suggests that a strong ethnic identity can be a protective factor in relation to academic completion and persistence [32]. In this vein, an emerging literature has begun to illuminate how students from underrepresented populations learn to “navigate” [33], “negotiate” [29], and relate to discourses and perceived qualities and identities understood to represent STEM knowledge and careers [34-37]. It has become clear that cultural dimensions of identity are associated with academic success. “Findings suggest that students who believe that they can be true to their ethnic identity and draw strength from it while facing the challenges of campus life may be more likely to succeed in their academic pursuits” (p. 172) [cited in 34].

However, research shows that the relationship between individual

identity and academic success is complex [38]. We know that identity is not fixed, and this fluidity has implications. Phinney and Ong [39], and Huffman [40,41] propose that because identity is derived from experience, one's identity can dynamically change over time. Specific experiences and contexts can alter life trajectories by changing not only the material and social realities of a person's life, but also influencing the way that a person thinks about themselves now, and about their possibilities for the future [42,43]. Weaver [11] posits an active, agentive role for Native individuals and communities in writing their own identity stories. Educational and professional contexts are important arenas where these indigenized personal and group stories are elaborated and communicated as tableaux of identity.

### Cultural integrity and expansive identity construction

These identity dynamics play-out in the documented educational experience of Native Americans. The academic literature demonstrates that a strong connection to Native culture has been shown to be associated with academic success [17,36,40,44-48]. Our research builds on these works and on an emerging literature conceptualizing identity issues in relation to STEM education [30,48-50]. We are inspired, in particular, by constructions developed by Waterman and colleagues [45-47] situating culture and identity as foundational for understanding educational outcomes for Native Americans. Waterman [47] investigated the fact that individuals in her Tribe (Haudenosaunee) who demonstrate a strong affiliation with their Native culture are also the ones who are successfully going to college and completing college. She refers to this as maintaining "cultural integrity." She suggests that these individuals use their culture to be resilient and successful in college. Their cultural identity becomes an anchor and a source of strength. Schiefer and Krahé [44] found that Native Americans who have a strong self-association as Native have more confidence in their own internal resources. Huffman [40,41] similarly conceptualizes ways that a strong sense of ethnic identity provides emotional security for Native Americans to operate in non-Native contexts.

Despite the depth and strength of these findings, however, in the design of STEM educational spaces and curricular materials, Indigenous experiences are often invisible and Indigenous perspectives and ways of knowing backgrounded and underappreciated. In fact, the indigeneous and the non-Indigenous are often mistakenly positioned as antithetical. This lapse conceals the key nature of identity in educational contexts, and ultimately limits opportunities for learning and innovation. This is particularly true for thinking about Native Americans and STEM in everyday discourse in both mainstream and Native contexts. Academics writing in scholarly journals have figured out that identity does not "work" the way that mainstream culture tends to convey it. Yet while academic literature now conceptualizes identity as a fluid process rather than a thing or a list of specific traits, the everyday understanding of culture and identity continues to be as something a person "has" or "is" that has definable boundaries and identifiable forms. If asked, people may not be able to define those boundaries or identify those forms, but they imagine them to exist. For Native Americans, this often takes the form of settler colonialist configurations continuing to hold sway over public perceptions of what things are appropriate or possible for Native Americans. How this plays out in everyday discourse, particularly in STEM classrooms and professional settings is something worthy of further study.

### Methods

This study was conducted as a collaborative engagement between researchers at the University of New Mexico (UNM), the American

Indian Science and Engineering Society (AISES), and Northwestern University (NU)<sup>1</sup>. Research presented here is from 40 ethnographic interviews with 21 participants conducted in two iterative Phases (21 interviews in Set I and 19 in Set II) and one structured dialogue group session with a subset of six of the interviewees. Approval for the research was obtained from the Human Research Protections Office at the UNM. At the first interview appointment, all participants provided signed informed consent. Selection of interviewees was purposive and systematic with an eye to interviewing individuals who were likely to have information, experience, or perspectives relevant to our research about success among Native Americans in STEM. We conceptualized success broadly to include academic and professional achievement, participation in supporting Native community goals, and expanding spaces of participation for others. Interview and group session participants received a \$25 Amazon card each time they participated to thank them for taking the time to contribute their expertise to helping us understand the factors that could promote Native American participation in STEM.

With input from AISES and from our seven-member project Advisory Board of distinguished Native STEM professionals, educational researchers, and advocates, we identified a list of 36 potential interviewees. The list was national in scope, including Native STEM professionals from across the U.S. As per the inductive nature of qualitative research, the interviewee cohort was not designed to be "representative" in the quantitative research sense. It would be impossible to represent nearly 600 tribes in a qualitative research project with a small number of participants. Instead, our sample was designed to provide an opportunity for us to obtain information from a diverse cohort to provide different perspectives and insights regarding the factors that contribute to success among Native Americans in STEM—including unexpected dimensions of this process. Our objective was to flesh out the contours of a conceptual landscape as a foundation for identifying strategies to improve Native American STEM participation.

Thirteen of the 36 potential interviewees were not able to be contacted or did not respond to our phone/email inquiry, two declined to participate, and 21 of the 23 contacted agreed to be interviewed. The interviewee cohort of 21 participants was gender-balanced with 11 men and 10 women, and was diverse in terms of Tribal affiliation, geography, scientific discipline, academic degree (BS, MS, Ph.D., M.D., including one individual who obtained a GED high-school equivalency degree prior to a BS), and sector (industry, academia, Tribal government, government, self-employed). The six participants in the structured dialogue group were selected because their interview responses demonstrated capacity for analytical discussion that we felt could further advance our understanding of the factors that contribute to success among Native Americans in STEM. Group session participants showed exceptional ability to talk about and reflect on their own experience, to think about the experiences of others, and to extrapolate to conceptualize the experience of Native Americans as a group at a theoretical level. Eight group participants were invited, but two had schedule conflicts that made it impossible for them to attend the group session.

Potential interviewees were contacted by AISES to gauge interest. Page-Reeves [author #1] who is a cultural anthropologist with extensive experience interviewing individuals from underrepresented, marginalized, and at-risk communities, contacted the 21 who agreed

<sup>1</sup>The University of California at Los Angeles (UCLA) also became a collaborating institutional partner on this study when Dr. Marin switched her affiliation midway through the project.

to participate individually by phone and/or email, and coordinated all of the logistics necessary to set-up each interview. Interviews were conducted by Page-Reeves in-person at a location of convenience to the participant such as a hotel or the participant's home, and Page-Reeves travelled extensively to be able to accommodate the needs of each participant. One of the Set II interviews was conducted by phone because of scheduling conflicts on the part of the interviewee. Interviews were designed to have an informal atmosphere, lasted 1-2 hours, and were audio-recorded using a small hand-held audio-recorder with a USB port to upload MP3 audio files into a computer. Audio-recordings of interviews were professionally transcribed.

For the structured dialogue group session, the six participants traveled at the expense of the study (including per diem, flight, and hotel expenses) to Albuquerque for an all-day meeting at the home of Page-Reeves. The group session was co-facilitated by Page-Reeves and Marin [author #2] who is an experienced qualitative researcher trained in psychology. The atmosphere of the group session was informal and convivial, and meals were provided. Discussion which occurred during the group session was audio-recorded and transcribed by a professional transcriptionist.

We use the nomenclature of ethnographic to describe the interviews and the structured dialogue group session because we pursued a holistic, anthropologically inspired approach to data collection [52]. Interview and group session questions were developed collaboratively by the research team. Rather than using narrowly focused questioning, interviews explored interviewees' lives more broadly in order to provide background and to contextualize our understanding of the more focused research domains. An anthropological stance assumes that we (the researchers) do not necessarily know the right questions to ask—it is only through conversation with interviewees that this becomes clear. Although often underappreciated in more quantitatively oriented research, an anthropological lens provides contextual rigor to ground our interpretations. We believe this ethnographically inspired, holistic framework from anthropology improved our capacity to conceptualize social, behavioral, and cultural processes described by interviewees, to develop a reliable and grounded understanding of individual experiences, and to better capture and identify subtle dynamics that influence success of Native Americans in STEM disciplines and careers.

During the interviews and the group session, participants' discussion of their personal stories, of their experience in STEM, and of various paradigms of science was intertwined. As part of the process of contextualizing and honing the quality of our data, information learned through conversation with interviewees was incorporated into prompts and follow-ups in subsequent interviews and more explicitly into the group session questions. As a result, each set of interviews was internally iterative and adaptive, and the group session was conceptually and theoretically rich in relation to our preliminary analysis of the data. This process allowed us to "fact check" information emerging in the context of interviewee narratives and to verify that our interpretive framework reflected concepts and paradigms that fit with intellectual schemas embraced by participants. The structured dialogue group session was consciously designed with this in mind. We presented the group with ideas we had and concepts we were developing from our analysis of the interview transcripts. The group provided input and suggestions regarding ways of thinking about the data and for framing our analysis. In keeping with our ethnographic sensibility, we did not treat the group session as merely a "focus group." We used a "structured dialogue" approach [53,54] to work collaboratively with the group

participants as co-analysts in developing our interpretation, and we are continuing to engage them as we move forward with our research<sup>2</sup>.

We also employ an ethnographically inspired approach in our holistic analysis of the data. We conceptualize culture as fluid, porous, dynamic, relational, contested, negotiated, contextual, and situated in keeping with theoretical stances that have been explored in the anthropological literature [55], and in education theory [56]. As per Fischer [57], we adopt a cultural analytic perspective, treating culture as a system that "experimentally" integrates recurrently structured and emergent patterns. Additionally, our theoretical orientation appreciates the mutually constitutive relationship between culture and power in the production and reproduction of social relations, meanings, and cultural forms [58], and our approach aligns with conceptualizations of identity as a process rather than a thing [21,22]. Individual and group identities are formed through a negotiation between the self, others, and structures of power, and they change over time and in different contexts [20,21,27].

To develop this manuscript, we conducted a rigorous, disciplined, empirical analysis of our data according to Hamersley's [59] criteria for qualitative research based on plausibility, credibility, and relevance. Hamersley proposes that ethnographic analysis can be validated as credible if information presented demonstrates that claims are plausible based on existing knowledge (e.g., from the literature or based on researcher experience), credible based on available evidence (e.g., through quotations from interviewees), and relevant to the social reality of the individuals involved in the research (e.g., as evidenced through fact-checking and context analysis). We followed Gläser and Laudel's [60] framework for theory-driven qualitative analysis that integrates "coding" with interpretive content analysis. This process nurtures the development of theoretically derived explanations for patterns in the data that would otherwise be unintelligible and can usefully be employed to understand complex, embedded dynamics and processes. We used "constant comparison" [61] to explore interconnections between theme categories and we made connections with concepts we had identified in the literature by developing a holistic interpretation of the data that we present below.

Forty-one transcripts were analyzed (21 from Set I, 19 from Set II, and one from the Workgroup Session) involving 1400+ single-spaced pages of transcript data, with individual transcripts varying in length from 25 to 55 pages. Three team members with different types of experience in qualitative research (Page-Reeves from anthropology, and Marin and Medin [author #5] from psychology) participated in analyzing the transcript data. Using hardcopy, Page-Reeves read and re-read the first set of interview transcripts. She employed manual coding methods to identify themes and categories that were theoretically related to this study or that occurred in a patterned way in interviewee narratives, and she developed a conceptual summary that described the categories. She reviewed literature on the issue of Native Americans and STEM, and on specific emerging themes. Using discussions from the literature as a base, she developed a framework for interpreting and integrating findings. Marin and Medin read the interview transcripts (and at the same time, Marin was engaged in a parallel component of the study conducting a narrative analysis of AISES scholarship essays).

Informed by these preliminary analyses, and with feedback from the project Advisory Board and input from research team member,

<sup>2</sup> At a second group session with the same group participants in spring 2017, the group decided to be co-authors on a number of future publications from the research.

DeerInWater [author #4], we collaboratively developed Deer questions for Set II interviews that were designed to explore themes emerging in our review of the data and to obtain further participant input. After Set II interviews were complete, Page-Reeves, Marin and Medin read the Set II transcripts to deepen our understanding of the conceptual categories and patterns related to our preliminary analysis, and we refined our categories and domains.

The team met regularly across these phases of the work (Set I, Set II, and the Group Session) and reflected on and refined our conceptual findings. This secondary, refined analysis, including Marin's parallel analysis of the content of scholarship essays plus feedback from the Advisory Board and discussion during project meetings, provided the foundation for us to develop the Group Session questions. It was our explicit intent to review the ideas and theories we were formulating with the group and get their "take" on our emerging interpretations. Following the Group Session, Page-Reeves read transcripts from both Set I and Set II interviews and from the Group Session as one complete data set to further hone our analysis, and the group developed a conceptual understanding of dominant themes. Using this analysis of the complete data set, Page-Reeves conducted a review of the literature to identify ideas, concepts, and approaches to help us understand what we were seeing in the data, and we identified ways that data from this study and our emerging analysis could address gaps in the literature and/or contribute to theory in relation to the issue of success among Native Americans in STEM.

Following review of the literature, Page-Reeves read the complete data set again and coded for our initial theoretically derived categories, for unanticipated categories that emerged from interviewee narratives, and for categories salient to the existing literature. Coding categories included identity, way-finding, perspective, giving back, resilience, and Native organizations. Some data were coded into more than one category when appropriate. Here we discuss our analysis of data in the category of "identity." Page-Reeves worked with the "identity" data file in three iterative stages. She deleted quotes that were duplicative in meaning or that did not seem as significant or coherent when reviewed in the context of the other quotes, and "cleaned" quotes to remove identifying data and discursive utterances that did not relate to the intent or meaning of the quote (such as "like," "you know," and "umm"). The data file produced in iteration #3 was internally hand-coded for systematic themes and sub-themes. Data related to each sub-theme were extracted and used to create separate electronic files. Each of these files was subjected to a final round of honing, refinement, and reduction. We used "constant comparison" (Perry 2003) to explore interconnections between theme and sub-theme categories and concepts we had identified in the literature by developing a holistic interpretation of the data that we present below.

## Results and Discussion

We found that a common factor in the experience of Native STEM professionals interviewed for this project, despite significant differences in background, geography, discipline, and work sector, is the strength of their self-identity as Native people. Indigenous identity was the overarching, core theme that emerged from our first set of interviews with Native STEM professionals. Our data show that a strong sense of their Native self is something from which interviewees have drawn strength and which has provided a foundation for their success in STEM. Interviewees feel a deep connection to their indigenous heritage. In Set II interviews, when asked to consider the fact that Native identity emerged as such an important theme in our analysis of the transcripts

from the first set of interviews, interviewees thought this was both interesting and that it made sense. One interviewee said,

*I think it boils down to do you know who you are? That, do you know where you come from? Do you know the significance of that? Do you know how that can shape the world, how it can help your people, how it can help you, how it can help the white world? If you have your identity, you know who you are... So I think identity, knowing who you are, your Native identity is very, very, very important...*

While interviewees talked about many components of which they are, they also explicitly identified themselves as scientists, saying things like: "I always identify myself as being Native first, [but] I think my identity is tied to being a scientist," and "I guess I'd like to feel like I've always been a scientist." And interviewees also have other ways of thinking about themselves. For example, one interviewee described how in addition to being Native and being a scientist, her core sense of herself was tied explicitly to being a daughter. Another said, "my lab coat...has sequins or...maybe I have feathers in my hair with my lab coat on...it's part of me, and I'm part of it, but it's not all who I am... 'cause I am the cowgirl, the snowboarder, the leader, the wild child festival girl... all these things." As we describe below, for a number of interviewees, the process of going to college and becoming a STEM professional was one of personal transformation in which their individual identity shifted, but not in ways that decreased their sense of themselves as Native people. This is an important point for understanding the STEM experience for Native Americans. We argue that understanding this dynamic reveals important insights for developing strategies to improve Native Participation in STEM.

The discussion of our data that we present here demonstrates the importance of identity as a theme that runs throughout people's lives. Seven core identity-related themes emerged from analysis of the interview and group session transcripts: 1) Native identity, 2) Embracing STEM identity and finding strength in Native identity, 3) Finding balance, 4) Belonging and giving back, 5) Fitting-in in STEM, 6) Rejecting colonial confinement, and 7) Being and becoming a STEM professional. With regard to STEM more specifically, we identified a diversity of viewpoints in how interviewees framed connections between themselves as Native people and their work as Native scientists. Interviewees talked about personal life perspectives grounded in holism but also about the experience of conflict. They discussed the lack of Native presence in STEM academic and career contexts and how this influenced their views of themselves and their STEM field. Taken together, the interviews point to a tension between interviewees' views of their work and experience in STEM as important, compelling, and exciting, and associated views of practicing western forms of science as "white." Yet "tension" was not the predominant gist of the narratives. More central was that interviewees have learned to manage this tension by interweaving different dimensions of their lives [62,63].

### Embracing a STEM identity and finding strength in Native identity

Although there are challenges to weaving together multiple identities, as we discuss in the next section, in general, interviewees embrace the multidimensionality of their identities, and they tend to see a synthetic relationship (in the sense of being harmoniously blended, synthesized, or integrated) between their Native culture and their careers as science professionals. They identified this synthesis as an important dimension of their success. One interviewee stated very explicitly, "If you're asking whether there's a clash between my scientific training and my traditional knowledge and understanding, the

answer's absolutely not." Another was taught that integrating different dimensions of her life is something she should actively try to cultivate. She explained, "My mom always said you're lucky because you can bridge both worlds, she said that is going to be a tool that as you get older you'll realize is a blessing." Importantly, interviewees see their connection to Native culture as contributing to rather than diminishing their capacity as scientists. One interviewee said, "The culture and...the Indian ideas I was raised with are integral to my science, and then in the Indian community, the fact that I'm a scientist is always there." Another said, "Your Native culture and your Native values actually make you a better scientist...you can use that Native culture and Native identity to help you...and also make you a better scientist. I do feel strongly about that. I believe that's true." One interviewee framed it as being all about the "ability for an individual to synthesize the differences and then find the commonalities."

Interviewees also discussed a counter to this synthetic paradigm as represented in the idea of "walking in two worlds" that is commonly used to describe the experience of Native Americans in relation to mainstream culture and particularly with respect to Natives in STEM [64] (p. 281). Above described is Lomawaima's [13] critique of dimensions of this concept as pathology. In general, interviewees did not embrace the two world's conceptualization of their experience as Native STEM professionals. They said things like,

*I get confused...because a lot of people use this whole "walking in two worlds" [idea]...like...you're Native...this one time when you're in your community, but then you're not Native, or you're something else when you're in another community...That was foreign to me...I am Native always [laughs], there's none of this two worlds thing, there is just one world and this is where I am, and I need to navigate it as a Native person.*

*I carry everything with me everywhere I go...I don't really try to hide it or anything like that...so the "walking in two worlds" ...I hated that...I just didn't see the point [laughs]. It's like no, you're a Native and you'll always be this and don't try to push these two things aside.*

Part of the ambivalence interviewees expressed toward the idea of separate "worlds" is that they see interconnection as a defining feature of their life's experience, and holism underpins their philosophical understanding of the nature of all things. One interviewee described it as, "Well, I think we're definitely all [connected]...it's all connected. I don't...see how it cannot be. I mean, how can you separate [it]? It's impossible. It's all connected." This experience of synthesis and connectivity, reflected in the way they view themselves, was captured beautifully by one interviewee:

*I don't feel separate...It's just a part of who I am. I don't behave differently on either side of the house. I don't think differently. I don't process differently and everybody when they use that term [walking in two worlds] and a lot [people] use that, I'm like, really? And how are you different when you walk in the two different worlds? Do you stop becoming Indian as soon as you cross into a non-Indian restaurant? Do you eat differently? Like all of a sudden, I'm left-handed and I will eat like this? That really doesn't make any sense to me. It never [has]. I've never got that concept. I don't think my family would have allowed me to have that concept. My mom always said to us, "First and foremost, you are [Tribe Name] ...and that's who you are and it defines who you are through your whole life and what a blessing that you get to be [Tribe Name]. Because very few people on this planet get to be and you get all this amazing knowledge that's gonna be your foundation and what you do with that knowledge to become who you are by the end of your life, lucky you," and that's what she would always say. "Lucky you."*

## Finding balance

At the same time that interviewees generally embrace synthesis, they also experience or acknowledge that conflict exists, and they seek to create balance in their everyday lives in relation to how they are able to incorporate things that are important to them based on culturally defined values. Interviewees have developed strategies to live with identity conflict that arises in this process and are able to navigate contradictions, sometimes without being conscious that conflict or contradiction even exists. However, a few interviewees find it difficult to integrate the different dimensions of their "selves." One interviewee, in particular, described her struggle:

*I think I do stop being Native American at work...I stop being Native American because of work...I can't do my cultural activities that I want to...and I think that's a big part of the Native identity is being able to express your culture and so I still think...I like [my science self-]. I understand that, but I still think I'm [my Native self].*

Another who described how although she has come to terms with the conflict, she still understands it, saying, "to not have to abandon that for the sake of doing something not traditional, I struggled with that. I feel I like know a lot of Indigenous people who have struggled with that."

A key challenge described was that of finding a way to balance one's everyday personal and professional life. One interviewee feels that "the challenge is balancing out who I am on a daily basis versus what I need to get done. Balancing and remembering that my position here doesn't define me, what defines me is how I relate to my family, to my friends, to my husband, not getting caught up in the fact that I have so much work to do that I forgot to say a prayer in the morning that said thank you".

Another interviewee explicitly recognized that finding that balance is the key to success, saying,

*For an individual to learn early that you can actually bridge them together, then that's, I think what helps people overcome these things. The only thing that I think will keep someone from being successful is that world view that you can, can combine and bridge the two that you can, you know, live in two worlds, or walking in two worlds or whatever it may be. In some cases it's not even just two worlds. It's more than two worlds. But in the case that, you know, you have to accommodate both expectations of being Native and non-Native is that you're gonna run across more people who don't have that same view.*

Contradicting ideas about cultural difference and conflict that are common in the literature on Native Americans in STEM [65-67], interviewees see interconnection portrayed in their everyday existence and they experience synthesis.

We find these sentiments especially intriguing given that the interview questions were framed as being in relation to the individual's experiences as STEM professionals. To us this suggests that interviewees do not have bifurcated identities. Similar to the mixed-heritage individuals in a study by Houston and Hogan [24] whose identity construction involved a positive celebration of complexity, interviewees in this study embrace the multidimensionality of their lives as a form of joy. In particular, this joy is rooted in personal relationships. Interviewees draw strength in connections to family, tribe and Native community. These relations inform their ways of being and the way they approach their lives as STEM professionals. Grande, San Pedro and Windchief [22] write that "Indigenous identity is relational—it is not only influenced by one's own internal understanding of who one is, but also by the Indigenous community to which one belongs" (p. 115). They see Native identity as co-constructed through "various acts

of intentionality, to remember, to reclaim, and to regenerate” (p. 116). We believe that this is what we are seeing in our data.

### Belonging and giving back

Many of the interviewees described the source of their Native identity in their connection to and the experience of belonging to a community. One interviewee said, “*The thing...that makes us all successful is the fact that we’ve got a place, we’ve got somewhere where we know we belong and I think that makes you really strong.*” Another said, “*There’s people in the community and in our families who say...this is how we are, this is who we are, this is where we’ve come from as a people... these are the values we hold, and this is the path that we walk. So, to that extent...there’s...something that comes from our community and our families that orients us in a particular direction*”.

Alfred and Corntassel [68] see these social relations of connection “to be at the core of an authentic Indigenous identity” (p. 60s9). Grande, San Pedro and Windchief [22] discuss “how complex systems of relationality—ways of being-through-relationship—continue to be a distinctive feature of Indigenous identity formation” (p.115). For example, one interviewee described how Native identity influences his career goals, saying,

*I think it does influence me. It influences what I want to research... what I want to pursue and my priorities. You know, like I want to do research, but I want to do research that would help...other Native people... I want to help out...other people...that could have been me a few years ago. Um, you know...not just Native students but any student that really wants to, I don’t want them to quit before they, before they realize their potential.*

Similarly, in a study of student career counseling, Juntunen and colleagues [64] found that career choice for Native students was significantly influenced by a strong sense of community and that the ability to help others was a key metric in their sense of their own success. One interviewee in our study spoke about this in identity terms, saying, “*we wanna do good things, we wanna help people and it’s kind of who we are and we wanna be able to give back and go back and help our communities.*” Commitment to giving back to community—whether narrowly or more broadly defined—is a dimension of the identity of many Native people. What we see in our data is that Native STEM professionals are figuring out how to make their STEM knowledge and education serve Native needs and interests—what Grande, San Pedro and Windchief [22] call a “process of exercising traditional Indigenous values and applying them to contemporaneous environments” which they see as a form of community “regeneration.”

Yet just as identity is not one-dimensional, nor is its source fixed. For a number of interviewees, the process of going to college and becoming a STEM professional was one of personal transformation in which their individual sense of belonging shifted. Some described developing a sense of their own indigeness and beginning to see them more concretely connected to a broader Native community. One interviewee who had a relatively suburban, mainstream upbringing said, “*Well for me it...actually has strengthened my Native identity.*” Another who had grown up in a town bordering a reservation where cultural and social divisions between Native people who live on the reservation and those who live in town are stark and often conflictive, described how going to a college where he was one of only a few Native students increased his positive sense of himself as a Native person, as belonging to a Native community, and as having a leadership role to play. He said,

*I went to [Elite University] where there was...a handful of us together and...I was sort of the voice for all of my people, or I became the*

*representative for all my people and all of the sudden I took much more heart in it and that rocked me into that, in that way, saying like, “I am native, I am that person, and I’m gonna be a representative and a good representative.”*

Mihsuah [69] explains how experience in non-Indigenous contexts “precipitates identity awareness” for Native Americans [cited in 68 p. 605]. Alfred and Corntassel [68] see this as a process of indigenizing that involves a conscious intent on the part of individuals to nurture or recuperate an Indigenous identity in a way that contributes to the strength and vitality of Indigenous “peoplehood.”

Discussing underrepresentation of Native Americans in higher education, Collins [70] describes the enactment of “indigeneity” as a “reconciling of consciousness with colonial narratives” and a negation of what Grande, San Pedro and Windchief [22] call the embedded “logic of elimination” (p. 108). Garcia [19] suggests that it is essential for Native Americans to find “sacred spaces of pedagogy” or “sacred landscapes” in their educational and developmental passage where they can learn to negotiate their own consciousness—an internal negotiation of their own positionality that allows them to transcend the hegemonic paradigms that create limits and box people in. Development of critical consciousness and the re-centering of cultural knowledge and values are necessary components of this type of decolonization process. Windchief and Joseph [28] discuss the ways in which this is occurring as Native Americans claim higher education as indigenous space. They argue that Native students can “achieve success while maintaining cultural integrity by claiming educational space as their own” (p. 267) and that “utilizing something that has originated in another cultural context is not something new within the [Native American] collective experience” (p. 268). Weaver [12] believes that in this process, “individual cultural renewal and collective cultural renewal are intertwined” (p. 245). Interviewees who had this experience believed that it contributed to their ability to be successful in their careers.

### Fitting-in in STEM

A component of identity is seeing yourself to fit-in with those around you. A few interviewees found empowerment in being one of only a few Native Americans in their college, graduate school or STEM discipline. One of the female interviewees found it particularly invigorating and galvanizing. She said,

*I definitely drew strength from it. I knew there must be something special when you look around and there’s nobody like you...I think being Native, and a Native woman...it just felt empowering. It was empowering to be unique at [Highly Competitive State University], and incredibly empowering at [Elite University]...Being a Native woman was a true positive for me.*

However, because Native Americans are significantly underrepresented in postsecondary educational settings, and especially in STEM—both as students and as faculty—most of the interviewees found that it was challenging to feel as if they fit-in. Collins [70] calls this a feeling of “erasure.” One interviewee said, “*I think it’s hard...you don’t see many Natives in science in general, so it’s hard to see like okay how do I fit-in with everybody else in science?*” Another put it more bluntly, saying, “*I think to this day I feel like I’m in an alien culture.*”

Other interviewees presented a more ethno-political perspective. One interviewee described the underlying challenge as, “*There’s the world where I have to deal with people and their privileges and their micro aggressions, and then there’s a world where I don’t because they’re like me.*” Another explained,

*What I felt...like I didn't quite...it wasn't quite for me. Like...those very smart people... come from very well-off families and...it almost felt like [Elite University] was for them. I don't know why. Like I just didn't feel like...it was my university. I felt like I was attending it and they were being gracious.*

Interviewee narratives contain stories that demonstrate the nature and depth of the experience of separateness, erasure, and internalized inferiority that confront Native Americans pursuing a degree and a career in STEM. Such dynamics generate the feeling among interviewees for this study that they do not fit-in.

### Rejecting colonial confinement

However, despite these feelings and experiences of alienation, interviewees were adamant in their rejection of colonial stereotypes and limitations. Many of the interviewees framed their pursuit of a career in STEM as pushing boundaries through their rejection of an imposed "confinement"—a word that was used repeatedly. For example, they said things like,

*I think that...one thing that stops Natives from going into higher education, into the sciences, is...the perception by outsiders that we can't do it...and...those things together create the sense of confinement for Natives. Well, you're just confined to stay on this "res" ["reservation"], this is where you belong, you don't belong anywhere else. You can't be a scientist or an engineer. You don't have the ability... We have to overcome this sense of confinement that's been...imposed on the Indian people by policy and attitudes of outsiders.*

and,

*The tribes on the reservations are very important for maintaining the...cultural identity and...integrity of the culture. But the idea that you have to stay here, you're confined there, that was something imposed by outside parties. That was not something that we traditionally practiced. And unfortunately a lot of Natives have internalized that.*

Cerulo [71] writes about how such "subjective definitions imprison individuals in spheres of prescribed action and expectation" (p. 388). In his piece on the "Insurrection of Subjugated Futures," Saranillio [14] addresses this challenge, calling for destruction of "colonial categories that limit our worlds of possibility" (p. 638) or what Levi and Maybury-Lewis [23], describe as "liberating the term 'Indigenous' from its previous colonial entanglements" (p. 33). Windchief and Joseph [28] identify "claiming education, its tools, and the spaces associated with it [as providing] the essential skill set that Indigenous communities can use in augmenting notions of tribal sovereignty, quality community life, and Indigenous community educational persistence" (p. 274). The interviewees in our research are doing just that in the arena of STEM and STEM careers.

### Becoming a STEM professional

As such, we were led to consider the fact that identity was a key theme in interviewee narratives in terms of both the strength of interviewees' sense of themselves as Native people, but also their explicit self-identification with STEM, with science, and as STEM professionals. Identity was seen by interviewees as something they were actively constructing as they move through their lives in ways that contradict colonial expectations and confinement. However, as we discuss above, their identities have not remained fixed. Identities change over time and are derived from a person's experience and personal circumstances in relation to broader contextual and structural dynamics. One interviewee phrased it as, "a very clear sense of the equality of the wisdom of [our]

*ancestry...knowing that it's equal, that you can actually be both, that is a gift to not struggle with denying some part of you that's shaped you, that's molded you, that's informed you, that's made you who you are."* In a study with individuals from multi-racial backgrounds, Houston and Hogan [24] discuss how people "construct themselves actively and perpetually from a fluid menu of options..., [they] negotiate and create a social space for themselves" (p. 143).

At the same time, it is said that you cannot dream about something that you cannot imagine. People are limited by the extent that they can imagine possibilities for who they could be—their "possible selves" [42,43]. If you cannot imagine being an astronaut, for example—because you don't like science class, because the idea of blasting through the earth's atmosphere in a little capsule gives you the creeps, because you don't think you have the skills or intelligence to make it, or because people like you don't do that sort of thing—then in addition to structural considerations that perhaps may make it impossible for you to dream of being an astronaut, you are not likely to pursue any of the requisite things required to end up as an astronaut. Thinking about your future self also involves being able to see yourself as engaging in the process of becoming. One interviewee said, "You know...I always had a plan. I always said, you know, I was gonna be an engineer, do all this and then... be flexible when something happens." Another had a wonderful story about how in grade school, he unexpectedly received an award with a medal that said "future engineer" and how this dramatically changed his self-perception and he believes, influenced his career trajectory. Other interviewees spoke about actively transforming themselves in this process: "Those opportunities were there and I took advantage of [them]. Because I also knew that it was something that I had to work on personally. It was just like I knew that if I'm gonna be who I wanna be or...who I hope to be, I have to fix some things about my personality [laughs]."

In the literature, we now have a clearer understanding of identity as a social process. Grande, San Pedro and Windchief [22] discuss how we have "[moved] beyond traits "into the realm of mediated experiences [that] emphasizes the relational, a constantly negotiated and constructed space defined by and through socio-historical and political processes" (p. 107). However, the process of identity construction is a dialogic one that oscillates between being and doing. Although we have come to embrace a processual view of identity that rejects a laundry list of individual traits, the being dimension of identity continues to be significant. One interviewee captured an essential dynamic of personal identity, saying, "It is easy to have a to-do list and then you can just check that and be like 'yeah, I did that.' It's much harder to have a 'to-be' list." In the public health literature, it has been documented that people make a narrative shift when they begin to identify themselves differently as they make positive health behaviors become routine and reflected in their everyday activity—for example, from "I swim" to "I am a swimmer"—from doing something to being something. This dynamic is extremely important in the narratives that we gathered from professional Native STEM professionals.

Marker [72], a Native scholar, taps into the dialectic involved when he framed it as "ways of thinking...become ways of being" (p. 2). Ways of being and experiences influence the way we think—dynamically, iteratively and dialectically. One interviewee described the kind of back and forth process that has defined her experience:

*I feel like I did get here accidentally... yes...I made many of the choices that got me here, but it wasn't something that I dreamed of as a child, it wasn't something that I aspired to...but...I understand who I am and I understand who I don't wanna be. And I think that that is actually one of*



*the things that whether you're in STEM or not will make you successful, because if you don't know who you are, you can lose yourself so easily in the grind...I think that's the most important part, is having people understand that it is a choice and some things will be long suffering, but it's a choice for you to decide if it's worth it, it's a choice for you to decide if the path that you wanna take takes you through that dark forest.*

Being and becoming, and the multidimensionality of the identities and relationships that are associated with these processes, are key for thinking about our data and the creation of Native spaces in STEM. Weaver [11] discusses the challenge that Native people face in confronting frontiers and boundaries that confine and structure individual experience. Our data suggest that in their experience and pursuit of education and careers in STEM, interviewees are challenging accepted definitions of cultural identity and rejecting boundaries and confinements that have been created by others that exclude Native people from the spaces of STEM. As we discuss elsewhere, they are transforming themselves in ways that dialectally (re)connect with their Indigenous heritage, values and community at the same time that they are embracing and deepening their identities and skills as science professionals.

### Being a STEM professional

Cooper, Gonzalez and Wilson [73] discuss how important it is for students to learn to navigate educational contexts without losing the multiplicity of their identities. When we presented our ideas about the strength of Native identity being a foundation for success in STEM to interviewees in Set II interviews, 100% indicated that they feel this is an extremely astute way of thinking about their own lives and their careers in STEM. They believe that this is an avenue of inquiry that has deep implications. All of them agree that they do have this strong sense of Native identity and they see it as compatible with pursuing a degree or career in STEM and being a scientist. Interviewees are transforming themselves and actively plotting a course for their lives that will allow them to do science, to be scientists, and to be true to their vision of themselves as Native people. But interviewees expressed concern that this is not a view that is more commonly understood by the educational systems they experienced, by the people they work with, and most importantly, by people in their families and communities.

Brayboy and Maughan [36] describe how difficult it is for Native students to believe that getting an education and pursuing a profession do not mean that you are less "Native." One of the participants in their study had a personal epiphany in the context of their project, saying, "I can be smart and Indian at the same time, I want to be a teacher so that my students can see that being smart and [Indian] can go hand-in-hand" (p. 6). But even more so than other educational or career paths, STEM is viewed by many Native people as something that is not "Native." Engagement with Western forms of science is seen as representing behavior and values that are considered Western and mainstream, often referred to by interviewees in our work as "white." One interviewee explained this but was explicit in apologizing and saying he was sorry to have to say it to her (Author #1, the interviewer), a white person, but telling someone they are being white is the worst sort of insult or disparagement you could use in his community. Another said, "Some people tell me...you're becoming too white or you're forgetting where you come from." This narrative allows for and treats as normalized or inevitable the fact that Western, mainstream, white culture is allowed to appropriate all-things-science.

However, in our data, we see that interviewees are not buying-in to this colonized discourse. As indicated above, while they

recognize social challenges and continue to struggle with epistemic conflict, most see overlap, continuity, and affinity between Native and Western approaches rather than antagonism—or at least they see this potential. Brayboy and Maughan [36] write about the importance of not dichotomizing because an oppositional stance "erases complexity and nuance, closing off spaces of potential and possibility" (p. 5). However, the pervasiveness of a dichotomous view is something that causes challenges for Native individuals pursuing a career in STEM. One interviewee said,

*A strong sense of identity...I think knowing that it's equal, that you can actually be both, that is a gift to not struggle with denying some part of you that's shaped you, that's molded you, that's informed you, that's made you who you are. To not have to abandon that for the sake of doing something not traditional. I struggled with that. I feel like I know a lot of indigenous people who have struggled with that.*

In general, however, the interviewees dismiss that these ideas have relevance for their own lives today, saying things like: "I've heard of that...being afraid of losing their Native identity...I've never worried about it...I'm just too entrenched...I'm too connected to the community and...whatever I do, I tend to go and pull from that and bring it back," and "I don't feel that [being a scientist has] taken away who I am. ... Someone came up and [said that I was being white]. I told them they're full of crap." But while they themselves may be secure in embracing synthesis, the interviewees believe that the belief in dichotomy is a huge barrier that keeps Native youth from seeing themselves becoming or being a STEM professional. Many young people believe or assume that being a scientist would mean that they have to give up their Native selves and become "white"—that the two (being Native, and doing science/being a scientist) are not compatible. One interviewee, recognizing the difficulty entailed, said,

*It is a part of me...I don't have to deal with the burden of questioning [my] identity or having [my] identity questioned and I can understand how...if that's in the back of your mind...that can really take a toll on you...[if you are thinking,] am I turning...into a white person...by doing this?"*

As a result, the idea that the narratives we gathered demonstrate robustly that this is not the case was seen universally by interviewees as a powerful finding that should have implications and applications in Native communities. One interviewee said, "It would make an enormous difference with the Native community to understand that you don't sacrifice your identity...you don't have to give up those values." Another said, "I think a lot of students...struggle with that...they think they have to be somebody else...and they can't deal with that adjustment. So, I think it's a really important message to relate to young people that they don't need to leave that behind." A number of interviewees expressed their hopes for the outcomes of our research, saying things like,

*There's some folks who will define culture as...if you do this you're Native, if you do that you're not...Hopefully one outcome [of this research] will be that...young folks [will say]...you can still...be Native and [become a scientist] and that's all, you know, do whatever you want really...just another possibility, just another option, and options are good. I think maybe sometimes, you know, we view ourselves as kind of limited.*

Interviewees are searching for a way to develop strategies to improve life in Native communities and to create opportunity for youth to understand this more expansive conceptualization of the nature of how Native people exist or a possibility of how they can exist in the world—how to find this "balance."

Windchief and Joseph [28] write about how important it is for Native Americans to claim nontraditional terrain as indigenous space.

Through their pursuits as STEM professionals, interviewees in our study are staking their claim. Their success is pushing boundaries and reframing old frameworks, “beginning to co-construct new realities of what it means to be Indigenous” (p. 115) [22]. They are challenging social dynamics that exclude Native people from STEM educational and professional spaces, but they are also reclaiming the intellectual and philosophical domains of science. They are rejecting exclusionary and limiting discourses, and disbelieving Western ideological appropriation of all-things-science. Instead, they are embracing science as an indigenous intellectual legacy and celebrating the knowledge and experience they are co-constructing in their journeys. In this process, they are finding ways to make their lives and work meaningful in relation to culturally defined values and goals related to community and giving back.

Interviewees for this study are doing this constructive work on the ground in their everyday lives. But in the halls of the academy, we need to do more to broaden understanding of the fact that in this process, they are not losing their Native selves. This message is a crucial one for young Native people who might be considering a career in STEM, or better yet, for those who would never have thought to consider it. It is not enough for us to tell ourselves that we know that culture and identity are fluid and situated—using big words in presentations at conferences and jargon-filled peer reviewed articles. We need to develop ways to communicate stories like those told by interviewees in this study so that these ideas are more broadly understood. “By reframing identity as something one does, rather than a set of characteristics one embodies, we also affirm an understanding of Indigenous identity as socially constructed. Identity is in the process of being made and remade in local and global spaces and is thus not something that exists in the past or forever lost” (p. 119) [22].

## Conclusion

The overarching theme that ties together the interviewee’s lengthy, distinct, and extremely diverse narratives is that each of the Native science professionals interviewed holds a deep-seated sense of their own personal identity as a Native person. We propose that the depth of this identity provides a well of strength that each of them has drawn upon and that has provided a foundation for them to be successful in STEM, despite having to overcome repeated and often daunting challenges, and an institutional context that is often less than welcoming. This analysis of our data correlates with literature about cross-cultural interaction for a broad variety of groups (immigrants, etc.) where a strong sense of personal identity provides a core, rooted base that is protective against depression and associated with positive sense of well-being. It also dovetails with research by Waterman and colleagues [45-48] on the positive relationship between Native cultural affiliation and postsecondary academic persistence and completion. Their findings challenge negative assumptions about the ability of individuals who strongly identify as Native to be successful in mainstream education. Our data add a STEM dimension to this analysis, contradicting mainstream beliefs that STEM prowess/expertise requires a Western sensibility. This is an essential perspective given that despite extensive interest among educational institutions, corporate employers, Native communities, and education funders to develop strategies for improving representation of Native Americans in STEM disciplines and careers, the issue of identity continues to be underappreciated, or even ignored.

The fact that perhaps seemingly abstract issues of identity are actually of critical importance was recently brought home to staff of the American Indian Science and Engineering Society (AISES) during a retreat with profoundly talented young Native scientists and potential

scientists who expressed a sense of shame about their own success and career choices—indicating a problematic relationship between their vision of themselves in cultural identity terms, and their understanding of what science is and what it means to be a scientist. Creating a more nuanced portrait of how successful Native STEM professionals experience and relate to science—a more intricate picture than that which is currently drawn from the literature—requires gathering data on individual identity, epistemology, personal agency, and cultural orientation. This study builds on the theory of and knowledge about Native Americans in STEM education and careers that have been developed through multi-disciplinary research, and on the work of Native scholars who have used an Indigenous lens to further expand our understanding. Using that knowledge base, this project illuminates affective and identity-related aspects of the ways that Native identity must be conceptualized as foundational for success among Native Americans in STEM and suggests avenues for using that information to address underrepresentation and disparity.

## Funding Statement

This work was supported by the National Science Foundation (NSF) Research and Evaluation on Education in Science and Engineering (REESE) program for “Collaborative Research to Understand the Role of Culture, Identity and Bi-Cultural Efficacy in American Indian Educational and Professional Success in STEM” [under grant awards #DRL1251532, #DRL1251516, and #DRL1251588]. The views expressed here are those of the authors and do not represent those of the NSF.

## Disclosure Statement

The authors do not have any financial conflict of interest to disclose and have not derived any benefit from the direct application of this research.

## Acknowledgements

We would like to express our thanks to the participants in this study who shared truly amazing personal stories and to acknowledge that their individual thoughtful insights provided the substance for our interpretations. We would also like to thank our project advisors, Pamala Silas, Sandra Begay-Campbell, Bryan Brayboy, Megan Bang, Carol Lee, Larry Hedges, and John Herrington, for their wise suggestions and helpful input that improved the framework for this paper.

## References

1. Lomawaima KT (2014) History without silos, ignorance versus knowledge, education beyond schools. *History of Education Quarterly* 54: 349-355.
2. Winkleby MA, Ned J, Ahn D, Koehler A, Kennedy J (2009) Increasing diversity in science and health professions: A 21-year Longitudinal Study Documenting College and Career Success. *J Sci Edu Technol* 18: 535-54.
3. National Science Board (2016) Science and Engineering Indicators 2016 (NSB-2016-1), Digest (NSB-2016-2). National Science Foundation, Washington, DC., USA.
4. Ferrini-Mundy J (2013) Driven by diversity. *Science* 340: 278-278.
5. Landivar LC (2013) The relationship between science and engineering education and employment in STEM occupations, ACS-23. U.S. Census Bureau, Washington, DC., USA.
6. Norris T, Vines PL, Hoeffel EM (2012) The American Indian and Alaska Native population 2010. U.S. Census Bureau, Washington, DC., USA.
7. Brayboy BMJ, Gough HR, Leonard B, Roehl RF II, Solyom JA (2011) Reclaiming scholarship: Critical Indigenous research methodologies. In Lapan SD, Quartaroli MT, Riemer FJ (eds.), *Qualitative Research: An introduction to methods and designs* (Volume 37), pp. 423-450. Hoboken, New Jersey, John Wiley & Sons, NY, USA.
8. Cajete G (2008) Sites of strength in Indigenous research. In Villegas M, Rak Neugebauer S, Vinegas K (eds.) *Indigenous knowledge and education: Sites of struggle, strength, and survivance*. Harvard Educational Review, Cambridge, Massachusetts, USA.
9. Tuck E (2009) Suspending damage: A letter to communities. *Harvard Educational Review* 79: 409-427.
10. Yazzie-Mintz T (2009) “Intimately biased”: Creating purposeful research in

- American Indian education with appropriated and authentic methodology. In: Bridging the gap between theory and practice in educational research: Methods at the margins. Palgrave MacMillan, New York, USA.
11. Weaver H (2015) Reframing new frontiers for indigenous peoples. *Journal of Society and Social Welfare* 42: 25-44.
  12. Weaver H (2001) Indigenous identity: What is it and who really has it? *American Indian Quarterly* 25: 240-25.
  13. Lomawaima T (2017) "Walking in two worlds" is not a pathology. Paper presented at the Annual Conference of the Society for Applied Anthropology, March 30, 2017. Santa Fe, New Mexico.
  14. Saranillio DI (2015) The insurrection of subjugated futures. *American Indian Quarterly*, 67: 637-644.
  15. Reardon J, TallBear K (2012) Your DNA is our history. *Curr Anthropol* 53: S233-S245.
  16. Deloria P (2004) *Indians in unexpected places*. Lawrence, Kansas, University Press of Kansas, USA.
  17. Brayboy BMJ (2004) Hiding in the ivy: American Indian students and visibility in elite educational settings. *Harvard Educational Review* 74: 125-152
  18. Brayboy BMJ (2005) Toward a tribal critical race theory in education. *The Urban Review* 37: 425-446.
  19. Garcia J (2017) Temporary spaces? Indigenous teacher education and predominantly White institutions. Paper presented at the Annual Conference of the Society for Applied Anthropology, March 30, 2017. Santa Fe, New Mexico.
  20. Brubaker R, Cooper F (2000) Beyond "identity." *Theory and Society* 29: 1-47.
  21. Friedman J (2016) Weekend update: Identity, culture, politics and anthropology since the 1980s. *Oceania* 86: 344-356.
  22. Grande S, San Pedro T, Windchief S (2015) Indigenous peoples and identity in the 21st century: remembering, reclaiming, and regenerating. In Salett EP & Koslow DR (eds.), *Multicultural Perspectives on Race, Ethnicity, and Identity*. NASW Press. Washington, D.C., USA pp. 105-122.
  23. Levi JM, Maybury-Lewis B (2012) *Becoming Indigenous: identity and heterogeneity in a global movement*. In: *Indigenous peoples, poverty, and development*. Cambridge University Press, New York, USA. pp. 73-117.
  24. Houston HR, Hogan M (2009) Edge dancers: Mixed heritage identity, transculturalization, and public policy and practice in health and human services. *The Applied Anthropologist* 29: 143-170.
  25. Page-Reeves J (1999) *Challenging the boundaries, redefining the limits: the experience of Bolivian handknitters in the global market*. Doctoral Dissertation in Cultural Anthropology, New York, The City University of New York (CUNY), USA.
  26. Page-Reeves J (2017) Identity construction as an arena for challenging boundaries and redefining limits. Panel presentation at the Annual Meeting of the Southwest Anthropological Association. Page-Reeves, Chair. San Jose, California, USA. April 28-29, 2017.
  27. Halliday A (2010) Complexity in cultural identity. *Language and Intercultural Communication* 10: 165-177.
  28. Windchief S, Joseph DH (2015) The act of claiming higher education as Indigenous space: American Indian/Alaska Native examples. *Diaspora, Indigenous, and Minority Education* 9: 267-283.
  29. Martin D (2009) Researching race in mathematics education. *Teachers College Record* 111: 295-338.
  30. Nasir NIS (2002) Identity, goals, and learning: Mathematics in cultural practice. *Mathematical Thinking and Learning* 4: 213-247.
  31. Altschul I, Oyserman D, Bybee D (2008) Racial-ethnic self-schemas and segmented assimilation: Identity and the academic achievement of Hispanic youth. *Social Psychology Quarterly* 71: 302-320.
  32. Syed M, Azmitia M, Cooper CR (2011) Identity and academic success among underrepresented ethnic minorities: an interdisciplinary review and integration. *Journal of Social Issues* 67: 442-468.
  33. Hurtado S, Eagan MK, Tran MC, Newman CB, Chang MJ, et al. (2011) "We do science here": Underrepresented students' interactions with faculty in different college contexts. *Journal of Social Issues* 67: 553-579.
  34. Okagaki L, Helling MK, Bingham GE (2009) American Indian college students' ethnic identity and beliefs about education. *Journal of College Student Development* 50: 157-176.
  35. Meyer X, Crawford B (2009) Being explicit about science: Instruction in the nature of science as a multicultural approach. Paper presented at the National Association of Research in Science Teaching Conference. Garden Grove, California, USA.
  36. Brayboy BMJ, Maughan E (2009) Indigenous knowledges and the story of the bean. *Harvard Educational Review* 79: 1-21.
  37. Huffman T (2001) Resistance theory and the transculturation hypothesis as explanations of college attrition and persistence among culturally traditional American Indian students. *Journal of American Indian Education* 40: 1-23.
  38. Rumbaugh-Whitsell N, Mitchell C, Spicer P (2009) A longitudinal study of self-esteem, cultural identity and academic success among American Indian adolescents. *Cultur Divers Ethnic Minor Psychol* 15: 38-50.
  39. Phinney JS, Ong AD (2007) Conceptualization and measurement of ethnic identity: current status and future directions. *Journal of Counseling Psychology* 54: 271-281.
  40. Huffman T (2008) *American Indian higher educational experiences: cultural visions and personal journeys*. New York, Peter Lang Publishing Inc.
  41. Huffman T (2010) *Theoretical perspectives on American Indian education: Taking a new look at academic success and the achievement gap*. Altamira Press, Rowman & Littlefield, Lanham, Maryland, USA.
  42. Fryberg S, Markus H (2003) On being American Indian: Current and possible selves. *Self and Identity* 2: 325-344.
  43. Markus H, Nurius P (1986) Possible selves. *American Psychologist* 41: 954-969.
  44. Schiefer D, Krahe B (2015) Ethnic identity and orientation to white American culture are linked to well-being among American Indians—but in different ways. *Social Psychology* 45: 1-14.
  45. Shotton HJ, Lowe SC, Waterman SJ, Garland J (2013) *Beyond the asterisk: Understanding native students in higher education*. Sterling, Virginia, Stylus Publishing, LLC, USA.
  46. Waterman S, Lindley L (2013) Cultural strengths to persevere: Native American women in higher education. *NASPA Journal About Women in Higher Education* 6: 139-165.
  47. Waterman S (2007) A complex path to Haudenosaunee degree completion. *Journal of American Indian Education* 46: 20-40.
  48. Fryberg SA, Troop-Gordon W, D'Arrioso A, Flores H, Ponizovskiy V, et al. (2013) Cultural mismatch and the education of Aboriginal youths: The interplay of cultural identities and teacher ratings. *Dev Psychol* 49: 72-79.
  49. Deyhle D, Swisher K (1997) Research in American Indian and Alaska Native education: from assimilation to self-determination. *Review of Research in Education* 22: 113-194.
  50. Fryberg SA, Covarrubias R, Burack JA (2013) Cultural models of education and academic performance for Native American and European American students. *School Psychology International* 34: 439-452.
  51. Page-Reeves J, Marin A, Bleecker M, Moffett M, Deer-In-Water K, et al. (2017) From community data to research archive: partnering to increase and sustain capacity within a Native organization. *Gateways: International Journal of Community Research and Engagement* 10: 283-297.
  52. Madden R (2011) *Being ethnographic: A Guide to the theory and practice of ethnography*. Thousand Oaks, Sage Press, California, USA.
  53. Page-Reeves J, Scott A, Apodaca V, Apodaca, V, Moffett M (2014) It is always that sense of wanting...never really being satisfied: Women's quotidian struggles with food insecurity in a Hispanic community in New Mexico. *Journal of Hunger and Environmental Nutrition* 9: 183-209.
  54. Williams PL, MacAulay RB, Anderson BJ, Barro K, Gillis DE, et al. (2012) I would have never thought that I would be in such a predicament: Voices from women experiencing food insecurity in Nova Scotia, Canada. *Journal of Hunger & Environmental Nutrition* 7: 253-270.
  55. Ortner SB (1984) Theory in anthropology since the sixties. *Comparative Studies in Society and History* 26: 126-166.
  56. Lee CD (2008) The centrality of culture to the scientific study of learning and

- development: how an ecological framework in education research facilitates civic responsibility. *Educational Researcher* 37: 267-279.
57. Fischer M (2007) Culture and cultural analysis as experimental systems. *Cultural Anthropology* 22: 1-65.
58. Wolf E (2001) *Pathways of power: Building an anthropology of the modern world*. Oakland, California, University of California Press.
59. Hammersley M (2008) *Questioning qualitative inquiry: Critical essays*. Thousand Oaks, California, Sage Press, USA.
60. Gläser J, Laudel G (2013) Life with and without coding: Two methods for early-stage data analysis in qualitative research aiming at causal explanations. *Forum Qualitative Sozialforschung/Forum Qualitative Social Research* 14: 2.
61. Perry K (2003) Constant comparison. From Lewis-Beck, M & Futing, T (eds.), *The Sage encyclopedia of social science research methods*. Thousand Oaks, Sage Publications, California, USA. pp. 181-182.
62. Nasir NIS, Rosebery AS, Warren B, Lee CD (2006) Learning as a cultural process: Achieving equity through diversity. *The Cambridge Handbook of the Learning Sciences*, Pp. 489-504.
63. Spencer MB, Swanson DP (2013) Opportunities and challenges to the development of healthy children and youth living in diverse communities. *Dev Psychopathol* 25: 1551-1566.
64. Juntunen C, Barraclough D, Broneck C, Siebel G, Winrow S, et al. (2001) Indian perspectives on the career journey. *Journal of Counseling Psychology* 48: 274-285.
65. LaFromboise T, Coleman HL, Gerton J (1993) Psychological impact of biculturalism: Evidence and theory. *Psychol Bull* 114: 395.
66. Benet-Martínez V, Leu J, Lee F, Morris MW (2002) Negotiating biculturalism cultural frame switching in biculturals with oppositional versus compatible cultural identities. *Journal of Cross-Cultural Psychology* 33: 492-516.
67. Benet-Martínez V, Haritatos J (2005) Bicultural identity integration (BII): components and psychosocial antecedents. *J Pers* 73: 1015-1049.
68. Alfred T, Cornstassel J (2005) Being Indigenous: Resurgences against contemporary colonialism. *Government and Opposition* 40: 597-614.
69. Mihesuah D (1998) American Indian identities: Issues of individual choice and development. *American Indian Culture and Research Journal* 22: 193-226.
70. Collins RK (2017) Reducing barriers to Native American student success in higher education: challenges and best practices. Paper presented at the Annual Conference of the Society for Applied Anthropology, March 30, 2017. Santa Fe, New Mexico, USA.
71. Cerulo KA (1997) Identity construction: New issues, new directions. *Annual Review of Sociology* 23: 385-409.
72. Marker M (2015) Indigenous knowledge, Indigenous scholars, and narrating scientific selves: "to produce a human being." *Cultural Studies of Science Education*.
73. Cooper C, Gonzalez E, Wilson A (2014) Identities, cultures, and schooling: how students navigate racial-ethnic, Indigenous, immigrant, social class, and gender identities on their pathways through school. From McLean KC, & Syed M (eds.), *The Oxford Handbook of Identity Development*. Oxford, UK.