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The Influence of Affirming Kindness and Community on Broadening Participation in STEM Career Pathways

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The United States' inability to achieve equitable workforce development in science, technology, engineering, and mathematics (STEM) career pathways is well-recognized and has been attributed to the poor retention of a diverse stream of students in academia. Social science theory and research provide evidence that social contextual variables—specifically kindness cues affirming social inclusion—influence chronic underrepresentation of some groups within STEM career pathways. Review of the literature suggests that the current STEM academic context does not consistently provide cues that affirm social inclusion to all members of the academic population, and that policies that address this disparity are essential to broadening STEM workforce development in the United States.

So, with boundless heart
Should one cherish all living beings
Radiating kindness over the entire world
Upwards towards the sky
Downwards towards the depths
Omitting none

—Buddhist Prayer

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The United States' inability to achieve equitable workforce development in science, technology, engineering, and mathematics (STEM) career pathways is well-recognized and has been attributed to the poor retention of a diverse stream of students in academia (National Academy of Sciences, 2016; The President's Council of Advisors on Science and Technology [PCAST], 2012). National data examining retention of historically underrepresented (HU) (i.e., African American, Hispanic or Latino/Latina, American Indian, and Alaskan Natives) undergraduates, graduates, and faculty in STEM show that the disparity only increases the further people progress into these career pathways. Specifically, HU scholars comprised 29.3% of the U.S. population in 2010, but only14.7% of STEM awarded bachelor's degrees, 12.6% of master's degrees, 8.3% of doctorates, and 7.3% of faculty at 2- and 4-year institutions (see Estrada et al., 2016). Much has been written about how to decrease these achievement gaps (Graham, Frederick, Byars-Winston, Hunter, & Handelsman, 2013; Linn, Palmer, Baranger, Gerard, & Stone, 2015). However, social science research has placed the majority of emphasis on what student attributes lead to perseverance, including studies on student efficacy, motivation, grit, and mindset (e.g., entity and incremental theories) (Byars-Winston et al., 2013, 2014; Duckworth, Peterson, Matthews, and Kelly, 2007; Duckworth, and Quinn, 2009; Dweck, 2006; Hernandez, Schultz, Estrada, and Chance, 2012; Lent et al., 2005; Oyserman, and Lewis, 2017; Wilson et al., 2012). Meanwhile, the research that describes contextual factors tends to focus on describing negative factors such as racism, stereotype threat, prejudice, and a variety of implicit cognitive biases that contribute toward the perpetuation of these (Dunham, Baron, & Banaji, 2008; Greenwald, & Banaji, 1995). In contrast, there has been relatively less emphasis on positive factors, including contextual kindness cues that affirm social inclusion—which potentially increase student integration into the STEM community and influence a person's choice to pursue STEM career pathways.

The objective of this article is to review the relevant literature that describes (a) why cues that affirm social inclusion are important to consider, (b) what types of higher education contextual cues are HU students and faculty currently experiencing, (c) the state of the current research on successful approaches to creating inclusive social environments for students and faculty in higher education, and (d) social issues and policy implications that exist if we are to both increase HU students' persistence in these careers, and also enhance the social cues that sustain such persistence.

Overall, the review of this literature suggests strongly that the current STEM academic context does not consistently or equally provide kindness cues that affirm social inclusion and community acceptance to all members of the academic population, and that addressing this disparity is essential to broadening workforce development in the United States. Addressing this disparity is particularly

important at this time when the number of HU students enrolled in undergraduate courses and programs is increasing (Bangera, & Brownell, 2014).

Why Are Kindness, Dignity, and Community Important to Consider?

Classic work by anthropologists, sociologists and social psychologists describe how humans have an innate need for affiliation and attachment to others of their species (Bowlby, 1969, 1973; Casella, and Fowler, 2005; Coon, 1946; Cosmides, Tooby, and Barkow, 1992; Sherif, Harvey, White, Hood, & Sherif, 1988). From an evolutionary perspective, pursuing the satisfaction of this need is akin to the pursuit of survival, which is reflected strongly across many species, including all primates (De Waal, 1990, 2009). A deep need for affiliation leads humans to set aside personal preferences for the sake of belonging to a group where differentiation of tasks and responsibilities that promote the survival of all group-affiliated members can occur (Cheney, Seyfarth, & Smuts, 1986; Panter-Brick, Layton, & Rowley-Conwy, 2001). There are physiological, mental, and emotional benefits to experiencing connection to community. Baumeister and Leary (1995) conclude in their review article that "the desire for interpersonal attachments—the need to belong—is a fundamental human motivation" (p. 520) and there is tremendous stress when it is denied. Evolutionary and social psychologists find ample evidence that people are more likely to survive and prosper when feeling socially connected (Baumeister, & Leary, 1995; Dunbar, & Barrett, 2007) and that social exclusion results in pain akin to physical pain (Eisenberger, & Lieberman, 2005; Fiske, 2009).

Stress of Aggression and Rejection

There is strong evidence that people scan social environments to determine and maintain personal safety, including staying aware of social relationship cues of who is a foe or friend. Human capacity to perceive threatening information and respond with fight-or-flight reactions bypasses higher cognitive function processing is well documented (Jänig, 1989; Jansen, Nguyen, Karpitskiy, Mettenleiter, & Loewy, 1995). Almost everyone can recall recoiling or lashing out in self-defense when feeling threatened, even before knowing what the threat was. This classic fight-or-flight tendency is associated with brain activity in the amygdala, which triggers a rapid neural response in the hypothalamus (Blascovich, Vanman, Mendes, & Dickerson, 2011; Jänig, 1989; Lange, 1921). At the same time that people look for macro indicators of threat or aggression (including menacing looks, weapons, or other forms of intention to reject), they also look for micro aggressions that are subtler such as nonverbal communications that notoriously leak information, ambiguous insults, slights, mistreatments, or other nonvalidating muted gestures

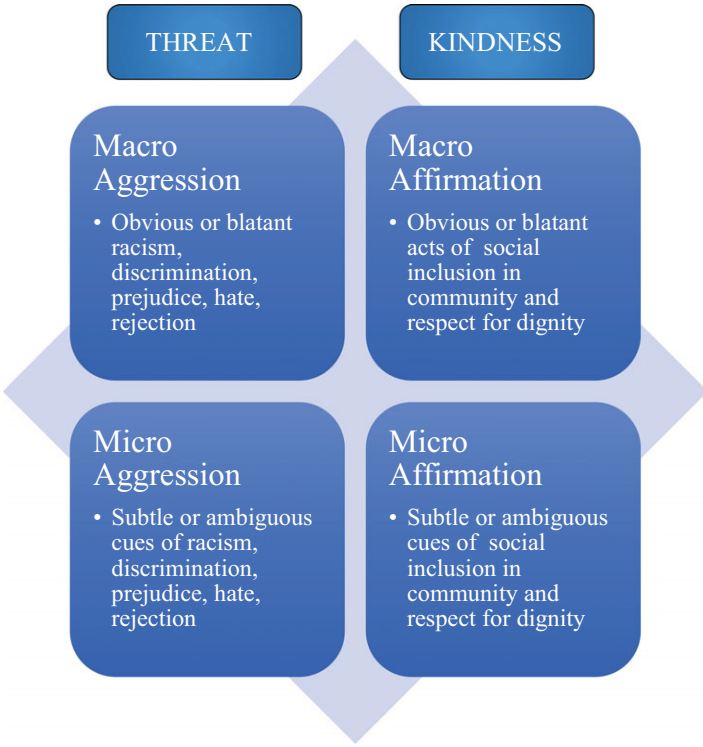

Fig. 1. Definition of macro and micro aggression and affirmation of social inclusion.

(Sue, 2010; Torres-Harding, & Turner, 2015) (see Figure 1 for full definition of terms). Nonverbal information that is least under control is often deemed the most authentic information about a person and is most easily decoded by those who have *social sensitivity* (Koenig, & Eagly, 2005). And interestingly, people under cognitive load (such as a person scanning for social information about threats or acceptance) actually show more accurate social sensitivity than a person intentionally trying to scan for this subtle information, as scanning is an intuitive strategy that occurs relatively automatically (Patterson, Foster, & Bellmer, 2001; Patterson, & Stockbridge, 1998).

For most students, physically threatening experiences are not common in academic settings, and yet for HU students navigating classrooms and research environments in which they are a clear minority, there is a similar fatigue that occurs, which is hard to measure, and some may argue, articulate. Informally among HU populations, there is often a reference to being tired of "it," or other

Table 1. Assessment of Current Experience of Dignity

Thinking about your current life, please read each of these statements and rate to what extent you feel this is true for you in your academic institution, on a scale of 1 (never) to 10 (always).									
Never									**Always**
1	2	3	4	5	6	7	8	9	10
I feel my **identity** is **accepted**									
I feel **recognized** for my good efforts, thoughtfulness, and talents									
I feel **acknowledged** (seen, heard, listened to, validated and responded to about my concern)									
I feel **included** (a sense of belonging)									
I feel **safe** (both physically and psychologically)									
I feel **treated fairly**									
I feel **autonomous** (free to make my own decisions and act on my own behalf)									
I feel **understood**									
I feel I am given the **benefit of the doubt**									
I feel **apologized to** when someone violates my dignity.									

Note: Adapted from Hicks (2010). *Dignity: Its essential role in resolving conflict.*

majority group members not getting "it." But what is this "it" that causes fatigue and burden? We contend that the "it" is hard to explain to students who do not experience perpetual macro and micro aggressions that violate their dignity, as well as the deficit of macro and micro kindness cues that affirm social inclusion and validate students' dignity.

Dignity violations. What is dignity? Early social psychological work on Maslow (1943) and Burton's (1990) human needs theory suggests that human beings have basic needs that cause discomfort when not fulfilled. Herbert Kelman's interactive problem-solving writing (1972, 2017), describes how when basic needs are not met, particularly the need for one's life and identity to be respected, great conflict can occur. Hicks' (2011) recent writing on dignity extends Kelman's 40 years of work. Drawing on evolutionary, social, and developmental psychology to support her approach, Hicks concludes that individuals experience deep violations when their dignity is not upheld in social interactions, triggering a fight-or-flight response. She defines dignity as including 10 essential elements (see Table 1) and describes how violations to a person's dignity are experienced as deep discomfort, undermining interpersonal connection and trust. This occurs because a violation of dignity conveys a rejection of some aspect of a person and cues social exclusion and nonacceptance. The very human experience of a dignity violation, which can include an obvious act of discrimination to more opaque gestures of noninclusion, is to experience a type of aggression. The result are shifts in emotional states that can influence decision making, social judgments, perceptions, problem-solving, and social behaviors (Isen, 2008; Keltner, & Lerner,

2010). Although not yet studied, dignity violations in the context of STEM academic settings can potentially impact cognitive functioning related to academic success, such as learning, retention, recognition and recall.

Affirming Social Inclusion

At the same time that people notice cues of aggression and exclusion, there is an innate inclination to scan for the macro and micro cues of kindness that affirm social inclusion. The most well-researched area of study regarding this centers on perceptions of smiles. There is strong evidence that humans are hard wired to notice, perceive, and respond to smiles, beginning even as young as 3 months old (Walker-Andrews, 1997; Walker-Andrews, Krogh-Jespersen, Mayhew, & Coffield, 2011). In contrast, perceiving anger emerges around 6 months (Striano, Brennan, & Vanman, 2002). Macro cues that affirm social inclusion can include physical touch, facial expressions that convey care, sharing, helping, politeness, and other easily perceived prosocial actions (free of duress). Subtly, "micro" cues that affirm social inclusion include space left between people when interacting, eye contact, subtle mimicry, voice tone, and actions that convey vulnerability. Thus, at the same time as people are scanning for threats, they are also scanning for macro and micro cues affirming social inclusion and respect for dignity, or in short, *kindness cues*.

Kindness does not appear in the index of the latest version of the Handbook of Social Psychology (Fiske, Gilbert, & Lindzey, 2010). However, Snyder and Lopez (2007), in *Positive Psychology*, define kindness as "doing favors and good deeds for others; helping them, taking care of them" (p. 20), but do not provide any further description. The Oxford Dictionary provides this broad, but relevant definition, "the quality of being friendly, generous, and considerate" (Oxford, 2017). These definitions have in common the notion that kindness is *an act or quality of action that conveys, in subtle and sometimes obvious ways, respect for the dignity of another person*. Even if there is no intention to have a long-term relationship, when a person experiences kindness, they experience affirmation of their presence at that moment, in that space. And ultimately, we argue that this is the "it" present or lacking for HU students.

Kindness cues that affirm social inclusion are the antidote to dignity violations. However, authentic kindness does not exist just because there is an absence of threat or aggression. A person can be in an environment where there is no communication of threat or aggression and simultaneously not feel safe because of the absence of kindness. For instance, imagine walking into a room of strangers where nobody is outwardly hostile, everyone's faces are neither aggressive or welcoming. No one avoids you, but also no one welcomes you. In this case, there is no threat, and yet for most people, this is not a comfortable environment because there is ambiguity about whether they are safe or not in that social environment.

This is not unlike walking into a large lecture hall before a new class begins. And what do many people do, especially those who come from interdependent cultural backgrounds? They scan for a kind face. Why? Because on a deep level, most people feel safer among persons who show kindness, rather than those who do not, even if they are strangers. People who are low in agreeableness, have insecure attachment, or who are highly independent may not scan as rigorously. But regardless of background and predisposition, people who are feeling vulnerable are likely to scan, irrespective of whether it is a social occasion or a STEM research environment or classroom. Ultimately, authentic kindness can be conveyed through a variety of micro and macro kindness cues affirming social inclusion, which communicate respect for the dignity of another person.

Cultural Difference in Importance of Community and Connection

Research on culture and self is also relevant to understanding why kindness cues that affirm social inclusion are worthy of attention when understanding why HU students do not persist in STEM career pathways. There is strong evidence that the propensity to seek and maintain connections, even at the risk of losing personal autonomy, is not equally valued across all cultures. Those acculturated into individualistic cultures value independence, uniqueness, and a focus on self as separate from others (Markus, & Kitayama, 1991; Snyder, & Lopez, 2007). In contrast, those raised in more collectivist cultures emphasize connection to others and the duties one has to the groups to which they belong (Bellah, Madsen, Sullivan, Swidler, & Tipton, 2007; Miller, 1994). There is some evidence that African American culture leans toward independence and is not significantly higher in collectivism, however, measurement matters. Studies that did not include questions regarding "seeking advice" showed African Americans scored significantly higher on collectivism than European Americans (Oyserman, Coon, & Kemmelmeier, 2002). Overall, research shows that European Americans most consistently are found to be more individualistic, with greater value placed on individual and independent accomplishment (Oyserman et al., 2002). In contrast, many HU students value community and cooperation more than individualism and competition (Brown, 2008; Valenzuela, 2010), which can conflict with academic institutional values. When people seek connection as a source of self-worth, persisting in an environment that is hostile, uninviting, rejecting, and "cutthroat" may be highly problematic to their collectivistic sense of self. And experiencing kindness, which includes respect for their dignity and experiencing belonging to community, may significantly decrease perceptions of vulnerability and increase a sense of social safety that is optimal for learning and persistence.

Social evolutionary and cultural difference literature provide strong evidence that all people have social needs and prefer inclusion over exclusion, and that our cognitive functioning is wired to support this preference. There is also evidence that

breaks in social connection can cause people to feel less safe and more stressed, and the impact of this effect may differ, depending on cultural experiences. However, there is no evidence that decreasing the negativity in social contexts automatically increases positivity. That is, decreasing social threat and increasing inclusion can be orthogonal to each other. The experience of being in a nonthreatening social environment does not automatically result in one feeling kindness cues that affirm social inclusion. Readers should keep this in mind as we review the literature describing the experiences of HU students navigating STEM career pathways.

Cues of Aggression and Affirmation of Social Inclusion in Higher Education Settings

Social psychologists have shown that social influence is occurring all the time and in a wide variety of situations (see Cialdini, & Goldstein, 2004), including in higher education contexts where students can integrate or disengage from their disciplinary communities (Estrada, Woodcock, Hernandez, & Schultz, 2011). With this in mind, in this next section we will first review research from higher education that describes the current STEM educational context in which HU students pursue their degrees. Second, we will describe social science theories that provide explanations for why HU students' higher education experiences differ from majority students, and in some cases, provide evidence on how to promote greater academic success. We will highlight the findings regarding the presence (or absence) of kindness cues that affirm social inclusion for HU students in STEM career pathways. We acknowledge that threats and kindness can occur in any career pathway. However, if we utilize Gidley et al.'s (2010) definition of social inclusion occurring in academic contexts that provide access, participation and success, there is strong statistical evidence that STEM fields in particular lack social inclusion for HU students relative to non-STEM career pathways (Humanities Indicators, 2017).

STEM Higher Education Context for HU Students

From the field of higher education, there is mounting evidence that HU students' sense of belonging and connection (sometimes referred to *social cohesion)* to their academic community is complex and often obstructed (Hurtado, & Carter, 1997). Experiencing a campus or discipline culture that is hostile or unwelcoming—in short, unkind—leads to an array of negative outcomes including academic and social withdrawal, isolation, stress, cognitive fatigue, and exiting (see National Academies *Barriers and Opportunities for 2-Year and 4-Year STEM Degrees* report for full list of consequences and references to this body of literature). Analysis of a national, multi-institutional research project, titled Preparing College Students for a Diverse Democracy, found HU students perceiving racial

tension experienced a reduced sense of belonging (Locks, Hurtado, Bowman, & Oseguera, 2008). Further, results from the Higher Education Research Institutes' national study showed college culture influenced STEM student performance, engagement, and persistence even when the influences of socioeconomic and academic preparation were controlled (Chang, Eagan, Lin, & Hurtado, 2011), demonstrating there are real consequences to being in an academic environment that lacks cues affirming inclusion.

Discipline identity. A large number of studies suggest that students who feel social inclusion in their academic community are more likely to develop and maintain a social identity related to their pursued discipline (i.e., study domain). Discipline identity is a type of *social identity*, a term coined by Tajfel and Turner (1986), which corresponds to various circles of group membership—such as a person's gender, ethnicity, profession, religion, age, etc. In the Tripartite Integration Model of Social Influence (TIMSI), Kelman (1958, 2006) describes three levels of social connection, including (a) adhering to the communities' rules to avoid sanctions or gain benefits, (b) developing identification with the community, and (c) internalizing the group values as one's own values. All three orientations were found to predict persistence in science (Estrada et al., 2011). But identification is unique and when affirmed, a person is more likely to think, feel, and act in ways that comply with requests and norms only when in the context of that favored community (Hamilton, 2004; Hogg, and Vaughan, 2002; Turner, 1982). In contrast, when a person is rule oriented, they only comply with requests and norms when sanctions and benefits exist. And when one has a value orientation, a person is likely to comply with the requests and norms even when not in the context of the community.

Research on student development of academic identities shows that some students can develop a *dual identity* in which they adhere to different social norms depending upon their context, with greater positive outcomes when social and personal selves are congruent (Oyserman, Bybee, & Terry, 2006). In other cases, students simply do not develop a discipline identity, resulting in less adherence to the norms of that group and persistence in their fields. Research specific to STEM discipline identification, such as science or engineering identity, has been credited as being a strong, direct predictor of persistence in STEM (Chemers, Zurbriggen, Syed, Goza, & Bearman, 2011; Estrada et al., 2011; Graham et al., 2013). Thus, social identity is now regarded as a good proximal measure for students being socially connected to their academic communities.

Building on the higher education findings regarding social context and importance of developing a discipline identity for HU persistence, we will review several important lines of research that describe how the higher education context impacts HU students' psychosocial experiences, academic successes, and persistence. We will also highlight research that tests how to best intervene to ameliorate

student diaspora from STEM career pathways through providing macro and micro kindness cues affirming social inclusion.

Theory and Research Regarding Threats to and Affirmation of Community Inclusion in Academia

Stereotype threat. Steele and colleagues introduced the concept of stereotype threat in 1995. Their robust research program has shown that when a student consciously or unconsciously perceives others to hold a negative stereotype of a group to which they belong, and that there is danger of confirming that negative stereotype and being discriminated against, there are costs (Goff, Steele, & Davies, 2008; Steele, 1998; Steele, & Aronson, 1995). Inherently, to experience stereotype threat is to experience a social context that lacks kindness cues that affirm inclusion. Further, there is abundant research on this topic showing that experiencing stereotype threat can impede academic performance (e.g., Aronson, and Salinas, 1997; Gonzales, Blanton, and Williams, 2002; Inzlicht, Tullett, Legault, and Kang, 2011; McKay, Doverspike, Bowen-Hilton, and Martin, 2002; Schmader, and Johns, 2003; Steele, and Aronson, 1995; Walton, Spencer, & Erman, 2013) and can occur for any person who identifies with a negatively stereotyped group, such as women in math, white men playing basketball, or African American students taking intelligence tests (see Steele, 2011). Research also shows that the impact of stereotype threat on HU student academic performance occurs both publically and privately (Inzlicht, & Ben-Zeev, 2003) and can deplete working memory resources (Ben-Zeev, Fein, & Inzlicht, 2005). The breadth of the research on this topic is wide and Steele's (2011) book, *Whistling Vivaldi*, provides an accessible way to learn about this still-growing research area. But for the purposes of this article, the important contribution of this work is the demonstration that anticipating threat, and perceiving context cues that communicate to HU students that they do not belong in the academic or STEM community, results in students' performances declining, while cognitive vigilance increases (Murphy, Steele, & Gross, 2007).

Research on identity and stereotype threat provides considerable evidence that the expectations derived from a negative stereotype about a group to which one belongs, not only hampers a student's academic performance, but can lead to disidentification from the majority group, including one's discipline (Steele, 1997). In doing so, students come to reduce their engagement in behaviors necessary for success in their career pathway and develop personal identities in areas outside of that pathway (Cokley, 2000; Osborne, 1999; Steele, 1997; Woodcock, Hernandez, Estrada, & Schultz, 2012). Ironically, disidentification from their discipline identity is more likely for students who enter their academic careers most highly identified with their discipline. For example, students who think of themselves as a scientist when they arrive at college are more at risk of disidentifying

from being a scientist if they experience stereotype threat (Aronson, Cohen, & Nail, 1999; Stone, 2002).

Self-affirmation theory. Self-affirmation theory informed Steele's early work on stereotype threat and hypothesizes that when people encounter a situation that challenges their positive self-view, they experience a "hit" to the self, which can be relieved if other aspects of their self-worth are affirmed (Steele, 1988). The initial theory describes how each person's sense of self, or self-system, has many interrelated parts. Thus, a threat to one part can be counteracted by affirming another aspect of the self, prior to, during, or after the threat, even if the affirmation is unrelated to the aspect of the initial threat (Aronson et al., 1999). They hypothesize that affirmation buttresses a person's self-worth, which results in reduction in stresses associated with situations that students experience as threatening (Creswell et al., 2005).

A series of studies have been conducted to demonstrate the efficacy of the theory (Cohen, & Sherman, 2007, 2014; Sherman et al., 2013). Cohen and colleagues showed that class writing assignments that provide an opportunity for students to affirm their adequacy or "self-integrity" resulted in significant grade improvements for African American students, reducing racial achievement gaps by 40% (Cohen, Garcia, Apfel, & Master, 2006). Further, Sherman's research demonstrated that this approach has robust long-term effects for a variety of underrepresented groups and for students in middle school, high school, and college (Sherman et al., 2013). The work by Walton and Cohen most explicitly demonstrates that increasing macro level cues of social connection raises motivation for students to persist in discipline-relevant tasks and sustain interest (Walton, Cohen, Cwir, & Spencer, 2012), and that greater effects on academic achievement may occur for African American students compared with White students (Walton, & Cohen, 2007).

Overall, this research demonstrates that affirmation is important to academic performance and motivation for all students. One could argue, given the affirmation descriptions, academic performance improves because students perceive less threat of rejection and inadequacy in addition to experiencing affirmation. While very promising, this research has only recently been tested among HU STEM students in a higher education context and the findings are not entirely supportive. Ben-Zeev et al.'s (2017) online study of 670 STEM undergraduates tested the efficacy of a Speaking Truth to EmPower (STEP) intervention compared to an affirmation or control condition. Participants first were assigned to one of three interventions and then all participants were exposed to a stereotype threat experience in which they were given the Ravens Advanced Progressive Matrices. Results showed that when HU students learned about stereotype threat and were prompted to consider "be-prepared" coping strategies to respond to that threat (i.e., the STEP intervention), they garnered higher grades and were less worried about confirming negative

stereotypes than students participating in a self-affirmation intervention (in which they were asked to list values and then write about a value that mattered to them) or the control condition. Non-HU students, however, showed no significant effects from any of the conditions on immunity from concern about confirming a negative stereotype or grades. Further research is needed to better understand the nuances of these findings.

Race-based rejection sensitivity. From the moment students walk into an academic environment, they carry with them very different expectations, filled with a plethora of emotional and cognitive predispositions that shape their motivation (Braxton, Vesper, & Hossler, 1995; Mendoza-Denton, Downey, Purdie, Davis, & Pietrzak, 2002). Mendoza-Denton and colleagues' research on race-based rejection sensitivity (RS-race), which describes the tendency to anxiously expect rejection from racial outgroup members contributes to the literature by demonstrating that not all HU students are experiencing the same context in the same way (Mendoza-Denton et al., 2002; Mendoza-Denton, Pietrzak, & Downey, 2008). Results from a series of studies, consistently showed that a student's expectation that she will experience rejection based on her stigmatized minority group membership status, influenced both personal and interpersonal experiences, when in a majority group context. For example, findings show that college students' expectations of RS-race strained social relationships and undermined confidence in the academic institution in which they were enrolled, resulting in lower levels of motivation to persist in the pursuit of personal goals (Mendoza-Denton et al., 2002). Motivation to persist was measured as willingness to receive academic help and overall GPA. Students low in RS-race were more likely to show signs of persistence. A follow-up study showed that ethnic identification and RS-race predicted decreased intention to stay in school among African Americans, but did not predict decreases in GPA (Mendoza-Denton et al., 2008). These differences may occur because RS-race levels impact how a student receives feedback when their race is known (Mendoza-Denton, Goldman-Flythe, Pietrzak, Downey, & Aceves, 2010).

Other research also indicates that breaking down ingroup/outgroup lines by forging cross-race friendships can reduce the impacts of RS-race among Black and Latin@ students (Page-Gould, Mendoza-Denton, & Mendes, 2014). This is consistent with previous findings showing that repeated associations with outgroup members can eliminate learned associations between outgroup members and RS-race (Mendoza-Denton, Page-Gould, & Pietrzak, 2006). Mendoza-Denton and colleagues conclude that cross-race friendships can provide social support when discrimination occurs and be particularly helpful to high RS-race persons coping with race-related difficult experiences. Other research shows that first year, high RS-race college students physiologically benefit from living in ethnically based residential program or "theme houses" even years after (Rheinschmidt-Same,

John-Henderson, & Mendoza-Denton, 2017). These results further demonstrate that social relationships can make a difference and illuminate why some HU students excel and others are less likely to achieve and persist in STEM environments.

Communal goal affirmation theory. Communal goal affirmation theory (also called *goal congruency theory*) shifts focus from threats and rejection, to the idea that HU students and women may not pursue STEM fields because the goals of these fields are not congruent with their goals and values (Diekman, Brown, Johnston, & Clark, 2010; Diekman, Clark, Johnston, Brown, & Steinberg, 2011). The work examining why HU students persist provides a critique of the educational environment's emphasis on individualistic goals, which focus on personal gain, prestige, and agency (Abele, & Wojciszke, 2007; Diekman et al., 2010). Communal goals, in contrast, focus more on the benefits of working with and helping others (Diekman et al., 2011). Goal congruency theory posits that people pursue and persist toward goals that match their values (Sansone, Sachau, & Weir, 1989). When there is congruence, there is increased motivation to complete shared tasks (Isaac, Sansone, & Smith, 1999), and interestingly, increased feelings of belonging in academic contexts. When applied to STEM field progression, research indicates that some students perceive and then avoid STEM fields that emphasize agency and personal success (as opposed to helping others and having community impact) (Abele, & Wojciszke, 2007; Diekman et al., 2010).

Among HU students there is growing evidence that communal goals are important to the retention and departure of students in science and engineering fields. In response to learning from Native American students, Smith and colleagues broadened the definition of communal goals to include valuing connection, caring for others, and doing work that benefits students' indigenous community (Smith, Cech, Metz, Huntoon, & Moyer, 2014). They conclude their study with the finding that student belonging includes not only overt environmental cues, but also STEM programs that "foster an environment where communal, as well as individualistic, work goals can be afforded" (p. 425). Unstated, but suggested, is the possibility that when students experience goal congruence, they may also be experiencing affirmations of connection, acceptance, and inclusion of their full identity.

Expectancy-value theory. Similar to communal goal theory, the expectancy-value model posits that if a person holds the expectation that they can succeed at a task and intrinsically values the engagement in the task and the utility of the task, she will be more likely to engage in challenging tasks (Eccles, 1983, 2009; Wigfield, Tonks, & Klauda, 2009). Research in this area also shows that students, including HU students, who feel engaged in their coursework and education show marked improvement in their academic outcomes (Hulleman, Durik, Schweigert, & Harackiewicz, 2008; Hulleman, and Harackiewicz, 2009; Okagaki, 2001).

Interventions that increase positive expectation and intrinsic value in a task potentially increase the contextual kindness cues that affirm social inclusion in the context of that classroom.

Students who report utility value in courses are more likely to develop interest in advanced courses in those topics, including STEM courses (Durik, Vida, & Eccles, 2006; Harackiewicz, Barron, Tauer, and Elliot, 2002; Harackiewicz, Durik, Barron, Linnenbrink-Garcia, and Tauer, 2008; Hulleman et al., 2008). Harackiewicz, Rozek, Hulleman, and Hyde (2012) extended this research to show that a three-part utility-value intervention with high school parents affects children's persistence in STEM courses. Building upon this, they randomly assigned biology undergraduates to (a) affirm personal values and later to (b) focus on the relevancy and utility-value of their biology course material (or not). The control condition included a neutral writing assignment of equal length and format (Harackiewicz, Tibbetts, Canning, & Hyde, 2014). Results showed improved course grades, semester grades, and persistence for first-generation students (relative to continuing generation students, who had one or more parent that attended college). In a follow-up study that utilized a double-blind randomized experimental design with introductory biology students, the utility-value intervention, where students wrote about the personal relevance of course material, resulted in the reduction of academic achievement gaps for first generation HU students by 61% (Harackiewicz, Canning, Tibbetts, Priniski, & Hyde, 2016). The most statistically at risk students, who focused on the utility and value of the course content, were significantly and positively affected. The authors, while acknowledging that future research is needed, do offer that their findings are consistent with those found in the communal goal research. Specifically, being given a chance to reflect on how the course content connected to personal values of helping others, giving back to community and families, and contributing toward the betterment of society, may have contributed to increasing interest and motivation. There is also the possibility that providing the opportunity for students to bring their whole self to the class, in terms of their values, shift the social experience of students to perceive the class as a less threatening and kinder environment in which they can learn.

Critical-race theory. Critical-race theory (CRT) offers a more systemic explanation for why HU students do not persist and emerges from legal scholarship in the 1970s as an explanation for why racial reforms in the United States were not progressing more rapidly (Delgado, 1995). Applied to the educational context, the theory contends that racism and the systemic preservation of white supremacy is deeply embedded in academic institutions at every level—including teacher training, textbooks, curriculum, institutional hierarchies, use of space, and the subtle ways in which students experience education. Leonardo (2010) goes so far as to describe education systems as a "*racial apparatus.*" Critical-race theorists

call for significant modifications to occur in which the content of education is changed to be more reflective of HU experiences and intentionally departs from the dominant, Eurocentric linear approach to sense-making (Kozol, 1991). CRT challenges the deficit-based perspectives that view HU students as underachievers and challenges the "dominant paradigm" that student persistence is based exclusively on the personal characteristics of the students (Bensimon, 2007; Dowd, & Bensimon, 2015). CRT views institutional and structural racism as the ongoing source of the equity gaps in education and calls for institutions to look inward at policies and practices that perpetuate inequity.

CRT describes academic contexts as replete with messages that HU students are at best "no different from" everyone else, which discounts their unique experiences and contributions, and at worst, are given the message of inferiority in the form of macro and micro aggressions from teachers and educational material. Even the message to HU students that they are "no different" than the majority can have deleterious impacts, sending a message that a person's culturally different experiences of academia are not acceptable and that the only way to belong is to become like the dominant culture (Dovidio, Gaertner, Ufkes, Saguy, & Pearson, 2016). Consistent with this conclusion, Yosso's (2005) community cultural wealth model employs a CRT framework to challenge deficit-based perspectives and instead challenges educators to view students' cultural differences from an asset perspective. Research on validation theory has shown positive effects on persistence when educators value what students bring to the classroom and affirm the student cultural experience and voice, designing activities where students can "witness themselves as powerful learners" (Barnett, 2011, p. 19) and provide opportunities for students to validate each other (Rendón Linares, & Muñoz, 2011). These shifts in classroom that celebrate students' assets potentially provide contextual kindness cues that affirm social inclusion.

Summary of What We Know about Kindness Cues Affirming Social Inclusion

The current social psychological research on why HU students do not achieve academic equity or persistence in STEM higher education settings focus on two areas of cause. First, the work on stereotype threat, race-sensitivity, and critical-race theory contend that the academic setting is fraught with cues that convey threat, noninclusion, and even inferiority to HU students. While these experiences have multiple outcomes for an individual, especially when experienced chronically, the common thread from all these theories is that there are negative consequences for HU students who do not receive kindness cues affirming social inclusion, with some students being more sensitive to rejection than others. Paired with the social evolutionary theory, we can hypothesize that, when chronically experienced by many HU students, these threatening environments prime a fight-or-flight

response, resulting in distress and deidentification. These theories suggest that significant shifts in the academic institutions need to occur if all students are to thrive equally, especially in disciplines with substantial underrepresentation such as STEM fields. In the long-term, these theories emphasize reducing both macro and micro aggression cues in the environment and increasing macro and micro kindness cues affirming social inclusion, respect for the dignity, and connection to community.

The research on self-affirmation theory, communal goal affirmation, and expectancy-value theory build off of the stereotype threat literature to explicitly test how shifting some aspect of the social context can better affirm students and connect to their values within the existing institutional environment. The empirical research in this area is robust and has demonstrated efficacy in reducing achievement gaps and promoting persistence in STEM fields among majority students with some evidence of efficacy among HU students (Harackiewicz et al., 2014). We can argue that these interventions of affirming a student or their values actually are gestures of kindness (i.e., cuing acceptance and affirmation of ones' identity, values, skill set, etc.) that reduces social ambiguity. Further research is needed to better understand the nuances of how HU and majority students are alike and differ with regards to these relationships. However, collectively, these research theories suggest that equity between HU groups and majority groups in experiencing optimal social contexts for learning and professional productivity may not currently exist and that interventions that provide affirming cues of affiliation can help increase equity and connect students to their academic community, which relates to greater persistence. Connection to community includes developing or maintaining identification and shared values with their institution, discipline, or field area.

Current Research on Successful Approaches to Creating Socially Affirmative Environments for Students and Faculty in Higher Education

In addition to research describing HU students' experiences utilizing institutional data and experimental research conducted by social behavioral scientists, an interdisciplinary area of research also exists that combines educational, social science, and higher education expertise. The research area aims to understand interventions that broaden participation and diversify STEM career pathways. In some cases, these interventions create "micro-climates" that develop in classrooms, research laboratories, and departments, which convey warmth and vary in terms of their supportiveness or culture of care. In this next section we will summarize the current literature regarding types of interventions that have received research attention and show promise for contributing toward the retention of HU STEM students—curricular change, training programs, and mentorship.

Curricular Changes

Science faculty and institutions have been called to "unleash the power of the curriculum" in order to address differential STEM attrition rates, particularly for HU students in entry-level undergraduate courses (Estrada et al., 2016). By building partnerships across institutions, faculty have become instructional innovators that significantly shift undergraduate STEM education to increase critical thinking and agency (see the Partnership in Undergraduate Life Science Education [PULSE], the Association of American Universities Undergraduate STEM Education Initiative, and Science Education for New Civic Engagements and Responsibilities [SENCER] <http://sencer.net/> for examples) (Kezar, & Gehrke, 2015). One significant movement has occurred with the adoption of course-based undergraduate research experiences (referred to as CUREs, CREs, and Freshman Research Initiatives). In these experiences, students are provided opportunity to engage in discovery as part of a course, as opposed to a traditional "cookbook" research. With guidance from instructors, students work collaboratively in a research group consisting of classmates to devise their own research questions, collect and analyze data, and ultimately, come together as a class to draw conclusions (Alkaher, & Dolan, 2014; Auchincloss et al., 2014; Bangera, and Brownell, 2014; Corwin, Graham, and Dolan, 2015; Weaver, Russell, & Wink, 2008). For example, the SEA-PHAGES curriculum engages students in curriculum that involves isolating and characterizing bacteriophages from local environments, annotating the phage genomes, and submitting the annotated sequences to the National Center for Biotechnology Information GenBank database. The research on CREs demonstrates that this shift in the curriculum toward doing "authentic" research results in greater retention and persistence for all students (Brownell, Kloser, Fukami, & Shavelson, 2013; Rodenbusch, Hernandez, Simmons, & Dolan, 2016). This type of curriculum shows not only greater knowledge acquisition but shifts in psychosocial outcomes, including increases in self-efficacy (Drew, & Triplett, 2008; Jordan et al., 2014; Lopatto et al., 2008; Shaffer et al., 2010), greater experiences of belonging in science community (Jordan et al., 2014; Shaffer et al., 2014), and increased science identity (Alkaher, & Dolan, 2014; Hanauer, Frederick, Fotinakes, & Strobel, 2012). These courses demonstrate equal retention rates for HU and non-HU students (Rodenbusch et al., 2016), which is significant, given that entry-level courses contribute toward large numbers of HU students, with interest in STEM, dropping-out of their STEM career pathway. Despite critiques (Linn et al., 2015), CREs have been recommended in several national reports as a way to increase retention and persistence of students (National Academy of Sciences, 2016; PCAST, 2012). The measured psychosocial shifts indicate that in addition to impacting learning outcomes, this learning environment potentially provides increased social kindness cues that affirm student dignity and inclusion.

Beyond CREs, some faculty have shifted STEM course content to connect more explicitly to student communal goals, such as social and economic development issues, while also incorporating active or collaborative learning techniques. Many NSF-funded projects, including the Problem-Based Learning (PBL) Clearinghouse <http://www1.udel.edu/inst/index.html> and National Center for Case Study Teaching in Science <http://sciencecases.lib.buffalo.edu/cs/>, provide case studies to engage students in "real-world problems." For instance, SENCER has developed model courses, program modules, and case studies that connect subject matter to students' interests in civic engagement and community, resulting in greater confidence and learning (Weston, Seymour, & Thiry, 2006).

Larger studies of institutional transformation provide corroborative evidence that curriculum changes toward more interaction can shift the social context in a way that increases student engagement (Freeman et al., 2014; Handelsman, Miller, & Pfund, 2007). For example, in a study of 2,050 second-year students across 23 institutions, engagement in Collaborative Learning, an active learning pedagogy where students work in small groups on complex problems, was a significant positive predictor for understanding science and technology, while also significantly impacting students' openness to diversity (Cabrera, Nora, Crissman, & Terenzini, 2002). Collaborative learning-based pedagogies, including Peer-Led Team Learning (PLTL), Process Oriented Guided Inquiry Learning, and Problem-based Learning, can foster positive classroom relationships, which potentially communicate kindness cues affirming social inclusion for all students (Eberlein et al., 2008). Together, the research in this area shows promise on positively impacting the retention of HU students in STEM fields.

STEM Research Training and Support Programs

To better understand interventions that broaden participation, the impact of STEM research training and support programs is being measured using behavioral science research techniques. STEM training programs, also sometimes referred to as co-curricular programs, occur outside the classroom and with a variety of durations, ranging from short-term programs (commonly held during the summers) to "wrap-around" experiences that span multiple semesters or even years (National Academies of Science, 2017). For example, the Biology Scholars program at UC Berkeley provides academic advising, training and community building space and support to talented but underprepared HU and first-generation students across an academic year (Matsui, Liu, & Kane, 2003). In contrast, the Maryland Baltimore County Meyerhoff Scholars program provides a summer bridge program, a stipend and an array of academic support activities to a small community of talented and prepared HU students (Summers, & Hrabowski, 2006). What these experiences share in common is student engagement in supportive academic experiences and the vast majority aim to create a cohort experience that is positive and inclusive.

Mixed methods evidence consistently has shown that research training programs enhance belonging and inclusion for students who may perceive the larger academic institution to be exclusionary (Hurtado, Clayton-Pedersen, Allen, & Milem, 1998). Analyses of quasi-experimental data indicate that HU students engaged in science training programs do report increased retention (Schultz et al., 2011), an increase in feelings of belonging to STEM fields, and are more likely to persevere even if they do experience stereotype threat (Estrada, Woodcock, & Schultz, 2008). Analyses of longitudinal data show that research training experiences occurring during the last 2 years of college are particularly important for increasing professional identity, which is related to persistence in STEM fields among HU groups 3–4 years after graduation (Estrada, Hernandez, & Schultz, in press).

The importance of providing supportive "STEM learning communities," cannot be emphasized enough (Graham et al., 2013). This community, which research training programs often provide, becomes a gathering place that "enable students to work with and learn from each other" (p. 1126). As described earlier, UC Berkeley Biology Scholars Program and the University of Maryland Baltimore County Meyerhoff Scholars program, among others, establish cohorts of students with similar ethnic or socioeconomic backgrounds that provide a friendlier community (relative to the typical academic context) that supports academic success. In related work, Espinosa's (2011) researched the experiences of 1,250 women of color (compared to 891 White women) attending 135 academic institutions found that women of color who were successful in STEM more frequently created a supportive culture for themselves by engaging in STEM-related clubs and organizations, interacting with peers outside of classes to discuss STEM related course content, and participating in research programs. She concludes that these activities helped "women of color see beyond a STEM culture that is fraught with barriers" (p. 232).

Mentorship

Mentorship refers to the relationship between a seasoned, experienced person—a mentor—and a less experienced protégé (Rhodes, Reddy, Roffman, & Grossman, 2005). Within the context of this relationship, the protégé is expected to acquire the skills necessary to inhabit a more professional role under the guidance of the mentor (Eby, Rhodes, & Allen, 2007). There is an assumption in the literature that mentorship is beneficial (Tenenbaum, Crosby, & Glinder, 2001) and that it results in academic achievement, productivity in scholarship, academic persistence, and even psychological health (Johnson, Rose, & Schlosser, 2007). Current research on STEM mentors does not support these assumptions and instead show that the quality of mentorship is important to measure when identifying impact on persistence in STEM career pathways (Hernandez, Estrada, Woodcock, &

Schultz, 2017). Meta-analyses of mentor-protégé studies indicate that providing both instrumental and psychosocial support is important to the protégé experiencing positive outcomes (Eby et al., 2013). Mentors that provide *instrumental support*, provide resources and opportunity for the protégé to engage in goal attainment (Kram, 1985), which can include providing access, visibility, sponsorship, and other forms of career assistance. *Psychosocial support* occurs when a mentor enhances "an individual's sense of competence, identity, and effectiveness in a professional role" (Kram, 1985, p. 32), including attention to emotional and personal development (Flaxman, Ascher, & Harrington, 1988; Nakkula, & Harris, 2013) and recognition that one is being held to the same standards of everyone else (Cohen, Steele, & Ross, 1999).

Quality mentorship is related to HU STEM students' increased belonging, discipline identity development, and overall confidence to be a scientist (Chemers et al., 2011; Dolan, and Johnson, 2009; Lopatto, 2007; Thiry, & Laursen, 2011). Experimental data are less available to provide evidence that quality mentorship directly causes persistence for HU students. Hernandez et al. (2017) utilizing a longitudinal quasi-experimental design, provide evidence that quality mentorship (not ethnic similarity of mentor to protégé) contributed to retention and persistence of African American students drawn from 50 different institutions. Further, work by Byars-Winston, Branchaw, Pfund, Leverett, and Newton, 2015, which analyzed archival data from over 400 protégés collected from 2005 to 2011 from several undergraduate biology research programs, found that perceived mentor effectiveness indirectly predicted enrollment in science-related doctoral or medical degree programs through research self-efficacy. Mentor social support, a likely cue of kindness and belonging, may be particularly key for HU STEM students, which can impact student persistence through strengthening science identity (Hernandez et al., under review; Estrada, Zhi, & Gershon, in preparation).

Emerging research suggests that HU undergraduate students and majority students do not have similar mentorship experiences or needs. Students' culture can influence the mentor attributes they value, perceptions of science, identity, sense of belonging, and their overall experience of the mentoring relationships (Blake-Beard, Bayne, Crosby, & Muller, 2011; Carlone, and Johnson, 2007; Graham et al., 2013; Hurtado, Cabrera, Lin, Arellano, and Espinosa, 2009; Johnson, Brown, Carlone, and Cuevas, 2011; Laursen, Hunter, Seymour, Thiry, & Melton, 2010).

Summary

Overall, the research on broadening participation in higher education STEM fields is replete with examples of how modifying academic environments through changing curriculum, providing support, and training or engaging in a quality mentorship experience buffers students from traditional "sink-or-swim" STEM initiation experiences and are more likely to provide cues affirming social inclusion.

While much of this research is anecdotal in nature, we have reviewed here some quasi-experimental and experimental studies that show how curriculum, programs, and mentorship experiences can connect students to their professional community, resulting in greater persistence even years after students graduate from their baccalaureate degree program. In these studies, connection to professional community is often measured as acquisition of a professional identity or sense of belonging. Taken together, the research evidence strongly supports the hypothesis that academic environments that foster kindness cues affirming social inclusion potentially create micro-climates and cultures that "warm up" institutional environments for diverse students in STEM educational environments.

Social Issues and Policy Implications

Theory and research inform us that inhabiting environments that emit kindness cues affirming social inclusion is central to our mental, emotional, and physical well-being and that humans are hard wired to find and preserve these environments. Further, research examining the experiences of HU students in the context of STEM fields indicates that they do not always experience this affirmation for social inclusion in their academic environments, thereby impacting their personal identification with STEM disciplines. Research also shows that reducing stereotype threat and institutionalized racism while increasing value congruence and meaning, along with experiences of self-affirmation, can help students improve academic performance and, in some cases, retention in college. Overall, the research reviewed here provides examples of how to not only reduce the negative impact, but also to enhance and strengthen the positive so that all students, regardless of gender, culture, and socioeconomic status, inhabit an academic context that has kindness cues that affirm student dignity and inclusion.

We now ask the question, if excellent and effective policies were implemented to eradicate underrepresentation, what would institutions look like? In our opinion, success would mean that curriculum, programs, and mentorship for "special populations" are no longer needed. Instead diversity would be a byproduct of high functioning institutions that focus on each student's intellectual and social development. These institutions would expect that each student will excel academically, and policies and practices would be responsive to the backgrounds of all its learners by fostering a culture that provides kindness cues that affirm social inclusion to all students.

The current state of higher education shows that most academic institutions are far from successfully integrating diversity and excellence in teaching and learning. For example, many institutions have one committee working on diversity initiatives while another is tasked with strengthening the quality of the educational experience of its students (Williams, Berger, & McClendon, 2005). Such structural divisions undermine the attainment of what Nivet (2011) describes as Diversity 3.0, where

diversity and inclusion are woven into the core workings of the institution. This is in contrast to Diversity 1.0, where excellence and diversity are viewed as competing ends or Diversity 2.0, where diversity and excellence co-exist, with diversity on the periphery. For faculty and students navigating academic career pathways, this division is more than structurally confusing, it also perpetuates macro and micro cues of prejudice, racism, stereotype threats, and diminishes macro and micro affirmations of social inclusion. In many cases, the diversity committees attempt to remedy this situation, while the rest of the institution perpetuates that status quo.

Consider the evolution of policies in the 20th century. Prior to the Civil Rights Movement, many colleges and universities perpetuated what would now be described as prejudiced institutional environments where HU STEM students experienced blatant (i.e., macro) and subtle (i.e., micro) aggressions in the form of prejudice, racism, and rejection from the academic community. Then came affirmative action, where diversity was valued to further open the door to people previously excluded, yet the culture of the institutions did not significantly shift to welcome these newcomers. This leads to the current "politically correct" response where macro aggressions are no longer acceptable, and macro cues affirming social inclusion are visible. The shift to showcasing pictures of HU students on university websites, the establishment of diversity committees, and mission statements that extoll the virtues of diversity are evidence of social inclusion. However, as the literature reviewed in this article reflects, a great deal of social ambiguity continues to remain. The occurrence of micro aggressions and a lack of micro affirmations, which includes subtle or ambiguous kindness cues, threaten the social inclusion that students should feel in their STEM disciplines. A final shift is now required to move from ambiguous to inclusive institutional contexts (see Figure 2).

To achieve this, we will describe four opportunities to steer policies and practices in a new direction: (1) fix our institutions, not our students; (2) work from students outward; (3) structure resources and rewards to support change makers on campus; (4) "unlearn" conventional models and wisdom.

Fix Our Institutions, Not Our Students

The first opportunity is to shift focus from fixing students to fixing institutions. By shifting the locus of responsibility onto our institutions, we acknowledge that there are significant changes needed to be made in colleges and universities. Specifically, we recommend promoting actions and activities that authentically convey kindness cues that affirm social inclusion to HU students at both macro and micro levels. Formulating school policies and procedures, revising the structure of the curriculum and its delivery, implementing support and research training programs, and commitment to training and rewarding faculty when they improve

Fig. 2. Progression to an inclusive institutional environment.

the classroom, campus and research lab climate can help facilitate this shift (HHMI, Inclusive Excellence, 2017; Williams et al., 2005).

To reduce the perpetuation of stereotypes, prejudice, and racism, we also need to be mindful not to frame or to message what we do as "charity" or "remedial," a frame that feeds into the deficit view of HU students, conveys no kindness, and undermines the dignity of the students. Rather, we can ensure that the reality and message we convey acknowledges the value of students from diverse backgrounds in the academy. In the short term, to demonstrate this, we can structure regular opportunities for students to connect their full person—including their backgrounds, cultures, interests, and values—to what they are learning. For example, connecting course content to improving health in vulnerable populations. Further, we can promote teaching innovations in both course structure and programs that increase widespread perceptions that the STEM community is authentically welcoming, kind, and inclusive. This requires a cultural shift in academia.

Ultimately, as stated above, the long-term goal is to move from a model that localizes the responsibility for broadening participation in STEM from an office or a program to a more distributed model (the institution), counteracting the "islands of innovations" (Williams et al., 2005) phenomenon where effective efforts are

isolated with too little influence on overall institutional structures, policies, and practices. Instead, we recommend working to first identify and then coordinate multiple efforts so they have a greater impact on all students and on the whole institution. In current practice, there are rarely structures that link them, and as a result, their impact are isolated (local) rather than pervasive (institutional). As such, *we also recommend in the long-term transition from isolated campus initiatives with the goal of broadening participation to comprehensive institution-wide plans that will make excellence inclusive*. For example, in addition to providing isolated student training program on campus that broadens participation, institutions can modify their curriculum, new faculty orientations, staff and administrative workshops, mentorship training and the institutional messaging to convey greater kindness cues that affirm social inclusion.

Work from Our Students Outward

The second opportunity is to build from what we already know about students to inform both short- and long-term shifts toward more kindness which conveys respect for the students' dignity and an inclusive academic community. As the research shows, policy shifts should be driven by considerations of the fit between our educational STEM practices and our students' cultural values and how they influence their science experience and career interests (Jackson, Galvez, Landa, Buonora, & Thoman, 2016). As described in Table 2, there are several recommendations for how to use what we know about students to inform institutional, curricular, programmatic, and mentorship activities. Incorporating these short- and long-term recommendations are challenging, but taking into consideration the unique experiences of HU STEM students, and the current situation they face, is relevant to authentically affirming other human beings. Intentionally utilizing what we know to inform institutional transformation efforts is critical to interrupting the cycle of underrepresentation.

Beyond financial resources, we must also consider resource disparities more broadly to include students' prior knowledge of the culture and system of higher education, prior experience in STEM enrichment activities, and other factors that make the leap into higher education socially challenging to HU's who are the first generation to attend college and low income students. These individual differences can be considered in students' academic course planning, when they begin research, their time to degree, and during career planning. In a focus group conducted at UC Berkeley, we found that HU STEM students wanted advisors to recognize these attributes in particular, and see them for more than their current GPA. Taking guidance from what we know about HU students, institutions can provide regular training to help its educators more effectively mentor, teach, and advise all students, utilizing culturally and socially affirming approaches that convey kindness and inclusion.

Table 2. Summary of Theory and Recommendations

Theoretical approach	HU student challenge to persisting	Short-term recommendation	Long-term recommendation
Stereotype threat	Agents of academic environment hold negative stereotypes regarding HU group performance	Increase individual's resilience to threat, increase cues of belonging in environment, reduce threat priming in classrooms and research environments	Increase understanding about stereotype threat among all educators and eliminate negative stereotypes in academia and society
Self-affirmation theory	Negative feedback confirms negative stereotypes and undermines positive self-concept	Increase affirmation of individuals' self-concept	Academia institutionalizes positive, affirming environment for all students
Race-sensitivity	Students sensitive to racism are negatively impacted by academic environments that do not foster belonging and equal participation for all students	Foster social belonging through both cross-group and within-group friendships; build trust and empathy between educators and students	Increase representation among all stakeholders of educational enterprise; structure programs and evaluations to reduce or eliminate negative bias
Communal goal affirmation	Academia strongly emphases agentic or individualistic values, which are not congruent with HU student values	Provide opportunities for students to link academic work with communal goals in classrooms and programs	Academia institutionalizes the inclusion of individualistic and communal goals as valued in curriculum, policies, and image.
Expectancy value theory	Academic curriculums and courses contents disengages students from STEM career pathways	Curriculum provides opportunity for students to connect personal values with course content	Academic curriculums intentionally connect to all student's intrinsic values (not just majority group)
Critical race theory	Institutionalized racism is imbedded in all aspects of academia	Increase radical inclusiveness at all levels of academic institutions	Abolish racism

Build Community to Support Change Makers on Campus

A third opportunity is to upgrade institutional resources and reward structures to better support change makers. Substantial research on STEM education and psychosocial mechanisms that lead to broadening participation exist and can provide the STEM community with data and theory-based effective practices to guide efforts. However, change has been slow to come. Why? And why especially have research university faculty not taken the lead? According to Handelsman et al., 2004, research faculty and administrators may be unaware of the abundant

research demonstrating the effectiveness of interventions (e.g., active learning, increasing the transparency of how STEM research has applications for communities, integrating community based learning opportunities, etc.). Those aware of the research may distrust the findings in light of their and other colleagues' success as products of the current educational approach. Further, many may be intimidated by the lack of time, support and resources, and rewards for learning new methods. And yet others may fear that identification as teachers reduces their credibility as researchers (Brownell, & Tanner, 2012).

Establishing Faculty Learning Communities (FLCs) has the potential to change faculty practices regarding teaching and mentorship that provide stronger kindness by (1) identifying and showcasing exemplars in instructional innovation and (2) involving both new (junior) and future (graduate students and post-docs) faculty, as well as mid-career and senior faculty as champions and institutional change agents. Typically, faculty development activities involve isolated intensive workshops designed to change the beliefs, instructional practices, and mentorship approaches of individual faculty that rarely lead to lasting change (Connolly, & Millar, 2006). By contrast, according to Cox (2004), the FLC model has the potential to lead to systemic change by (1) building a campus-wide teaching and learning community, (2) increasing faculty interest in undergraduate teaching and learning, (3) promoting and supporting the scholarship of teaching and its application to student learning, (4) broadening the authentic evaluation of teaching and assessment of learning, and (5) increasing rewards for and prestige of excellent teaching. Ideally, a well-executed FLC will model what an academic career should be like, with colleagues exposed to new resources provided both by and to participants. Second, FLCs should meet frequently and over enough time to build a community in which they help each other meet their individual goals around common teaching interests and concerns (Richlin, & Essington, 2004).

Beginning with FLCs or other enrichment activities, it is possible for faculty, staff, graduate students, and post-doctoral students to gain instrumental and social support to translate STEM education and social science research into practices that impact their teaching and mentorship approach to include kindness cues that affirm inclusion. While limited time and discipline-specific terminology are barriers for scholars to read outside of their disciplinary training and expertise, there exist "translational" resources (such as the professional organization *Understanding Interventions that Broaden Participation in Science Careers* < http://understanding-interventions.org/> and the NIH funded initiative *National Research Mentoring Network* < https://nrmnet.net/>), that are available to disseminate research and evidence-based best practices to train STEM practitioners.

"WIIFM". In all of this, the "what's in it for me?" (WIIFM) factor is critical. Investing time to improve how we teach, mentor, and advise typically "does not count" significantly during career advancement decisions (especially for

tenure-track faculty at R1 institutions), acting as a profound barrier to institutional change. Short of changing the weight of research, teaching, and service in the promotion and tenure process, a workable near-term strategy is building community in places where there is little. For instance, policies can be changed to support and reward faculty who coteach classes, thus observing and sharing pedagogical strategies. This could also help with program assessment when faculty can come up with agreed upon outcomes and course assessments. Embedding modified, abbreviated, and adapted versions of the training and best practices to increase kindness cues that affirm inclusion into already existing activities and functions (e.g., departmental faculty meetings, seminars, and retreats), could also build community while learning together without adding one more thing to an already "overflowing plate."

Reinvent Stereotypes, Myths, and Conventional Wisdom

A final opportunity is to reinvent our stereotypes, myths, and conventional wisdom around STEM education. Myths and stereotypes pervade the conventional wisdom about "who belongs" in STEM and why others leave (Byars-Winston, 2014). Research has shown that much of this conventional wisdom is not supported by evidence, such as: Whites and Asians have a higher interest in pursuing a science career than HUs (PCAST, 2012), the untalented students are the ones to leave STEM majors (Seymour, & Hewitt, 2000), STEM participation is based on an "early calling" (Fisher, & Margolis, 2002), and the dearth of HU faculty in some STEM programs (e.g., medical schools) is due to the lack of available talent (Gibbs, Basson, Xierali, & Broniatowski, 2016). Challenging these unfounded myths is essential for shifting the academic climate toward kindness cues affirming social inclusion and we argue, it is impossible to make this shift without updating the stories we tell.

In line with this deficit thinking, traditional approaches to increase participation and success of HU students and faculty have focused on what they are "missing" (e.g., preparation, mentorship, skills, motivation) rather than capitalizing on the strengths that they bring (Thoman, Brown, Mason, Harmsen, & Smith, 2014). Even within social psychology, there have been decades of research on the barriers to success such as prejudice, racism, conflict, and threats, and on what makes students more able to persist anyway (e.g., by shifting efficacy, motivation, grit, and mindset) (Byars-Winston et al., 2013, 2014; Duckworth et al., 2007; Duckworth, and Quinn, 2009; Dweck, 2006; Hernandez et al., 2012; Lent et al., 2005; Oyserman, and Lewis, 2017; Wilson et al., 2012). The majority of positive research programs, as described in this manuscript, are relatively recent with room for growth. Furthermore, the dominant approach of the STEM community has been to change students to become more like the majority (assimilation; Thoman et al., 2014) rather than acknowledging how HU students and

faculty possess aspirational, linguistic, familial, social, navigational, and resistance capital, which can be affirmed and validated as a source of strength (Rendón, 1994).

Research as a Way to Initiate and Sustain Change

The opportunities just described are idealistic and feasible as well. To make efforts concrete, we recommend initiating and sustaining change going forward through utilizing data and research by (1) capitalizing on the power of institutional data and (2) actively researching how classrooms, programs and mentors communicate kindness that upholds dignity, and connection in STEM education environments.

Capitalize on the Power of Institutional Data

In the short term, it is imperative to incentivize institutional level shifts and identify effective practices, institutional and department level data collection. Data allow us to reward success in broadening STEM participation and recognize failures. Institutional research offices have the potential to contribute significantly to fulfilling this recommendation by tracking student academic performance and persistence. Specifically, we recommend collecting and tracking student data including (a) department level disaggregated demographic information (e.g., ethnicity/race, gender, socioeconomic status, first generation status), (b) participation in research training and support program, (c) mentorship, and (d) outcomes typically already tracked such as course progression, degree attainment, and time to degree. In support of this, funding agencies can require STEM degree attrition and attainment data from institutions that receive support in a standardized format that identifies disparity and equity (see Estrada et al., 2016 or recommendations in the National Academy of Sciences report, 2016). Posting summaries of this type of data on college and university websites also provides transparency and usability of the information.

In the longer-term, institutional data give educational leaders and staff the information they need to commit to and expand effective practices, while attending to department and programs where underrepresentation persists. Institutional data can provide evidence of how better supporting all students in our classrooms, majors, and research laboratories decreases time to degree and increases research productivity and career persistence, which are metrics of success relevant to the different institutional stakeholders. When possible, tracking data regarding faculty engagement in institutional transformation efforts, productivity, and career persistence would also be useful to stakeholders interested in broadening access in STEM departments across the academic hierarchy—from top to bottom. Systematically collecting and disseminating this sort of data to STEM educators will

be critical to implementing and sustaining systemic level changes at academic institutions.

Actively Study How Classrooms, Programs, and Mentors Communicate Kindness, Dignity, and Connection in STEM Education Environments

Institutional research data can allow us to identify when reconceptualizations of curricular, research and support programs, and mentorship practices and policies are successful in affecting our HU students' and faculty retention and persistence. However, while these data are necessary, they are not sufficient. Social scientists, in collaboration with STEM educators, can design studies (both experimental and quasi-experimental) to not only understand *if* changes make a difference, but also *why* and *for whom*. Further, strong research designs with control or comparison groups can establish causation, while longitudinal data identify short- and long-term impact on STEM career pathway persistence. To extend the current research, we recommend funding for research that measures macro and micro kindness cues affirming social inclusion and connection to students' academic and discipline communities. Using student and faculty self-report measures as well as observational measures would strengthen this research (National Academies of Sciences, 2017). For instance, measurement of institutional communication materials, faculty–student interactions in courses, advisor interactions, and the multiethnicity of peer groups in common spaces might be a few of the nonself-report measures to include in the research designs. Pairing this with validated self-report measures of psychosocial variables (such as self-efficacy, social identities, values, and belonging) could advance the research considerably. Measurement of all these elements in the context of classrooms, programs and in mentorship settings, as well as controlled lab experiments, will be critical to advancing this field to better understand HU student persistence in STEM career pathways.

Conclusion

Capitalizing on the opportunities to shift toward affirming social inclusion for all students may be an incremental process, some might argue, on a "geologic scale." As we work toward parity in our STEM disciplines, we recommend the community take a "both-and" approach—working to change our institutions while simultaneously helping today's diverse students and faculty navigate institutional policies and practices, which sometimes are poorly designed to support them. Our classrooms, programs, and mentorship activities can both target talented students and faculty whose potential would otherwise be underexpressed, while at the same time, working to make our institutions affirm social inclusion through macro and micro communications, to all.

In conclusion, this article provides specific guidance on how to make useful shifts in institutional culture and policies that enhance experiences of affiliation, belonging, and acceptance among all populations. Further, this review can help researchers and educators in colleges and universities interpret emerging results from several large initiatives including the NIH funded Diversity Consortium and Howard Hughes Medical Institute's (HHMI) Inclusive Excellence programs. Ultimately, this review provides a new lens with which to think about how to transform academic institutions in a manner that supports broader participation and persistence in STEM fields in measurable ways. These institutional and disciplinary approaches, which promote healthy affiliations, are ambitious, but perhaps essential to broadening the workforce in STEM fields.

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JOHN MATSUI is Cofounder and Director of the Biology Scholars Program (BSP) at the University of California, Berkeley. He is also a lecturer in the Department of Integrative Biology and the Assistant Dean of Biology, in the College of Letters and Science. Since 1992, 3500 Berkeley undergraduates have participated in BSP—80% first-to-college/low-income, 70% women, and 60% from ethnic groups (African American, Hispanic, and Native American) underrepresented in science. Dr. Matsui's focus has been to recruit "undervalued" STEM talent into BSP, students who enter Berkeley with lower SAT scores and high school GPAs and are less well-prepared to succeed in STEM majors. In spite of their significant "academic deficit," BSP members graduate in equal percentages with biology degrees and with equivalent exit GPAs as biology majors-at-large; demonstrating that in the right environment, students from underresourced backgrounds can attain parity in academic performance with peers from more resource-rich backgrounds. Additionally, Dr. Matsui serves on national advisory boards to broaden participation in STEM for the National Science Foundation, the National Institutes of Health, and the Howard Hughes Medical Institute, and is the Associate Editor for the *"Understanding Interventions that Broaden Participation in STEM"* journal. Finally, in 2015, President Obama recognized him for his 25 years of work to diversify STEM by presenting him with the NSF Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring (PAESMEM) in the Oval Office.