Considering Intergroup Emotions to Improve Diversity and Inclusion in the Geosciences

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Abstract

While the geosciences are interdisciplinary in nature, they are not demographically diverse, which challenges the future viability and relevance of the geosciences. Causes and potential solutions for this deficiency have been proposed for several decades, but diversity within the geosciences has barely changed in that time. Dominant cultural, historical, and socioeconomic factors contribute to the lack of diversity and those factors only change slowly over generations. Solutions proposed for more immediate changes have been ineffective. Providing specific emotional support to those who are systemically non-dominant (SND) will be more impactful in improving diversity and inclusion within the geosciences. Specifically, we focus on intergroup emotions, which can be pleasant or unpleasant emotions that individuals feel due to their identification with one or more social groups. Using the Intergroup Emotions Theory, we argue that diversity and inclusion can be improved by helping those who are SND minimize undesirable emotions that arise when their group memberships are perceived to be negative. We end by making recommendations based on available research, yet we strongly call on the geoscience community to conduct further discipline-based research in this crucial area in the near future.

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ABSTRACT

While the geosciences are interdisciplinary in nature, they are not demographically diverse, which challenges the future viability and relevance of the geosciences. Causes and potential solutions for this deficiency have been proposed for several decades, but diversity within the geosciences has barely changed in that time. Dominant cultural, historical, and socioeconomic factors contribute to the lack of diversity and those factors only change slowly over generations. Solutions proposed for more immediate changes have been ineffective. Providing specific emotional support to those who are systemically non-dominant (SND) will be more impactful in improving diversity and inclusion within the geosciences. Specifically, we focus on intergroup emotions, which can be pleasant or unpleasant emotions that individuals feel due to their identification with one or more social groups. Using the Intergroup Emotions Theory, we argue that diversity and inclusion can be improved by helping those who are SND minimize undesirable emotions that arise when their group memberships are perceived to be negative. We end by making recommendations based on available research, yet we strongly call on the geoscience community to conduct further discipline-based research in this crucial area in the near future.

1.0 INTRODUCTION

1.1 Lack of diversity in the geosciences, identified causes, and proposed solutions

The geosciences are among the least demographically diverse fields within science, technology, engineering, and mathematics (STEM) (Velasco & de Velasco, 2010; Stokes, Levine, & Flessa, 2014; Glass, 2015; King et al., 2018; Vila-Concejo et al., 2018). Specifically, while there is some indication that the gender gap has decreased over the past 40 years, racial and ethnic diversity has not improved. This trend can be broadly seen by considering those who obtained Ph.D. degrees (Bernard & Cooperdock, 2018) and at the department-level by considering the demographics of faculty members. As an example from the lead author's department at Johns

Hopkins University, 2 of 11 faculty members identified as female in 2015, while 5 of 14 did so in 2017 (JHU Progress Report, 2019). Yet, 13 of those 14 faculty members identified as White, with the one non-White faculty member identifying as Asian (ibid.). Such statistics led Riggs, Callahan, and Brey (2018) to call for improving inclusion of those who are systemically non-dominant (SND) in the recent report "A Community Framework for Geoscience Education Research." Here we use the term SND from Jenkins (2017) instead of the less inclusive term "underrepresented minority" that is typically used in the literature. Before getting to proposed solutions, we will consider some causes.

There are a number of documented causes for the lack of diversity in the geosciences. Those include students having insufficient prerequisite knowledge (e.g., Baber, Pifer, Colbeck, & Furman, 2010), students facing discouraging environments (e.g., Mattox et al., 2008), students having less social capital (e.g., Callahan, Libarkin, McCallum, & Atchison, 2015), students' decreasing or lack of interest in the subject (e.g., Defelice, Adams, Branco, & Pieroni, 2014), students' uncertainty regarding their future earning potential (e.g., Hanks et al., 2007), and students not having or having less access to early geoscience educational experiences (e.g., Levine, González, Cole, Fuhrman, & Floch, 2007). Additionally, implicit biases limit access to the geosciences. For example, letters of recommendation written on behalf of female postdoctoral researchers were of lower quality than those written for their male counterparts (Dutt, Pfaff, Bernstein, Dillard, & Block, 2016). Implicit biases are not limited to the geosciences nor to gender. Eaton, Saunders, Jacobson, and West (2019) found that faculty members in physics and biology rated each of the eight identical synthetic curriculum vitae (CVs) differently based solely on perceiving gender and race from the name listed on the CV. Similarly, recent work found journals of the American Geophysical Union had fewer female scientists peer review articles (Lerback & Hanson, 2017). This was due to both authors and editors inviting fewer female reviewers. While those biases may be implicit, bias can also be very explicit. As an example, a female respondent to a survey administered to coastal geoscientists and engineers

stated, “my supervisor aked [sic] me to abandon my PhD when I become pregnant” (Vila-Concejo et al., 2018). Additionally, the list above would be severely lacking if we did not also acknowledge that societal blights such as ableism, ageism, classism, homophobia, racism, sexism, transphobia, and xenophobia working within the culture of the geosciences may lead to a lack of diversity and inclusion within the field. Given the numerous causes for the lack of diversity, we now consider some proposed solutions.

Proposed solutions to improve diversity in the geosciences include: encouraging students to participate in undergraduate research (e.g., Gilligan et al., 2007), having more students involved in summer programs (e.g., Hallar et al., 2010), having larger institutions partnering with minority-serving institutions (e.g., McDaris, Manduca, Iverson, & Orr, 2017), supporting students who transfer from two-year colleges (Wolfe & Riggs, 2017), better mentoring of students (e.g., Huntoon & Lane, 2007), improving instructor training (e.g., Sherman-Morris, Brown, Dyer, McNeal, & Rodgers, 2013), increasing students’ self-efficacy (Baber et al., 2010), increasing students’ social capital (Callahan et al., 2015), changing the current biased demographical depiction of geoscientists in textbooks (Mattox et al., 2008), using more culturally inclusive and relevant geoscience teaching (e.g., Riggs, 2005; Semken & Butler Freeman, 2008; Ward, Semken, & Libarkin, 2014), and improving recruitment of SND students (Stokes, Levine, & Flessa, 2015). In spite of successful individual interventions towards retention, for example through undergraduate research experiences (e.g., Russell, Hancock, & McCullough, 2007; Pender, Marcotte, Sto. Domingo, & Maton, 2010; Bangera & Brownell, 2014), there has yet to be a broader demographic shift in a sustained way. We posit that proposed solutions are ineffective because they only marginally treat symptoms caused by harmful systemic factors. While systemic causes cannot be significantly changed in a short period of time, providing specific emotional support to those who are SND could be more effective at making the field more diverse and inclusive. In this commentary, we use some of the extensive literature on emotions to argue that systemic causes negatively affect emotions of

79 those who are SND, resulting in them either failing to engage with or completely disengaging
80 from geoscience-related studies, careers, and interests. Therefore, we should directly consider
81 emotions of those who are SND in such a manner as to reduce or possibly reverse influences that
82 direct them away from the geosciences.
83
84 **2.0 THEORY DEVELOPMENT**
85 **2.1 What are emotions?**
86 Before delving into the centrality of emotions in discussions of diversity and inclusion in
87 the geosciences, we first consider emotions more generally to understand their fundamental role
88 in human psychology. Emotions have been scientifically investigated for at least 150 years (e.g.,
89 Darwin, 1872; Barrett & Satpute, 2017). They have been studied using various techniques, such
90 as from a psychological perspective in terms of verbal expressions and from a neuroscientific
91 perspective in terms of physiological responses (Bach & Dayan, 2017). While in the recent past
92 some have advocated for the universality of basic emotions (i.e., anger, disgust, fear, happiness,
93 sadness, and surprise; e.g., Ekman, 1992), today emotions are viewed to be more complex and in
94 line with a constructivist view in that they are culturally dependent and are formulated by
95 individuals (e.g., Jack, Blais, Scheepers, Schyns, & Caldara, 2009; Tarlow, 2012; Touroutoglou,
96 Lindquist, Dickerson, & Barrett, 2015; Mesquita, Boiger, & De Leersnyder, 2017). Here we
97 consider emotions to be specific interpretations by the brain of our physiology and environment
98 in relation to its internal model (e.g., Barrett & Satpute, 2017). Since presently there are at least
99 15 theories of emotions and research is ongoing, it is difficult to define emotions more precisely
100 (Scarantino, 2016). Though the above definition may be incomplete, we use it as a working
101 definition. Our definition of "emotions" is also narrower than "affect" or "affective domain" used
102 in education research (e.g., Barrett & Bliss-Moreau, 2009; McConnell & van der Hoeven Kraft,
103 2011; Perera et al., 2017). "Affect" is very broad in that it includes a wide range of phenomena

104 from metacognition to emotion to motivation (Illeris, 2009). Given our working definition, we
105 will next consider how emotions are connected to cognition.
106
107 **2.2 Emotions and Cognition**
108 The connection between emotions and cognition has a long-established basis in
109 neuroscience (e.g., Pessoa, 2008), psychology (e.g., Öhman, Flykt, & Esteves, 2001), and
110 anthropology (e.g., Anderson, 2011). Though connected, emotions and cognition (i.e., attention,
111 language, memory, planning, and problem solving) have been considered as separate constructs
112 (e.g., Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). For instance, certain regions of the
113 brain (e.g., amygdala and ventral striatum) were considered to control emotion and other
114 regions (e.g., lateral orbitofrontal cortex, ventromedial prefrontal cortex, and anterior cingulate
115 cortex) were considered to control cognition (Duncan & Barrett, 2007). This is akin to electricity
116 and magnetism being regarded as two separate phenomena prior to the 1820s, though we now
117 know that electricity and magnetism are fundamentally related. Similarly, our current
118 neurological understanding of the human brain finds emotions and cognition to be highly
119 integrated. In fact, traditional emotion-control areas are involved in cognition and traditional
120 cognition-control areas are involved in emotion (Pessoa, 2008). As an example, the amygdala,
121 often termed the "fear center" of the brain, influences attention by increasing awareness to
122 sensory information that is particularly emotionally meaningful to the person (Duncan &
123 Barrett, 2007). The connection between emotions and cognition is further illustrated by
124 research that showed emotions affect processing, encoding and retrieving of information (e.g.,
125 Levine & Pizarro, 2004). Additionally, Sohn et al. (2015) showed that more impulsive decisions
126 are made under high-arousal conditions as compared to a neutrally aroused state. For an
127 extensive overview of emotions in education, we refer the reader to Pekrun & Linnenbrink-
128 Garcia (2014) who thoroughly examined all facets of how emotions impact student learning and
129 classroom dynamics. The challenge is moving from recognizing emotions as an important facet

of learning to understanding how they can ultimately impact diversity and inclusion within the geosciences.

2.3 Intergroup (Group-based) Emotions

Emotions and diversity in the geosciences may be linked by considering intergroup (group-based) emotions, which are "emotions that arise [in an individual] when [they] identify with a social group and respond emotionally to events or objects that impinge on the group" (Smith & Mackie, 2016, p. 412). The underlying theory, called Intergroup Emotions Theory (IET; Smith, 1993), was inspired by previous work on social identity theory (Tajfel, 1978) and self-categorization theory (Turner, Hogg, Oakes, Reicher, & Wetherell, 1987), since fundamentally these emotions arise from a sense of self as it relates to group membership. The crux of IET is that when group membership is made salient, the emotions experienced by an individual tend to be dominated by intergroup emotions.

A number of studies have shown that intergroup emotions can be powerful, but may also be destructive. For example, DeSteno, Dasgupta, Bartlett, and Cajdric (2004) conducted two experiments to show that when anger was induced in participants, they showed automatic bias (viz. prejudice) towards outgroup members (who were only randomly assigned that role). Further, Gordijn, Yzerbyt, Wigboldus, and Dumont (2006) showed that undergraduate students (who were residents of Colorado) deemed a fee increase aimed at out-of-state students to be unfair when they thought of themselves more as students, but fair when they thought of themselves as residents of Colorado. Since both those studies were cases where groups were formulated experimentally, they give credence to the possibility of altering perceptions in educational settings to improve diversity and inclusion. To that end, recent work in human resources has considered the connection between intergroup emotions and diversity. For example, Tufan, De Witte, and Wendt (2017) used IET to study how failure to meet diversity-related promises by employers resulted in higher anxiety and avoidant behavior by ethnic

minority employees. While emotions of individuals can stem from their group membership, a complication is that in turn their group membership can be strengthened or weakened by those very emotions (Kessler & Hollbach, 2005). For instance, happiness towards an outgroup can weaken association with an ingroup, which again is important as we try to consider intergroup emotions of SND students in improving diversity and inclusion in the geosciences.

2.4 Intergroup Emotions of Systemically Non-Dominant (SND) Students

Before we consider the emotions of SND students in educational settings, we need to acknowledge that SND students need to cope with the harsh conditions of the wider society in which they live. Previous works have demonstrated this as it relates to those who identify as transgender (Dhejne, Vlerken, Heylens, & Arcelus, 2016; Evans, Bira, Gastelum, Weiss, & Vanderford, 2018) and female (Eaton et al., 2012; Evans et al., 2018) as generally experiencing higher levels of anxiety and depression. Additionally, SND students experience emotions in educational settings that are destructive to their learning. For example, they experience microaggressions, which may consist of microinsults, microassaults, and microinvalidations (Sue et al., 2007). Nadal, Griffin, Davidoff, and Sriken (2014) found that microaggressions can lower self-esteem and in turn degrade academic performance. While initially proposed for racial microaggressions (Pierce, 1969), it has been widened to include other demographics such as gender (e.g., Barthelemy, McCormick, & Henderson, 2016) and sexual orientation (e.g., Shelton et al., 2011). In addition to dealing with microaggressions, SND students face stereotype threats, in which students are aware of larger perceived societal stereotypes about their designated group (e.g., race, gender, and nationality). Those threats in turn impact their academic performance (Steele, 1997). Past work demonstrated that the most successful students of color tend to be the most likely to withdraw from school (Osborne & Walker, 2006). Furthermore, it is important to note that when a person belongs to multiple marginalized groups (i.e. intersectionality; Crenshaw, 1989), the negative effects are worse. For example, Clancy, Lee,

Rodgers, and Richey (2017) found that women of color in astronomy and planetary science reported the highest rates of negative experiences (including harassment and assault) in the workplace. Carlone and Johnson (2007) also studied the career paths of 15 women of color, 6 of them had a "disrupted scientist identity" due to obstacles such as not conforming to established laboratory culture (e.g., manner in which mice were killed) and messages of not belonging (e.g., "well, maybe you can change your major"). These findings are consistent with IET in that intergroup emotions in individuals mediate between an external destructive effect (e.g., microaggressions) and their academics (e.g., lower academic performance). As such, those wanting to implement effective means of improving diversity and inclusion in the geosciences need to consider intergroup emotions of SND students.

3.0 RECOMMENDATIONS

3.1 Finding Research-based Psychological Interventions

To make their courses more learner-centered, geoscience instructors can plan their courses today using research-based practices such as backward design (e.g., Wiggins & McTighe, 1998; Reynolds & Kearns, 2016). Some may even implement evidence-based cognitive psychological interventions to help their students learn. For example, values affirmation interventions have been shown to reduce the negative effects associated with stereotype threat (Shnabel, Purdie-Vaughns, Cook, Garcia, & Cohen, 2013) and have been shown to reduce the gender gap substantially (Miyake et al., 2010). Yet, geoscience instructors may not have access to many research-based practices for improving intergroup emotions, as evidenced by the lack of any geoscience discipline-based education research (DBER) pertaining to intergroup emotions. As such, we call on the geoscience DBER community to help fill this need. Since such work will inherently be transdisciplinary, we encourage geoscience DBER groups to work closely with their psychology and sociology colleagues. A recent literature review mentioned how few papers "integrate cognitive, social, or psychological theories into their discussion of different

208 programs" (Callahan et al., 2017). While quantitative research is important and allows for a
209 broader sampling, we particularly recommend qualitative research, so that we can obtain richer
210 data about intergroup emotions from the relatively few SND students currently in the
211 geosciences and can in turn propose better-targeted, more relevant, and more effective
212 interventions.

213 Generally, effective means of improving intergroup relations are still developing (e.g.,
214 Schellhaas & Dovidio, 2016 and references therein) as revealed to us daily by conflicts and
215 tensions in the world. Yet, it is important to consider a few nascent strategies that may help in
216 the context of the geosciences. Previous works showed there to be less bias towards outgroups
217 when individuals are designated into multiple groups (i.e., *multiple categorization*) than when
218 they are classified into two dichotomous groups (e.g., Crisp, Hewstone, & Rubin, 2001). For
219 instance, there tends to be less bias towards outgroups when a person categorizes others by
220 gender, ethnicity, and age rather than only gender. Another strategy of reducing bias is to
221 encourage people to reclassify themselves and their outgroups into a *superordinate common*
222 *ingroup* (e.g., human beings or college students; Gaunt, 2009). Albarello and Rubini (2012)
223 found that combining those two methods was the most effective way of lessening
224 dehumanization of those who identify as Black. As we qualified earlier, while these methods
225 have been shown to work they are not invariably effective. For instance, Schellhaas and Dovidio
226 (2016) noted that the process of recategorization into a superordinate common ingroup is not
227 effective when a group feels that they are losing their identity in the process. As such an effective
228 strategy may be to encourage seeing commonalities between groups while being careful not to
229 discourage group identifications. Experiments by Bruneau and Saxe (2012) support another
230 strategy to improve intergroup dynamics. They suggest that attitudes towards outgroups can be
231 improved when members of the dominant group (e.g., White Americans and Israelis) are
232 'perspective-taking,' while those in the nondominant group (e.g., Mexican immigrants and
233 Palestinians) are 'perspective-giving.' A different yet related intervention emphasizes the

234 importance of building trust. Consider that SND students likely come into an institution with
235 mistrust due to past unfair experiences in academic settings (e.g., Okonofua & Eberhardt, 2015).
236 Yeager, Purdie-Vaughns, Hooper, and Cohen (2017) note that an institution is seen as
237 trustworthy when it is recognized by an individual to be "procedurally just" in that it is fair and
238 the institution has "personal regard" in that they care about the wellbeing of that person. In
239 their study, they found that African American and Latino/a/x middle school students' awareness
240 of bias was predictive of their decrease in trust in the institution. That decrease in trust in turn
241 predicted these students' later increased discipline infractions and their decreased likelihood of
242 enrolling in college. Likewise, Yeager et al. (2014) found that African American students who
243 were provided feedback along with specific encouragement that indicated the instructor thought
244 the student was capable of being a high-achiever were more likely to persist and performed
245 better than those who only received feedback. Future work should explore these and other
246 interventions that help improve intergroup emotions.
247
248 **3.2 Working Towards a More Inclusive Geoscience Community**
249 Our group identifications are vital to our self-identity, yet it is important to be self-
250 reflective of how our own ingroup identifications may negatively affect those we consider to be
251 in our outgroup. For example, Cikara, Bruneau, and Saxe (2011) found that people are more
252 likely to help those in their ingroup than those in their outgroup. This is in line with *ingroup*
253 *favoritism* discussed by Greenwald and Pettigrew (2014), who noted that it is that favoritism
254 that serves as the basis for discrimination. With that in mind, there are specific ways in which a
255 learning environment may not be inclusive. Here we discuss a few examples of how such
256 environments may trigger negative intergroup emotions that signal to a student that they are
257 not welcome. For instance, instructors need to be aware and responsive to cultural differences
258 when using certain scientific terminology. In the geosciences we often use analogies and
259 examples to discuss a principle, such as the "heat engine" of the Earth. Use of such mechanical

metaphors is common in Western epistemology. Yet, since many indigenous people in the Americas and elsewhere view the Earth system as a living entity, such inanimate metaphors should be replaced by more inclusive terms (e.g., "heat cycle") and instructors can go further by asking students to create their own preferred metaphors. Otherwise, emotions may be triggered that hinder a student's learning (e.g., Aikenhead & Jegede, 1999; Semken, 2005). Along similar lines, Cheryan, Plaut, Davies, and Steele (2009) found that computer science classrooms with more stereotypically male objects (e.g., Star Trek posters and video games) discouraged women by reducing their sense of belonging. Comparably, Traxler et al. (2018) discussed how examples used in physics can introduce gender bias (e.g., references to sports and vehicles in the Force Concept Inventory). Specific interest-based examples, however, can improve learning for both female and male students (Hoffman, 2002). Another important factor to consider is accessibility for students with disabilities (both emotional and physical; e.g., Kirch, Bargerhuff, Cowan, & Wheatly, 2007; Carabajal, Marshall, & Atchison, 2017). A shift is required in how these students are viewed, from individuals who cannot effectively participate to those who can succeed if given the appropriate support and accommodations. Institutions, for example, can broaden access to field-based learning experiences through the use of virtual-reality (e.g., Atchison & Feig, 2011; Mead et al., 2019) and augmented-reality (e.g., Bursztyn et al., 2017) field trips, many of which are readily available online.

Place-based approaches offer one outstanding example of inclusive geoscience educational practices. Those approaches can be traced back to indigenous and communal teaching practices (e.g., Cajete, 1994, p. 243; Cajete, 2000, p. 315; Kawagley & Barnhardt, 1999). Place-based teaching situates learning in local landscapes, environments, and communities; leverages students' intellectual and emotional connections to places; meaningfully integrates (or at least respectfully acknowledges) traditional and local knowledge of the place(s) studied; and teaches attitudes and practices that favor environmental and cultural sustainability (Semken, 2005). Several recent studies and literature reviews (Apple, Lemus, & Semken, 2014 and other

papers in that volume; Semken, Ward, Moosavi, & Chinn, 2017) present evidence for the effectiveness of place-based geoscience teaching in better engaging culturally diverse and SND students in different, but mostly small-group, instructional settings. Longitudinal research on place-based geoscience education for large student populations and on their intergroup emotions remains to be done.

4.0 OUTLOOK

In this commentary, we tried to convey that "emotions are not just messy toddlers in a china shop, running around breaking and obscuring delicate cognitive glassware" (Immordino-Yang & Damasio, 2007, p. 5). In fact emotions are vital to both learning and improving diversity in the geosciences. Yet, emotions are generally not considered when discussing plans to improve diversity (e.g., JHU Progress Report, 2018; ASU Diversity Plan, 2018; UO IDEAL Framework, 2016). Given the deficiency of diversity and inclusion in the geosciences for at least several decades, it is important to ask ourselves a question posed by Alfred Wegener: "why should we hesitate to toss the old views overboard?" We strongly recommend the community to specifically consider intergroup emotions of students in the near future. It is undeniable that we need to do better.

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FIGURE

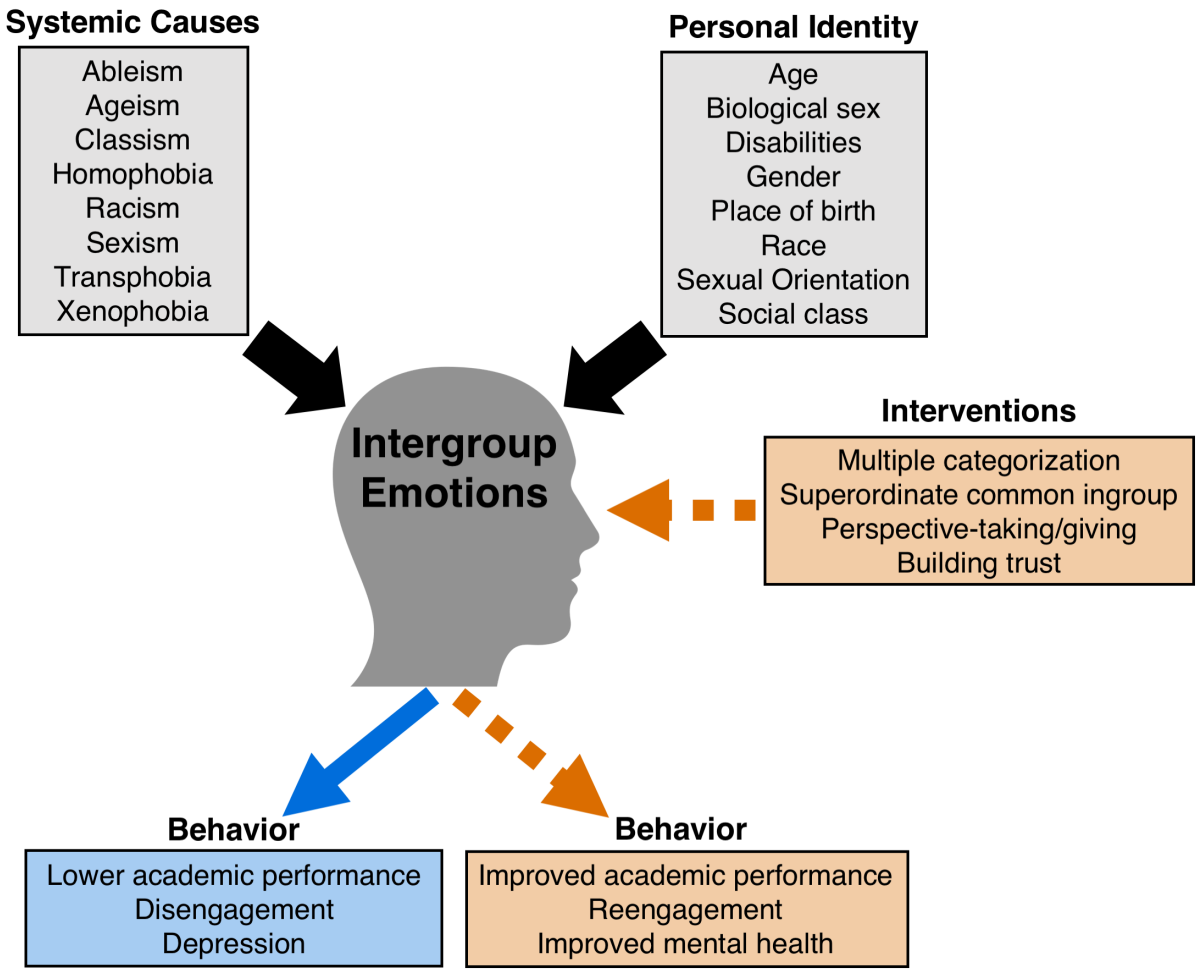

Figure 1: Intergroup emotions are generated by systemic causes that regard aspects of personal identity as negative. The blue (hexadecimal color #006ddb) solid arrow shows that intergroup emotions generated in this manner can be destructive to a student's learning. The orange (hexadecimal color #db6d00) arrows and boxes show that interventions may reduce destructive effects.

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