Beyond Gender and Race: The Representation of Concealable Identities Among College Science Instructors at Research Institutions

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ABSTRACT

Concealable stigmatized identities (CSIs) are identities that can be kept hidden and carry negative stereotypes. To understand the potential influence instructors have as role models, we must first explore the identities instructors have and whether they disclose those identities to undergraduates. We surveyed national samples of science instructors (*n* = 1248) and undergraduates (*n* = 2428) at research institutions to assess the extent to which instructors hold CSIs, whether they reveal those identities to undergraduates, how the prevalence of CSIs among instructors compares to their prevalence among undergraduates, and the reasons instructors reveal or conceal their CSIs. The most common CSIs instructors reported were having anxiety (35%) and being a first-generation college student (29%). Relatively few instructors revealed CSIs to students. The largest mismatches of CSI prevalence were for struggling academically in college (-30%) and having anxiety (−25%); all mismatches grew when accounting for instructor CSI disclosure, highlighting that students perceive fewer role models of scientists with CSIs than actually exist.

INTRODUCTION

Concealable stigmatized identities (CSIs) include some of the most salient under-served identities held by modern-day science undergraduates, yet they are highly understudied. Individuals holding CSIs, defined as identities that can be kept hidden and carry negative stereotypes (e.g., LGBTQ+ identities, growing up in a low-income household, struggling with mental health; Quinn, 2006; Quinn and Earnshaw, 2011), have reported an array of challenges in college science (Cooper and Brownell, 2016; England *et al.*, 2017; Cooper *et al.*, 2018; Araghi *et al.*, 2023), which are presumed to contribute to disproportionately high attrition rates (Ost, 2010; Moon *et al.*, 2012; Chen, 2013; Hughes, 2018; Maloy *et al.*, 2022). Failing to consider CSIs in equity efforts risks propagating social inequalities and compromising the objectivity of scientific endeavors (Intemann, 2009).

Undergraduates with CSIs highlight that a lack of same-identity role models in science can amplify identify-related challenges (Cooper and Brownell, 2016; Cooper *et al.*, 2020; Barnes *et al.*, 2021), whereas the presence of same-identity role models can help them see themselves as future scientists. Indeed, undergraduates who hold the same marginalized identities as instructors, such as identifying as a woman or Black in science, have been shown to reap a myriad of benefits, from enhanced sense of belonging (Harmsen, 2018) and self-efficacy (Stout *et al.*, 2011; Shin *et al.*, 2016) to improved course outcomes (Crombie *et al.*, 2003; Solanki and Xu, 2018). However, these studies focus on identities that tend to be visible (e.g., gender, race), and undergraduates with CSIs, including LGBTQ+ students and those with depression, are rarely able to name scientists who share their identities (Cooper and Brownell, 2016; Cooper *et al.*, 2020). The previous work focused specifically on CSIs has found that in courses where the

instructor verbally discloses their CSI in less than 1 min during class, students report greater sense of belonging in class, being able to more easily relate to instructors, and higher confidence in their decision to pursue a science career (Busch *et al.*, 2022; Mohammed *et al.*, under review).

The extent to which instructors hold CSIs and have the potential to serve as role models has not been documented. Further, the invisible nature of CSIs requires instructors to disclose them to students for any potential benefits to come to fruition. Yet, talking about identities is often avoided in scientific contexts in order to appear objective and apolitical (Seymour and Hewitt, 1997; Cech, 2013; Christe, 2013; Seymour and Hunter, 2019). This extends to science departments, where faculty report rarely revealing CSIs such as LGBTQ+ identities (Yoder and Mattheis, 2016; Cooper *et al.*, 2019). While instructors report being able to live more authentically when revealing CSIs to students (Chaudoir and Fisher, 2010; Nielsen and Alderson, 2014; Cooper *et al.*, 2019), many express concerns about revealing CSIs to undergraduates, such as students' negative opinions (Chaudoir and Fisher, 2010; Cooper *et al.*, 2019) and department disciplinary actions (Cooper *et al.*, 2019), which can prevent them from revealing their identities. Further, the culture of academic science is shaped by society and social systems of oppression and biases that work against individuals with CSIs in the U.S. broadly permeate the academic context and may discourage instructor disclosure. For example, in the U.S. individuals struggling with mental health have historically faced public stigma and even institutionalization (Chaudoir and Quinn, 2010; Shen and Snowden, 2014) and the LGBTQ+ community has repeatedly been subject to violence and faced criminalization due to their identities (Nadal, 2020; Trans Legislation Tracker, 2023), both of which may affect how instructors with any CSI approach disclosure in all contexts including the undergraduate classroom.

Given the current paucity of comprehensive demographic data of academic scientists, coupled with the potential for science instructors to serve as role models to undergraduates with whom they share a CSI, we argue that it is necessary to identify how common CSIs are among college science instructors, to what extent instructors share these identities with students, and what motivates or discourages instructors from revealing their CSIs. We focused on the following CSIs, all of which are typically not visible and are considered stigmatized in the context of academic science: LGBQ+, trans/nonbinary, being a first-generation college student, struggling academically during college, being a community college transfer student, growing up in a low-income household, having anxiety, depression, addiction, or a disability.

To address these gaps in the literature and minimize self-selection bias, we investigated the following research questions (RQs) by sending a personalized email without reference to any of these identities to all science faculty members at research intensive institutions in the United States.

1. To what extent do science instructors hold CSIs?
2. To what extent are instructors revealing their CSIs to undergraduates?
3. How does the prevalence of CSIs among instructors compare to undergraduates?
4. What are the primary reasons why instructors conceal or reveal their CSIs?

METHODS

This study was conducted under approved Institutional Review Board protocols from Arizona State University (#00013208 and #00016674). All participants provided written consent before completing the survey and after the nature and possible consequences of the studies were explained.

Instructor survey development

We developed a survey with closed-ended items to assess the extent to which undergraduate science instructors report a variety of CSIs and the extent to which they reveal those identities to undergraduate students. To establish cognitive validity, we conducted six think-aloud interviews with undergraduate science instructors to ensure that the questions were being interpreted as intended (Trenor *et al.*, 2011). Each of the think aloud participants had at least one identity of interest (see *Identities of interest*). The survey was iteratively revised after each think aloud interview. For example, based on feedback during the think-alouds we included the definition of stigmatized on the survey, and one of the reasons to conceal an identity originally read "I did not know others in the department, such as other faculty or instructors, who had revealed a similar identity" and we clarified it to say "I did not know others in the department, such as other faculty or instructors, who had revealed a similar identity *to people in the department*" (emphasis added). A full copy of the survey items analyzed is included in Supplemental Table S1.

Screening questions. The survey began by asking instructors whether they teach an undergraduate course; participants who reported not teaching undergraduate students were sent to the end of the survey. Those who teach undergraduates were asked about the course discipline (e.g., biology, chemistry), level (e.g., introductory), and number of students typically enrolled. Participants were instructed to consider this course as the context for subsequent questions on the survey.

Identities of interest. Following the screening questions, participants responded to a series of demographic questions which included identities we hypothesized would function as CSIs in the context of academic science based on prior literature. These identities are considered to be stigmatized broadly in the U.S. and were considered to be concealable by at least half of the participants with the identity in our study. Specifically, these 10 identities include identifying as LGBQ+, trans/nonbinary, being a first-generation college student, struggling academically during college, being a community college transfer student, growing up in a low-income household, having anxiety, depression, addiction, or a disability.

Some of these identities (e.g., struggling academically during college, having anxiety) may change over time and are somewhat subjective in nature (Keller, 2006; Penninx *et al.*, 2011; Binning *et al.*, 2019; Buzzetto-Hollywood and Mitchell, 2019), so individual participant responses could be different at another timepoint but we have no reason to think that the overall rates of reporting were higher or lower when we distributed the survey. Low academic self-concept and lower academic achievement than expected are well-documented reasons for undergraduates to not participate as much, not feel as comfortable, and even choose to leave the sciences

(Seymour and Hewitt, 1997; Ost, 2010; Chen, 2013; Eddy *et al.*, 2015; Cooper, Krieg *et al.*, 2018; Seymour and Hunter, 2019), so we hypothesized that instructor disclosure of their prior challenges academically would be particularly impactful for their students who are currently struggling academically. While not all anxiety is considered detrimental and low levels of anxiety can be motivating, we have found that individuals who report struggling with anxiety have higher levels than these (Yerkes and Dodson, 1908; Downing *et al.*, 2020; Teigen, 1994; Cooper *et al.*, 2018). We did not require a diagnosis of any anxiety disorder to report having anxiety, so the prevalence we report may be higher than those with a diagnosed anxiety disorder. However, undergraduates who self-report mental health conditions, including anxiety disorders, have been shown to have similar psychopathology to those who have already been diagnosed (Rutter *et al.*, 2023), making self-report appropriate in this nonclinical context. Additionally, diagnosis of mental health conditions such as anxiety or depression requires a doctor's appointment; access to healthcare and medical insurance is disproportionately available to individuals with higher incomes and there are cultural stigmas against mental health, so both of these factors would skew the participant pool and make this work less generalizable to certain populations, which is another reason why we chose to rely on self-report. Participants who reported none of the identities of interest were sent to the end of the survey and did not answer follow-up questions about revealing or concealing their identities. Supplemental Table S2 contains the evidence-based justification for the inclusion of these identities.

Extent of reveal. For each identity of interest that a participant reported, the participant was asked whether they consider the identity to be concealable. If so, they were asked to what extent they revealed this identity to the students in the undergraduate course indicated earlier in the survey. Participants selected whether they reveal the identity to all students (i.e., to the whole class), to some students (e.g., during office hours), or that they never reveal the identity to undergraduates.

Reasons to reveal or conceal. We identified factors that influence instructors' decisions to reveal or conceal CSIs from prior studies investigating specific identities in the context of academic science (e.g., Cooper and Brownell, 2016; Cooper *et al.*, 2020; Barnes *et al.*, 2021) and those describing identity management strategies for individuals with CSIs (e.g., Quinn and Chaudoir, 2009; Chaudoir and Fisher, 2010; Quinn and Earnshaw, 2011). If an instructor had an identity of interest and revealed that identity to all students in their undergraduate course, they selected all factors that influenced their decision from a list of 14 factors. Example reasons to reveal an identity include "I prefer to live authentically or be open with others about my identity" and "I thought revealing my identity could make me more relatable to students." For instructors with an identity of interest and who revealed that identity to only some undergraduates or to no undergraduates, they selected all factors that influenced their decision to conceal their identity in the classroom from a list of 12 reasons. Example items include "I was concerned students would have a negative opinion about my identity" and "I did not feel my identity was relevant to the students in this course." The list of factors to reveal or conceal an identity was the same for

each identity of interest and participants selected all factors that applied. Due to the descriptive nature of this study, the large range of identities being considered, and our specific research questions, we did not include an open-response option for participants to provide additional factors.

Instructor survey recruitment and distribution
We recruited instructors from science departments from every very high research activity doctoral-granting institution in the U.S. as indicated by the Carnegie Classifications (Indiana University Center for Postsecondary Research, 2021). We defined science as the natural sciences, including the disciplines of biology, geosciences, chemistry, and physics. From the publicly available departmental webpages, we identified faculty and instructors and collected their contact information. We distributed the survey via personalized emails using a mail merge service in November 2021 and sent a final reminder in January 2022. As incentive for participation, the first 50 participants who completed the survey were awarded $100 gift cards and all participants were entered into a drawing for one of two $500 cash awards. Of the approximately 50,000 instructors contacted, 1473 completed the survey. After filtering the data for individuals who had taught undergraduate courses in the sciences, the data set consisted of 1248 responses.

Undergraduate survey development
To compare the prevalence of each of the identities of interest among science instructors to undergraduates enrolled in science courses, we developed a survey to collect the same demographic information as that on the instructor survey described above (see *Identities of Interest*). We have used this suite of demographic questions on prior survey studies of undergraduates, so we have previously collected validity evidence through think aloud interviews (e.g., Mohammed *et al.*, 2021). A full copy of the survey questions analyzed is provided in Supplemental Table S3.

Undergraduate survey recruitment and distribution
We distributed our survey to undergraduates at very high research activity doctoral-granting institutions nationally by contacting 141 science instructors who teach large-enrollment courses and agreed to be contacted for follow-up studies from the instructor survey and asking them to distribute the survey to their students. Fifteen (10.6%) instructors agreed to distribute the survey to their students. Undergraduate participation was incentivized either through a small number of extra credit points or to be entered into a drawing for one of two $100 gift cards. We distributed the survey in November 2022. In total, 2748 undergraduates participated in the survey. After filtering the data to only include individuals who completed the survey, the undergraduate data set consisted of 2428 responses. The geographic and disciplinary distribution of instructor and undergraduate participants is included in Supplemental Tables S4 and S5.

Data analysis
For each of the identities of interest, we calculated the percentage of instructors and the percentage of undergraduates who reported the identity. For each identity among instructors, we calculated the percent who revealed the identity to all, some, or none of their undergraduate students. To calculate the
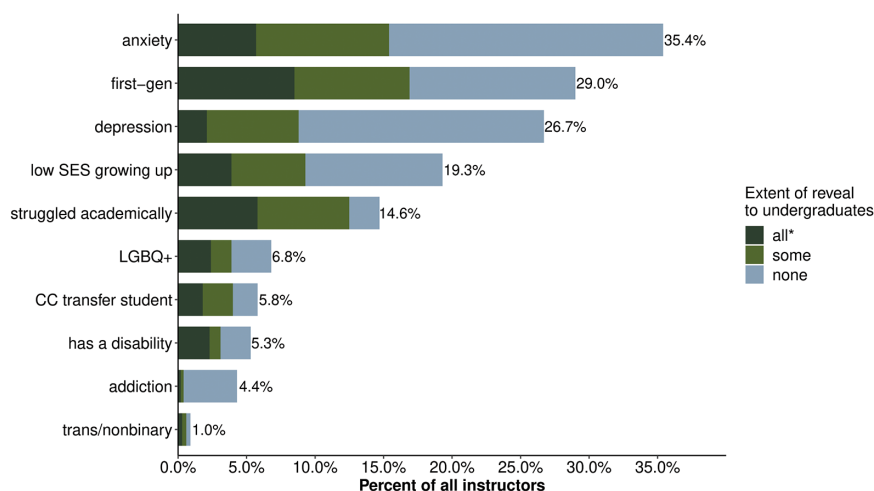
FIGURE 1: Prevalence of CSIs among instructors and the extent to which they reveal those identities to undergraduates. Instructors often do not disclose their CSI to undergraduate students in their courses. Percentages represent the total proportion of instructors with each identity. The colored portions of the bar indicate if they reveal that identity to all* (dark green), some (light green) or none (blue) of the students in their undergraduate courses. *Instructors who perceive that their identity is not concealable are included in the count of instructors who reveal their identity to all undergraduates in the course.

compositional mismatch, we subtracted the percent of undergraduates who reported the identity from the percent of instructors who reported the identity. The compositional mismatch illustrates the difference in prevalence of these identities between instructors and undergraduates. To calculate the realized mismatch, we subtracted the percent of undergraduates who reported the identity from the total percent of instructors who either did not consider the identity to be concealable or who revealed the identity to all undergraduates. The realized mismatch better reflects undergraduates' perspectives of how represented these identities are among science instructors because it accounts for instructor disclosure. To calculate the magnitude differences, we divided these percentages (undergraduates divided by instructors) rather than subtracting. We calculated the mismatches in these two ways (i.e., subtracting and dividing) to better account for the large variation in the prevalence of the identities. For example, having anxiety is relatively common among undergraduates (American College Health Association, 2021; Center for Collegiate Mental Health, 2023), so considering the difference in the percent of instructors and undergraduates who report anxiety helps to illustrate the large number of undergraduates who could be impacted from instructor disclosure. Conversely, trans/nonbinary identities are less common but undergraduates with trans/nonbinary identities are underserved in the sciences (Casper *et al.*, 2022; Maloy *et al.*, 2022), so considering the magnitude difference between instructors and undergraduates is more appropriate. We aggregated instructors' responses for why they reveal or conceal their identities across all CSIs and calculated the percentage of participants who selected each reason. To determine the top five reasons for why instructors reveal or conceal their CSIs, we used the aggregate number of times the reason was selected across all CSIs. All analyses were conducted in R

(R Core Team, 2022) and the scripts can be found in a GitHub repository (https://github.com/carlybusch/Beyond-gender-and-race).

RESULTS

RQ1: Having anxiety or depression, being first-generation college going, and coming from a low-income household are relatively common among science instructors but are rarely disclosed to undergraduates

Among the CSIs surveyed, having currently or previously struggled with anxiety (35.4%), being a first-generation college student (29.0%), having currently or previously struggled with depression (26.7%), and growing up in a low-income household (19.3%) were the identities most represented among science instructors at very high research activity doctoral-granting institutions; see Supplemental Table S6 for a further demographic breakdown of participants.

For each of an instructor's identities that the instructor perceived to be concealable, we asked whether they revealed that identity to all (i.e., the whole class), some, or none of the undergraduate students in the course they teach most often. Overall, very few instructors disclosed any CSI to all of their students; for each identity, the number of instructors who never disclosed their identity to undergraduates was higher than those who revealed their identity to all undergraduates with one exception: having struggled academically in college (Figure 1).

RQ2 & 3: Lack of instructor disclosure of CSIs exacerbates the disparity in representation of these identities between science undergraduates and instructors

Comparing the percent of instructors with each CSI to the percent of science undergraduate students at the same institution type, nearly all CSIs are more highly represented among undergraduates than instructors. The discrepancies in the prevalence of these CSIs between instructors and undergraduates is the *compositional mismatch,* calculated by subtracting the percentage of undergraduates with each identity from the percentage of instructors with the identity. The CSIs with the greatest compositional mismatches are struggling academically in college (–29.9%) and reporting a history of anxiety (–25.0%), whereas growing up in a low-income household (+0.2%) and being a first-generation college student (–0.7%) have the smallest differences in percent representation (Figure 2, A and B). Considering the magnitude of difference in representation of each identity between undergraduates and instructors, trans/nonbinary and LGBQ+ have the biggest differences, with the percentage of undergraduates with each identity 5.0x and 3.7x higher than the percent of instructors, respectively (Figure 2C).

However, the compositional mismatch is not truly representative of the experience of undergraduates; when accounting for whether students would know that an instructor has a
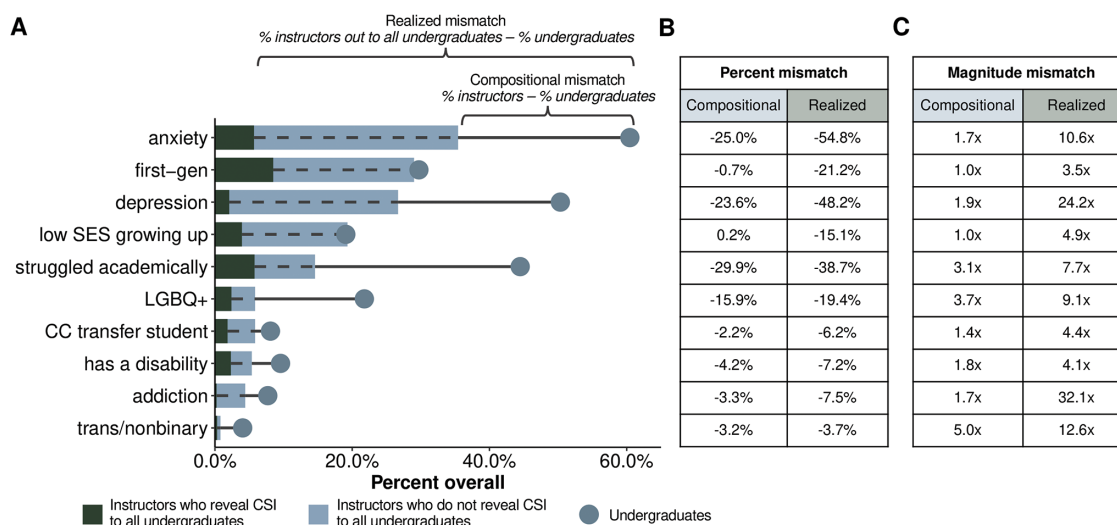
FIGURE 2: Compositional and realized mismatches for each CSI. (A) The *compositional* mismatch, or the difference between percent of instructors with a given identity (entire length of bar) and the percent of undergraduates with that identity (point) as illustrated by the solid line, and the *realized* mismatch, or the difference in percent of instructors who disclose a given identity to all undergraduate students in their course (green portion of bar) and the percent of undergraduates with that identity (point) as illustrated by the combined length of the dashed and solid lines. (B) For both, the percent mismatch is calculated by subtracting the percent of undergraduates with an identity from the percent of instructors and (C) the magnitude mismatch is calculated by dividing the percent of undergraduates with an identity by the percent of instructors.

particular CSI based on whether the instructor reveals their identity to all undergraduates in their course, many of these differences grow (Figure 2, A, B and C). Comparing the percent of students with an identity and the percent of instructors who tell all of their undergraduates that they have an identity is the *realized mismatch*. Similar to the compositional mismatch, the realized mismatch can be considered by the differences in percentages and/or the magnitude of the differences. The CSIs with the largest realized mismatches by percent difference are reporting anxiety (–54.8%), depression (–48.2%), and struggling academically in college (–38.7%). Considering the magnitude of the difference, having struggled with addiction and reporting depression have the greatest realized mismatch, or the greatest potential for instructors to enhance representation by revealing their respective CSI, with the percentage of undergraduates who have struggled with addiction being 32.1x higher and the percent who report depression being 24.2x higher compared with the percent of instructors who reveal each identity (Figure 2C). The compositional and realized mismatches, both by percentage difference and magnitude, are included in Figure 2, B and C.

RQ4: The impersonal norms of academic science, not potential consequences, drive instructors' decisions to conceal their identities while those who reveal attribute it to potential student benefits

Science instructors who did not reveal their identities to any undergraduates, or who only revealed them to some students, selected applicable reasons for not revealing from a provided list. Instructors most frequently attributed concealing CSIs to norms: they did not typically share the identity or had not previously considered revealing the identity (Figure 3, A and B). Additionally, instructors concealed CSIs because they did not

think revealing their identity was relevant to course content or to students, or because they felt that revealing the identity would be inappropriate. Notably, relatively few instructors attributed concealing their CSI to potential consequences, such as negative opinions from students (21.9%), poor course evaluations (15.3%), or department disciplinary actions (6.9%). Conversely, instructors who reveal their identities to all undergraduates most frequently selected that they did so to be an example to students, to be a known supporter of those with similar identities, and to serve as a mentor to students with the identity (Figure 3, C and D). Further, they attributed their decisions to reveal their CSIs to it being appropriate and relevant to the students. Instructors rarely selected factors related to benefits to themselves such as revealing the identity to help students understand them or their circumstances better (19.7%). The full list of potential reasons for instructors to reveal or conceal their identities and associated frequencies is in Supplemental Tables S7 and S8.

DISCUSSION
The untapped potential for students to see themselves in their instructors
This study found that although CSIs are often not as prevalent among science instructors as they are compared with science undergraduates at very high research activity institutions, the concealable nature of the identity masks the extent to which these identities are represented by science instructors and makes students perceive even greater underrepresentation than exists. In fact, in the cases of some identities such as being a first-generation college student and growing up in an economically disadvantaged home, if all instructors disclosed their CSIs, they would almost reach parity with the percentage of students who also hold those CSIs. Additionally, the realized magnitude
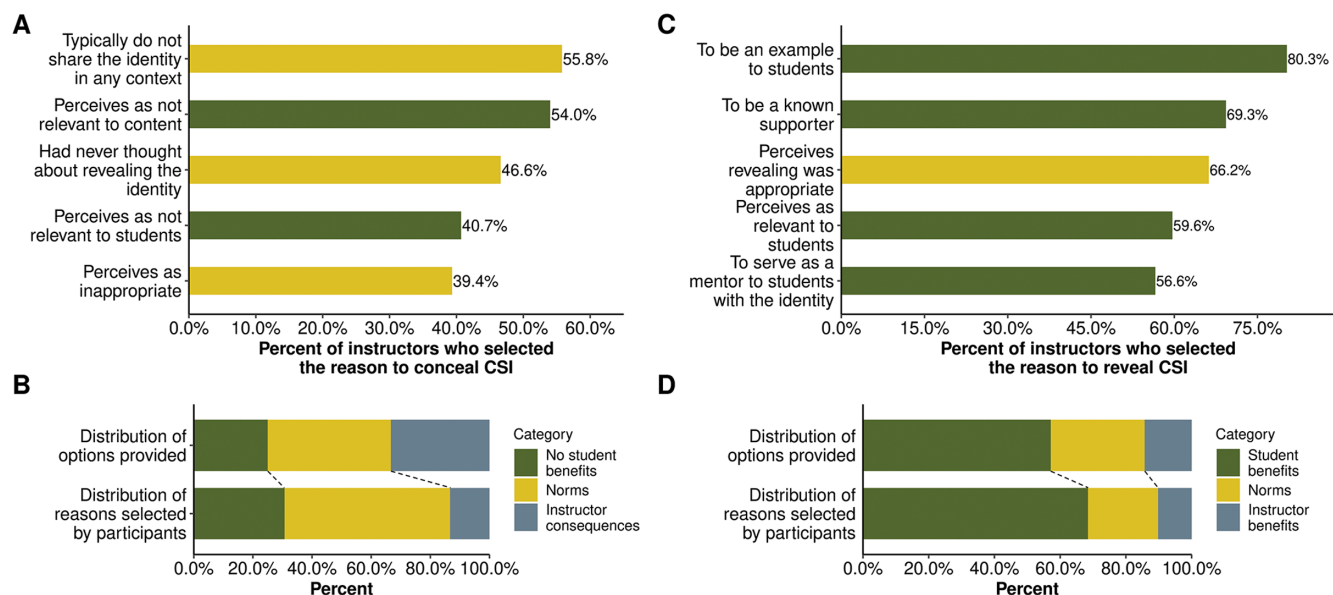
FIGURE 3: Instructors' rationale for concealing or revealing their CSIs. (A) Top five reasons instructors conceal CSIs from their undergraduates, colored by category. Yellow indicates norms and green indicates not recognizing student benefits. (B) Of reasons to conceal CSIs, distribution of options to select from and what participants selected across the three categories: not recognizing student benefits (green), norms (yellow), and instructor consequences (blue). (C) Top five reasons instructors reveal CSIs to undergraduates, colored by category. Green indicates student benefits and yellow indicates norms. (D) Of reasons to reveal CSIs, distribution of options to select from and what participants selected across the three categories: student benefits (green), norms (yellow), and instructor benefits (blue).

mismatch between undergraduates and instructors would be halved for the respective identity if three out of five more LGBQ+ instructors, one in two more instructors who transferred from community college, and seven in 10 more instructors with disabilities revealed their CSIs to students.

The most common CSIs held by students included anxiety, depression, and struggling academically. Our data suggest that anxiety and depression both present tremendous potential in terms of increasing the extent to which undergraduates see these identities reflected at them from instructors. Currently, the realized magnitude difference for anxiety is 10.6x. If just one in four more instructors with anxiety disclosed to all undergraduates, the realized magnitude mismatch would go down to 4.6x. The potential difference is even greater for depression. If one in four more instructors with depression disclosed to all undergraduates, the realized magnitude mismatch would go from 24.2x to 6.1x. Considering that over half of the undergraduates reported having anxiety or depression, the potential impact on the undergraduate population is profound. While these high rates of anxiety and depression may be partially due to the self-reported nature of this survey, they are consistent with prior studies, including those which categorize mental health conditions using clinical criteria (American College Health Association, 2021; Mohammed *et al.*, 2021; Busch *et al.*, 2022; Center for Collegiate Mental Health, 2023). Therefore, this is particularly encouraging in light of recent research demonstrating not only the need for role models in science who struggle with mental health (Cooper *et al.*, 2020; Gin *et al.*, 2021), but also a study highlighting that an instructor revealing depression has a positive or neutral impact on all students, while disproportionately

benefiting students with depression (Mohammed *et al.*, under review). We hypothesize that instructor mental health disclosure, regardless of its association with academic performance (e.g., not limited to test anxiety), would benefit undergraduates due to the variety of ways in which undergraduates have reported their mental health impacts their experiences in college science courses, particularly in social contexts such as group work (Cooper *et al.*, 2018; Downing *et al.*, 2020; Mohammed *et al.*, 2022; Araghi *et al.*, 2023). Further, while the potential for a role model is not quite as large for those who struggle academically in college, learning that even one instructor has struggled academically may violate students' assumptions of scientists being perfect students and result in a more positive view of themselves (Burgoon, 2015; Eccles and Wigfield, 2020). Additionally, highlighting prior academic struggles as a successful scientist can model growth mindset for students, demonstrating that success in science is something that all students can work towards and accomplish (Dweck, 2008), which has the potential to bolster students' own growth mindsets (Kroeper *et al.*, 2022; Yeager *et al.*, 2022) and serve as motivation for student persistence in science degree programs (Gladstone and Cimpian, 2021).

The impact of the culture of academia and student benefits on instructor decisions to reveal their CSIs

Two overarching factors appear to influence instructor decisions to conceal their identities. Instructor decisions to conceal their CSIs seem to be driven by either the culture of academia or a lack of understanding the potential student benefits of revealing. The culture of an organization often manifests in its norms (Schein, 2010). If the norms of a department are such

that individuals generally do not reveal personal information, then disclosure of CSIs may be less likely in that context due to those descriptive norms (Nolan *et al.*, 2008; Follmer *et al.*, 2020; Masur *et al.*, 2023). The antecedent recognition of potential student benefits aligns with prior studies which have identified that ecosystem goals for motivation of disclosure, that is being motivated by the potential for contributing to or supporting others (Garcia and Crocker, 2008), is associated with an increase in disclosure intentions (Garcia and Crocker, 2008; Foster and Talley, 2021) and more positive first disclosure experiences (Chaudoir and Fisher, 2010). The culture of a particular context (e.g., academic science) is created by the individuals in the community (Walsh and Ungson, 1991; Mowday and Sutton, 1993). As such, groups of people can work to shift norms (Thomas *et al.*, 2015) and revealing CSIs can become normalized in academic science. As more instructors choose to reveal CSIs to students or other individuals in the scientific community, the presence of these personal identities may no longer seem out of the ordinary, which evidence suggests would encourage additional instructors to be open about these identities (Chaudoir and Fisher, 2010; Chaudoir and Quinn, 2010). Notably, few instructors report that their decisions to conceal their CSIs are driven by consequences. However, because the culture of a department or institution can influence career advancement such as tenure and promotion decisions (Hearn and Anderson, 2002; Freeman, 2018; Moher *et al.*, 2018), instructors will need to consider potential professional repercussions before deciding to reveal a CSI to students. While relatively few instructors expressed concern about department disciplinary action or being fired, those that did may be correctly assessing their risks. Being open about some CSIs, particularly LGBTQ+ identities, may negatively affect an individual's professional standing (Cech and Waidzunas, 2021). Further, we argue that any instructors fearing such consequences from disclosing a personal identity warrants further consideration and reflection from the scientific community and academia to work to change these perspectives and ensure these concerns do not come to fruition.

An instructor may also keep an identity concealed because they do not recognize potential benefits to students and emerging evidence may inform their decision. Many instructors reported that they did not reveal their CSI because they perceive it to be irrelevant to students or had not considered revealing it, yet students expect to benefit from learning that an instructor shares a CSI (Cooper and Brownell, 2016; Cooper *et al.*, 2020). Additionally, undergraduates in courses where an instructor has revealed a CSI report many of the anticipated benefits (Busch *et al.*, 2022; Mohammed *et al.*, under review). In fact, 60% of instructors who reveal CSIs do so because they perceive it to be relevant to students. This suggests that whether an instructor perceives a CSI to be relevant to students may be malleable and with more conversation about the impact of personal identities, including CSIs, on individuals' experiences in academic science, more science instructors may see that their identities are indeed relevant to their students and worthwhile to disclose. Overall, the combination of reasons instructors reveal or conceal their CSIs as well as the relative lack of concern for consequences from disclosure implies that now may be a prime opportunity to effectively work to promote awareness of the benefits to students and to change the culture of science

departments and the scientific community to encourage instructor CSI disclosure.

Limitations
In this study, we surveyed only science instructors and undergraduates at very high research activity doctoral-granting institutions; as such, our results may not be generalizable across other institution types. Other institution types (e.g., Master's granting, primarily undergraduate) may employ instructors with a greater diversity of identities. Our research group is in the process of surveying other institution types to gain a deeper understanding of the representation of CSIs of science instructors. In recruiting instructors to participate in the study, we may have experienced sampling bias due to the language of the recruitment script to "help improve undergraduate education." Instructors who are involved in efforts to incorporate evidence-based teaching practices or diversity, equity, and inclusion initiatives may have been more likely to participate due to this language. We tried to counteract this bias by providing incentives for participation and emailing instructors individually rather than through national listservs. Because we collected the discipline of instructors based on the subject of the course they teach most often and of undergraduates based on their major, we could not match the discipline of instructors and students to assess differences across the sciences. Due to the nature of our sampling strategies for instructors and students, the geographic distribution of responses was not uniform across the two samples so our results comparing the prevalence of CSIs among instructors and students may not be generalizable beyond the states in which we sampled undergraduate courses.

Takeaways
This work represents the first to our knowledge that examines the differences in prevalence of CSIs between science instructors and undergraduate science students at scale. Notably, a key novelty of these data is that many CSIs are underrepresented in science instructors compared with undergraduates. Yet, undergraduate science students who hold CSIs are likely far more represented among their instructors than they actually perceive. While there is a notable mismatch between the percentage of science instructors who hold CSIs and science students who hold CSIs, the gap in representation is magnified by instructors concealing their identities, namely owing to norms within the scientific community. Therefore, instructor disclosure of CSIs may be a powerful way to model to students with the same or similar identities that they belong in science and promote a more inclusive classroom environment and scientific community.

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