Somewhere Over the Rainbow: Investigating presence, perceptions, and engagement with LGBTQ+ inclusion symbols in STEM departments in the UK and US

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Executive summary

- Previous research has highlighted that LGBTQ+ scientists experience challenges related to issues with inclusion within departments. Solutions should focus on fostering inclusion in a systemic way, rather than placing the burden on LGBTQ+ individuals. **Displaying symbols of inclusion** (such as rainbow flags) may contribute to these efforts, but there has been a lack of research to establish whether these symbols are uniformly positively perceived and whether they reliably signal a safe environment.
- STEM departments in universities across the UK and US signal inclusion in various ways. Common approaches include **displays of rainbow symbolism, pronouns, and Pride month participation**. Some differences also exist: for example, some UK departments have the Athena Swan gender equality initiative, while some US departments have Safe Zone initiatives which aim to create inclusive spaces for LGBTQ+ students and staff.
- This project used a **pilot study, mixed-methods online survey, and experimental research** totalling **776 participants** from UK and US STEM departments. The goals were to establish which symbols are present, how they are perceived, and what helps foster feelings of safety and willingness to engage with symbols for staff and students in UK and US STEM university departments.
- We **discussed the results** of all studies **with stakeholders** to help us interpret and contextualise the findings. Stakeholders included UK and US STEM scientists, some of whom have lived experience around LGBTQ+ inclusion.
- The findings of this report suggest that symbols are **generally perceived relatively positively by staff and students in UK and US STEM university departments**, with average ratings above the midpoint. However, variations still exist: symbols are **perceived more positively when used within an institutional climate that is more inclusive for LGBTQ+ people.**
- **We did not observe significant differences** in these perceptions between the UK and US or across career stage, gender, or LGBTQ+ status when looking at the quantitative data. Symbols were perceived relatively positively across these demographic groups.
- However, open-ended responses analysed through qualitative methods paint a slightly more nuanced picture. Although symbols can show genuine support, they can

also be perceived as performative – **actions are needed alongside symbol displays to create genuinely inclusive environments**.

- Preliminary experimental data also suggest that **the organisation's motivation in displaying these symbols matters**: while symbol display was perceived relatively positively, for LGBTQ+ scientists, organisational trust and perceived sincerity of the display were higher when organisations display these symbols due to their values rather than for financial gain.
- Overall, our findings suggest that **displaying LGBTQ+ inclusion symbols can be positively perceived** and helpful in signalling an inclusive climate in STEM university departments, **but this should be embedded within genuine, actionable, and systemic improvement** of the climate for LGBTQ+ scientists.

Introduction and project background

STEM (science, technology, engineering, and mathematics) academic departments have made progress in increasing LGBTQ+ (lesbian, gay, bisexual, transgender, queer, questioning, and otherwise) inclusion, but issues persist. A 2019 report on workplace experiences for LGBT+ physical scientists found that 28% had considered leaving their workplace due to the climate (Institute of Physics et al., 2019). Similarly, 18% had experienced exclusionary behaviour at work, with even higher numbers for trans and nonbinary people. Research with over 25,000 scientists found that those who were LGBTQ+ were more likely to intend to leave STEM across varied disciplines and sectors, and were more likely to experience harassment, social exclusion, devaluation of their expertise, and career limitations (Cech & Waidzunas, 2021). In the university context, Hughes (2018) notes that LGBQ students are 9.5% less likely to stay in STEM than comparable straight peers.

Indeed, sexual and gender minority group members face a conundrum in the places where they work and study. They can choose to disclose their identity, thus risking stigma and discrimination (Pachankis, 2007), or they can choose not to disclose it and risk feeling lower belonging and collective self-esteem (Newheiser et al., 2017). This indicates that organisations need to first ensure the environment is actually safe from prejudice and discrimination, and may then use identity safety cues to signal that LGBTQ+ identities are valued. This could encourage LGBTQ+ individuals to disclose their identity and be seen, if they feel it is safe to do so. Communicating that a workplace or place of study is safe for LGBTQ+ people can be done in different ways, for example by creating dedicated networks or spaces, expanding the curriculum to include underrepresented groups, emphasising LGBTQ+ inclusion in recruitment brochures, or advertising inclusion training for staff. There are also cues that visually and symbolically communicate LGBTQ+ inclusion, such as displaying rainbow flags in common spaces, wearing rainbow lanyards and pins, using personal pronouns in emails, websites, and social media, or celebrating LGBTQ+ Pride month, for example on social media or by participating in parades.

While research shows that these cues can be effective (Johnson et al., 2021; Kruk, 2022), it is possible that their effectiveness depends on the context in which they are presented. For example, if identity safety cues are presented within an organisational climate that is not inclusive, minority group members may notice this inconsistency between messaging and context and perceive these cues as hypocritical. Previous research around this issue is mixed and sparse when it comes to LGBTQ+ inclusion, with most past research focusing on marginalised racial groups. On one hand, minority group members may see identity safety cues as valid even if they are inconsistent with organisational cues that suggest a lack of

inclusion (e.g. Dover et al., 2014). On the other hand, they may be vigilant to cues related to inclusion and thus perceive conflicting or inconsistent cues as threatening (Kroeper et al., 2022). If the presence of symbolic support does not match the reality of institutional support, sexual and gender minority group members may need to grapple with complex and uncertain information to determine whether it is safe to disclose their identity. This additional burden may, in the long term, lead them to leave the field, thusly contributing to attrition. It is therefore important to investigate how symbols of inclusion in STEM departments are perceived, relative to the context in which they are presented, which is therefore a key aim of this project.

Beyond the departmental level, how LGBTQ+ inclusion symbols are perceived is also likely to be dependent on the institutional (i.e. university), local, and national context. Although both the UK and the US have made efforts in inclusion for LGBTQ+ scientists, differences remain. UK universities benefit from a widespread gender equality initiative that often includes LGBTQ+ issues (Athena Swan), while initiatives in the US are less widespread (e.g. SEA Change). Conversely, US universities often have campus space dedicated to the LGBTQ+ community, unlike many UK universities. The US is also seeing increasing attacks on LGBTQ+ rights, with 558 anti-LGBTQ+ laws currently being pushed across the country (American Civil Liberties Union, 2024). Within-country variation is also significant; for example, LGBTQ+ rights have progressed more slowly in Northern Ireland than in England. This project therefore aims to generate a better understanding of how symbols can function as authentic and effective identity safety cues for LGBTQ+ STEM students and academics and how this might vary across different settings and levels of the environment.

In this context, the perception of these symbols matters. A strength of displaying inclusion symbols is that it does not put the onus on LGBTQ+ individuals to disclose their sexual orientation or gender identity but instead directly alters the environment. These symbols may then operate as safety signals for the LGBTQ+ community and thus reduce attrition from STEM. However, it cannot be assumed that this approach is uniformly positively perceived either by members or non-members of the LGBTQ+ community. Symbol display can be seen as merely performative allyship: for example, commercial companies adopting these symbols in marketing have been described as ‘rainbow washing’, essentially using symbols to appear to support the LGBTQ+ community for monetary gain without taking meaningful action (BBC News, 2022), if they do not also make systemic changes. Symbol display can be viewed as merely performative, utilised to promote a veneer of inclusion when actual policies and climates are unsupportive, unwelcoming, or unsafe for LGBTQ+ community members (Zheng, 2021). This may compromise safety for LGBTQ+ staff and students if symbols are used to indicate a supportive environment when the environment is actually unsupportive or hostile. However, research suggests that seeing these inclusion symbols can increase feelings of social belonging for LGBTQ+ people (Matsick et al., 2020), indicating their importance when they are positively perceived.

Alternatively, if symbols are perceived as antagonistic by those not supportive of LGBTQ+ inclusion, this could lead to backlash to initiatives, thus reinforcing a negative diversity climate. Many people who do not identify as LGBTQ+ are supportive of their LGBTQ+ colleagues and identify as allies. However, others may be unsupportive or hostile, and may perceive symbols of LGBTQ+ inclusion negatively as a result. This is important to acknowledge, understand, and address, because initiatives that are poorly received at the ground level can create more backlash against minorities, and thus do more harm than good (see Dover et al., 2020 for a review). Although most previous research is not focused on LGBTQ+ inclusion, we can draw from work on other underrepresented groups to generate hypotheses about the types of psychological factors that could impact how LGBTQ+

inclusion symbols are perceived. For example, men, especially those high in masculine gender identification, are less supportive of gender equality initiatives in STEM because they perceive these initiatives as threatening (Jones et al., 2022). The framing of inclusion initiatives may also be important to how they are received. For example, STEM gender initiatives were more successful when an internal rather than external motivation was emphasised (Farrell et al., 2021) and when participants were made to feel change was possible, thus enhancing their self-efficacy to make these changes (Petzel et al., 2024). Similarly, it is important to understand the factors that would predict feelings of safety (for LGBTQ+ individuals) and willingness to engage with LGBTQ+ inclusion symbols in STEM academic departments, in order to create a positive inclusion climate and reduce attrition of LGBTQ+ colleagues and students.

This project therefore aimed to understand how these symbols are perceived, depending on the departmental, institutional, state/national, and UK/US inclusion climate, and to investigate the factors that predict safety and engagement in symbol displays, in order to offer recommendations about how policies should be implemented to allow effective engagement with symbols, improve inclusion in STEM academic environments, and ultimately prevent attrition.

Research Methodology

The full methodology and analytic approach including numbered hypotheses for specific studies is reported in Appendix A. In brief, this research included three studies totalling 776 participants.

Study 1 comprised an initial pilot study to review the existing LGBTQ+ inclusion climate in UK and US STEM departments via an online survey of project partners based in Chemistry departments across 6 UK and US universities. The aims were:

1. To establish which LGBTQ+ inclusion cues or symbols are being used by STEM academic departments in the UK and US.
2. To understand inclusion initiatives and climate within these departments.

Study 2 used a mixed-methods cross-sectional online survey to address three research questions:

1. What symbols of LGBTQ+ inclusion (pronouns, rainbow flags, LGBTQ+ pride celebration) are present in STEM departments and how are they perceived within the STEM academic community (i.e. as positive for LGBTQ+ inclusion, authentic, effective at creating inclusion, sincere, threatening)?
2. How do LGBTQ+ group membership and career stage affect perceptions of symbols?
3. How do perceptions depend on departmental inclusion climate, university inclusion climate, and state/nation inclusion climate, across the UK and US?

Study 3 used an experimental design in which participants were presented with varying information about a fictional LGBTQ+ inclusion initiative for a university that would involve the display of inclusion symbols. Data were collected via online survey to address the following research questions:

1. What contextual factors (e.g. internal vs. external organisational motivation, presence of actions towards inclusion) predict LGBTQ+ STEM students' and staff members'

feelings of safety and willingness to engage with symbols of LGBTQ+ inclusion within STEM academic communities?

2. What psychological factors (perspective taking, self-efficacy, perceived threat) and contextual factors (internal vs. external organisational motivation) predict straight and cisgender students' and staff members' willingness to engage with symbols of LGBTQ+ inclusion within STEM academic communities?

Study 3 included three sub-studies: Study 3a included only LGBTQ+ participants and examined the impact of organisational motivation and presence or absence of actions. Study 3b included only straight cisgender participants and examined the impact of organisational motivation and perceived threat. Study 3c included only straight cisgender participants and examined the impact of perspective-taking and self-efficacy.

For the quantitative data, we present descriptive and, where appropriate, inferential statistics. As a rule, inferential statistics results are considered significant beyond chance if the *p* (i.e. probability) value is below .05. This means there is less than 5% chance that the result has been observed due to chance. Other statistical notation is briefly described in Appendix A.

Research Findings

Research findings from the respective studies of this project are reported below.

Study 1

Participants

Six of our seven target partners responded to the survey. These represented 4 UK-based academics (in England and Northern Ireland) and 2 US-based academics (in Colorado and Massachusetts), all of whom work in Chemistry departments.

Findings

In surveying project partners about the existing inclusion climate within their universities, a range of symbols and actions were identified.

Organisational structure and characteristics of the department

The respondents represented departments at a range of sizes, from around 35 to 80+ faculty members. There were a range of organisational structures, with respondents' departments nested within colleges/faculties of arts and sciences, mathematical, physical, and life sciences, natural sciences, and representing crossovers with engineering.

Existing symbols of LGBTQ+ inclusion within the department

A range of symbols and actions were identified. The most common visual symbols were rainbow symbolism, particularly on lanyards (identified by $n = 5$), Pride celebrations ($n = 2$), and use of pronouns, for example in email signatures ($n = 3$).

With respect to rainbow symbolism, respondents also mentioned use of rainbow flag colouring in statements. Regarding Pride and related celebrations, respondents also described celebrating LGBTQ+ history month and social media posts during Pride month. Regarding pronoun display, a respondent also mentioned the use of pronoun badges.

More concrete (less symbolic) efforts included “Safe Space” signage (following a university training program), an LGBTQ+ Champion (point of contact for LGBTQ+ topics), participation in a departmental LGBTQ+ network and university network promoting the visibility of LGBT+ people in STEM, and signposting to support services.

In terms of general symbolism, participants also described use of the Athena Swan logo in communications (indicating a general commitment to gender equality) and LGBTQ+ and ally network stickers. One respondent specifically mentioned that the visibility of these symbols was limited in their department.

LGBTQ+ inclusion/equality initiatives being rolled out within the department and institution

While one respondent identified no specific initiatives, all respondents gave an indication of initiatives at a departmental level. In some cases, these were formalised arrangements; in others they represented symbolic efforts (e.g. representation of Pride month celebrations). Three respondents mentioned broader Diversity, Equity and Inclusion (DEI) initiatives in response to this question; one also mentioned an institutional-level LGBTQ+ services department. Other initiatives included an institutional-level programme on diversifying the STEM curriculum, the LGBTQ+ Champion role (point of contact for LGBTQ+ topics), and the formal introduction of use of pronouns in an all-staff meeting.

Aside from direct initiatives, one respondent mentioned LGBTQ+ representation on the Athena Swan assessment team and another described Pride and LGBTQ+ history month celebrations as representing an LGBTQ+ inclusion initiative.

At an institutional level, respondents described Safe Zone training (US), mentorship programs for LGBTQ+ students and staff, one-off events (e.g. community building, film screenings), and celebration of LGBTQ+ history month and Pride events. University- and college-level networks were also mentioned: an LGBTQ+ network and a network promoting visibility of LGBT+ people in STEM. One respondent described an LGBTQ+ Equality Steering Group/Equality Implementation Steering Group at the college-level.

Written EDI policies that address LGBTQ+ equality aims at an institutional level

Both US-based respondents described non-discrimination law and policy. Two of the UK-based respondents stated that these policies existed at an institutional level, although one noted that the policy regarding trans and non-binary people was proposed to be “watered down”. One respondent described a specific action plan for EDI policies relevant to LGBTQ+ people.

State or national laws that may contribute to the LGBTQ+ diversity climate within the area

One US-based respondent mentioned state-level anti-discrimination law; the other described the relevance of Title IX laws in the US. One UK-based respondent mentioned comprehensive equality legislation as relevant.

Other relevant points

One UK-based respondent noted that while the departmental inclusion climate was positive, their university was leaving the Stonewall Workplace Equality Index and noted concerns that this may impact symbolism and interaction with these symbols.

Conclusion

These findings guided the methodological design of the following studies; specifically, they informed the choice of visual LGBTQ+ inclusion symbols to be displayed and investigated in the next study (the rainbow Pride flag, display of personal pronouns, and display of Pride

celebrations). Although other signals of inclusion exist, we decided to use these three not only because of their relatively widespread use, but also because they are visually symbolic in signalling inclusion.

Study 2

Participants

239 participants completed Study 2 (of 365 who accessed the study), representing 48 departments across 16 universities (6 in the USA and 10 in the UK). 41.4% were based at universities in England, 39.7% in the USA, 13.4% in Northern Ireland, and 5.4% in Scotland; none represented Welsh universities. US-based participants were based at universities in Colorado (N = 39), Indiana (N = 33), Connecticut (N = 18), North Carolina (N = 4), and California (N = 1). 64.4% were staff or PhD students while 35.6% were undergraduate or Master's students. The majority were based in Chemistry (45.2%) and life sciences (17.2%) with smaller proportions representing physics/astronomy, mathematical sciences, engineering, geosciences, computer/information science, materials research, and other disciplines. They ranged in age from 18 to 73 years old (M = 30.37, SD = 12.20). 51.9% were women, 39.3% men, 6.3% non-binary, 2.1% genderqueer, and 0.4% identified another label; 10.5% stated that their gender identity was different to their sex assigned at birth. 45.2% had an LGBTQ+ identity, while 53.1% identified as straight and cisgender; 1.7% of participants stated that neither applied to them. 80.3% were White, 12.7% were Asian, Asian British, or Asian Irish, and smaller proportions were Hispanic or Latino, mixed or multiple ethnic groups, or preferred to self-describe. LGBTQ+ participants were more highly ingroup identified (M = 5.21, SD = 1.52) than straight participants (M = 3.11, SD = 1.45), indicating that being LGBTQ+ was a more central part of their identity than straight identity was for straight and cisgender participants.

It should be taken into account that this is a self-selected and not representative or random sample, as with the other samples in this project. Due to the method of recruitment (via networks which included individuals interested in DEI) and description of the study (as a study regarding gender and sexuality inclusion in STEM), the sample may overrepresent people with a specific interest in this topic who may not be representative of the average member of the STEM academic community. Still, variations in attitudes were observed in the data and we were able to investigate the relationships between the variables of interest.

Descriptive results

On a possible range from 0 – 10 where 10 indicated higher LGBTQ+ inclusivity, participants' mean ratings of inclusion at different levels are displayed in Figure 1. State/country here refers either to US state (for US-based participants) and England, Northern Ireland, Scotland, or Wales (for UK-based participants). One-sample t-tests indicated that the four levels of LGBTQ+ inclusion climate were all rated significantly higher than the midpoint of possible ratings (p's < .001), indicating generally positive perceptions of the climate at these levels.

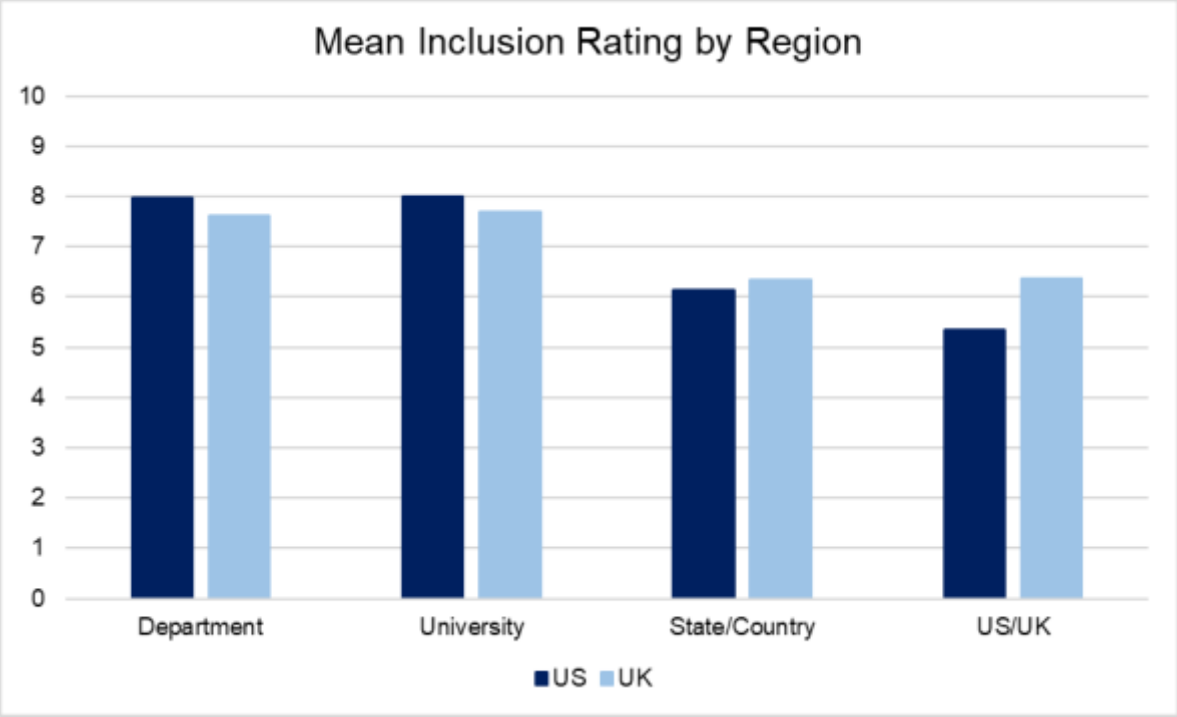

Figure 1. Mean inclusion ratings by US and UK region (higher values indicate more LGBTQ+-inclusive climates)

In terms of symbol presence, most participants indicated that rainbow, Pride, and pronoun symbols were present in their departments; see Figure 2.

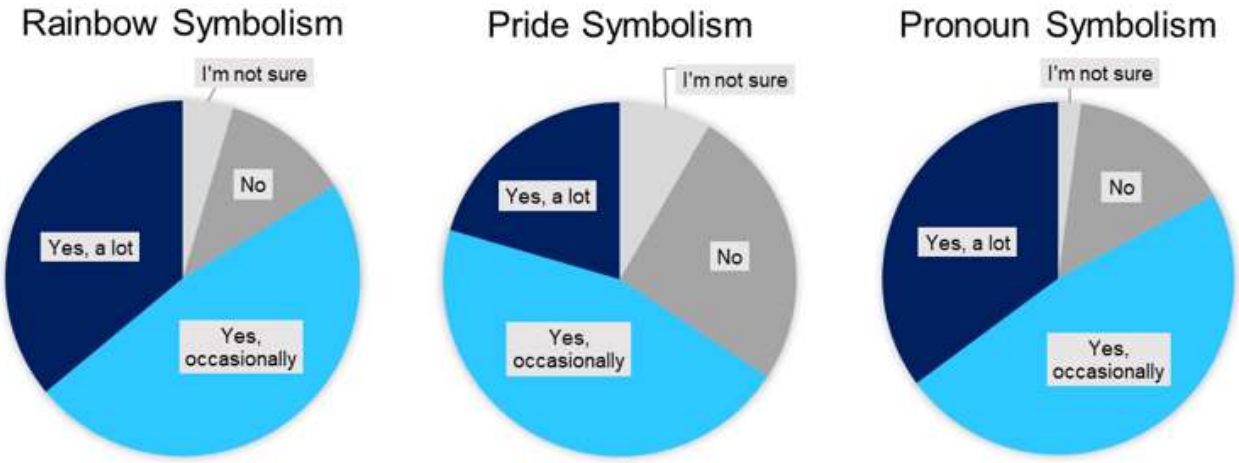

Figure 2. Presence of Pride, rainbow, and pronoun symbolism in departments (in response to the question "*Have you seen this symbol used in your university department*?")

Ratings for all symbols in the departmental context (when they were present) ranged from 0 to 10, indicating that the data represent participants whose perceptions range from very

negative to very positive. At a mean level, however, the perceptions were relatively positive: *M* = 7.04 for rainbow symbolism (*Mdn* = 7.25), *M* = 6.95 for pronoun display (*Mdn* = 7.25), and *M* = 6.94 for Pride symbolism (*Mdn* = 7.25), for an overall mean score of 6.88 (*Mdn* = 7.25) for the symbols. One-sample t-tests indicated that the three symbols were all rated significantly higher than the midpoint of possible ratings (*p*'s < .001), indicating generally positive perceptions.

Independent-samples t-tests and one-way ANOVA models indicated that these perceptions did not differ significantly by LGBTQ+ group membership, staff or student status, US or UK location, or gender (all *p*'s > .05). Across all those demographic groups, symbols were perceived positively.

Multilevel models

Multilevel analyses were used to investigate whether the perception of symbols depended on the LGBTQ+ inclusion climate at the institutional- and state/country-level, across several levels such as UK vs US, LGBTQ+ identity, or career stage. The first model included perception of LGBTQ+ inclusion climate at the institutional- and state/country-level as fixed effects. US or UK location was included as a fixed effect and interaction term to assess whether the impact of climate on symbol perception differed according to US or UK location. Random intercepts for department, university, and state/country were included. The outcome was perception of inclusion symbols.

Only the intercept and fixed effect for university-level climate (mean-centred) significantly predicted symbol perception (*b* = 0.51, *SE* = 0.13, *p* < .001), indicating that symbol perception is more positive when the university-level climate is more inclusive for LGBTQ+ staff and students. Hypothesis 1 (see Appendix A) was therefore supported. We did not observe an impact of state/country-level climate or differences by US or UK location. The data suggested that there may be an issue fitting the model due to low group numbers or variance by department, university, or state/country levels; we therefore ran the models without random effects and observed the same results (with a significant impact of university-level inclusion climate; *b* = 0.35, *SE* = 0.08, *p* < .001).

Model 2 added LGBTQ+ identity as a fixed interaction effect. Again, only the intercept and fixed effect for university-level climate (mean-centred) significantly predicted symbol perception (*b* = 0.40, *SE* = 0.16, *p* = .012). The simplified model without random effects was consistent with this. We did not find support for the hypothesis that symbols would be perceived more positively by LGBTQ+ students and staff relative to straight and cisgender students and staff. We had planned to assess whether ingroup identification moderated a proposed relationship between LGBTQ+ identity and symbol perception; this model was not tested given that such a relationship was not observed. Hypothesis 2 was therefore not supported.

Model 3 removed LGBTQ+ identity and added career stage (undergraduate or Master's student versus PhD student or staff member) as a fixed interaction effect. Again, only the intercept and fixed effect for university-level climate (mean-centred) significantly predicted symbol perception (*b* = 0.36, *SE* = 0.18, *p* = .044). The simplified model without random effects was consistent with this. We did not find an effect of career stage on symbol perception.

Fit of the three models was compared using likelihood ratio tests, which indicated no significant improvement in model fit when comparing Model 1 to Model 2 ($\chi^2(3) = 2.62$, $p = .454$) or Model 3 ($\chi^2(3) = 3.81$, $p = .283$). While Model 2 had a lower RSS value, this did not

lead to a significant improvement in model fit; therefore, the lower AIC and BIC of Model 1 indicate that the first model provides the best fit to the data.

In sum, the findings show that symbols are perceived more positively if the university climate is more inclusive for LGBTQ+ staff and students. Symbol perception did not seem to differ depending on respondents' LGBTQ+ identity and career stage.

Qualitative data

175 participants responded to one or multiple of the open-ended questions. Four qualitative themes were developed through the process of reflexive thematic analysis, representing recurring ideas in the dataset.

1. Symbols can show genuine support, or performative posturing

Many respondents expressed positive feelings towards LGBTQ+ inclusion symbols, suggesting that they can indicate that spaces are safe for LGBTQ+ staff and students.

> *"Seeing these symbols makes me feel like I have a safe space to be in at my university."* (PhD student, LGBTQ+, UK)

> *"Seeing an inclusion symbol on a door or a sign that says "all are welcome" makes me feel much safer and welcomed. I don't feel unsafe or unwelcomed just because I don't see these symbols, but I have a reassuring feeling instantly when seeing them."* (PhD student, LGBTQ+, USA)

Symbols could also make LGBTQ+ students and staff feel welcome, create a sense of community, and increase comfort by indicating acceptance, acknowledgement, and the presence of other LGBTQ+ people. Several respondents mentioned that seeing inclusion symbols had a demonstrable impact on their feelings of safety and inclusion.

> *"[T]here's a few offices in my dept [department] covered in rainbow flags and seeing them there in my first week made me feel quite secure."* (PhD student, LGBTQ+, UK)

They were seen as showing individual support for the LGBTQ+ community, as well as in some cases indicating organisational support.

> *"I think some of these symbols, like the rainbow flag / lanyards, serve as valuable expressions of both personal and communal support towards people who identify as LGBTQI+.*" (Lecturer, not LGBTQ+, UK)

However, respondents suggested that these symbols could be used both genuinely and performatively. In particular, some felt that these symbols were used insincerely by organisations and that a capitalistic motivation could drive these insincere displays.

> *"[E]specially around pride month their display feels more performative and less sincere. Unless inclusion and safety for everyone is emphasised all year around, it looks more like a box to tick for commercial benefits than genuine care for all members of the community."* (PhD student, LGBTQ+, UK)

Individuals could also use these symbols performatively. This overall performative use could be problematic given that people's behaviour may not align with the symbol display in these cases; for example, respondents discussed negative experiences such as being misgendered by staff wearing rainbow lanyards. However, a small proportion of respondents expressed that even performative use of symbols could be fine.

"I think they are a great way to let people know that a place is a safe space, though it still has to be judged whether it is just performative and the space is ACTUALLY safe. I think in the department I am in that it is used genuinely most of the time, though I think some people are again just doing it performatively, but as long as it is not hostile this does not bother me." (PhD student, LGBTQ+, USA)

One subtheme was developed as part of this theme:

1.1. Views on symbols are not homogenous

Respondents' views on the symbols in general, and of specific symbols, were variable. Some people held negative views towards the symbols; for some this was related to the display of symbols (*"I am against management using "symbols" - as they can be used to pigeon hole and identify LGBTQ+ people"* [Senior Lecturer/Reader, LGBTQ+, UK]) while for others this appeared to be linked to anti-LGBTQ+ attitudes. A small number of respondents expressed that others around them, such as their colleagues or men, held negative views of the symbols. Others appeared to feel neutral.

"I have no objection to any. Seems reasonable to me should other people wish to express their identity in this way." (Full Professor, not LGBTQ+, UK)

Moreover, some respondents were unclear on the need or purpose of these symbols.

"It's not clear that people at [University Name] understand why they are asked to consider declaring their pronouns." (Other career role, neither LGBTQ+ community member nor straight/cisgender, UK)

People commented on the variety of symbols that were used, for example different Pride flags, and in some cases expressed that certain symbols are more helpful than others. These views varied but some fell into two camps: people who felt that rainbow flags were particularly welcome while pronouns could be more fraught, and others who felt that pronouns were particularly useful while other symbols were less effortful.

Among a small proportion of respondents, mixed views towards pronouns were expressed. Some suggested that pronoun displays should be used: they were seen as more sincere and useful for a range of reasons.

"I do think that normalisation of using pronouns in emails etc by cis people is a good thing, it might make non-binary/trans people less self-conscious/anxious about introducing their pronouns into the workplace/university. As someone with an uncommon name [...] having my pronouns let people know by email my gender if I have not met them in-person, which can be a bonus." (PhD student, not LGBTQ+, UK)

However, others suggested that pronoun displays held the potential for harm if an LGBTQ+ person does not feel safe disclosing their identity in certain situations or is questioning their identity.

"I do occasionally worry that making it a norm to share pronouns can be threatening for folks who aren't ready to be out or aren't confident in their identity" (Associate Professor, not LGBTQ+, USA)

Some others mentioned that gender wasn't important to their identity, that they preferred not to be labelled, and that some others may be uncomfortable with pronoun displays; it was

suggested that pronoun displays being optional (rather than mandatory) was the right way to manage these concerns.

2. *Symbolism is not sufficient: Action is needed*

A common refrain was that concrete actions toward equality and inclusion are needed, not just the display of inclusion symbols. For some, LGBTQ+ inclusion symbols were seen as good or useful to some degree, but not sufficient.

> *"I think the symbols are useful, but they need to be accompanied with conversation. This is why I think they can be performative because an institution could use them but not actually take action in making sure those apart of these communities actually feel included, seen, represented, or heard."* (PhD student, not LGBTQ+, USA)

The symbols themselves did not equal support or inclusion; some suggested that they were pointless if actions were not in place and that instead, inclusion needed to be consistent and supported by systemic change.

> *"With symbols in general I feel that they often stop short of the actual issues. Queer and trans people need "inclusion" and visibility is certainly relevant to that, but we're currently in a period of significant backsliding for queer and especially trans people. Putting up a flag doesn't guarantee access to the appropriate restrooms and dorms or access to the correct healthcare at the student clinic."* (PhD student, LGBTQ+, USA)

For some people, the presence of out LGBTQ+ people and the support of specific individuals was more impactful than symbol displays (*"Flags and other items can signal an inclusive environment, but openly queer staff are a much stronger signal."* [PhD student, LGBTQ+, USA]).

A range of concrete needs were expressed by participants, for example more education and awareness, gender neutral bathrooms, inclusive healthcare, use of appropriate pronouns and gender options on forms, challenging discriminatory behaviour, and others. In general, a clear sense of a need for more than just symbols was expressed.

3. *Widespread use can weaken the usefulness of symbols*

While respondents suggested various benefits of LGBTQ+ inclusion symbols in their departments, there was also a sense that the widespread display of symbols could have downsides. Some mentioned the potential backlash to a widespread display of symbols.

> *"I do also think at times that the use or 'overuse' of symbols may antagonise some people based on a personal conversation with a friend that said he was 'fed up' of seeing the rainbow flag everywhere."* (Lecturer, not LGBTQ+, UK)

This was related to a sense from some that the display of these symbols could be *"too much"* or inadvertently create division.

> *"The fact that they cannot say "do what you want, but please do not force me to be an ally" for example makes them resentful towards the LGBTQ community. Therefore, these initiatives do not have the desired effect of acceptance, but instead of polarisation in our society."* (Senior Lecturer/Reader, not LGBTQ+, UK)

Respondents also suggested that individual displays are meaningful *("I feel that the use of symbols on an institutional level […] can seem performative. If department members are each finding individual ways to express inclusion and support, I find that to be far more*

indicative of a truly inclusive environment." [PhD student, LGBTQ+, USA]), but higher-level displays may not represent the views of everyone in a department – conversely, a person's behaviour may not align with these displays.

> *"I don't always agree with "safe space" type stickers in more public settings, like a classroom where the groups change, as they can be deceiving. I think they are most useful on an individual's property or on office doors where everyone inside is accepting, so not to inadvertently put someone in a dangerous position."* (PhD student, LGBTQ+, USA)

In this way, some respondents suggested that the broad use of these symbols could undermine their efficacy as identity safety cues. The default or mandatory usage of these symbols was therefore seen as potentially problematic by some. This was mentioned by multiple people with respect to rainbow lanyards being provided as the only or default option.

> *"In the past a rainbow flag meant a queer person or a well educated ally. Now universities hand them out so much they mean nothing. I've heard awful comments from staff wearing a rainbow lanyard. It's diluted the meaning."* (PhD student, LGBTQ+, UK)

> *"[A]t my university, the default (only?) lanyard provided to new staff has the progress flag as the patterning. That's an objective good and I hope it helps the students feel safer, but it leads me to feel a bit skeptical about whether everyone who is sporting that lanyard is really a safe person to be sharing marginalized identity with."* (Lecturer, LGBTQ+, UK)

4. Location-based differences are salient

Respondents discussed location-based differences in inclusiveness for LGBTQ+ people, which were related in many cases to the political climate. US-based respondents noted location-based differences in inclusion at a regional, state, and local level.

> *"I think LBTQ+ inclusiveness varies so massively across the US it is nearly impossible to give one figure. Looking at local policy alone there are immense differences between liberal and conservative areas. Add on cultural attitudes, population density, and town size and these differences are magnified."* (Undergraduate student, not LGBTQ+, USA)

The intersectionality of different aspects of identity and privilege, as well or aside from LGBTQ+ identity, were raised by a participant in this respect.

> *"[City/County] is also extremely affluent, athletic, and white. LGBTQ+ people of color may face more discrimination than a straight, cisgender person of color. Visibly disabled trans people may face more discrimination than athletic/fit trans people, or just visibly disabled straight/cisgender people. Intersectionality is very key to how welcoming [City/County] is."* (PhD student, LGBTQ+, USA)

Location-based differences appeared to be mentioned less by UK-based respondents, but some suggested that Northern Ireland and England lagged behind other parts of the UK.

> *"Scotland, and especially [City], has a great LGBTQ+ scene and is generally a really accepting place. Consideration of government and politics also factors in, especially as a trans person. I would consider the UK as a whole less inclusive. When searching for PhD places I had to rule out any English universities as it has proven to be an unsafe place for young trans people. Especially after the*

English government blocked Scotlands Gender Recognition Bill." (PhD student, LGBTQ+, UK)

The political climate was raised as central to inclusion, with respondents stating that this is a perilous time for LGBTQ+ people, and that discrimination is particularly strong for trans people in relation to governmental decision making and public discourses.

"A few years ago, I would've [...] probably ranked all of the categories higher on inclusivity, however given the recent rise in anti-trans legislation and transphobia, I would say that generally places are becoming a lot less inclusive, or at least people are more open about their negative feelings towards the LGBTQ+ community." (Undergraduate student, LGBTQ+, USA)

While there was a sense that the US and UK were not very inclusive from some, a number of respondents suggested that the UK is relatively safe for LGBTQ+ people despite shortcomings.

"In the context of LGBTQ+ inclusivity globally, I do think that the UK is significantly better than a large number of countries. There should, however, be more education, awareness and support." (Research fellow/Postdoctoral researcher, LGBTQ+, UK)

At a more immediate level, some responses suggested that departmental climates could differ in their inclusiveness. Moreover, some suggested that the department-level climate was more inclusive than the overall university.

"I've never felt like I had to hide any part of myself on campus or in my department. The state is pretty hit or miss on that front, as it will depend on the location I am in." (PhD student, LGBTQ+, USA)

Similarly, echoing the quantitative findings, there was a recurring sense that universities could be more inclusive than their surrounding environments. This could suggest that universities are a particularly important place to target inclusion efforts as they may already be more inclusive than wider environments that can be otherwise hostile or challenging.

"I feel that my university promotes equality for any person, and that different genders/identities are normal and not questioned here. In the UK as a whole, I feel that we aren't there yet unfortunately." (PhD student, LGBTQ+, UK)

Conclusion

The findings of Study 2 show that LGBTQ+ inclusion symbols can be relatively positively perceived within university departments, however these perceptions are more positive when embedded within more inclusive university-level environments for LGBTQ+ staff and students. These perceptions did not appear to differ by LGBTQ+ identity, career stage, or other relevant demographics. Qualitative data shed more light on the perception of these symbols, indicating that they can be used genuinely and perceived as welcoming, or used performatively and in an overarching way which can weaken their effectiveness as safety signals. Moreover, concrete actions towards inclusion are desired and needed, rather than symbol displays in isolation. Location-based differences, partly related to political climates, impact inclusion, but the potentially stronger inclusion climate within universities should encourage continued efforts to promote and strengthen inclusion at the departmental and institutional level.

Study 3

Participants

531 participants completed Study 3 (of 772 who accessed the study); *N* = 262 were recruited via Prolific (a paid source of participant recruitment) and *N* = 269 from other sources. 226 participants completed Study 3a (*N* = 54 – 59 per condition), 169 completed Study 3b (*N* = 41 – 44 per condition) and 136 completed Study 3c (*N* = 28 – 40 per condition).

35.4% were based at universities in the USA, 35.2% in England, 25.8% in Northern Ireland, 2.3% in Scotland, and 1.3% in Wales. US-based participants were located across 33 states with the majority in Washington (*N* = 73), Texas (*N* = 12), Massachusetts (*N* = 11), and New York (*N* = 10). 64.8% were undergraduate or Master's students while 35.2% were PhD students or staff. The majority were based in life sciences (26.9%), chemistry (21.5%), computer/information science (18.8%), and engineering (17.3%), with smaller proportions representing mathematical sciences, geosciences, physics/astronomy, materials research, and other disciplines. They ranged in age from 18 to 73 (*M* = 26.9, *SD* = 9.11). 47.8% were women, 45% men, 4.7% non-binary, 0.9% genderqueer, and 1.5% identified another label; 7.9% indicated that their gender identity was different to their sex assigned at birth. 40.5% had an LGBTQ+ identity, 57.4% were straight and cisgender, and 2.1% stated that neither applied to them. 58.8% were White, 16.8% were Asian, Asian British, or Asian Irish, 16.2% were Black, African American, Black British, Black Irish, Caribbean or African, 2.8% were Hispanic or Latino, and a smaller proportion indicated other options or preferred not to say.

In interpreting the data across these studies, it should be noted that scores on the outcome variables were generally high (e.g. across all sub-studies and conditions, mean Positivity = 64.52/100, *M* Behavioural intention to display symbols = 61.45/100, *M* Support for symbols = 4.97/7). It may be the case that all presentations of the fictional initiative were interpreted relatively positively, or that there was a ceiling effect in the data where scores were already generally high and therefore less likely to be altered by the manipulations. Indeed, we observed some skewness and non-normality in the dataset which should be taken into account when interpreting the results. We suggest that further research is needed on these relationships (see Policy Implications and Recommendations and Conclusions sections).

Study 3a

While almost all participants (98.2%) passed a manipulation check requiring them to correctly select the name of the initiative, there were indications of poor attention or comprehension of the external motivation conditions (where 38.6% of participants incorrectly stated that the motivation was to create a safe, inclusive, and welcoming environment) and the actions conditions, where in the absent action conditions, 21.2% incorrectly stated that specific actions would be in place, and in the present action conditions, only 78.8% correctly stated that both symbol display and specific actions would be in place. The data analysis presented below are computed on all participants who passed the name-based manipulation check (*N* = 222). This sample is sufficient to achieve statistical power for a medium effect size at 80% power, as indicated by G*Power 3.1.9.7.

The results show that organisational motivation had a significant effect on the outcomes (Pillai's $V = 0.09$, $F(8, 211) = 2.46$, $p = .014$); there was no effect of the action condition or the interaction between motivation and action. Post hoc comparisons using the Tukey Honestly Significant Differences test indicate a significant effect of organisational motivation on organisational trust ($p\ adj = .016$) and perceived sincerity ($p\ adj < .001$). Specifically, organisational trust is higher in the internal motivation ($M = 63.10$, $SD = 22.27$) than external

motivation condition (*M* = 54.73, *SD* = 28.59); perceived sincerity is also higher in the internal motivation (*M* = 53.76, *SD* = 24.16) than external motivation condition (*M* = 40.49, *SD* = 32.09). There was no effect of organisational motivation on perceived safety, positivity, support for symbol display, external motivation, internal motivation, or behavioural intention to display symbols. Hypothesis 3 was only partly supported: there was an effect of internal organisational motivation on the perception of initiatives, but this was not observed for safety or many of the other outcomes. Hypothesis 4 and 5 were not supported as there was no significant impact of actions.

Study 3b

While almost all participants (95.9%) passed the manipulation check requiring them to correctly select the name of the initiative, there were again indications of poor attention or comprehension, with 50% of participants in the external motivation condition incorrectly reporting that the initiative was values-motivated. Moreover, results of independent-samples t-tests suggested that there were not differences in realistic or symbolic threat (*p*'s > .05) between the two groups, suggesting that the manipulation did not impact threat as intended. The data analysis presented below is computed on all participants who passed the name-based manipulation check (*N* = 162). This sample is sufficient to achieve statistical power for a medium effect size at 80% power, as indicated by G*Power 3.1.9.7.

The results showed no significant effect of organisational motivation, threat, or their interaction on the outcomes (*p*'s > .05). Hypothesis 6 and 7 were therefore not supported.

Study 3c

Almost all participants (97.1%) passed the manipulation check requiring them to correctly select the name of the initiative, and participants were generally able to imagine the scenario (only 8.8% rating their ability as 4/10 or less). The data analysis presented below is computed on all participants who passed the name-based manipulation check (*N* = 132). It should be noted that this sample is too small to achieve statistical power for a medium effect size at 80% power, as indicated by G*Power 3.1.9.7 which indicated a requirement for 153 participants. However, an independent-samples t-test suggested that there were not differences in self-efficacy (*p* > .05) between the two groups, suggesting that the manipulation did not impact self-efficacy as intended.

The results showed no significant effect of perspective-taking, self-efficacy, or their interaction on the outcomes (*p*'s > .05). Hypothesis 8 and 9 were therefore not supported.

Career Stage

In line with the planned exploratory analysis, a one-way MANOVA in the full sample assessing the impact of career stage (student or PhD/staff member) on the outcomes (except safety) was significant (Pillai's *V* = 0.06, *F*(7, 523) = 4.77, *p* < .001). Post-hoc one-way ANOVAs with a Bonferroni correction applied for seven multiple comparisons (such that *p* must be less than .007) found a significant impact of career stage on internal motivation, where staff were more internally motivated to display symbols (*M* = 5.10, *SD* = 1.60) than students (*M* = 4.65, *SD* = 1.58). A further t-test in the Study 3a sample found no significant difference between LGBTQ+ staff relative to LGBTQ+ students in levels of perceived safety.

Conclusion

The findings of Study 3 should be considered preliminary and interpreted in light of the data quality, for example with some potential issues with comprehension of the experimental manipulations and an underpowered sample for Study 3c. However, they preliminarily

suggest that organisational motivation may play a role in organisational trust and perceptions of sincerity of symbol display for LGBTQ+ staff and students, where internally motivated displays give rise to higher trust and perceived sincerity. This suggests the importance of values-driven, rather than simply financially-driven, symbol displays in this context. They also indicate that the framing of these displays may impact perceptions of the organisation more than personal attitudes towards displays. It should be noted that perceptions were relatively positive across the different symbol display conditions.

Stakeholder Workshops

In November 2024, we held **two workshops** with stakeholders across the UK and USA to present and discuss our developing findings. There were 15 attendees in total, including members of the project team. These attendees represented academic staff and PhD students across Psychology and STEM disciplines at universities in the UK and USA, as well as representation from the RSC. A number of key points were raised related to these findings and the wider topic of LGBTQ+ inclusion in STEM.

- Echoing the qualitative data from Study 2, symbol displays were not perceived uniformly. Those that go above and beyond the standard displays within a department may be perceived as more genuine (for example, displaying a self-chosen supportive sticker rather than just wearing the standard rainbow lanyard).
- Expanding on the idea of performative symbol use, it was suggested that some people use these symbols because they look appealing or to feel good about themselves, which can undermine their effectiveness as cues of inclusion. Future research could explore motivations for using these symbols (both personal motivations and perceptions of others' motivations) to better understand how they are used in practice.
- It would help to build shared knowledge bases about departmental inclusion climates within universities to enable tailored approaches to displays, ensuring they align with each department's current culture while drawing on successful practices from others. This could act as a pathway to develop inclusion: some departments may already have more inclusive cultures which can support wider symbol display, while others may need to take preliminary steps to grow inclusion and be more tentative about displays.
- The development of standardised survey questions may aid departments and learned societies in collecting meaningful and comparable data on these topics in a consistent way, as DEI/EDI groups within STEM departments may be less equipped to design these kinds of surveys.
- Although we did not find significant statistical differences in perception between the US and UK, some distinctions relevant to university-level climate were raised. The recent Supreme Court decision on affirmative action has had knock-on effects on DEI/EDI initiatives, with some university-level initiatives being discontinued and an example of LGBTQ+ inclusion symbolism being discouraged. Conversely, the use of the Research Excellence Framework (REF) in the UK may act to protect and prioritise these efforts.
- The generally positive ratings of trust and buy-in for different approaches to symbol display in Study 3 suggest that external forces for symbol display are good but internal motivations are better. Bodies like Athena Swan and the REF process in the UK can act as effective external motivators for inclusive actions, but it is also

important to foster genuine, internally motivated displays, which are perceived more positively by LGBTQ+ staff and students.

- Genuine displays from safe people are valued, and it seems important to use these symbols but ensure that there is a genuine climate of inclusion to support their display. People displaying these symbols should be educated, knowledgeable, and ideally able to refer LGBTQ+ students or colleagues who may be experiencing challenges related to their identity to appropriate support organisations or services. This change should come through providing education about what these symbols mean and their importance for the LGBTQ+ community. In some cases, this education could be delivered by LGBTQ+ scientists, provided that they are willing and reimbursed appropriately for their time. It was suggested that learned societies like the RSC could host a database of scientists who are willing to give invited talks on their research and speak on these topics to humanise these symbols while providing opportunities for progression and networking.
- This education could also take the form of training to be delivered alongside the provision of symbols like rainbow lanyards (for example, some UK participants felt favourably about a system similar to US Safe Zone training).
- University leadership can be key drivers of this change by displaying symbols, integrating DEI/EDI work into career progression, and emphasising education on these issues for staff and students.
- With respect to authenticity, it is important that symbols are used but not mandated, that allies are educated so they practice meaningful allyship, and that training is therefore provided alongside symbol provision and display.
- More exploration is needed in this area, given the generally positive skew of ratings in this dataset, the mixed findings regarding actions (for example, respondents may have assumed that actions would follow symbol displays in Study 3), and the absence of qualitative data to understand how the Study 3 initiatives were perceived. More longitudinal research would also be beneficial to understand the impact and perception of using specific symbols or actions within a given department over time.

Policy Implications and Recommendations

- Symbols are generally perceived as positive and welcoming, although it should be noted that they can be seen as performative and that widespread or inauthentic use can be harmful. Organisations can use these symbols to signal a welcoming environment provided that systemic approaches are in place to back up this symbolism.
- Symbols are more positively perceived if displayed within a more positive institutional inclusion climate, so universities need to explore how this can be achieved. The findings of this research suggest that creating a genuine culture of inclusion which is supported by education and action is part of this process. Symbolism alone is not sufficient to create an inclusive environment for LGBTQ+ students and staff.
- The findings suggest that it is beneficial for inclusion symbols not to be made mandatory or default for individuals within a department. For example, it is best if students and staff opt in to use a rainbow lanyard rather than being given one as a default. This may improve confidence that symbol displays at an individual level are genuine and safe.
- It may be best if symbol displays can be supported with education from a lived experience standpoint about what these symbols mean, their importance for

LGBTQ+ individuals, and how to practice meaningful inclusion and allyship. A version of US ‘Safe Zone’ training, where individuals receive LGBTQ+ awareness and allyship training before receiving a sticker indicating that they have received this training, may be one way to achieve this.

- At all levels, with respect to horizon scanning, it is important to bear in mind the political climate and its impact on inclusion efforts. This is particularly relevant in the US with a recent Supreme Court ruling which is impacting DEI/EDI initiatives. This is likely to impact the inclusion climate within universities in the US and may have cascading impacts on use and perception of these symbols.
- To progress knowledge in this area, funders might support research (1) using representative samples to address potential skew in self-selected samples, (2) using qualitative approaches to better understand nuances in how inclusion climate and symbolism are perceived, (3) exploring own and others’ motivations for symbol displays, and (4) using longitudinal applied data to look at how changes in policy or symbol display impact symbol perception and inclusion climate.

Conclusions

A truly inclusive climate for LGBTQ+ scientists has yet to be achieved in the UK and USA. More applied research and work are needed to understand processes of inclusion, exclusion, and the role that LGBTQ+ inclusion symbols play in these contexts. This report suggests that inclusion symbols can be relatively positively perceived in STEM departments across demographic groups, acting as signals of welcomeness, acceptance, and safety. However, the context matters: These perceptions are more positive when symbols are embedded within more inclusive institutional environments. Importantly, these symbols can also be displayed inauthentically and seen as purely performative, which can challenge their effectiveness as safety cues for LGBTQ+ staff and students. A genuine approach which is backed up by systemic change appears to be favoured in order to create more inclusive university environments.

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Appendix

Appendix A: Methodology

The methodology and analytic approach for specific studies is reported below. All studies were preregistered on OSF with specific links included below.

Study 1

Design

An initial pilot study was used to review the existing LGBTQ+ inclusion climate in UK and US STEM departments via an online survey of project partners based in Chemistry departments across 7 UK and US universities. The aims were:

1. To establish which LGBTQ+ inclusion cues or symbols are being used by STEM academic departments in the UK and US.
2. To understand inclusion initiatives and climate within these departments.

Data were collected by circulating the survey (hosted on Qualtrics) with the 7 initial project partners.

Procedure and Measures

In the online survey, participants were asked to give their name and affiliation. They were then asked to provide open-text responses to a series of questions regarding the organisational structure of their department, the use of LGBTQ+ inclusion symbols such as rainbow flags, Pride celebrations, or pronouns and actions in their department and university, the presence of LGBTQ+ inclusion or equality initiatives at a departmental or institutional level, written EDI policies addressing LGBTQ+ equality, and any relevant state or national laws (see Appendix B for full questions).

Analysis

The responses were reviewed and summarised to identify key impressions and takeaways. No formal coding system or statistical analysis was applied.

Study 2

Design

This study used a mixed-methods cross-sectional online survey to address three research questions:

1. What symbols of LGBTQ+ inclusion (pronouns, rainbow flags, LGBTQ+ Pride celebrations) are present and how are they perceived within the STEM academic community (i.e. positive, authentic, effective at creating LGBTQ+ inclusion, sincere, threatening)?
2. How do LGBTQ+ group membership and career stage affect perceptions of symbols?
3. How do perceptions depend on departmental inclusion climate, university inclusion climate, and state/nation inclusion climate, across the UK and US (see Figure 1 on https://osf.io/fu7hd)?

We had the following hypotheses:

Hypothesis 1: We predicted that symbols of LGBTQ+ inclusion would be perceived positively overall but that they will be perceived less positively in more negative inclusion climates, particularly at the institutional level.

Hypothesis 2: We predicted that symbols would be perceived more positively by LGBTQ+ students and staff compared to academics and participants who are not LGBTQ+.

Exploratory analyses: We also planned to assess how career stage impacts perception of symbols and whether ingroup identification moderates the relationship between inclusion climate and symbol perception.

Data were collected by circulating the survey (hosted on Qualtrics) with project partners, networks for LGBTQ+ university staff, RSC contacts, and emails to STEM departments and contacts in the UK and USA. The study design and analysis were preregistered (https://osf.io/94xgd). The study received ethical approval from the Research Ethics Committee in the Faculty of Engineering and Physical Sciences at Queen's University Belfast. Participants could enter a raffle to win a £10/$10 voucher upon survey completion.

Procedure

Upon entering the survey, participants were presented with an information sheet and provided informed consent, as well as completing screening questions to confirm that they were over the age of 18 and a student or member of staff in a STEM university department in the US or UK. They completed socio-demographic questions (see Measures section) and then rated whether three types of inclusion symbols (rainbow flag symbolism, Pride events, and display of personal pronouns) were present at the departmental, institutional, state/nation, and country level. They then rated their perception of these symbols on sliding scales (as positive for LGBTQ+ inclusion, authentic about LGBTQ+ inclusion, effective at creating LGBTQ+ inclusion, sincere, and nonthreatening), and completed the first open-response question. They then rated the inclusion climate at different levels and answered the second open-response question before completing measures of ingroup identification, existential loneliness, stigma consciousness (LGBTQ+ participants only), and the third open-response question. The order of presentation of the three inclusion symbol stimuli and associated ratings were randomised. Following completion of the study, they were presented with the opportunity to enter a prize draw to win a voucher and thanked for their participation. Details of support organisations that they could contact if they felt distressed and wanted to discuss any issues arising from their participation were also presented.

Measures

The following measures were included. For complete details, see the study preregistration (https://osf.io/94xgd).

Socio-demographics: Participants indicated their age, gender, whether they were transgender, LGBTQ+ community membership, country, US state, university, department, STEM discipline, ethnicity, sexual orientation, and career stage. In this study and all studies of this project, participants were able to describe their identity as (1) falling within the LGBTQ+ community, (2) straight and cisgender, or (3) neither of the above; where relevant, participants who selected the third option were shown survey materials for LGBTQ+ participants. This approach was based on the assumption that the small proportion of participants selecting this option were more likely to have an LGBTQ+-adjacent identity than a straight and cisgender identity.

Presentation of LGBTQ+ inclusion symbols: In a randomised order, participants were shown a description and image of some examples of rainbow flag symbolism, Pride events, and display of personal pronouns (see https://osf.io/zh6dg). They indicated whether they had seen these symbols used at a departmental-, university-, state/country-, and US/UK-level and completed ratings of these symbols in the context of their university department on slider scales from 0 to 10 representing Negative for LGBTQ+ inclusion–Positive for LGBTQ+ inclusion, Inauthentic about LGBTQ+ inclusion–Authentic about LGBTQ+ inclusion, Ineffective at creating LGBTQ+ inclusion–Effective at creating LGBTQ+ inclusion, Performative–Sincere, and Nonthreatening–Threatening. If participants had not seen the symbol used at a departmental level, they were asked to complete these ratings based on how they would feel if these symbols were present.

Perception of the LGBTQ+ inclusion climate: Participants used slider scales to rate how inclusive their department, university, state/country, and the UK/USA are for LGBTQ+ people.

In-group identification: The Centrality subscale of Leach and colleagues' (2008) in-group identification scale, adapted to pertain to LGBTQ+ or straight people, was used to measure the extent to which participants' sexual orientation and gender identity were an important part of their identity.

Open-ended questions: Participants were invited to respond to three open-ended questions asking what they thought of these symbols and whether any others were used, whether anything impacted their rating of how inclusive these different environments were, and how inclusion symbols might signal inclusive environments for LGBTQ+ people in STEM.

Additional measures: While they are not analysed here, participants also rated the broader inclusion climate at each level and completed measures of stigma consciousness (LGBTQ+ participants only) and existential loneliness.

Analysis

Independent-samples t-tests indicated that there were significant differences between perception ratings when symbols were present versus hypothetically rated for multiple ratings, therefore the subsequent analysis includes only ratings of present symbols.

A series of exploratory factor analyses with principal axis factoring and direct oblimin rotation were used to assess whether ratings of inclusion symbols (as positive, effective, authentic, sincere, and nonthreatening) could be combined into a mean index score and whether the three inclusion symbols could be combined into one score. For each test, Kaiser Meyer-Olkin measure values over 0.6 and significant Bartlett's test of sphericity indicated that the data were suitable for factor analysis. All criteria described above suggested that mean scores for four ratings (positivity, effectiveness, authenticity, sincerity) for the rainbow, Pride, and pronoun symbols comprised a single factor with good reliability (α = .87) which explained 70.8% variance in the data. Therefore, a mean score of the three symbols was computed and is the outcome measure of the following modelling analysis.

Multilevel modelling using restricted maximum likelihood estimation was used to test the main hypotheses using R software (R Core Team, 2021). A complete cases approach (including N = 221 participants) was used to allow model comparison; non-categorical predictors were grand-mean centered to address high Variance Inflation Factor for some variables. The first model included perception of LGBTQ+ inclusion climate at the institutional- and state/country-level as fixed effects. Departmental-level inclusion climate was not included given its high multicollinearity with institutional-level climate. US or UK

location was included as a fixed effect and interaction term to assess whether the impact of climate on symbol perception differed according to US or UK location. Random intercepts for department, university, and state/country were included. The outcome was perception of inclusion symbols. Model 2 added LGBTQ+ identity as a fixed interaction effect. Model 3 removed LGBTQ+ identity and added career stage (undergraduate or Master's student versus PhD student or staff member) as a fixed interaction effect. We planned to assess whether ingroup identification moderated a proposed relationship between LGBTQ+ identity and symbol perception; this model was not tested given that such a relationship was not observed. Fit of the three models was compared using likelihood ratio tests, the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and Residual Sum of Squares (RSS).

The open-ended data were analysed through reflexive thematic analysis, which is a flexible approach to analysing qualitative data in which themes are generated through iterative and reflexive engagement with the data (Braun & Clarke, 2019). This method allows the identification of overarching patterns in qualitative data. The analytic procedure described by Braun and Clarke (2021) was followed; first reading the data and noting key points; then thoroughly coding the data (assigning labels to sections of the text which capture distinctive points relevant to the research); then checking and refining codes for their coherence, appropriateness, and how well they represent the data; organising the codes into themes which explain important patterns in the data; reviewing these themes; and finally rereading the full dataset to ensure that the themes represent the data well.

Study 3

Note: Analysis is reported on data collected up to 20th November, 2024.

Design

This study used an experimental design in which participants were presented with varying information about a fictional LGBTQ+ inclusion initiative ("PRIDE") for a university that would involve the display of inclusion symbols. Data were collected via online survey to address the following research questions:

1. What contextual factors (e.g. internal vs. external organisational motivation, presence vs. absence of actions) predict LGBTQ+ STEM students' and staff members' feelings of safety and willingness to engage with symbols of LGBTQ+ inclusion within STEM academic communities?
2. What psychological factors (perspective taking, self-efficacy, perceived threat) and contextual factors (internal vs. external organisational motivation) predict straight and cisgender students' and staff members' willingness to engage with symbols of LGBTQ+ inclusion within STEM academic communities?

We had the following hypotheses:

Hypothesis 3 (Study 3a): We predicted that feelings of safety would be higher and attitudes towards engaging with LGBTQ+ inclusion symbols more positive when presented as part of initiatives that show an internal organisational motivation.

Hypothesis 4 (Study 3a): We predicted that feelings of safety would be higher and attitudes towards engaging with LGBTQ+ inclusion symbols would be more positive when presented as part of initiatives that are supported by concrete actions to promote inclusion.

Hypothesis 5 (Study 3a): We predicted that organisational trust and perceived sincerity of symbol display would be higher when the display of LGBTQ+ inclusion symbols were presented as part of initiatives that are supported by concrete actions to promote inclusion.

Hypothesis 6 (Study 3b): We predicted that attitudes towards engaging with LGBTQ+ inclusion symbols would be more positive when presented as part of initiatives that show an internal organisational motivation.

Hypothesis 7 (Study 3b): We predicted that attitudes towards engaging with LGBTQ+ inclusion symbols would be more positive when presented as part of initiatives that reduce threat.

Hypothesis 8 (Study 3c): We predicted that attitudes towards engaging with LGBTQ+ inclusion symbols would be more positive when presented as part of initiatives that promote high self-efficacy.

Hypothesis 9 (Study 3c): We predicted that attitudes towards engaging with LGBTQ+ inclusion symbols would be more positive when presented as part of initiatives that promote perspective-taking.

Exploratory analysis: We also assessed whether feelings of safety and attitudes towards symbols were impacted by interactions between (1) organisational motivation and presence of actions, (2) organisational motivation and threat, and (3) perspective-taking and self-efficacy. We also assessed whether career stage impacted feelings of safety and willingness to engage with inclusion symbols.

Data were collected by circulating the survey (hosted on Qualtrics) with project partners, emails to STEM departments and contacts in the UK and USA, posters around the Queen's University Belfast campus, and via Prolific (a research participation website which provides payment to a high-quality participant pool in exchange for completion of research surveys). The study design and analysis were preregistered (https://osf.io/39q8j). The study received ethical approval from the Research Ethics Committee in the Faculty of Engineering and Physical Sciences at Queen's University Belfast. Participants could enter a raffle to win a £10/$10 voucher upon survey completion.

Procedure

Upon entering the survey, participants were presented with an information sheet and provided informed consent, as well as completing screening questions to confirm that they were over the age of 18 and a student or member of staff in a STEM university department in the US or UK. They completed socio-demographic questions (see Measures section) and were then filtered into one of the studies: LGBTQ+ participants and those who selected that neither identity applied to them were taken to the Study 3a survey, while straight and cisgender participants were randomised into either Study 3b or 3c.

Study 3a participants were randomised into one of 4 conditions: (1) internal organisational motivation and presence of action, (2) internal organisational motivation and absence of action, (3) external organisational motivation and presence of action, or (4) external organisational motivation and absence of action. They were presented with a vignette in the form of an email from a Head of School describing a new LGBTQ+ inclusion initiative (for all study vignettes, see https://osf.io/yg3tq). The vignettes for each group differed slightly in describing either an internal or external organisational motivation for displaying LGBTQ+ inclusion symbols and describing the presence of absence of concrete actions to support LGBTQ+ inclusion. Following the vignette, participants completed manipulation check

questions and rated their feelings of safety in displaying LGBTQ+ inclusion symbols, positivity towards symbols, support for displaying symbols, motivations for engaging with symbols, behavioural intention to engage with symbols, organisational trust, and perceived sincerity of symbol display. The Study 3b design was similar, but participants were instead randomised into one of 4 conditions: (1) internal organisational motivation and reduced threat, (2) internal organisational motivation and neutral [not reduced] threat, (3) external organisational motivation and reduced threat, or (4) external organisational motivation and neutral threat; these participants did not rate safety. Study 3c participants were randomised into one of 4 conditions: (1) perspective-taking and high self-efficacy, (2) perspective-taking and low self-efficacy, (3) no perspective-taking and high self-efficacy, or (4) no perspective-taking and low self-efficacy. Firstly, participants completed the perspective-taking or no perspective-taking conditions, where they were presented with one of two written prompts: either to imagine themselves as a new member of staff who is LGBTQ+ and unsure whether to disclose their identity (perspective-taking condition), or to imagine themselves as a new member of staff who is generally unfamiliar with the department (control condition); they then imagined a day in the life of this person and wrote for 5 minutes about how they imagined the experience. Following this, they took part in the self-efficacy condition which used the same design as Study 3a and 3b, before completing the same outcome measures as Study 3b.

Measures

The following measures were included. For complete details, see the study preregistration (https://osf.io/39q8j).

Socio-demographics: Participants indicated their age, gender, whether they were transgender, LGBTQ+ community membership, country, US state, STEM discipline, ethnicity, sexual orientation, and career stage.

Safety: Participants completed a 0–100-point slider scale rating how safe they would feel displaying these symbols in a department with the PRIDE initiative.

Positivity: Participants completed a 0–100-point slider scale rating how positively they felt about displaying LGBTQ+ inclusion symbols.

Support: Participants completed 6 items from Jones et al. (2022) rating their support for displaying symbols (e.g. *"If the display of LGBTQ+ inclusion symbols in my department were up for a vote, I would vote in support of displaying these symbols"*).

External motivations to engage: Participants completed 6 items from Farrell et al. (2021) rating their external motivation to engage with symbols (e.g. *"Displaying LGBTQ+ inclusion symbols is more about looking good to employers and funders"*).

Internal motivations to engage: Participants completed 5 items from Farrell et al. (2021) rating their internal motivation to engage with symbols (e.g. "*According to my personal values, I agree with the goals of displaying LGBTQ+ inclusion symbols"*).

Behavioural intention: Participants completed a 0–100-point slider scale rating how likely they were to display LGBTQ+ inclusion symbols in their department.

Organisational trust: Participants completed a 0–100-point slider scale rating their trust in an organisation displaying these symbols due to the PRIDE initiative.

Perceived sincerity: Participants completed a 0–100-point slider scale rating how much they would feel that the display of symbols was sincere (i.e. a genuine attempt to improve inclusion) in an organisation following the PRIDE initiative.

Manipulation checks: To assess the effectiveness of the manipulations, participants completed manipulation checks. For all studies and conditions, they selected the name of the initiative from multiple options. For the organisational motivation condition, they selected why the initiative was being introduced from multiple options. For the self-efficacy condition, they reported what the email said about inclusion efforts from multiple options and completed a self-efficacy measure adapted from Petzel et al. (2024). For the perspective-taking condition, they rated how easy they found it to imagine the scenario. For the threat condition, they completed items on realistic and symbolic threat adapted from Jones et al. (2022).

Analysis

2x2 MANOVA analyses in R were used to compare the experimental manipulations (for each study) as predictors of safety (Study 3a) and willingness to engage (all studies) in terms of the dependent variables (1) Safety [Study 3a only], (2) Positivity (affect) towards symbols, (3) Support for symbol display, (4) External motivation, (5) Internal motivation, (6) Behavioural intention to display symbols, (7) Organisational trust, and (8) Perceived sincerity of display.

Statistical Notation

As noted, the *p* value has been used to designate the significance of inferential statistical tests, where appropriate in this research, in line with standard conventions. Other relevant statistical notation used in the report is briefly described below.

b: The regression coefficient, which indicates the increase in the dependent variable (in this case, symbol perception) for every one-unit increase in the given predictor variable, holding other predictors constant.

F: In MANOVA, the *F* statistic indicates how different group means are from one another.

M: Mean; the average of the given values.

Mdn: Median; the middle value of the range of given values.

Pillai's *V*: Pillai's trace is used to test whether group means are significantly different across multiple dependent variables.

SD: Standard deviation; the spread of values around the mean value, where a larger SD indicates that the data are more widely spread out around the mean.

SE: Standard error; the accuracy or variability of a statistic (in this case, the regression coefficient) in terms of how close the statistic in this sample is likely to be to the overall population.

Appendix B: Study 1 Survey Questions

1. Can you please briefly describe your Department/School's organisational structure and characteristics? For example, are you a small/medium/large department? Are you part of a Faculty or College? Any contextual details are helpful to understand the context.
2. Does your Department/School use any symbols of LGBTQ+ inclusion in physical or virtual spaces? This can be both internally (in internal communications) or externally (on social media). Examples include but not limited to rainbow flags/lanyards/pins, LGBTQ+ Pride celebration, pronouns (in email signatures, on nametags, etc). Please tell us about any symbols or actions used in the Department/School or University at large.
3. Does your Department/School have any inclusion/equality initiatives rolled out that address LGBTQ+ equality aims (e.g. as part of Athena SWAN or perhaps an EDI or DEI initiative)? Please describe what these are. If there is a weblink you'd like to share, please do so below.
4. Does your Institution/University have any inclusion/equality initiatives rolled out that address LGBTQ+ equality aims (e.g. Athena SWAN)? Please describe what these are. If there is a weblink you'd like to share, please do so below.
5. Does your Institution/University have any written EDI policies that address LGBTQ+ equality aims? Please describe or include a weblink below if publicly available.
6. Are there any state or national laws that may contribute to LGBTQ+ equality/inclusion (or exclusion) in your area that we should be aware of?
7. Is there anything else you'd like to add regarding LGBTQ+ inclusion symbol use in your department or any other aspects of the LGBTQ+ inclusion climate at different levels that affects the department?

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