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Multilevel determinants of school belonging: the moderating role of national safety climate

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Introduction: Why do some students feel they belong at school while others do not? We examined how perceived school safety and teacher–student relationships relate to belonging across countries, and whether national safety modifies these links.

Methods: Using PISA 2022 data from 501,731 15-year-olds in 74 countries, we estimated multilevel models with students nested within countries. Scales for belonging, teacher–student climate, and school safety were standardized; climate and safety were decomposed into within-country (individual) and between-country (national average) components. Random slopes and cross-level interactions tested heterogeneity across contexts. Model selection used likelihood tests and information criteria.

Results: Multilevel modeling revealed that students who felt safer and more supported by their teachers reported higher belonging. Country-level differences in average safety also mattered: in safer countries, the positive link between individual safety and belonging was even stronger. However, national variation in perceived teacher–student climate was not a significant contextual predictor.

Discussion: Belonging is shaped by students' personal experiences and by national safety climate. Improving perceived safety may yield especially large gains where average safety is high, while still offering protective benefits in lower-belonging contexts. Findings highlight safety climate as a policy-relevant lever for strengthening adolescents' connection to school across diverse settings.

KEYWORDS

belonging, educational psychology, multilevel modeling, PISA, school safety

1 Introduction

School belonging refers to the extent to which students feel personally accepted, respected, included, and supported in their school environment (Goodenow and Grady, 1993; Schachner et al., 2019). This concept is rooted in the broader psychological need for relatedness, the feeling of being connected to and cared for by others, which is considered a fundamental human motivation (Ryan and Deci, 2000). According to self-determination theory, internalization of school-related values and behaviors is more likely when students experience strong relationships with significant others, such as teachers and peers (Ryan et al., 1994).

School belonging has been associated with higher levels of cognitive and behavioral engagement, increased motivation, improved academic performance, greater prosocial behavior, improved mathematical literacy, healthy peer relationships, and enhanced overall life satisfaction (Allen et al., 2023; Anderman, 2003; Evans and Field, 2020; Goodenow, 1993; Korpershoek et al., 2019; Kovacevic Lepojevic et al., 2024). Importantly, school belonging also acts as a mediating factor between key elements of the school climate, such as teacher-student relationships and perceived fairness, and students' reported life satisfaction (Kovacevic Lepojevic et al., 2024). Similarly, school belonging was negatively associated with absence and dropout rates, showing that those who do not feel attached to their school are more likely to skip classes or even become early school-leavers (Hascher and Hagenauer, 2010; Lee and Burkam, 2003; Ream and Rumberger, 2008). As school belonging arises from multiple levels of influences from students and their environment, this study draws on Bronfenbrenner's socio-ecological framework (1979) to focus on teacher-student relationships, perceived school safety and sex as predictors of school belonging. These variables represent student environments where the teacher-student relationship represents the microsystem and the perceived safety reflects the mesosystem influences and have been key predictors in prior empirical research (Thapa et al., 2013; Wang and Degol, 2016).

First, supportive teacher-student relationships are essential for fostering school belonging since when students feel that their teachers care about them and value their presence, they are more likely to invest in their learning and feel connected to the broader school community (Goodenow and Grady, 1993). Meta-analytic evidence confirms moderate-to-strong links between teacher support and both school belonging and motivation across cultures; teacher support also buffers risk for academic failure and social disconnection (Allen et al., 2018). Likewise, following Bronfenbrenner's bioecological model, Štremfel et al. (2024) found that, at the micro level, teacher-student relationships are the strongest predictor of school belonging. Consistent with these findings, Furrer and Skinner (2003) showed that emotional engagement is predicted by ties to teachers, parents, and peers, but the strongest link is with teachers; students who felt appreciated by teachers reported greater interest and comfort in class, whereas those who felt ignored reported more boredom, unhappiness, anger, and drops in student engagement. Teacher support then facilitates emotional and psychological safety by acknowledging, validating and respecting students, which in turn fosters engagement and promotes positive school environments (Gage et al., 2014). Cross-national studies report that even though teachers support is a fundamental truth it varies considerably in reference to cultural and systemic factors, calling for interventions (Organisation for Economic Co-operation and Development [OECD], 2023). For instance, Abdulhamed and Beattie (2024) found that while teacher-student relations generally exert a positive effect on school belonging, the impact of this effect depended on contextual features such as student migration history and diversity policies at the school level. Given the link between engagement and positive outcomes, teacher-student relationships warrant attention as a focal predictor of school belonging.

In terms of sex differences, girls are generally more prone than boys to report a strong sense of school belonging, greater overall school motivation, and to perceive that their peers value

academic success (Goodenow, 1993; Fan and Bellmore, 2023; Kovacevic Lepojevic et al., 2024; Štremfel et al., 2024). However, school belonging is not static across time. Gillen-O' Neel and Fuligni (2013) conducted a longitudinal study that found that although girls initially reported higher belonging than boys, their sense of belonging declined more steeply throughout high school, eventually converging with boys' levels. This decline was especially pronounced among girls from Latin American backgrounds compared to their European American peers. By contrast, Sánchez et al. (2005) found no significant sex differences in a sample of Latino high school seniors possibly due to developmental stage with sex gaps weakening in later adolescence. Along the same lines, Lee and Huang (2021) hypothesized a female advantage in school belonging, but it was not observed; boys and girls did not differ in belonging, though girls reported higher kindness as a character strength. Overall, the evidence does not point to a uniform female advantage: sex gaps in belonging shift with age and context, so sex remains a meaningful lens for interpreting who feels connected in particular settings.

School safety is also a core predictor of belonging. Research shows that students' perceptions of safety and support at school are associated with greater belongingness to school, highlighting the importance of emotional and physical safety and positive school climates for students' wellbeing and engagement (Acosta et al., 2019; Allen et al., 2023; Duchesneau and Zapata, 2023; Konold et al., 2018; Palikara et al., 2025; Thapa et al., 2013; Wang and Degol, 2016), including those whose identities have been historically marginalized, like Black, Latine, and queer youths (Wilkins et al., 2023). The opposite applies as well: when students report feeling less safe at school, their wellbeing decreases (Jerrim, 2025). Côté-Lussier and Fitzpatrick (2016) found out that students who feel unsafe in school environments reported elevated depressive symptoms and physical aggression, resulting in both lower social emotional wellbeing and engagement in learning. Similarly, drawing on longitudinal data, Yin et al. (2024) observed that harsher school climates coincided with lower belonging and higher depressive symptoms. In this study, the authors also noted that belonging served as a mediator in this association, suggesting that practices that help students feel that they matter may reduce some of the strain linked to negative climates. Evidence from large-scale assessments also supports these findings. First, OECD data suggests that roughly 10% of students feel unsafe during travel to and from school or in non-classroom spaces, and approximately 20% have witnessed vandalism, threats, or injurious fights, and a subset also report the presence of gangs or weapons at school (Organisation for Economic Co-operation and Development [OECD], 2023), leading to less safe school climates and lower reported school belonging across global contexts (Li et al., 2025). Second, the United Nations Educational, Scientific and Cultural Organization [UNESCO] (2017) reported that approximately one in three students worldwide experience some form of school violence at least once a month, with prevalence and intensity varying across regions. Although the report does not directly address students' sense of belonging, it underscores the broader socioemotional costs of unsafe school climates and calls for stronger school-violence prevention strategies, including both comprehensive safety measures and culturally responsive policies. Because belonging tends to be stronger where climates feel safer—and because risk is uneven across contexts—school safety remains

a substantively important correlate for interpreting variation in connection.

It is important to note that exposure to school violence and insecurity is not equally distributed across societies. International organizations indicate that students in low- and middle-income countries experience higher rates of bullying, corporal punishment, and violence at or around school than those in higher-income contexts (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2019; United Nations Children's Fund [UNICEF], 2014). Yet, most empirical work on school climate and socioemotional wellbeing continues to rely heavily on data from Western, Educated, Industrialized, Rich, and Democratic (WEIRD) societies (Henrich et al., 2010). Research in psychology and education continues to draw predominantly from Western industrialized nations, which together represent only a small fraction of the world's population (Arnett, 2008). This overrepresentation limits the generalizability of findings and risks overlooking cultural and structural variations that shape students' experiences of safety, teacher–student relationships, and belonging (Chirkov et al., 2003; Schachner et al., 2019). Prior cross-cultural work has shown that results derived from WEIRD samples often differ from those in non-WEIRD settings in domains such as reasoning, perception, and personality assessment (Henrich et al., 2010; Laajaj et al., 2019). In education, similar biases have been observed in learning analytics and related research fields, though emerging evidence suggests growing attention to non-WEIRD contexts, narrowing the gap between WEIRD and non-WEIRD studies (Baek and Doleck, 2024). Using PISA data, Cortina et al. (2017) have explored how cultural orientations and school climate affect school belonging, showing that approximately 2.4% of the variance in students' sense of belonging occurs at the school level and 6.9% across countries. Moreover, their findings illustrate that students in high power distance societies, where hierarchy is prevalent, reported lower school belonging than in low power distance ones. Similarly, analyzing PISA 2018 data across countries, Ooi and Cortina (2023) reported that perceived cooperative and competitive school climates together explained about 18.8% of the between-country variance in belonging, with higher perceived cooperation linked to higher belonging and higher perceived competition linked to lower belonging. Thus, examining these constructs across diverse societal profiles helps to identify whether the mechanisms linking safety, teacher–student climate, and belonging are universal or context-dependent.

Despite these advancements in cross-cultural quantitative psychology studies on school belonging, most PISA-based studies continue using fixed-effect models without testing for cross-level moderation. Neither do they report how predictors such as teacher student relationship or school safety might function differently across schools or countries. This may be due in part since PISA 2018 reported that only 2–5% of the variation in belonging occurs between schools, which has encouraged a focus on student-level predictors (Organisation for Economic Co-operation and Development [OECD], 2019). This does not mean, however, that school or national contexts do not moderate those individual-level relationships; only that there are fewer studies testing for moderation (Organisation for Economic Co-operation and Development [OECD], 2019). Abdulhamed and Beattie (2024) and Rare et al. (2025) highlight many studies relying on fixed effects and assert that researchers are overlooking substantial heterogeneity

when they neglect cross-level variation. In sum, there are not many studies that have examined sex, teacher–student relationships, and school safety altogether as predictors of school belonging with an integrated, cross-national multilevel approach. Most of the existing work examines these constructs in isolation or focuses on few country contexts or along with academic achievement. The relatively limited examination of all three variables together presents a significant research gap. Moreover, little is known about how these relationships vary across societies with different cultural and structural profiles, commonly distinguished as WEIRD and non-WEIRD contexts (Henrich et al., 2010).

The present study uses multilevel models to test fixed and random effects as well as cross-level interactions to build on the literature by examining the role of sex, students' perceptions of school climate, and school safety to predict their sense of school belonging across different countries, including WEIRD and non-WEIRD contexts, which expands existing evidence of school belonging to a more representative framework.

2 Materials and methods

2.1 Data source and sample

This study utilized the publicly available dataset from the 2022 cycle of the Programme for International Student Assessment (PISA), a large-scale international assessment coordinated by the OECD. The original dataset included students from 80 countries and economies. Six countries were excluded from the analytic sample due to systematic missingness on key constructs: Canada (missing school climate data), Spain, Germany, Denmark, and Japan (missing school safety data), and Israel (missing school belonging, safety, and climate items).

After excluding these countries and applying listwise deletion for cases missing any analytic variable (sex, school belonging, school climate, school safety), the final analytic sample included 501,731 students across 74 countries. Less than 0.01% of cases were missing data on sex, and between 5 and 5.5% were missing data on scale-based variables. Given the large sample size and the fact that most missingness was attributable to design features (e.g., optional national modules), listwise deletion was considered appropriate.

The final dataset consisted of 254,014 female students (50.6%) and 247,717 male students (49.4%). Sample sizes across countries ranged from approximately 3,000 to over 22,000 students, with an average cluster size of roughly 6,200 students per country. As shown in Supplementary Table 1, national sample sizes differed substantially, with countries such as the United Arab Emirates, Kazakhstan, Indonesia, and Australia contributing the largest student samples in absolute terms.

2.2 Measures

Three constructs were measured based on student responses from the PISA 2022 Student Questionnaire: sense of school belonging, perceived teacher–student relationship climate, and perceived school safety. Each construct was assessed using multiple items rated on 4-point Likert-type scales. For all

TABLE 1 PISA 2022 sense of belonging items.

Item code	Item given to learners
ST034Q01TA	I feel like an outsider (or left out of things) at school.
ST034Q02TA	I make friends easily at school.*
ST034Q03TA	I feel like I belong at school.*
ST034Q04TA	I feel awkward and out of place in my school.
ST034Q05TA	Other students seem to like me.*
ST034Q06TA	I feel lonely at school.

* means that the items were reverse coded.

TABLE 2 PISA 2022 teacher–student relationship climate items.

Item code	Item given to learners
ST267Q01JA	The teachers at my school are respectful towards me.
ST267Q02JA	If I walked into my classes upset, my teachers would be concerned about me.
ST267Q03JA	If I came back to visit my school 3 years from now, my teachers would be excited to see me.
ST267Q04JA	I feel intimidated by the teachers at my school.*
ST267Q05JA	When my teachers ask how I am doing, they are really interested in my answer.
ST267Q06JA	The teachers at my school are friendly towards me.
ST267Q07JA	The teachers at my school are interested in students' wellbeing.
ST267Q08JA	The teachers at my school are mean towards me.*

* means that the items were reverse coded.

scales, responses were recoded where necessary such that higher scores consistently reflected more positive perceptions. Composite scores were computed as the mean of available items using the rowMeans() function in R with na.rm = TRUE, such that students were retained in scale computation if they responded to at least one item in the respective set. Reliability was assessed using Cronbach's alpha for each scale.

The six items of the PISA index of sense of belonging at school (BELONG) (Table 1) were formatted on a four-point Likert scale ranging from 1 to 4 (*Strongly agree*, *Agree*, *Disagree*, and *Strongly disagree*). Items marked with an asterisk were reverse-coded so that higher values reflect stronger belonging. Internal consistency for this scale was acceptable ($\alpha = 0.79$).

The scale on teacher–student relationship climate included the eight items from the PISA index of quality of student-teacher relationships (RELATST). Items were presented with a different Likert scale, ranging from 1 (*Strongly disagree*) to 4 (*Strongly agree*), and reflected students' perceptions of teacher support and relational quality. Two items were negatively worded and reverse-coded so that higher values indicated a more positive climate. Internal consistency was adequate ($\alpha = 0.80$). The full set of items is shown in Table 2.

Perceived school safety was measured using the four items of the PISA FEELSAFE index, which covers different locations and times during the school day. The response scale ranged from 1 (*Strongly agree*) to 4 (*Strongly disagree*). All items were reverse-coded so that higher scores indicated a greater sense of safety. This scale showed strong internal consistency ($\alpha = 0.89$), and all items are listed in Table 3.

TABLE 3 PISA 2022 school safety items.

Item code	Item given to learners
ST265Q01JA	I feel safe on my way to school.*
ST265Q02JA	I feel safe on my way home from school.*
ST265Q03JA	I feel safe in my classrooms at school.*
ST265Q04JA	I feel safe at other places at school (e.g., hallway, cafeteria, restroom).*

* means that the items were reverse coded.

Framing the analyses around teacher–student relationships and perceived school safety keeps our analysis actionable since these two variables capture day-to-day conditions under which school belonging develops. Both constructs are strongly linked to engagement and overall wellbeing (including lower depressive symptoms and aggression), are modifiable through classroom practice and school-level policy, and are measured consistently across countries in PISA 2022, allowing comparable inference. We treat the PISA indices as cross-nationally comparable because PISA embeds reliability and measurement invariance checks in index development and flags entities that fail linkage to international item parameters (Organisation for Economic Co-operation and Development [OECD], 2019; Organisation for Economic Co-operation and Development [OECD], 2023). Independent evidence spanning WEIRD and non-WEIRD settings aligns with this premise: Costa Rica's PISA 2022 data show no DIF across the six BELONG items (Elizondo, 2024); a cross-national study reports the BELONG scale invariant across countries and student populations (Casas and Sireci, 2025); and measurement-invariance work on school climate supports construct comparability between the United States (WEIRD) and Mexico (non-WEIRD) (Shukla et al., 2019).

2.3 Analytic strategy

Given the nested structure of the PISA 202 dataset—with students clustered within countries—multilevel modeling was employed to account for dependency in observations and partition variance across levels. All models were estimated using the glmmTMB package in R with maximum likelihood estimation (REML = FALSE), and country was specified as the Level 2 grouping variable throughout.

To examine whether this grouping affects the accuracy of results, we calculated the intraclass correlation coefficient (ICC), using a null model (model 1) that estimated the total variance in students' sense of school belonging and assessed the proportion attributable to between-country differences through the following equation:

$$Y_{ij} = \gamma_{00} + u_{0j} + \epsilon_{ij}$$

Where:

- Y_{ij} is the school belonging score for student i in country j
- γ_{00} is the average score across all students in all countries (the overall mean)
- u_{0j} is the difference between each country's average and the overall average

- ϵ_{ij} is the difference between each student’s score and their own country’s average.

The ICC was 0.032, which is considered small—values near 0 suggest little similarity, while values closer to 1 would indicate strong clustering (Roberts, 2004). However, even a small ICC can have a big impact when each group (in this case, country) contains many students. On average, each country had about 6,200 students, which led to a design effect (DEFT) of 14.76. A DEFT of 1 means no effect; values above 2 are typically considered large (Lai and Kwok, 2015). A DEFT of 15 indicates that ignoring the grouping would severely underestimate uncertainty. For this reason, we used multilevel modeling, which adjusts for the nested structure of the data and produces more trustworthy results.

To isolate individual- and country-level effects, we decomposed the teacher–student relationship climate and school safety scales using group-mean centering. Within-country deviations (Level 1; student-level) were calculated by centering each student’s score around their country mean, yielding *climate within* and *safety within*. Country-level averages (Level 2) were computed and grand-mean centered to obtain *climate between* and *safety between*. All continuous predictors were standardized (z-scores) to facilitate coefficient interpretation and model convergence. The binary sex variable was left unstandardized to preserve interpretability.

3 Results

3.1 Descriptive statistics

Table 4 presents descriptive statistics for the three student-level composite variables. Students reported moderate levels of school belonging ($M = 2.99$, $SD = 0.59$), teacher–student relationship climate ($M = 2.93$, $SD = 0.55$), and perceived school safety ($M = 3.29$, $SD = 0.64$).

Correlations among the three constructs were statistically significant at $p < 0.001$ after Holm correction for multiple tests. School belonging was moderately correlated with perceived school

safety ($r = 0.33$) and teacher–student relationship climate ($r = 0.27$). The correlation between safety and climate was also significant but weaker ($r = 0.19$). These results support the theoretical expectation that students’ emotional connection to school is linked to both interpersonal and environmental dimensions of their school experience.

3.2 Model 2: individual-level predictors

Model 2 examined how students’ perceptions of school safety, teacher–student relationship climate, and sex were associated with their sense of school belonging. All predictors were modeled as within-country effects, meaning the analysis estimated how students’ experiences related to belonging relative to other students in the same country.

Model 2 was computed as:

$$Y_{ij} = \gamma_{00} + \gamma_{10} (Sex_{ij}) + \gamma_{20} (Climate_{within, ij}) + \gamma_{30} (Safety_{within, ij}) + u_{0j} + \epsilon_{ij}$$

Where:

- Y_{ij} is the belonging score for student i in country j
- γ_{00} is the average belonging score across all students and countries
- γ_{10} reflects the average difference in belonging between male and female students across all countries
- γ_{20} and γ_{30} estimate how students’ individual-level perceptions of school climate and safety (compared to their country average) relate to belonging
- u_{0j} captures how much each country’s average belonging deviates from the overall mean
- ϵ_{ij} is the residual—the part of each student’s score not explained by the model

All three predictors were significantly associated with school belonging. The results (Table 5) showed that students who felt safer

TABLE 4 Descriptive statistics for key constructs.

Construct	<i>M</i>	<i>SD</i>	<i>Mdn</i>	<i>Min</i>	<i>Max</i>	<i>Skew</i>	<i>Kurt</i>	<i>SE</i>
School belonging	2.99	0.59	3	1	4	−0.6	0.61	0
Teach-student relationship	2.93	0.55	3	1	4	−0.58	0.85	0
School safety	3.29	0.64	3.25	1	4	−0.85	1.2	0

TABLE 5 Results for model 2.

Fixed effects parameter	Coefficient	SE	95% CI	<i>z</i>	<i>P</i>
Intercept	−0.03	0.02	[−0.07, 0.01]	−1.46	0.145
Sex (male)	0.07	0.0026	[0.06, 0.07]	26.23	<0.001
Teach-student climate (within)	0.22	0.0013	[0.22, 0.22]	167.94	<0.001
School safety (within)	0.27	0.0013	[0.27, 0.27]	206.33	<0.001
Random effects					
SD (intercept: country)	0.18				
SD (residual)	0.91				

TABLE 6 Results for model 3.

Fixed effects parameter	Coefficient	SE	z	95% CI	p
Intercept	−0.03	0.02	−1.46	[−0.07, 0.01]	0.145
Sex (male)	0.07	0.0026	26.23	[0.06, 0.07]	<0.001
Teach-student climate (within)	0.22	0.0013	167.94	[0.22, 0.22]	<0.001
School safety (within)	0.27	0.0013	206.33	[0.27, 0.27]	<0.001
Teach-student climate (between)	0.02	0.02	1.07	[−0.01, 0.05]	0.283
School safety (between)	0.1	0.02	6.04	[0.07, 0.13]	<0.001
Random effects					
SD (intercept: country)	0.14				
SD (residual)	0.91				

at school and perceived more positive relationships with teachers were more likely to feel that they belonged at school. A small but statistically reliable difference by sex was also observed, with male students reporting slightly higher levels of belonging than female students.

The addition of these student-level predictors resulted in a substantial improvement in model fit over the null model, as indicated by a decrease in AIC (from 1,409,685 to 1,326,730) and a significant likelihood ratio test [$\chi^2(3) = 82,961, p < 0.001$].

3.3 Model 3: country-level predictors

Model 3 added two fixed effects at the country level: the average teacher–student relationship climate and the average perceived school safety across students in each country. These predictors were used to examine whether, after accounting for individual experiences, students reported higher levels of belonging in countries where school climate or safety was generally rated more positively.

Model 3 was expanded as:

$$Y_{ij} = \gamma_{00} + \gamma_{10} (\text{Sex}_{ij}) + \gamma_{20} (\text{Climate}_{\text{within}, ij}) + \gamma_{30} (\text{Safety}_{\text{within}, ij}) + \gamma_{01} (\text{Climate}_{\text{between}, j}) + \gamma_{02} (\text{Safety}_{\text{between}, j}) + u_{0j} + \epsilon_{ij}$$

Where:

- γ_{01} γ_{02} represent between-country effects (whether countries with higher average school climate or safety tend to report higher belonging)
- All other terms are defined as in Model 2.

These results (Table 6) suggest that the overall safety climate of a country contributes to students' sense of school belonging, even after accounting for their individual perceptions. However, once students' personal experiences with teacher–student relationships are considered, national differences in teacher climate do not appear to explain further variation in belonging.

Compared to Model 2, Model 3 showed a statistically significant improvement in model fit ($\chi^2(2) = 32.05, p < 0.001$).

3.4 Models 4a, 4b, and 4c: random slope for sex, teacher–student relationship climate, and school safety

Model 4a extended Model 3 by allowing the effect of sex to vary across countries. This was specified as a random slope for sex at the country level:

$$Y_{ij} = \gamma_{00} + \gamma_{10} (\text{Sex}_{ij}) + \gamma_{20} (\text{Climate}_{\text{within}, ij}) + \gamma_{30} (\text{Safety}_{\text{within}, ij}) + \gamma_{01} (\text{Climate}_{\text{between}, j}) + \gamma_{02} (\text{Safety}_{\text{between}, j}) + u_{0j} + u_{1j} (\text{Sex}_{ij}) + \epsilon_{ij}$$

The model showed a significant improvement in fit compared to Model 3 ($\chi^2(2) = 1371.89, p < 0.001$), indicating that the relationship between sex and belonging is not constant across countries. In other words, the size of the sex difference in belonging varies depending on national context (see Supplementary Table 2 for Models 4a, 4b, and 4c results).

Model 4b further extended the model structure in 4a by allowing the effects of both sex and within-country teacher–student relationship climate to vary across countries:

$$Y_{ij} = \gamma_{00} + \gamma_{10} (\text{Sex}_{ij}) + \gamma_{20} (\text{Climate}_{\text{within}, ij}) + \gamma_{30} (\text{Safety}_{\text{within}, ij}) + \gamma_{01} (\text{Climate}_{\text{between}, j}) + \gamma_{02} (\text{Safety}_{\text{between}, j}) + u_{0j} + u_{1j} (\text{Sex}_{ij}) + u_{2j} (\text{Climate}_{\text{within}, ij}) + \epsilon_{ij}$$

These random slopes were added to capture whether the associations between these predictors and school belonging differ meaningfully depending on the national context. The addition of these random slopes led to a substantial and statistically significant improvement in model fit over Model 3, as indicated by the likelihood ratio test [$\chi^2(5) = 3,275.50, p < 0.001$]. This result suggests that the strength of the relationship between teacher–student relationship climate and belonging, as well as the sex gap in belonging, are not uniform across countries.

Model 4c introduced additional random slopes to allow the effects of sex, school climate, and school safety to vary across countries:

$$Y_{ij} = \gamma_{00} + \gamma_{10} (\text{Sex}_{ij}) + \gamma_{20} (\text{Climate}_{\text{within}, ij}) + \gamma_{30} (\text{Safety}_{\text{within}, ij}) + \gamma_{01} (\text{Climate}_{\text{between}, j})$$

$$+ \gamma_{02} (\text{Safety}_{\text{between}, j}) + u_{0j} + u_{1j} (\text{Sex}_{ij}) + \\ + u_{2j} (\text{Climate}_{\text{within}, ij}) + u_{3j} (\text{Safety}_{\text{within}, ij}) + \epsilon_{ij}$$

Model fit improved substantially compared to Model 3, as indicated by the likelihood ratio test [$\chi^2(9) = 8,667.39$, $p < 0.001$], confirming that allowing these effects to vary across countries significantly enhances model accuracy. Despite the added complexity, the fixed effects remained stable. These results emphasize that while individual perceptions of safety and support remain robust predictors of belonging, the degree to which sex, teacher–student relationship climate, and safety matter for students is shaped by the broader country context.

3.5 Models 5a, 5b, 5c, and 5d: cross-level interactions

Model 5a introduced a cross-level interaction term between sex and country-average school climate, γ_{11} , testing whether the relationship between sex and school belonging depends on the national context of teacher–student climate:

$$Y_{ij} = \gamma_{00} + \gamma_{10} (\text{Sex}_{ij}) + \gamma_{20} (\text{Climate}_{\text{within}, ij}) \\ + \gamma_{30} (\text{Safety}_{\text{within}, ij}) + \gamma_{01} (\text{Climate}_{\text{between}, j}) \\ + \gamma_{02} (\text{Safety}_{\text{between}, j}) + \gamma_{11} (\text{Sex}_{ij} \times \text{Climate}_{\text{between}, j}) \\ + u_{0j} + u_{1j} (\text{Sex}_{ij}) + u_{2j} (\text{Climate}_{\text{within}, ij}) + \\ u_{3j} (\text{Safety}_{\text{within}, ij}) + \epsilon_{ij}$$

The interaction was not statistically significant ($\beta = -0.01$, $SE = 0.01$, 95% CI $[-0.03, 0.01]$, $p = 0.304$), and the model did not yield a significant improvement in fit compared to Model 4c ($\chi^2(1) = 1.05$, $p = 0.306$). These results suggest that the association between sex and school belonging does not systematically vary based on national averages in teacher–student climate. All other fixed effects remained consistent with prior models (see [Supplementary Table 3](#) for Models 5a, 5b, 5c results). In summary, this model provides no evidence that the sex gap in belonging is moderated by country-level teacher–student climate.

Model 5b tested whether the relationship between sex and school belonging varies across countries with different average levels of perceived school safety. This was done by adding a cross-level interaction term (γ_{11}) between sex and country-level school safety:

$$Y_{ij} = \gamma_{00} + \gamma_{10} (\text{Sex}_{ij}) + \gamma_{20} (\text{Climate}_{\text{within}, ij}) \\ + \gamma_{30} (\text{Safety}_{\text{within}, ij}) + \gamma_{01} (\text{Climate}_{\text{between}, j}) \\ + \gamma_{02} (\text{Safety}_{\text{between}, j}) + \gamma_{11} (\text{Sex}_{ij} \times \text{Safety}_{\text{between}, j}) \\ + u_{0j} + u_{1j} (\text{Sex}_{ij}) + u_{2j} (\text{Climate}_{\text{within}, ij}) \\ + u_{3j} (\text{Safety}_{\text{within}, ij}) + \epsilon_{ij}$$

The interaction was not statistically significant ($\beta = -0.006$, $SE = 0.01$, 95% CI $[-0.03, 0.02]$, $p = 0.626$), and model fit did not improve compared to Model 4c ($\chi^2(1) = 0.24$, $p = 0.626$). These results indicate that the sex gap in school belonging does not systematically differ depending on national safety climate. Model

5c tested a cross-level interaction between within-country school climate and country-average school climate (γ_{21}), evaluating whether the strength of the relationship between individual perceptions of teacher–student climate and belonging depends on the broader national climate, through:

$$Y_{ij} = \gamma_{00} + \gamma_{10} (\text{Sex}_{ij}) + \gamma_{20} (\text{Climate}_{\text{within}, ij}) \\ + \gamma_{30} (\text{Safety}_{\text{within}, ij}) + \gamma_{01} (\text{Climate}_{\text{between}, j}) \\ + \gamma_{02} (\text{Safety}_{\text{between}, j}) + \gamma_{21} (\text{Climate}_{\text{within}, ij} \times \text{Climate}_{\text{between}, j}) \\ + u_{0j} + u_{1j} (\text{Sex}_{ij}) + u_{2j} (\text{Climate}_{\text{within}, ij}) \\ + u_{3j} (\text{Safety}_{\text{within}, ij}) + \epsilon_{ij}$$

The interaction term was not significant ($\beta = -0.0024$, $SE = 0.0062$, 95% CI $[-0.01, 0.01]$, $p = 0.700$), and model fit did not improve over Model 4c ($\chi^2(1) = 0.15$, $p = 0.700$). These findings suggest that the link between individual-level perceptions of teacher–student relationship climate and school belonging is not moderated by the national average level of perceived climate.

Model 5d tested a cross-level interaction between within-country perceptions of school safety and country-level average school safety (γ_{31}), evaluating whether the individual association between feeling safe at school and school belonging is influenced by the overall safety climate of a country, through:

$$Y_{ij} = \gamma_{00} + \gamma_{10} (\text{Sex}_{ij}) + \gamma_{20} (\text{Climate}_{\text{within}, ij}) \\ + \gamma_{30} (\text{Safety}_{\text{within}, ij}) + \gamma_{01} (\text{Climate}_{\text{between}, j}) \\ + \gamma_{02} (\text{Safety}_{\text{between}, j}) + \gamma_{31} (\text{Safety}_{\text{within}, ij} \times \text{Safety}_{\text{between}, j}) \\ + u_{0j} + u_{1j} (\text{Sex}_{ij}) + u_{2j} (\text{Climate}_{\text{within}, ij}) \\ + u_{3j} (\text{Safety}_{\text{within}, ij}) + \epsilon_{ij}$$

This interaction was statistically significant ($\beta = 0.04$, $SE = 0.007$, 95% CI $[0.03, 0.06]$, $p < 0.001$), and its inclusion improved model fit over Model 4c ($\chi^2(1) = 32.95$, $p < 0.001$). This indicates that the strength of the relationship between perceived safety and belonging depends on the average safety levels in a student's country. In safer national contexts, students who personally feel safe report even greater belonging—amplifying the positive relationship.

All main effects remained consistent and significant. Individual perceptions of school climate ($\beta = 0.22$, $p < 0.001$), school safety ($\beta = 0.29$, $p < 0.001$), and sex ($\beta = 0.06$, $p < 0.001$) were strong positive predictors of belonging. Country-average school safety also had a significant direct effect ($\beta = 0.10$, $p < 0.001$), whereas country-average school climate remained non-significant ($p = 0.221$). Overall, Model 5d suggests that fostering a safe school environment not only directly supports students' sense of belonging but also strengthens the effects of individual perceptions in countries with higher baseline safety.

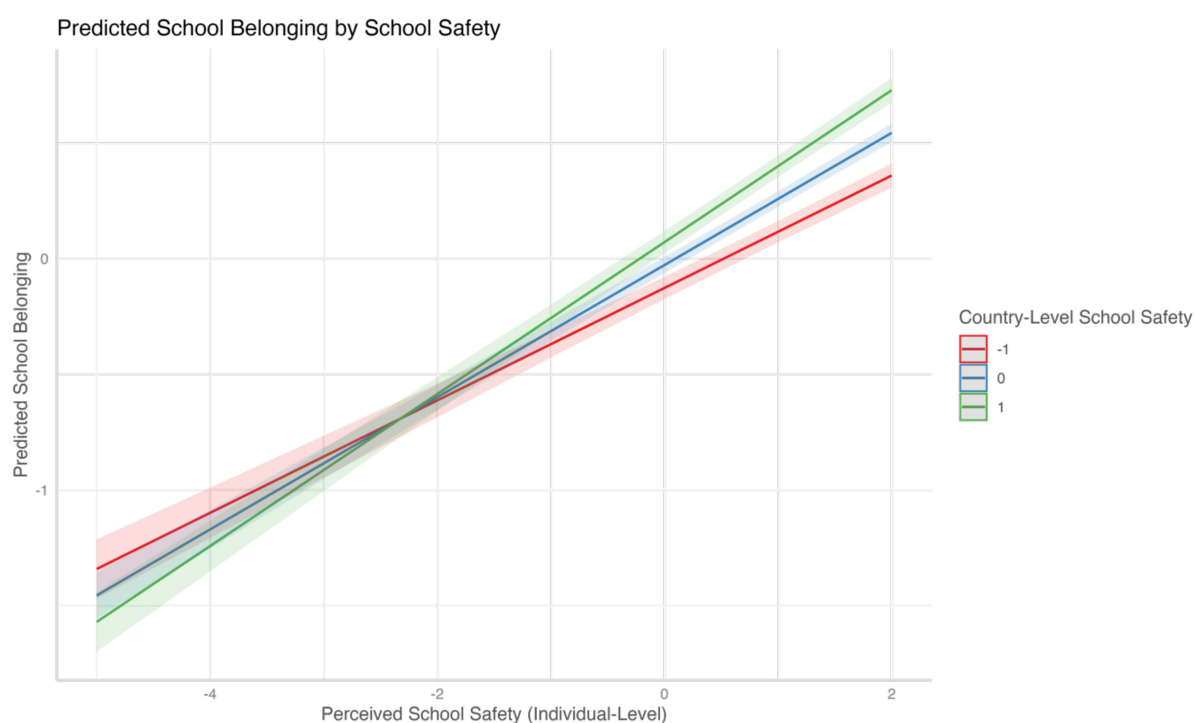


FIGURE 1
Predicted school belonging by student-perceived safety.

3.6 Model selection

Based on model comparison indices, the final model (Model 5d) was selected as it provided the best fit (AIC weight = 0.999; BIC weight = 0.999), and significantly outperformed the simpler model without the cross-level interaction between within-country (individual-level) and between-country (national-level) school safety perceptions (Model 4c), $\chi^2(1) = 32.95$, $p < 0.001$. These results indicate that the effect of perceived school safety on students' sense of belonging depends on the overall safety climate in their country.

3.7 Determinants of school belonging in final model

The results in the final model—Model 5d—show that students' sense of school belonging is strongly shaped by their personal experiences with teacher-student climate and school safety. While national context plays a smaller role, it does influence how powerful those personal experiences are, especially when it comes to feeling safe.

Students' sense of school belonging was significantly predicted by both individual- and country-level perceptions of school climate and safety. At the individual level, males reported slightly higher levels of belonging. Also, students who felt safer and perceived a more positive climate compared to peers in their own country reported stronger belonging (within effects).

At the country level, students in countries with higher average levels of safety and climate also showed higher belonging (between

effects), though the effect of climate between countries was not statistically significant. In other words, how a student views their own school climate matters more than how their country compares overall.

The interaction between within-country perceived school safety and between-country average safety was statistically significant. This indicates that the positive relationship between students' individual feelings of safety and their sense of belonging was moderated by their country's overall level of perceived safety. Figure 1 depicts this interaction. Across all contexts, higher student-perceived safety is associated with higher belonging (positive slope). However, the slope is steeper in countries with higher average safety (green line), indicating that students in safer countries gain more in belonging as their own sense of safety increases. Conversely, in less safe countries (red line), the increase in belonging with safety is shallower, suggesting a weaker link between individual safety perception and belonging.

Along the same lines, Figure 2 illustrates the varying slopes for within-country school safety across countries. While the relationship between student-perceived safety and school belonging is consistently positive, its strength differs across national contexts. Specifically, in countries where average belonging is lower, the slope is steeper, indicating that individual perceptions of safety have a stronger impact on belonging. In contrast, in countries where students already feel a strong sense of belonging on average, the slope is flatter, suggesting that individual perceptions of safety contribute less to differences in belonging.

This pattern suggests that in lower-belonging contexts, students' personal feelings of safety are particularly impactful in fostering a sense of connection to school. Conversely, in

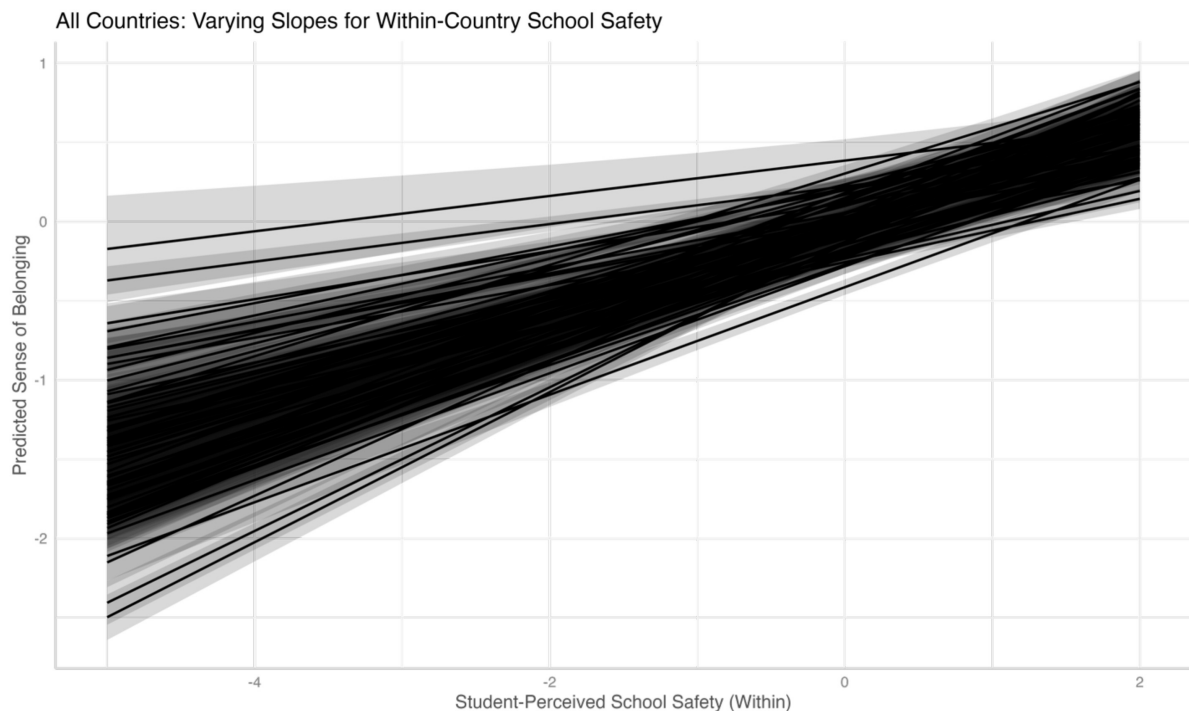


FIGURE 2
Country-specific random slopes for the within-country safety–belonging association.

high-belonging contexts, the protective role of safety appears to matter less, possibly because baseline belonging is already high across students.

As a post hoc descriptive check, we examined whether feeling safe at school relates to students' sense of belonging across broad societal contexts. We grouped countries into WEIRD and non-WEIRD categories, randomly sampled nine countries from each group, and graphed model-based predictions from the final multilevel model with country-specific random slopes (Figure 3). Two patterns emerged. First, belonging increases as students report greater safety in both societal types; all lines slope upward. Second, dispersion differs by group. In the WEIRD panel, lines are tightly clustered and nearly parallel, indicating that countries tend to begin at similar predicted belonging when safety is low and increase at a similar rate as safety rises. In the non-WEIRD panel, lines are more spread out: some countries begin higher or lower in predicted belonging at low safety, and several lines are noticeably steeper or flatter, suggesting more variation in how strongly belonging changes with safety. Concretely, in the WEIRD panel, Norway, Ireland, and Australia trace almost indistinguishable lines—similar starting points at low safety and near-parallel increases as safety rises—illustrating the group's homogeneity. In the non-WEIRD panel, Uzbekistan begins among the highest in predicted belonging and climbs rapidly across the safety range, while Uruguay and the Dominican Republic start near the bottom yet show two of the steepest slopes, suggesting that improvements in perceived safety are associated with comparatively large gains in belonging. The remaining countries cluster mid-range with varied slopes, reinforcing that dispersion in both baselines and rates of change is greater outside the WEIRD group. These plots descriptively show that the safety–belonging relationship is positive in both societal

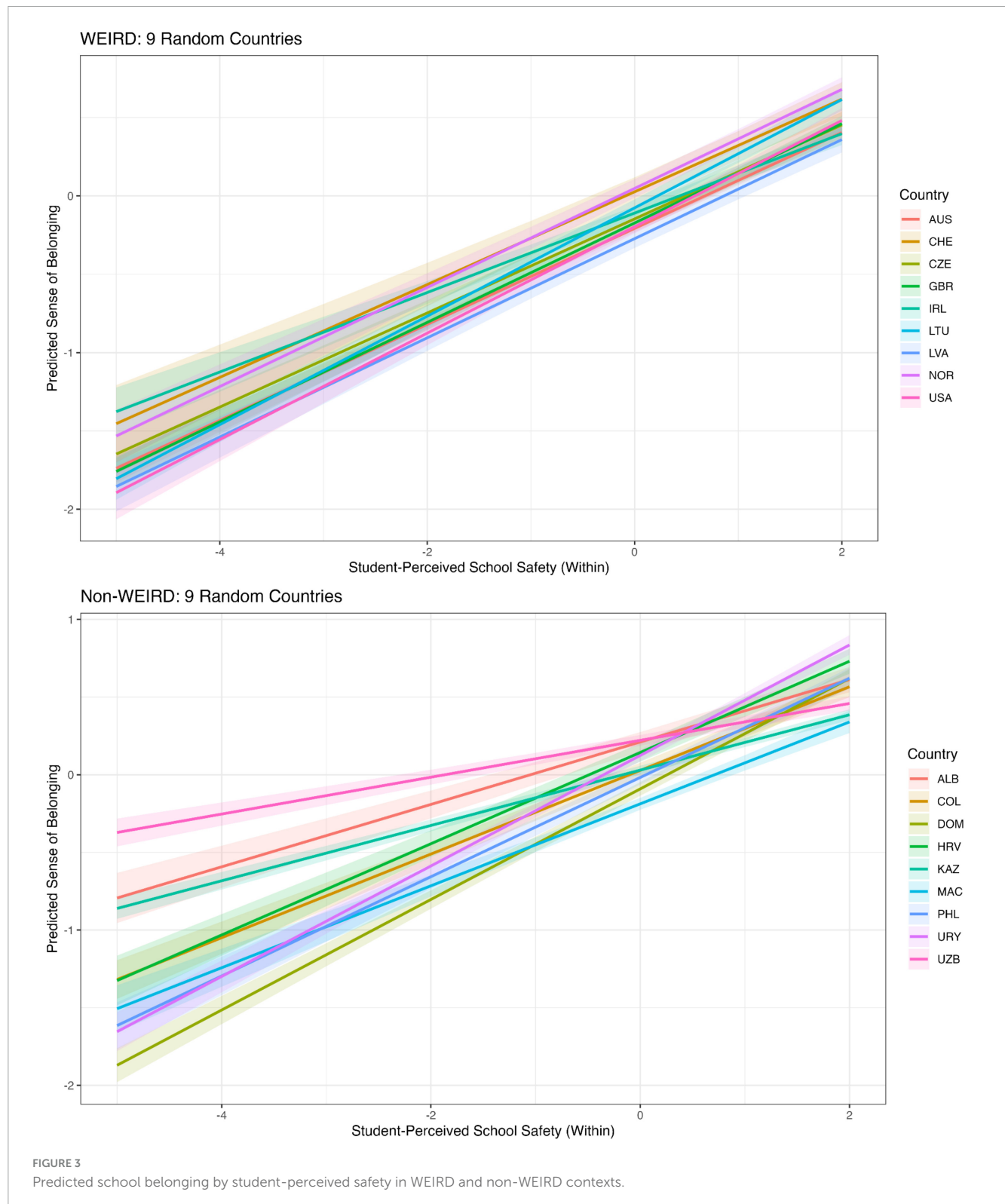
types, with overall levels and rates of change more homogeneous among WEIRD countries and more heterogeneous among non-WEIRD countries.

3.8 Evaluation of the final model

Assumptions for multilevel modeling were examined (see [Supplementary Figures 1–4](#)). Linearity was assumed based on theoretical expectations and model specifications, given rendering limitations and computational constraints with the large sample. Residuals were approximately normally distributed, as shown in the density plot. Visual inspection of the residuals versus fitted values suggested no clear evidence of heteroscedasticity, with observed banding likely due to the discrete response scale. Variance inflation factors (VIFs) were all below 2, indicating low multicollinearity. No influential outliers were detected using Cook's distance with a 0.9 threshold. Posterior predictive checks also suggested the model provided a reasonable approximation of the observed data distribution.

4 Discussion

This study examined how students' sense of school belonging is shaped by both their personal experiences and the broader school environment across 74 countries. Using data from the 2022 PISA survey, we looked at how students' perceptions of school safety and teacher–student relationships relate to belonging, and how these relationships vary across national contexts.



At the individual level, the students who felt safe at school and had positive relationships with their teachers were more likely to feel that they belonged. These findings align with previous research (Jang and Lee, 2024; Organisation for Economic Co-operation and Development [OECD], 2023), which highlighted

strong relationships between perceived safety, supportive teacher-student relations, and school belonging across the OECD countries. For example, meta-analysis evidence highlights that there is presence of moderate to strong teacher-student relationship with belonging as well as motivation across different cultural contexts

(Allen et al., 2018), while Dearth-Wesley et al. (2023) also reported consistent findings of positive teacher connection associated with school belonging across different countries and assessment cycles. In terms of sex, male students also had slightly higher levels of belonging than female students, reflecting a very small but consistent trend observed in past PISA cycles (Organisation for Economic Co-operation and Development [OECD], 2023), which does not echo other research findings, where girls tend to report higher belonging than boys (Fan and Bellmore, 2023).

At the country level, national averages in school safety, how safe schools are perceived to be across an entire country, were also linked to belonging. In other words, in safer environments, feeling personally safe may reinforce a shared sense of connection to school. In countries where students generally felt safer, students reported higher belonging overall. This relationship was also stronger in countries where average belonging was lower (see Figure 2). This interaction aligns with Bronfenbrenner (1979) ecological systems theory, which posits that developmental outcomes result from interactions between individuals and their environments. Prior research studies highlight that belonging plays a crucial role in contributing to wellbeing in adolescence. Students feeling unsafe at school show poorer classroom engagement, which may lead to an increase in depressive symptoms (Côté-Lussier and Fitzpatrick, 2016), more recent findings from PISA data confirm that personal, school and family influences wellbeing, with belonging as a significant predictor of students' overall life satisfaction (Li et al., 2025). The PISA 2022 report (Organisation for Economic Co-operation and Development [OECD], 2023) shows that students in high-performing schools not only reported stronger belonging and greater perceptions of safety, but also that the negative link between belonging and unsafe experiences at school was reduced by 36%, and further improved by 17% when teacher support was considered. While feeling safe matters across all countries, its impact varied. In some, small increases in perceived safety were linked to large increases in belonging. In others, especially where students already felt connected, the effect was smaller. This suggests that school safety plays both a protective and amplifying role, depending on the context. In low-belonging contexts, it may serve as a much-needed anchor. In high-belonging settings, safety may still matter, but its role is less pronounced. To illustrate this interaction across broader contexts, Figure 3 also showed that predicted belonging rose as students felt safer in both WEIRD and non-WEIRD settings, echoing the overall pattern. What differed was the spread of the lines: WEIRD countries seemed to cluster tightly, suggesting that similar improvements in safety tended to yield similar gains in belonging, while the non-WEIRD panel was more dispersed, indicating that the size of the gain varied more by setting. Read alongside Figure 2, this may indicate that the mechanism appears common, but its payoff is context-dependent—typically larger where baseline belonging is lower and more uniform where it is already high. Practically, the emphasis shifts from asking whether safety matters to estimating how much improvement is likely in each context. These findings echo other PISA studies where there has been a documented behavior difference among WEIRD and non-WEIRD contexts in school belonging scores (Cortina et al., 2017; Ooi and Cortina, 2023).

In contrast, country-level teacher–student relationship climate did not significantly predict belonging once individual perceptions were accounted for. Findings by Abdulhamed and Beattie (2024)

reflect that while teacher and student relationships can be beneficial, the benefits might not uniformly extend across all student groups. These contextually dependent effects underscore the complex interdependent relationship between their individual experiences and the school climate, which aligns with the multidimensional models of belonging (Jang and Lee, 2024; Jones and Fleming, 2021; Willms, 2018).

These findings have important implications for schools and policymakers. First, they show that improving students' sense of safety strongly supports school belonging. Second, in low-belonging contexts, even small improvements in safety could have large impacts. In high-belonging settings, the focus might shift to maintaining safety while investing in other aspects of school life, such as teacher support or peer relationships. This study highlights the value of using flexible models that can detect differences in patterns rather than assume they are the same everywhere. Students' experiences are shaped not only by who they are and what they feel, but also by the systems and environments in which they learn. Finally, these implications point toward the necessity of developing well-rounded policies, particularly context-specific policies, that promote school safety regardless of where or what community students attend school while implementing interventions that respond to the needs of specific communities (López et al., 2024; Thapa et al., 2013; Organisation for Economic Co-operation and Development [OECD], 2023).

5 Limitations and conclusion

While this study offers valuable insights into how safety and broader contexts relate to school belonging across countries, several limitations merit attention. First, the evidence is cross-sectional and self-reported, which precludes causal claims, since student perceptions on the variables of interest may be time-variant and affected by mood, social desirability, and cultural norms about how strongly to agree on concepts that may reflect cultural differences in interpretation. Second, our school-safety climate variable is the country-level aggregate of the PISA FEELSAFE index—an OECD scale based on a fixed set of items—rather than external, country indicators of safety; results should therefore be interpreted as relationships among perceived constructs as operationalized by the test developers (Organisation for Economic Co-operation and Development [OECD], 2023). Future work could reduce single-source bias by triangulating student reports with other publicly available data, such as the Global Peace Index (Institute for Economics & Peace [IEP], 2025). Third, we assumed measurement invariance of the PISA scales for this analysis, as established in previous PISA studies and OECD technical reports (e.g., Casas and Sireci, 2025; Organisation for Economic Co-operation and Development [OECD], 2019; Organisation for Economic Co-operation and Development [OECD], 2023). Formal tests of invariance and potential item bias are encouraged for future work but were beyond the present scope. Fourth, the WEIRD vs. non-WEIRD contrast was a post hoc, descriptive visualization; because it was not part of the original analytic plan, we did not include it as a covariate and interpret it as exploratory. Finally, although we modeled sex (and reported the small male–female difference), we did not examine other within-country

subgroups (e.g., socioeconomic status, migrant background) or incorporate policy, resourcing, or community-norm indicators; these could be integrated in multi-source or longitudinal designs. Despite these limitations, the study contributes meaningfully to our understanding of how both personal experiences and broader school environments influence students' connection to school. The results show that feeling safe at school is a consistent predictor of belonging, but the strength of that relationship varies across countries, particularly depending on national safety climates and levels of average belonging. These patterns suggest that school belonging is shaped not only by what students feel, but also by the environments they are embedded in. Supporting students' psychological safety—especially in settings where belonging is fragile—may therefore be a powerful lever for improving students' overall connection to school.

Data availability statement

Publicly available datasets were analyzed in this study. This data can be found at: <https://www.oecd.org/en/data/datasets/pisa-2022-database.html#data>.

Ethics statement

Ethical approval was not required for the study involving humans in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was not required from the participants or the participants' legal guardians/next of kin in accordance with the national legislation and the institutional requirements.

Author contributions

JE-G: Validation, Investigation, Supervision, Data curation, Methodology, Writing – review & editing, Software, Conceptualization, Visualization, Formal analysis, Writing – original draft, Project administration. SM: Methodology, Writing – original draft, Validation, Investigation, Formal analysis, Writing – review & editing. SB-B: Writing – original draft, Writing – review & editing, Investigation, Project administration, Validation, Formal analysis, Supervision.

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Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2025.1697010/full#supplementary-material>

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