Supplemental Material

CBE—Life Sciences Education

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Supplementary Materials for

Factors influencing retention of transgender and gender nonconforming students in undergraduate STEM majors

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This PDF file includes:

Tables S1 to S3

Full HGLM equation

Full logistic regression equation

List S1

Table S1.

List of STEM majors.

Life Sciences

    Biology (general)

    Biochemistry or biophysics

    Botany

    Environmental science

    Marine (life) science

    Microbiology or bacteriology

    Zoology

    Other biological science

Engineering

    Aeronautical or astronautical engineering

    Civil engineering

    Chemical engineering

    Computer engineering

    Electrical or electronic engineering

    Industrial engineering

    Mechanical engineering

    Other engineering

Physical sciences and mathematics

    Astronomy

    Atmospheric science (incl. meteorology)

    Chemistry

    Computer science

    Earth science

    Marine science (incl. oceanography)

    Mathematics

    Physics

    Other physical science

Health-related fields

    Health technology (medical, dental, laboratory)

    Nursing

    Pharmacy

Agriculture

    Agriculture

Table S2.

List of all variables included in analysis

Variable	Coding	
Student background characteristics		
TGNC		
	0	Non-TGNC
	1	TGNC
LGBQ+		
	0	Non-LGBQ+
	1	LGBQ+
URM		
	0	Non-URM
	1	URM
First generation status based on parent(s) with less than 'some college'		
	0	Non-First-
	1	First-Generation
Academic self-confidence		
Self rating: Academic ability		
Self rating: Mathematical ability		
Self rating: Computer skills		
	1	Lowest 10%
	2	Below average
	3	Average
	4	Above average
	5	Highest 10%
Pre-college academic preparation		
What was your average grade in high school?		
	1	D
	2	C
	3	C+

4	B-
5	B
6	B+
7	A-
8	A or A+

SAT math score

College experiences

Felt depressed

Sought personal counseling

Studied with other students

Felt that your contributions were valued in class

Demonstrated for a cause

Looked up scientific research articles and resources

Faculty provided an opportunity to work on a research project

Demonstrated for a cause

1	Not at all
2	Occasionally
3	Frequently

Table S3. Descriptive statistics for all variables included in analysis

Variable	Cisgender		TGNC			
	Mean	SD	*Mean*	SD	Min	Max
LGBQ+	0.09	0.28	0.81	0.39	0	1
URM	0.16	0.37	0.21	0.41	0	1
Self rating: Academic ability	4.19	0.68	4.12	0.64	1	5
Self rating: Mathematical ability	3.74	0.93	3.51	1.00	1	5
Self rating: Computer skills	3.25	0.81	3.25	0.83	1	5
What was your average grade in high school?	7.13	1.03	7.03	1.11	1	8
SAT math score	642	98	624	126	200	800
Felt depressed	1.79	0.688	2.39	0.74	1	3
Sought personal counseling	1.42	0.67	1.95	0.81	1	3
Studied with other students	2.41	0.59	2.32	0.62	1	3
Felt that your contributions were valued in class	2.34	0.60	2.25	0.70	1	3
Demonstrated for a cause	1.30	0.54	1.81	0.66	1	3
Looked up scientific research articles and	2.59	0.60	2.58	0.59	1	3
Faculty provided an opportunity to work on a research project	2.05	0.74	1.98	0.73	1	3

HGLM for full sample:

$$\ln\left(\frac{\varphi_{ij}}{1-\varphi_{ij}}\right) = \beta_{0j} + \beta_{1j} * TGNC_{ij} + \beta_{2j} * URM_{ij} + \beta_{3j} * HSGPA_{ij} + \beta_{4j} * FIRSTGEN_{ij}$$
$$+ \beta_{5j} * RESEARCH_{ij} + \beta_{6j} * STUDY_{ij} + \beta_{7j} * ARTICLE_{ij} + \beta_{8j} * VALUED_{ij}$$
$$+ \beta_{9j} * ACADABILITY_{ij} + \beta_{10j} * COUNSELING_{ij} + \beta_{11j} * DEPRESSED_{ij}$$
$$+ \beta_{12j} * BELONGING_{ij} + \beta_{13j} * DEMONSTRATED_{ij}$$
$$\beta_{0j} = \gamma_{00} + u_{0j}$$
$$\beta_{1j} = \gamma_{11}$$
$$\vdots$$
$$\beta_{13j} = \gamma_{13,13}$$

The first equation is the level 1 equation, or the student-level equation, and the other equations are the level 2 equations for each level-1 coefficient in the model, where:

- ϕ_{ij} is the probability that STEMPERSIST = 1 for the ith student at the jth institution
- βs are the level 1 coefficients
- β_{0j} is the intercept for the jth institution
- γs are the level 2 coefficients
- γ_{00} is the overall intercept
- u_{0j} is the level 2 error term

Logistic regression model for TGNC sample:

$$\ln\frac{\hat{p}}{1-\hat{p}} = b_0 + b_1 * URM_i + b_2 * HSGPA_i + b_3 * FIRSTGEN_i + b_4 * RESEARCH_i + b_5$$
$$* STUDY_i + b_6 * ARTICLE_i + b_7 * VALUED_i + b_8 * ACADABILITY_i + b_9$$
$$* COUNSELING_i + b_{10} * DEPRESSED_i + b_{11} * BELONGING_i + b_{12}$$
$$* DEMONSTRATED_i + e_i$$

In this equation:

- $\hat{p}$ is the probability that STEMPERSIST = 1
- $\ln\frac{\hat{p}}{1-\hat{p}}$ is the logit link function for the model
- b_0 is the model intercept
- bs are the values of the slopes for each independent variable
- e_i is the measurement error for case i
- Standard errors are clustered by institution to account for nonindependence

List S1.
Data collection
1. Ask study participants about gender with two items:
    a. What is your current gender identity? (e.g., man, woman, nonbinary, genderqueer, other)
    b. Do you identify as transgender?
2. Consider providing open-ended items that allow people to name gender identities (researchers should be prepared for the possibility of receiving hostile or resistant responses as well).
    a. To avoid retraumatizing TGNC researchers, when possible non-TGNC peers should filter out hostile responses

Mental Health
1. Include information on course syllabus or day 1 presentation regarding mental health policies in the course.
    a. E.g., "I recognize that mental illness is a valid sickness just like any physical illness you might encounter. Just as our course absence policy allows for you to miss class days if you are physically ill, you are also not expected to attend class on days that might require you to focus on your mental health. If you need to take time off for your mental health, you may simply inform me that you will be out sick, and you will not be penalized."
2. Familiarize yourself with campus resources regarding mental health and resilience
    a. Include these resources on course syllabi
    b. Refer students appropriately

Understand TGNC experiences
1. Engage in qualitative work that describes the experiences of TGNC students in their own words
2. Provide multiple anonymous opportunities for students to provide constructive feedback regarding the climate of the course.