

## Overview

People who hold gender essentialist beliefs tend to explain variation within and between sex/gender groups as being the product of a single internal factor, such as a gene or a hormone, or multiple internal factors (e.g., alleles) that are inherited together through a sex chromosome (1-2).

This study begins to explore how the traditional genetics curriculum may contribute to essentialism by investigating a representative sample of high school biology textbooks to answer the following research questions:

1. How often is sex and/or gender terminology used in human genetics chapters and is a distinction drawn between sex and gender?
2. How do textbooks discuss variation within sex/gender groups?
3. How do textbooks discuss variation between sex/gender groups?
4. How do textbooks explain variation within and between sex/gender groups?

## Research Methods

**Sample:** 10 chapters from six biology textbooks used in at least 2 of the 4 most populous states (CA, TX, FL, NY). We estimate 66% of high school biology classes in the US use the textbooks in our sample.

### Coding:

1. Unitize each paragraph in our sample, and index it by textbook, chapter, section, and subsection number.
2. Code each paragraph for sex and/or gender terminology
3. Apply three sets of codes to paragraphs with sex/gender terminology for...
  - the type of traits described in a paragraph
  - the type of variation described as within and/or between sex and/or gender groups.
  - how variation within and/or between sex and/or gender groups was explained and the number of causes mentioned in an explanation (single or multiple)



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## Results

### 1. How often is sex and/or gender terminology used in human genetics chapters and is a distinction drawn between sex and gender?

- 36% of paragraphs included sex and/or gender terminology.
- Of these paragraphs, none acknowledged the possibility that gender is a socially constructed identity. Nor did they differentiate between sex and gender, in any way.

### 2. How do textbooks discuss variation within sex/gender groups?

**Uniformity**  
"Men tend to be tall"

- 12% of paragraphs described **individuals of a single sex/gender group** as similar or uniform and 10% of paragraphs described **categorical differences between members of a single sex/gender group**. (The difference between these code frequencies was not statistically significant ( $\beta = 0.02$ , 95% CI [-0.03, 0.06]).
- Descriptions of continuous variation within a sex/gender group occurred in only 3% of paragraphs. (Uniformity and categorical differences were significantly more common than continuous variation  $\beta = -0.10$ , 95% CI [-0.15, -0.04], and  $\beta = -0.08$ , 95% CI [-0.14, -0.02]).

### 3. How do textbooks discuss variation between sex/gender groups?

**Differences or Discreteness**  
"Men tend to be tall whereas women tend to be short"

- **Differences between sex/gender groups** were described in 16% of paragraphs.
- **Similarities between sex/gender groups** were described in only 11% of paragraphs. (The difference between the differences and similarities code frequencies was not statistically significant ( $\beta = 0.05$ , 95% CI [-0.01, 0.11])

### 4. How do textbooks explain variation within and between sex/gender groups?

**Genes as Underlying Explanation**  
"Men and women differ in height due to differences in their genes"

- **Internal explanations** were given in 12% of paragraphs. **External explanations**, in contrast, were given in only 1% of paragraphs This difference was statistically significant ( $\beta = 0.11$ , 95% CI [0.05, 0.19]).
- We found no difference in the prevalence of single- and multiple-cause explanations. **Single-cause explanations** were given in 7% of paragraphs. Similarly, **multiple-cause explanations** were given in 7% of paragraphs. These frequencies did not differ ( $\beta = 0.0009$ , 95% CI [-0.05, 0.05]).

## Discussion and Implications

**Our results have educational implications for instructional materials developers.** Developers should define and differentiate the concepts of sex and gender. Then, when discussing biological sex, they should communicate that human sex variation is not strictly dichotomous being instead determined by multiple genetic, hormonal, and social factors (3-6).

### Instructional materials should communicate that...

- there is a tremendous amount of variability within individuals of the same sex or gender and
- that individuals belonging to different sex or gender groups overlap substantially when it comes to their gene expression, brains, behaviors, etc.
- They might also include that gender-stereotyped traits cannot be explained by genes alone—the story is far more complicated, and scientists have a limited understanding

Revising these aspects of the curriculum could help students to understand that gender disparities are not due to the different genetic essences that men and women ostensibly possess.

## Next Steps

We will conduct an experiment that explores how reasoning about sex variation and its causes influences students' genetics knowledge, perceptions of variation within and between sexes, genetic attributions for sex differences, belief in gender essentialism, field specific ability beliefs, social belonging in STEM, and future interest in STEM. Then, we will conduct a cluster randomized trial to learn how our curricular interventions interact with peer and teacher level factors to affect these same outcomes.

### Citations

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