

# Making connections: Can lexical analysis reveal students' thinking about key genetics concepts?



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## Introduction

- In biology education, student understanding of the concept of “allele” is paramount to grasping basic genetics and making critical connections to evolution.
- Analyses of student-created models are one way to evaluate what a student knows and their ideas regarding how they understand connections among related concepts.
- Analysis of student models by text analysis software is one method for quantifying the connections that students made, as well as examining the complexity of these connections.

## Methods

- Students in three sections of a large introductory biology course for majors (n=504) created models for two conceptually similar problems, one on the midterm and one on the final examination. The problems asked students to construct a model that represents relationships among fundamental concepts of genetics and evolution.
- We transcribed the short phrases and linking words students used in their models to describe the relationships between concepts.
- Student responses were then categorized based on their lexical content using SPSS Text Analysis software (SPSS 2009).

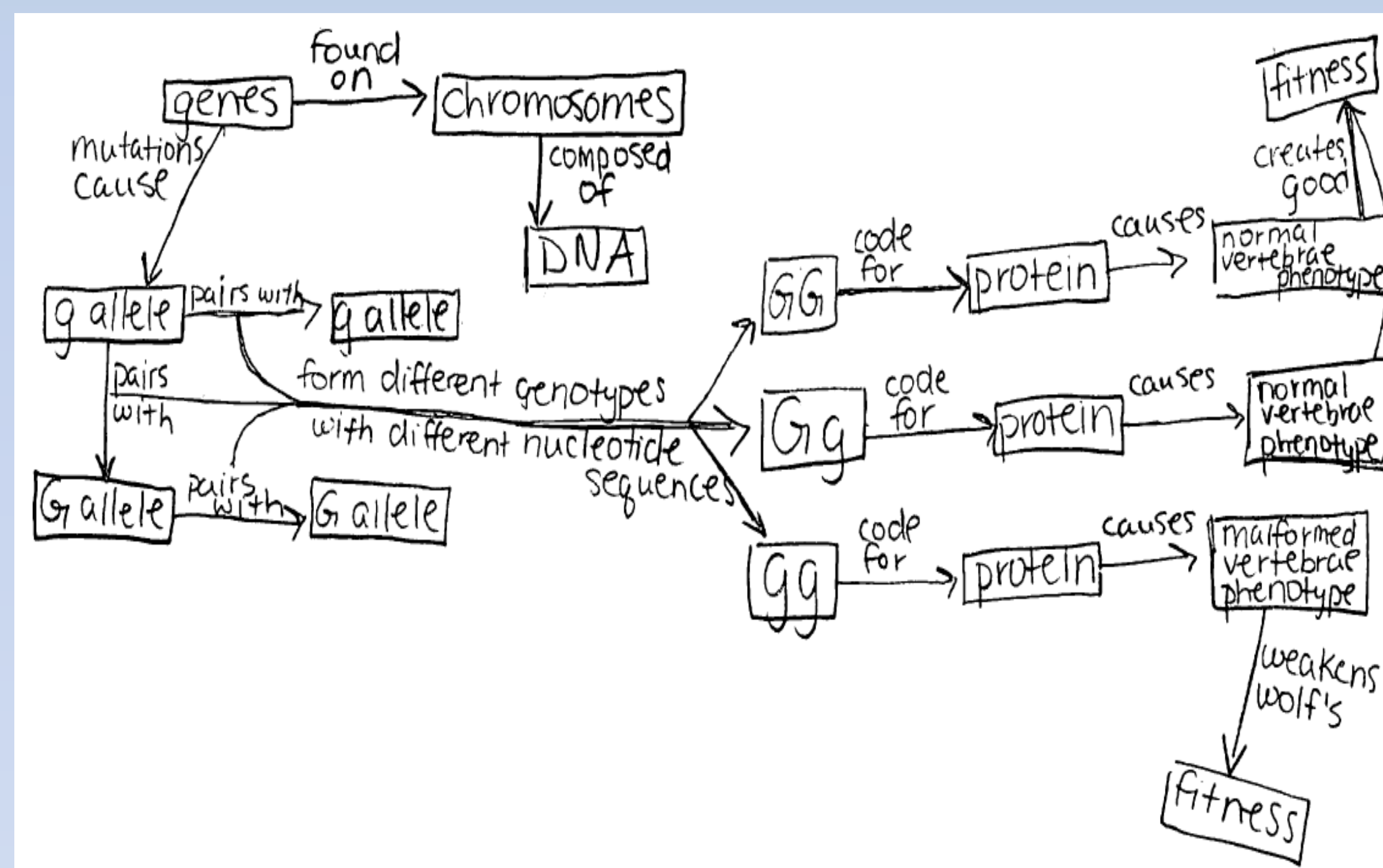


Figure 1: Example of student created model as seen on the final exam.

## Results

- From midterm and final, there was little difference in the numbers of connections students included in their models or in the pairs of concepts they chose to link (Figure 1 & Table 1).
- Category frequency within a connection remained constant from midterm to final (Figure 1 & Table 1).
- Category webs which visually illustrate the interconnectedness between categories for a certain connection show similar levels of complexity from the midterm exam to the final exam (Figure 3).
- Although students were not given any directions as to the order which they should create their models, most students tended to favor a particular directionality (Figure 2).
- For the specific connection of gene to allele, choices about the language students used was similar from midterm to final exam (Table 1); however more students used more accurate language (e.g., mutates/mutation) to describe the relationship.

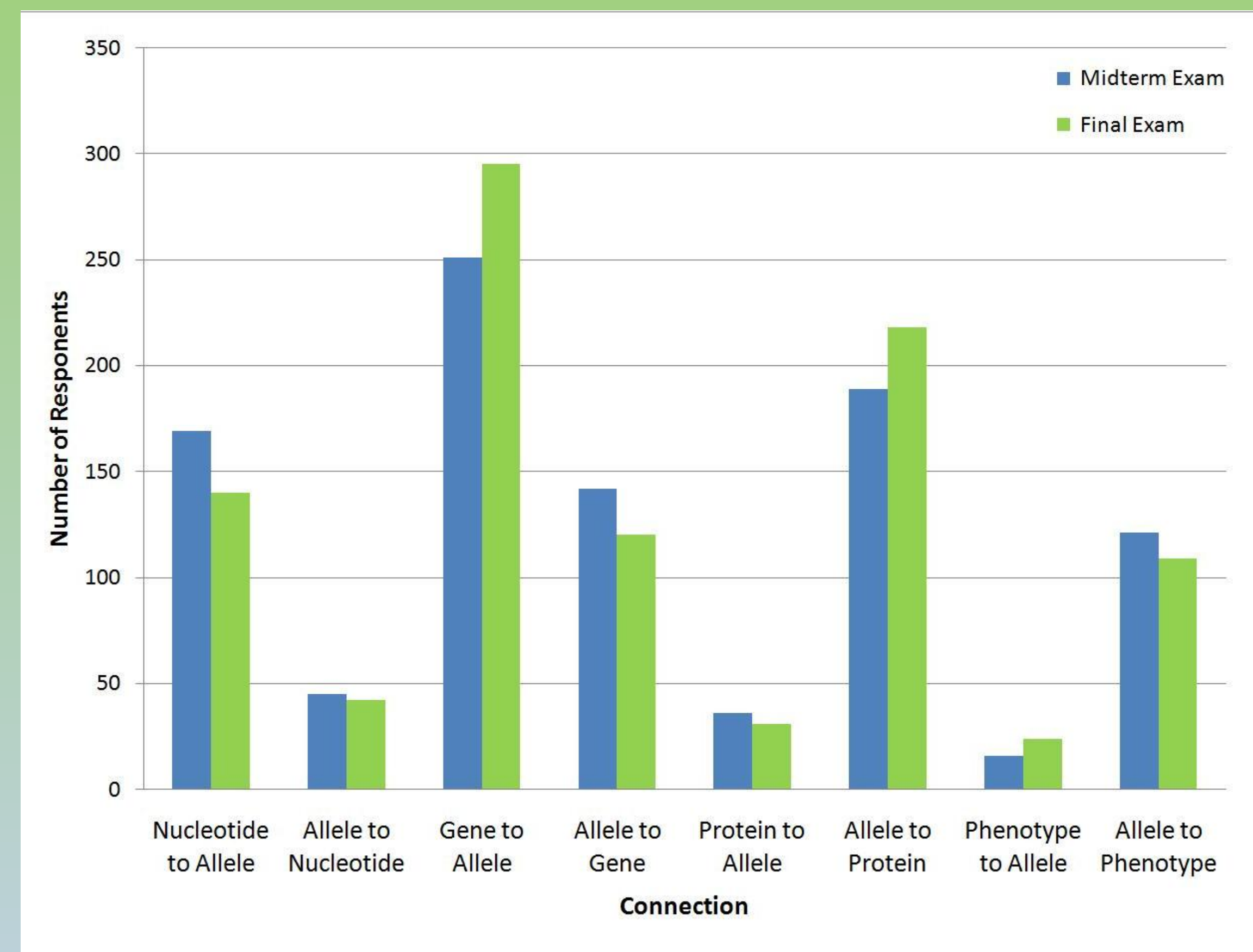
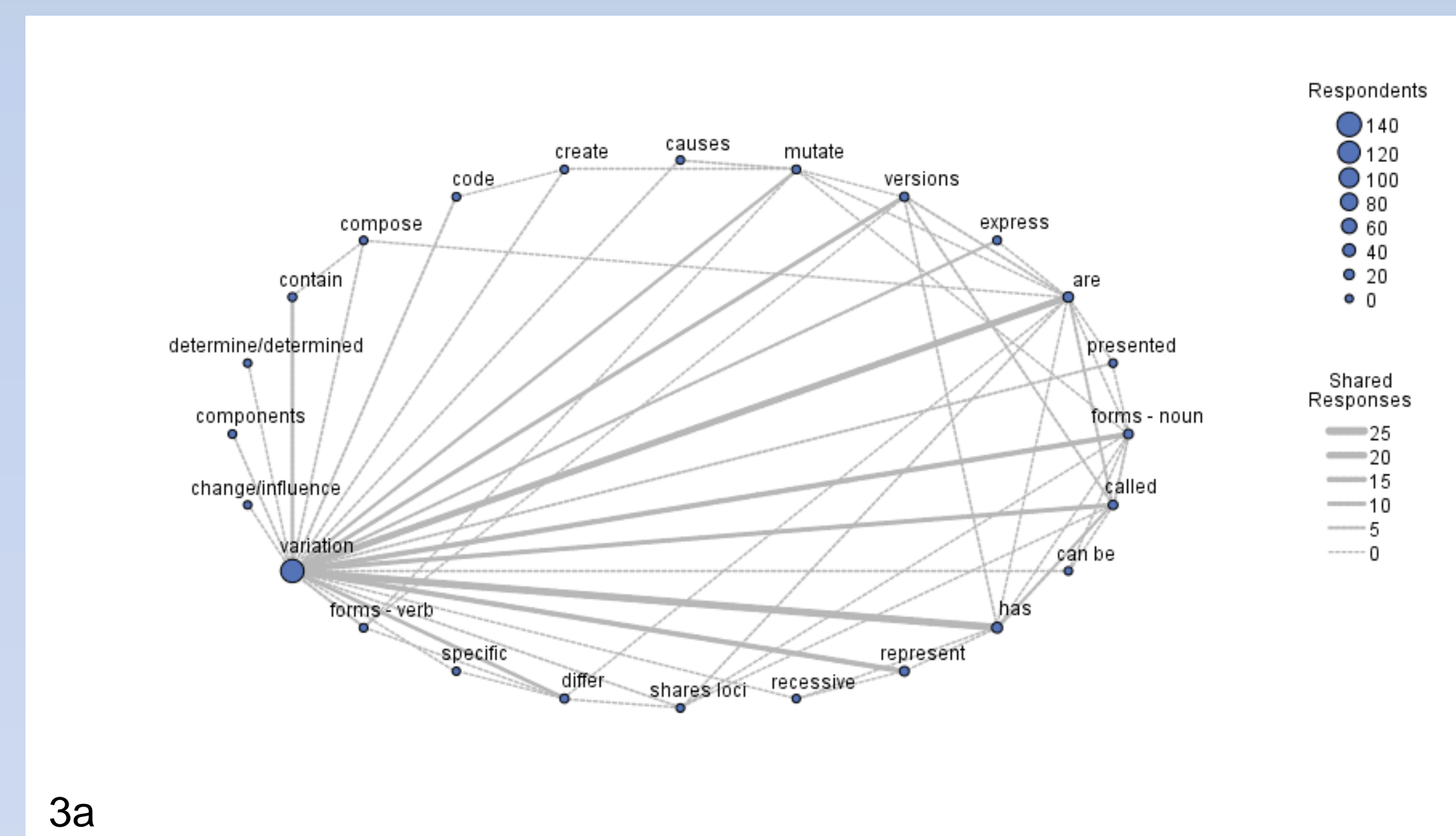
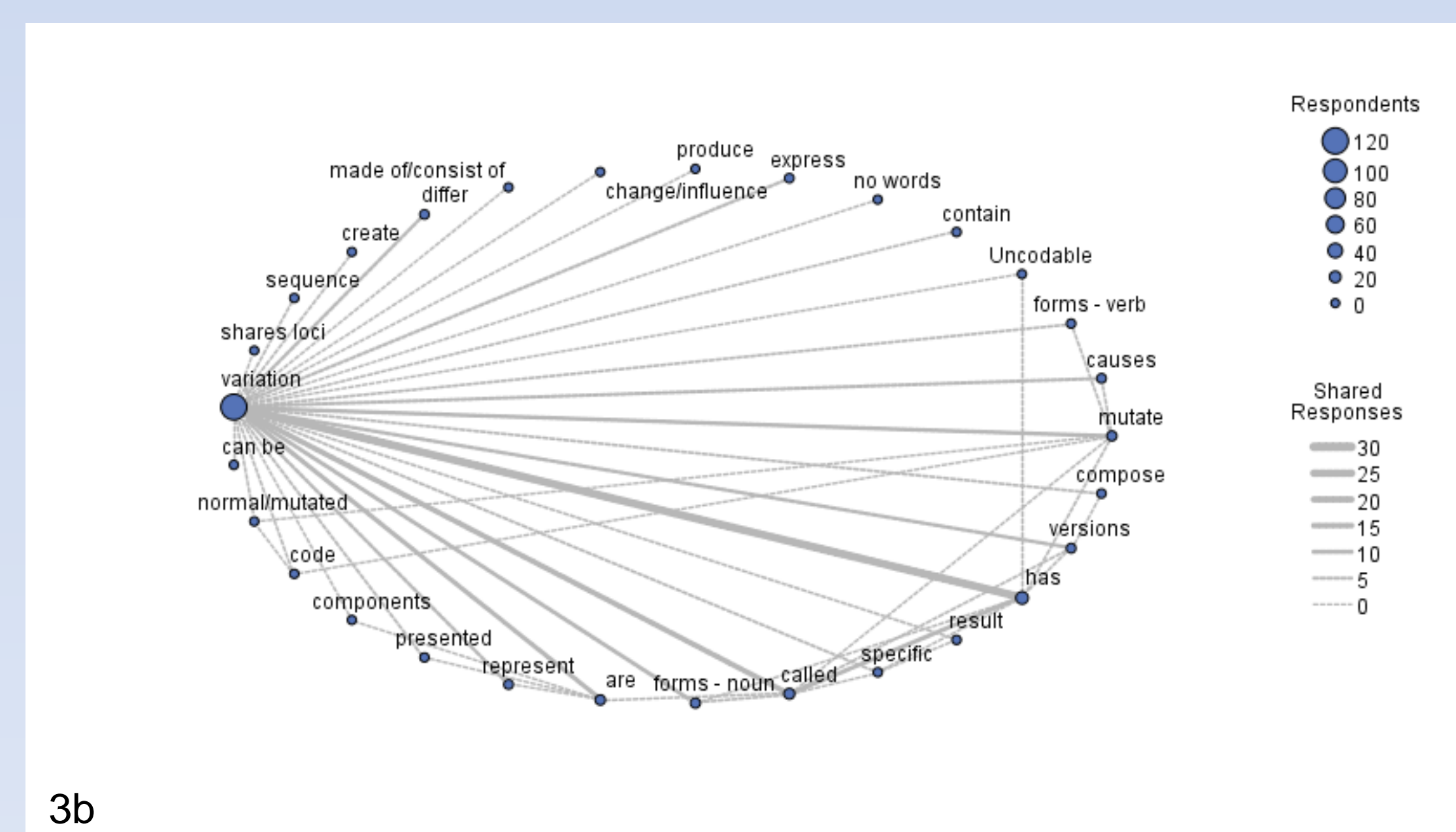


Figure 2: Number of student respondents for each connection for both midterm and final exams.



3a



3b

Figure 3: Category webs for the connection gene to allele, illustrating the interconnectedness between student responses being placed in the variation category and all others. Figure 3a was generated from the midterm data, while figure 3b is from the final.

Table 1: Frequency of student responses linking the structure gene to the structure allele by category and by exam.

Category	Exam	
	Midterm	Final
variation	120	106
mutate	27	41
has	38	31
students who made the connection without words	4	4

## Discussion and Future Research

- We have found models to be useful in providing insight into student thinking about the connections linking concepts of genetics and evolution. Our analyses here indicate consistency in the numbers and types of connections students regard as relevant when assessed at a midterm and final.
- Members of our lab are currently studying model correctness in relation to variables such as student performance, frequency of specific connections within a model, and language usage within model categories. In addition, we are using interview analyses to further explore the unidirectional bias reflected in many students' models. For example, did students learn the relationship only one way? Or, alternatively, is scale influencing students' decisions about how to arrange model components? (i.e., Do students tend to move from smaller structures toward larger structures?)
- In addition, the collaborative nature of our research has resulted in diverse tools that lend themselves to a wide array of research questions about student learning. Instructors and researchers using similar analyses can easily adapt the lexical categories and libraries we have developed.

## Reference

SPSS. 2006. Introduction to SPSS Text Analysis for Surveys. Chicago, IL: SPSS, Inc.

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