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Differences in the Way Organic Chemistry Students Categorize Molecules

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Introduction

Categorization is a fundamental ability necessary for many cognitive processes. In organic chemistry, students must establish groupings of different chemical compounds in order to not only understand course content, but also to solve problems. Classic models of categorization emphasize similarity as the primary means of categorization: if two items are similar, they belong in the same category and if they are dissimilar, they belong in different categories (Thibault, DuPont, & Anselme, 2002). These models also underscore a unidimensional mechanism of categorization where a single salient feature is used as the basis of categorization, even though multiple salient features may be present (Murphy, 2002).

For organic compound representations, saliency most commonly takes one of three forms: (1) the structure of the molecule (the longest carbon chain), (2) the functional groups (non-carbon/non-H atoms) attached to the carbon chain, or (3) the stereochemistry (the three-dimensional orientation) of the different parts of the molecule. This study examined the primary feature organic chemistry students used to categorize eight organic compounds possessing similar salient features related to structure, functional groups, and stereochemistry and how the primary feature changed over time.

Methods

Thirty-three students enrolled in either a regular or honors undergraduate organic chemistry course were given a worksheet containing pictorial representations of eight organic molecules. They were asked to categorize the molecules into two groups and provide a rationale for their groupings. This activity was repeated a total of three times over the course of the academic year (September, November, & March). The means of categorization was left open; that is, students were instructed to use a categorization scheme that made sense to them. Specific salient features of the molecules were not mentioned during the pre-task introduction.

Results

A relationship between the salient feature used to categorize the molecules and time was evident (Figure 1). A large number of students changed their means of categorization over the course of the academic year.

A difference between the students in the regular course and the honors course was also evident. The honors course students tended to demonstrate greater variability in the salient feature used for categorization.

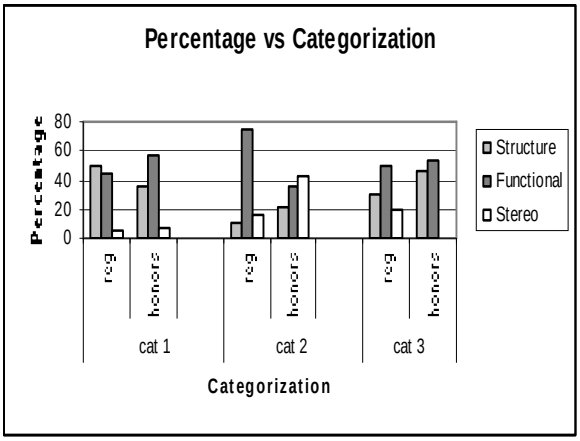


Figure 1: Percentage of students using a specific salient feature for categorization as a function of time.

These results suggest the following: (1) the perceived salient feature is not stable, but changes as student learning progresses and (2) a reason that higher-ability students (e.g., honor students) tend to be more academically successful is because they are less committed to the same salient feature. That is, they are able to alter what they perceive to be most relevant as the context of the course changes.

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