Overview of Motivation Response Types, or "Worms"

Collaborative Research: Understanding and Supporting Student Intrinsic Motivation in STEM Courses
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Jonathan Stolk, Yevgeniya V. Zastavker and Alex Dillon (Olin College)
Michael D. Gross (Wake Forest University)

Our research team has spent the past few years exploring student motivation in introductory STEM courses. We looked specifically at "situational," or activity-based, motivations in a range of institutional (small and large, public and private schools) and pedagogical settings (lecture-based, discussion-based, project-based, and hybrid courses). We asked students report on their motivations via weekly quantitative surveys and biweekly qualitative surveys.

Our quantitative characterization included clustering analysis of 7100 unique survey responses from about 1000 students enrolled in STEM courses at a range of institutions. One output of the quantitative clustering was the generation of a set of common motivational response types, or what we like to call "worms" (Figure 1).

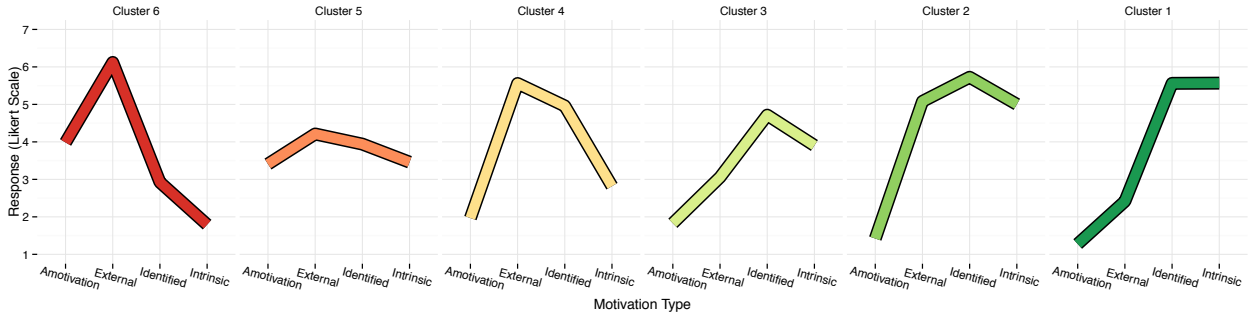


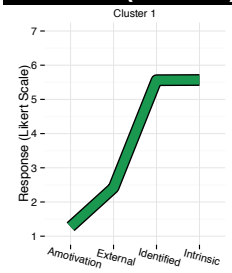
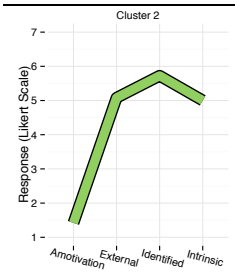
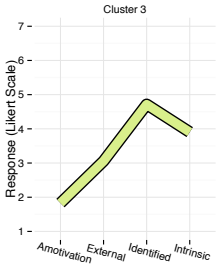
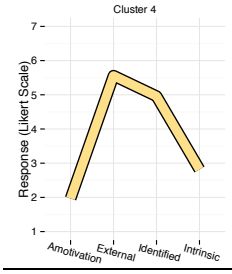
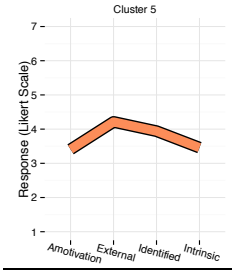
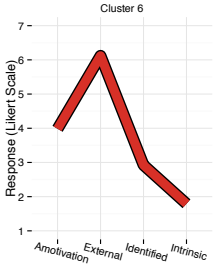
Figure 1. Common motivational response types (or "worms") found in introductory STEM courses, ordered from lowest self-determinatino (red, left) to highest self-determination (dark green, right). Curve shapes were generated from quantitative k-means clustring analysis of approximately 7100 indepenent survey responses from ~1000 students in STEM courses.

A central concept embedded in the worm graphs is that there are different types of motivation, defined by self-determination theory (SDT), that vary in their level of personal internalization. The SDT-defined types of motivation are:

- Amotivation – disconnection between action and outcome
- External – driven by a sense of external pressure or contingent reward
- Identified – driven by a sense of utility or perceived value
- Intrinsic – driven by an innate interest or enjoyment

We think the "worm" representations of motivations are interesting for a few reasons:

1. **Shapes are easier to interpret than numbers**. Each of the worms has a shape that carries significant meaning, and visually inspecting worm shapes is a lot easier than poring over a table of numerical data.
2. The worms simultaneously show four different motivational signals, so **we see a more complex perspective** on why students engage in course activities. Instead of simply labeling motivation as "intrinsic" or "extrinsic," we get to see how students might simultaneously perceive a sense of external pressure ("I have to do it") but also a sense of value ("this activity is useful to me") or enjoyment ("this activity is fun").
3. Worms provide a basis for **quickly checking how a course is going** for a large group of students, or for individuals. For example, we can look at how many green worm responses versus red worm responses after a week of class, or how the motivations of individuals or groups are shifting over time in response to pedagogy, assignments, or other contextual or personal factors.

Cluster ("worm")	Description
	High Identified Regulation and Intrinsic Motivation, and low External Regulation and Amotivation levels. This generally indicates engagement in learning for reasons of personal interest/fun/enjoyment, as well as value/importance/utility. Students in this cluster are generally very happy.
	Relatively high across the board except for Amotivation. This indicates that a student is interested in the course activity, but also is sensitive to external rewards or pressure. A student with this orientation is likely to do well in a diversity of class environments.
	Lower motivational intensity across the board, but with a positive relative balance of motivations. This cluster may indicate a student who is positively, but more passively, engaged in the class activities.
	High levels of External Regulation and Identified Regulation. This response appeared often in early pre-req classes tied to long-term goals, for example the chemistry courses required for students applying to medical school. Students understand the utility of the course activities, but they are engaging more out of obligation than innate interest.
	Moderate overall response – we call this the "blah" response, as it shows students who feel a little bit of everything, but nothing is particularly high or low. The theory suggests that motivations are not likely to be equal across the board. At times, this indicates a genuine response that simply does not match the other patterns. Responses in this cluster warrant further investigation.
	High External Regulation and Amotivation and low identified and intrinsic motivations. This generally indicates a student who is either very stressed, or is struggling to get through the class, or both.