Mindsets and the Learning Environment:
Language as Thought: Using Natural Language Processing to Investigate Mindsets, Learning Environments, and College Success
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Prior research[1] has found that high school students who participate in extracurricular activities are more likely to be successful in college. The linkage is thought to be due, in part, to the potential for extracurricular activities to be learning environments in which students can develop and demonstrate beliefs and skills that matter for college (e.g., confidence, identity, and purpose).[2]

This project used advanced analytic approaches to build on previous findings and explore the connections between extra-curricular/work experiences, psychological factors, and college success (as measured by graduating within four or six years).

The research team is also continuing to investigate how different aspects of students' high school and home learning environments affect the links between extracurricular/work experiences, psychological factors, and college success.

STUDY DESIGN

The team analyzed 150-word, open-ended written responses from the CommonApp, in which students elaborate on one extracurricular activity or work experience, to identify language related to learning mindsets and other psychological constructs. They also examined how other characteristics of extracurricular participation (in particular, number of activities, participation duration, and participation frequency), collected in another section of the Common App, related to college outcomes.

First, using a random sample of 550 responses, the researchers identified seven psychological constructs that could be identified from the open-ended responses: goal orientation, growth mindset, perseverance, psychological connection (intrinsic motivation), self-transcendent (prosocial) purpose, leadership, and team orientation.

Then, the team sampled 4,000 responses and manually coded them for these constructs. For example, the following response would be coded for endorsing a growth mindset, *"I choked during challenge matches and rode the bench for most of the season. Senior year, however, I was determined to have a successful last season. My doubles partner and I worked on our game during and out of practice and eventually took over the top doubles position. As a result of our hard work and motivation, we went on to win the doubles championship at our sectional tournament,"* whereas merely acknowledging growth (e.g., "I have grown a lot as a person") would not.

KEY FINDINGS

- This project provides evidence that language describing a significant extracurricular or work experience in students' college applications offers a lens into psychological factors important for college success, which can be captured using automated methods.

- Applicants who used language that was consistent with holding a growth mindset, having a clear goal orientation, demonstrating leadership, and adopting a self-transcendent purpose were more likely to earn a Bachelor's degree within six years.

- These findings held after controlling for sociodemographic factors, test scores, and intensity of extracurricular participation.

- Future analysis by the research team will examine the extent to which these findings vary for students in different home and school learning environments.

RESEARCH TEAM

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Areas of Expertise: cognitive science, computer science, psychology, education, human development

SAMPLE

The study leveraged data from the Common Application (CommonApp), the primary application portal for nearly 700 colleges, and the National Student Clearinghouse, where students' college enrollment and completion information is reported (together, the CommonApp-NSC). The CommonApp-NSC database contains data for more than 300,000 U.S. students, including information about demographics and students' high school environments.

student experience
RESEARCH NETWORK

Finally, the research team used a combination of natural language processing and machine learning techniques to automate the coding. This technology identifies which features of language are diagnostic of the various constructs, making it possible to complete these types of language-based analyses at scale. They trained the computer model on the initial sample of 4,000 responses and then had the computer model automatically score roughly 307,000 responses for the seven constructs.

KEY FINDINGS

Language provides a lens into psychological factors important for college success, which can be captured with automated methods.

Overall, the project was able to successfully extract information related to the seven psychological constructs from students' 150-word open-ended responses. The project successfully utilized natural language processing and machine learning techniques to code large volumes of student responses.

Applicants who used language that was consistent with holding a growth mindset, having a clear goal orientation, demonstrating leadership, and adopting a self-transcendent purpose were more likely to earn a Bachelor's degree within six years.

This is the first study relating psychological constructs derived from open-ended responses describing extracurricular/work experiences to college success. The researchers found that students who used language that was consistent with holding a growth mindset, having a clear goal orientation, demonstrating leadership, and adopting a self-transcendent purpose were more likely to earn a Bachelor's degree within six years. Importantly, these relationships were maintained despite controlling for a large number of sociodemographic, academic, and environmental factors known to robustly predict college graduation. In contrast, and somewhat surprisingly, perseverance, psychological connection (intrinsic motivation), and team orientation were not robust predictors of college graduation. The research is ongoing, however, so these findings are preliminary.

Preliminary analyses suggest consistent results for students with different racial/ethnic backgrounds, English Language Learner (ELL) status, parent marital status and education, and high school environment (Title I eligibility, racial/ethnic composition). Because the data used in the project were not a representative sample, the research team looks forward to future applications of this approach that can shed more light on the heterogeneity of the results.

Future analysis by the research team will examine the extent to which these findings vary for students in different home and school learning environments.

The research team will continue to analyze data about students' school, home, and neighborhood environments and explore how these relate to their extracurricular/work participation, learning mindsets, and college success.

INSIGHTS & FUTURE DIRECTIONS

This study, as well as future studies using similar methods, has implications for how practitioners can structure high school learning environments and college applications to best support students' long-term success.

For example, these data could provide insight into which elements of an extracurricular, work, or volunteer experience are most strongly correlated with goal orientation, growth mindset, perseverance, intrinsic motivation, self-transcendent purpose, leadership, and team orientation. Schools could, in turn, increase opportunities for the types of experiences that develop the constructs that best predict college graduation outcomes. It is important to note that the present findings are correlational and not causal, so there is additional work to be done before pursuing this application of the results.

Additionally, the results could help re-structure college applications to more accurately capture beneficial experiences, beyond extracurriculars and work, that contribute to students' development of these psychological constructs. It is widely known that there are many equity issues pertaining to extracurricular opportunities, so it is important that future essay prompts focus on other aspects of students' lives that afford them an opportunity to demonstrate these psychological factors. For example, applications might include the option for students to write about their leadership role in their family to achieve a more complete picture of students' preparation for college.

Finally, the approach demonstrates the informational value of text, even text collected a decade earlier and written in response to an evaluative prompt for a high-stakes outcome. If applied to existing archives of text, the present approach could yield valuable insights that could be used to support students in achieving success in college and beyond.

References

1. Mahoney, et al. 2003.

2. Eccles, et al. 2003; Bowers, et al. 2010.