Beliefs about enrolling in introductory geology: An application of the theory of planned behavior

Katherine Ryker, Danielle Jackson, Kevin Hurler, Jaquan High, Annie Klyce
Motivations for this study

- Introductory geology courses train an Earth science-literate citizenry and recruit majors
- Understanding of why students are attracted to geology often come from students further along in their degree or career progress
- Beliefs “are assumed to provide the cognitive and affective foundations for attitudes, subjective norms, and perceptions of behavioral control” (p. 7-8)
- Calls for more reliable, validated assessment instruments in DBER

Ajzen, 2006; Hoisch & Bowie, 2010; Gilbert et al., 2012; Houlton, 2010; LaDue & Pacheco, 2013; Levine et al., 2007; Martinez & Baker, 2006; NRC, 2012; Pugh et al., 2019; Sexton et al., 2018; Stokes et al., 2015
My parents would approve of me taking geology, and that matters to me.

The Theory of Planned Behavior (Ajzen, 1991)

Behavioral Intentions

“I intend to enroll in this geology course this semester”

Actual Behavioral Controls

Sections are full or cancelled, financial aid falls through

Behaviors

Enrolling in this geology course this semester

Behavioral Beliefs → Attitudes

“Geology is fun, interesting, etc.”

Normative Beliefs → Subjective Norms

“My parents would approve of me taking geology, and that matters to me.”

Control Beliefs → Perceived Behavioral Controls

“I believe I can fit this geology course into my schedule.”

UofSC
Thematic analysis of open-ended responses by authors 1 and 2, followed by expert review resulted in a preliminary pool of 40 semantic differentials, about half of which were negatively worded.

I (strongly like/strongly dislike) taking science courses.

This geology class is (much more/much less) interesting than other lab science courses, like chemistry and biology.

Convenience sample of physical geology students at a large, public research university in the Southeast.

Data were screened for consent and requested response to an attention check. Comments examined for any questions about the survey.

Comparison of Spring and Fall 2020 data - similar demographics.

Data split randomly in half for EFA and CFA. (n = 535)

Data met appropriate assumptions for factor analysis (KMO = .840; χ² (780) = 3546.477, p < 0.001)

Methods: Two-phase, qualitative-then-quantitative design

Initial open-ended survey

Initial survey of semantic differentials

Revised open-ended survey

Revised survey of semantic differentials

Revised survey

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Demographics (n = 755)

**Age**
- 18-19: 4.91%
- 20-21: 20.04%
- 22-25: 74.48%
- Older than 25: 0.38%
- Prefer not to say: 0.19%

**Gender**
- Male: 41%
- Female: 58%
- Other: 1%
- Prefer not to say: 0%

**Academic Rank**
- Freshman: 11%
- Sophomore: 54%
- Junior: 30%
- Senior: 0%
- Other: 0%
- Prefer not to say: 0%

**Racial/Ethnic Makeup**
- Black or African American: 4%
- Hispanic of any origin: 4%
- Native American or Alaskan Native: 3%
- Native Asian: 6%
- Native Hawaiian or Other Pacific Islander: 4%
- Non-Hispanic White: 80%
- Prefer Not to Say: 1%
- Some Other Race: 1%
- Two or More Races: 1%
- Other: 0%
## Methods: Phase I, Qualitative

<table>
<thead>
<tr>
<th>Belief Type</th>
<th>Open-ended survey question</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioral</td>
<td>What did you see as the ADVANTAGES to enrolling in this geology course this semester?</td>
<td>112</td>
</tr>
<tr>
<td>Behavioral</td>
<td>What did you see as the DISADVANTAGES to enrolling in this geology course this semester?</td>
<td>110</td>
</tr>
<tr>
<td>Behavioral</td>
<td>What else came to mind when you were considering enrolling in this geology course this semester?</td>
<td>108</td>
</tr>
<tr>
<td>Normative</td>
<td>Please list the individuals or groups who would have APPROVED (or did) or thought you should have enrolled in this geology course this semester.</td>
<td>76</td>
</tr>
<tr>
<td>Normative</td>
<td>Please list the individuals or groups who would have DISAPPROVED (or did) or thought you should not have enrolled in this geology course this semester.</td>
<td>76</td>
</tr>
<tr>
<td>Normative</td>
<td>Sometimes, when we are not sure what to do, we look to see what others are doing. Please list the individuals or groups who you believe were MOST likely to have enrolled in this geology course this semester.</td>
<td>76</td>
</tr>
<tr>
<td>Normative</td>
<td>Please list the individuals or groups who you believe were LEAST likely to have enrolled in this geology course this semester.</td>
<td>76</td>
</tr>
<tr>
<td>Control</td>
<td>Please list any factors or circumstances that made it EASY or enabled you to enroll in this geology course this semester.</td>
<td>32</td>
</tr>
<tr>
<td>Control</td>
<td>Please list any factors or circumstances that made it DIFFICULT or could have prevented you from enrolling in this geology course this semester.</td>
<td>32</td>
</tr>
</tbody>
</table>

220 students, 698 responses
Methods: Phase II, Quantitative

- **Behavioral**
  - This geology class is (much less/more interesting) than other lab science courses, like chemistry and biology.
  - Earning a lab credit was (not at all/very important) to me when deciding to take this geology class.

- **Normative**
  - The people in my life whose opinions I value would also take this geology class this semester, were they in my position. (Strongly disagree/agree)
  - People who influence my behavior would (strongly disapprove/approve) of my taking this geology course this semester.

- **Control**
  - It was (very difficult/easy) for me to fit this geology class into my schedule this semester.
  - The online enrollment system made it (very difficult/easy) to take this geology class this semester.

...and 34 more.
Methods: Factor Analyses

- Confirmed appropriate sample size
- KMO = .812; $\chi^2 (780) = 3428.160, p<0.001$
- Scree test to determine the number of factors
- Promax rotation (oblique) with a 0.4 loading cutoff
- **Initial EFA**: 43.2% of the cumulative variation, five factors; no cross-loading items, but 11 items did not load onto a single factor and were removed.
- **Final (third) EFA**: 52.6% of the cumulative variation, five factors; no cross-loading items

Costello & Osborne, 2005; Henson & Roberts, 2006; Mundfrom et al., 2005; Pearson and Mundfrom, 2010; Worthington & Whittaker, 2006
## Results: EFA

<table>
<thead>
<tr>
<th>Factor</th>
<th>Theory of Planned Behavior</th>
<th>Variance Explained</th>
<th>Number of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Other beliefs (TBD)</td>
<td>Mix of attitudes, subjective norms, and perceived behavioral controls</td>
<td>22.9%</td>
<td>11</td>
</tr>
<tr>
<td>2: Personal benefits and love of (Earth) science</td>
<td>Attitudes</td>
<td>12.6%</td>
<td>8</td>
</tr>
<tr>
<td>3: Students like me and “the other class”</td>
<td>Subjective Norms, Attitudes</td>
<td>6.3%</td>
<td>5</td>
</tr>
<tr>
<td>4: Autonomy</td>
<td>Perceived Behavioral Controls</td>
<td>5.7%</td>
<td>2</td>
</tr>
<tr>
<td>5: Professor</td>
<td>Attitudes</td>
<td>5.2%</td>
<td>2</td>
</tr>
</tbody>
</table>
## Factors 4 and 5: Autonomy and the Professor

<table>
<thead>
<tr>
<th>Factor 4: Autonomy</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>I had a choice of whether I took a science course this semester. (1 Strongly disagree, 7 Strongly agree)</td>
<td></td>
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<tr>
<td>Enrolling in this geology class this semester was entirely up to me. (1 Strongly disagree, 7 Strongly agree)</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Factor 5: Professor</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>RateMyProfessor (or similar) reviews were something I took into account when deciding to take this geology class this semester. (1 Strongly disagree, 7 Strongly agree)</td>
<td></td>
</tr>
<tr>
<td>The professor had ____ in me taking this geology class this semester. (1 No role, 7 A large role)</td>
<td></td>
</tr>
</tbody>
</table>
Factor 3: Students Like Me and “The Other Class”

<table>
<thead>
<tr>
<th>Question</th>
<th>Option 1</th>
<th>Option 2</th>
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<tbody>
<tr>
<td>The people in my life whose opinions I value would also take this geology class this semester, were they in my position.</td>
<td>1 Strongly disagree, 7 Strongly agree</td>
<td>Students like me would ____ of my enrolling in this geology course this semester.</td>
</tr>
<tr>
<td>Students like me are ____ to take this geology class this semester.</td>
<td>1 Very unlikely, 7 Very likely</td>
<td>Students like me would ____ of my enrolling in this geology course this semester.</td>
</tr>
<tr>
<td>This geology class is ____ than other lab science courses, like chemistry and biology.</td>
<td>1 Much less fun, 7 Much more fun</td>
<td>This geology class is ____ than other lab science courses, like chemistry and biology.</td>
</tr>
<tr>
<td>Question</td>
<td>Response Options</td>
<td></td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>------------------------</td>
<td></td>
</tr>
<tr>
<td>Fulfilling a [general education] requirement was ____ to me when deciding to take this class.</td>
<td>(1 Not at all important, 7 Very important)</td>
<td></td>
</tr>
<tr>
<td>Earning a lab credit was ____ to me when deciding to take this geology class.</td>
<td>(1 Not at all important, 7 Very important)</td>
<td></td>
</tr>
<tr>
<td>Taking this geology course will help me in my career.</td>
<td>(1 Strongly disagree, 7 Strongly agree)</td>
<td></td>
</tr>
<tr>
<td>The relationship to my field of study was ____ to me when deciding to take this class.</td>
<td>(1 Not at all important, 7 Very important)</td>
<td></td>
</tr>
<tr>
<td>Learning more about rocks and minerals was ____ to me when deciding to take this class.</td>
<td>(1 Not at all important, 7 Very important)</td>
<td></td>
</tr>
<tr>
<td>The main reason I am taking this geology class this semester is that I am interested in knowing more about the Earth.</td>
<td>(1 Strongly disagree, 7 Strongly agree)</td>
<td></td>
</tr>
<tr>
<td>Feeling more connected to the Earth and environment was ____ to me when deciding to take this class.</td>
<td>(1 Not at all important, 7 Very important)</td>
<td></td>
</tr>
<tr>
<td>I ____ taking science courses.</td>
<td>(1 Strongly dislike, 7 Strongly like)</td>
<td></td>
</tr>
</tbody>
</table>
## Factor 1: Other Beliefs (TBD)

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<th>Statement</th>
<th>Scale Options</th>
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<tbody>
<tr>
<td>I will be successful in this geology course this semester.</td>
<td>(1 Strongly disagree, 7 Strongly agree)</td>
</tr>
<tr>
<td>I believe this professor is ____ than other geology professors teaching the same course.</td>
<td>(1 Much less caring, 7 Much more caring)</td>
</tr>
<tr>
<td>I will ____ taking this geology course this semester.</td>
<td>(1 Not at all enjoy, 7 Greatly enjoy)</td>
</tr>
<tr>
<td>Taking this geology course will ____ my GPA.</td>
<td>(1 Greatly hurt, 7 Greatly help)</td>
</tr>
<tr>
<td>I will benefit from enrolling in this geology class this semester.</td>
<td>(1 Strongly disagree, 7 Strongly agree)</td>
</tr>
<tr>
<td>The number of events outside of my control that helped me take this geology course this semester were ____.</td>
<td>(1 Very numerous, 7 Very few)</td>
</tr>
<tr>
<td>The online enrollment system made it ____ for me to take this geology class this semester.</td>
<td>(1 Very difficult, 7 Very easy)</td>
</tr>
<tr>
<td>For me to take this geology class this semester was _____.</td>
<td>(1 Very difficult, 7 Very easy)</td>
</tr>
<tr>
<td>The people in my life whose opinions I value would ____ of my enrolling in this geology class this semester.</td>
<td>(1 Strongly approve, 7 Strongly disapprove)</td>
</tr>
<tr>
<td>People who influence my behavior would ____ of my taking this geology course this semester.</td>
<td>(1 Strongly disapprove, 7 Strongly approve)</td>
</tr>
<tr>
<td>My advisors would ____ my decision to take this geology course this semester.</td>
<td>(1 Strongly disapprove, 7 Strongly approve)</td>
</tr>
</tbody>
</table>
Future Work & Questions

Katherine Ryker, kryker@seoe.sc.edu

Interested in using the BaSIC-Geo I in your class this Spring? Please contact me!