Engineering Survivors: Students Who Persist in Engineering Through an Academic Setback

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Abstract

This work in progress is a qualitative study that explores the academic experience of undergraduate engineering students who persist in engineering despite an academic setback. This work is part of a larger study exploring the concept of grit for engineering students. Our sample population consists of engineering students who have earned a D or F in a required technical course but continue to persist in engineering. We use phenomenography as our methodology to describe the various ways in which engineering students respond to academic setbacks. We constructed four, qualitatively distinct categories based on our preliminary results. The finished analysis will provide insights to improving the retention of engineering students by understanding how to better support engineering students who have experienced academic setbacks.

Introduction

In the United States, only 57% of students who start as freshmen in engineering complete their baccalaureate degrees in engineering¹. Reasons for this attrition among engineering students have been studied for many years. Seymour and Hewitt² found two main reasons for departures from the sciences: disinterest or disappointment in field, and poor academic performance with subsequent loss of self-efficacy. Haag et al.³ also found that poor academic advising, unapproachable faculty, and complicated engineering curricula were important institutional contributors to student attrition. Although poor academic performance may motivate some students to leave engineering, other students persist despite these academic setbacks. In this paper, rather than focusing on students who leave engineering, we focus on students who persist in engineering despite academic setbacks. These persisting students seem to have a quality that has recently been called “grit.”

Grit⁴ is defined as “perseverance and passion for long-term goals” (p. 1087). For this study, we interpreted the perseverance aspect of grit’s definition to mean persisting in an engineering major through academic setbacks, and we defined academic setback as having received a failing grade in a required technical course. We expect the results to provide insight into why these engineering students persist despite academic setback and to help determine whether grit plays a role in the retention of these students. This study is part of a larger study where we explore the concept of grit and whether grit can be applied to the undergraduate engineering student population, or more specifically, retention in engineering. The larger study uses a sequential explanatory mixed methods approach where qualitative methods are used to explain earlier quantitative results. This paper presents the preliminary results from the qualitative side of our mixed methods. These qualitative results will be very insightful as there have been no previous qualitative studies on grit. Furthermore, we hope the results of the completed work will help improve the retention of engineering students either by preventing potential academic setbacks or by better supporting students who have experienced academic setbacks.
Background Literature

Grit was coined by Duckworth et al.\textsuperscript{4} to describe individuals who accomplish more than others of equal intelligence. The Grit Scale has two subscales: consistency of interest and perseverance of effort. They are measured using a 5-point Likert scale from “Not like me at all” to “Very much like me.” In their study, grit predicted the retention of freshmen cadets through the rigorous summer training program at the U.S. Military Academy (West Point) better than self-control, Conscientiousness (one of the Big Five personality traits), and Whole Candidate Score (a weighted composite of high school rank, SAT score, Leadership Potential Score, and Physical Aptitude Exam used by West Point’s admissions committee)\textsuperscript{4}. The first summer training at West Point (also referred to as Beast Barracks) was designed to test the limits of cadets’ capacities physically, emotionally, and mentally. Though West Point’s summer training is not considered equivalent to a full academic year of engineering, there have been previous studies that were interested in seeing whether grit could be applied to the retention of first-year engineering students\textsuperscript{5,6,7}. The main reason why we chose persisters of academic setback as our target sample in engineering was because “grit entails working strenuously toward challenges, maintaining effort and interest over years despite failure, adversity, and plateaus in progress” (p. 1087-8)\textsuperscript{4}. This “maintaining effort despite failure” mentality can be seen in Dweck’s theory of mindsets, or students’ implicit theories of intelligence.

There are many studies that connect mindset research with academic resilience\textsuperscript{8}. According to Dweck, there are two psychological worlds for students, one for each implicit theory of intelligence, where one promotes resilience and the other does not\textsuperscript{9,10}. The entity theory of intelligence, or “fixed mindset”, depicts a world where everything measures the student’s ability (challenging tasks, effort, setbacks); the student sees a world of threats and puts up a defense. The incremental theory of intelligence, or “growth mindset”, depicts a world where everything is seen as being helpful to learn and grow (challenging tasks, effort, setbacks); the student sees a world of opportunity to improve. Blackwell, Trzesniewski, and Dweck\textsuperscript{11} found that students’ implicit theories of intelligence predicted their academic performance over time, particularly when they faced challenging work. Based on these findings, we included Dweck’s theory of mindsets in our exploration of gritty behavior.

To conduct our exploration of gritty behavior, we chose phenomenography as our qualitative methodology. Phenomenography takes the second-order perspective where the researcher describes an individual’s experience of the world, or “content-oriented and interpretive descriptions of the qualitatively different ways in which people perceive and understand their reality” (p. 177)\textsuperscript{12}. Since the goal of the larger study was to explore grit for engineering students, we thought a phenomenographical approach was appropriate to understand how students themselves perceive, experience, and understand persistence in engineering, specifically in the context of their academic failure. By capturing the wide variety of engineering students’ responses to academic failure, we can better understand how students’ perception of failure influence their decision to persist in engineering despite their academic failure. Our methodology followed phenomenography described by Bowden and Green\textsuperscript{13} (see the Data Analysis section
Our research question is the following: “What are the variety of ways engineering students respond after experiencing an academic setback?”

**Methods**

**Recruitment**

During Spring 2015, we mass emailed all undergraduate students in the college of engineering at a large public university inviting them to participate in a one-hour, semi-structured interview and offered a compensation of $10 for their time. We specified in the email that we were looking for students who were persisting in engineering after having earned a D or F in a required technical course (physics, math, computer science, or engineering course). In the email, an embedded link led students to a Google Form that allowed students to self-identify themselves by leaving their email address, student ID, and first and last name. We received 76 responses from students who responded that they were interested in being interviewed. We conducted 26 interviews throughout April and May 2015 with all the students who maintained contact in follow-up emails and showed up for scheduled interview appointments. Interview consent forms were emailed to the potential participants before their scheduled interview appointment. Additional consent forms were offered in-person in case the participant did not fill out the consent form beforehand. Consent forms were collected at the beginning of the appointment. Next, participants were asked to complete a quick survey that consisted of the 12-item Grit Scale and a demographic questionnaire, which together took no longer than five minutes. All the interviews were audio-recorded and transcribed. The lengths of the interviews ranged from 32 to 97 minutes, with a median length of 66 minutes. Sample interview questions appear in the appendix. The author conducted all the interviews and transcribed 17 of them. The rest of the interviews were transcribed with the help of undergraduate researchers.

The procedures for this study were approved by the local International Review Board (IRB Protocol #15196).

**Participants**

These 26 participants represented a range of academic levels, engineering disciplines, and demographics (see Table 1). All of the participants’ information was self-reported. Participants’ academic levels varied from first-year to fifth-year. Among traditional aged students, there were three first-year students, six second-year students, six third-year students, six fourth-year students, and two fifth-year students. In addition, there were three non-traditional students who were older than 23 years of age: one second-year student and two fourth-year students. Out of fifteen engineering majors offered by the college of engineering, twelve were represented by at least one student and by four students at most. Among the participants, there were nine females and 17 males. Also, there were seven international students (one Black, one Hispanic, and five Asians) and 19 domestic students (one Black, one Hispanic, five Asian, and 12 White). Though female and international students were overrepresented, overrepresentation was not a concern since the purpose of phenomenography was to describe participants’ varied experiences rather than to generalize an experience across the entire population.
Table 1. Self-identified demographics of interview participants listed in the order in which they were interviewed

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Academic Level</th>
<th>Engineering Major</th>
<th>Gender</th>
<th>Ethnicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam</td>
<td>4th year</td>
<td>Aerospace</td>
<td>Male</td>
<td>Asian</td>
</tr>
<tr>
<td>Ben</td>
<td>4th year</td>
<td>Civil</td>
<td>Male</td>
<td>White</td>
</tr>
<tr>
<td>Cathy</td>
<td>2nd year</td>
<td>Electrical</td>
<td>Female</td>
<td>Asian (International)</td>
</tr>
<tr>
<td>Dan</td>
<td>4th year</td>
<td>Aerospace</td>
<td>Male</td>
<td>Black</td>
</tr>
<tr>
<td>Evan</td>
<td>2nd year</td>
<td>Civil</td>
<td>Male</td>
<td>Hispanic (International)</td>
</tr>
<tr>
<td>Felix*</td>
<td>2nd year</td>
<td>Industrial</td>
<td>Male</td>
<td>White</td>
</tr>
<tr>
<td>Greg</td>
<td>2nd year</td>
<td>Chemical</td>
<td>Male</td>
<td>White</td>
</tr>
<tr>
<td>Hugo</td>
<td>3rd year</td>
<td>Computer</td>
<td>Male</td>
<td>Asian (International)</td>
</tr>
<tr>
<td>Ivan</td>
<td>3rd year</td>
<td>Computer</td>
<td>Male</td>
<td>White</td>
</tr>
<tr>
<td>Jane</td>
<td>3rd year</td>
<td>Computer</td>
<td>Female</td>
<td>Asian</td>
</tr>
<tr>
<td>Ken</td>
<td>2nd year</td>
<td>Mechanical</td>
<td>Male</td>
<td>Asian (International)</td>
</tr>
<tr>
<td>Lucy</td>
<td>4th year</td>
<td>General</td>
<td>Female</td>
<td>White</td>
</tr>
<tr>
<td>Max</td>
<td>5th year</td>
<td>Civil</td>
<td>Male</td>
<td>White</td>
</tr>
<tr>
<td>Nancy</td>
<td>1st year</td>
<td>Chemical</td>
<td>Female</td>
<td>White</td>
</tr>
<tr>
<td>Owen</td>
<td>4th year</td>
<td>Computer Science**</td>
<td>Male</td>
<td>Asian</td>
</tr>
<tr>
<td>Pam</td>
<td>1st year</td>
<td>Mechanical</td>
<td>Female</td>
<td>Black (International)</td>
</tr>
<tr>
<td>Quinn</td>
<td>3rd year</td>
<td>Agricultural</td>
<td>Female</td>
<td>White</td>
</tr>
<tr>
<td>Ruth</td>
<td>4th year</td>
<td>Materials Science</td>
<td>Female</td>
<td>Asian</td>
</tr>
<tr>
<td>Simon</td>
<td>1st year</td>
<td>Aerospace</td>
<td>Male</td>
<td>White</td>
</tr>
<tr>
<td>Tim*</td>
<td>4th year</td>
<td>Aerospace</td>
<td>Male</td>
<td>Asian (International)</td>
</tr>
<tr>
<td>Ulysses</td>
<td>3rd year</td>
<td>General</td>
<td>Male</td>
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</tr>
<tr>
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<td>5th year</td>
<td>Mechanical</td>
<td>Male</td>
<td>White</td>
</tr>
<tr>
<td>Wayne</td>
<td>3rd year</td>
<td>Chemical</td>
<td>Male</td>
<td>White</td>
</tr>
<tr>
<td>Xavier</td>
<td>2nd year</td>
<td>Computer</td>
<td>Male</td>
<td>Asian (International)</td>
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<td>Yvonne*</td>
<td>4th year</td>
<td>Nuclear</td>
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<td>White</td>
</tr>
<tr>
<td>Zelda</td>
<td>2nd year</td>
<td>Civil</td>
<td>Female</td>
<td>Asian</td>
</tr>
</tbody>
</table>

Note: * denotes a non-traditional student (above at least 23 years of age)  
** Computer Science is a part of the College of Engineering at this institution

Data Analysis

The data analyzed in this paper were a subset of data from the larger study and are based on participants’ responses to interview questions on evaluating failure, learning from failure, and how to go through failure well (see Appendix). Before analysis began, whole transcripts were coded using the In Vivo method. In Vivo coding means that the code refers to a word or short phrase from the interview data themselves. In Vivo coding allowed the author to bracket his bias by using words directly from the interview transcript rather than creating codes with possible biases in interpretation. Whenever a word or short phrase was inadequate to capture the data, a long passage was coded as a whole. We determined that a short, ambiguous In Vivo code would delay the analysis process by forcing us to look up the actual passage, whereas the long passage would allow us to understand its context more quickly. The codes were organized into an Excel spreadsheet. The rows were labeled by the interview transcript number and the columns were labeled based on questions from the interview protocol. With the spreadsheet, the codes could easily be compared across transcripts as well as by interview questions.

Though our interview protocols were informed by grit and by Dweck’s theory of mindsets, the data themselves, rather than theory, were used to guide our analysis. Since our goal was to better understand gritty behavior of engineering students, we constructed categories based on the
different ways students responded after experiencing academic failure. In phenomenography, categories are qualitatively different from one another but can relate to one another, commonly structured through hierarchical relationship\textsuperscript{13}. To construct our categories, we read over the transcripts multiple times, making changes to our codes as we addressed ambiguity. When focusing on the subset of codes specific to a subset of interview questions, codes were always analyzed in the context of the whole interview to maintain the consistency of meaning. Additionally, we looked over notes that were taken during each interview about the participants and their particular context. We paid special attention to what participants did after failing and why they behaved that way.

As part of our future work, we will conduct a phenomenographical analysis of the data, which follows an iterative and constant comparative process where categories are continuously tested and refined with each transcript and until data saturation or redundancy is reached\textsuperscript{13}. An alternative way to confirm the closure of analysis is to test categories against negative cases or against published literature findings until categories adequately account for such cases. In this paper, we present the preliminary results from our analysis of interview data from five individuals.

**Trustworthiness**

In this section, we establish trustworthiness that is described by Lincoln and Guba\textsuperscript{15} as the process of establishing credibility, transferability, dependability, and confirmability. We are transparent with our methodology from sample selection to data analysis to establish credibility. We define our theoretical framework and our interpretations of the study to establish the context for transferability. To establish dependability, we describe our data analysis process and it is likely that another research would arrive at the same preliminary interpretation. In the future, we will increase confirmability through a more rigorous data analysis process.

**Credibility**

All participants who were interested in the interview were allowed to participate given that they responded to follow-up emails. Participants were allowed to refuse participation at any time and were given the option to not answer questions. In order to persuade participants to be honest, the author explained that their responses would be used to better understand students like them who had experienced academic setbacks in engineering and that their responses would be helpful in developing better ways to support them. We also let participants know that their responses would remain anonymous so that they would speak more freely.

For data analysis, In Vivo coding was used to help the author to bracket his bias. In Vivo coding allowed the author to code using words directly from the interview data rather than using his own words, which helped mitigate the risk of mis-constructing the social reality of the participants. When interpreting codes, codes were not interpreted in isolation but were interpreted with the whole transcript in mind to ensure the consistency of meaning based on the student’s whole perspective.

The constructed categories were created based on similarities and differences that emerged between the transcripts\textsuperscript{13}. The participants were all similar in that they were all engineering majors and that they all had an experience of receiving a D or F in a required course. They differed in what action they took after the failure and why they chose that behavior. This
outcome space of what and why was consistently applied to each transcript. We adhered strictly to interview data when developing categories to ensure that all interpretations were grounded in the data. However, the categorical structure presented here is likely to change as more transcripts are analyzed in the future.

**Transferability**

There have been no prior qualitative studies on grit and retention in engineering. The scope of this study was to explore what gritty behavior looked like in the context of academic setbacks. We chose the second-order perspective where academic setback was explained from the perspective of the student rather than the perspective of the researcher. As a result, phenomenography was an appropriate methodology to ensure that our data analysis captured the social reality of the student\(^2\). Dweck’s theory of mindsets were also based on the student perspectives. We included concepts from Dweck’s theory of mindsets because interventions designed to change students’ mindsets seemed to promote gritty behavior\(^1\). Though our results include selection bias, the goal of this study was not to generalize to the overall engineering population but to understand a specific phenomenon in a specific context, which, in our case, was engineering students persisting despite an academic setback. Bowden and Green\(^3\) would agree based on the following quote, “The set of transcripts as a whole represents a snapshot of the ways of experiencing the phenomenon by a particular group of people at a particular time and in response to a particular situation” (p. 81).

**Dependability and confirmability**

Dependability and confirmability at this point in our study cannot be fully established. However, the In Vivo coding method and our data analysis process mentioned in the Credibility section above do support the establishment of dependability, where another researcher would be likely to arrive at the preliminary results. Dependability and confirmability will be better established in the future by maintaining a rigorous data analysis process. The iterative process of interpreting the data and checking interpretations against the data is the way to most clearly establish interpretive rigor\(^3\). This process of data checking is an example of negative case analysis, which improves credibility within phenomenography but also strengthens the confirmability of our findings.

**Additional consideration**

According to Bowden and Green\(^3\), the prolonged engagement criteria is established for credibility because data collection is confined to a period of time. The researchers were only engaged with participants when setting up the interview schedule and during the interview itself. Persistent observation also became irrelevant as interviews were the sole data collected. Since interviews were the sole source of data, traditional triangulation methods were inapplicable. Instead, data analysis adhered strictly to interview data. Investigator triangulation would be possible if a team was used for data analysis. For an individual, critical peers would be consulted for feedback regarding preliminary results. These critical peers would be peers who may be, not limited to, academics, education researchers, or other phenomenographic researchers.

Regarding member checking, phenomenography focused on the collective experience of participants rather than individual experiences, and so, member checking was not necessary. The collective experience is chosen in phenomenography because variation may exist within the
individual and *between* individuals but the range of variation is likely to be encompassed by the collective range of variation *across* individuals. Another way to look at this is to see that the results are in the form of categories, or descriptions supported by excerpts across individuals, and these findings do not represent individual voices but serve as more holistic representations.

**Preliminary Results**

As mentioned previously, this work-in-progress paper focuses on five interview participants: Adam, Ben, Cathy, Dan, and Evan (refer to Table 1. in Methods section for demographics). The constructed categories were created based on similarities and differences that emerged between the transcripts. The participants were similar in that they were all engineering majors who had received a D or F in a required course. They differed in what actions they took after the failure and why they chose those behaviors. Four qualitatively distinct categories were constructed based on how engineering students experienced academic setbacks, where the distinctions between categories were based on two qualities: attitude toward academic setback and the consequent behavior towards academics (see Table 2).

<table>
<thead>
<tr>
<th>Category</th>
<th>Attitude Toward Academic Setback</th>
<th>Consequent Behavior Toward Academics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoider</td>
<td>Avoid things related to the failure</td>
<td>Discouraged to engage in academics</td>
</tr>
<tr>
<td>Ignorer</td>
<td>Failure is normal or inconsequential</td>
<td>No change</td>
</tr>
<tr>
<td>Boxer</td>
<td>Get back up and keeps going</td>
<td>Determined to change</td>
</tr>
<tr>
<td>Sleeper</td>
<td>Result of slacking off</td>
<td>Determined to change</td>
</tr>
</tbody>
</table>

**Avoider**

The first category was the Avoider. The students in this category avoided confronting the source of their failure. As a result, they chose to avoid classes or other resources that were designed to help them to improve academically. This desire to escape the source of failure was explained by their lack of emotional management. Their negative emotions were robbing them of any motivation to improve. The participants whose transcript composed this category were Adam and Cathy.

After getting those F's what do you do? Um, I was at that stage where I was looking for another major. I was sitting through the course catalog and like looking through all these majors and I'm like, ‘Oh what fits me best than what I'm doing right now?’ … The biggest thing was- I would just- I would feel so bad about my mistakes I would just not do anything about it. I would not go to class, not do anything. (Adam)

Uh, [failure] discourages me a lot. I don't wanna go to class and sit there and look stupid… I don't wanna go to my discussions because I'm afraid that I'll go there and- because in discussion we form groups, I'm afraid of being the weakest link. And, um, yeah, so it discourages me a lot. And I also just feel stupid… I think ‘Why can't you do this? Why are you stupid? I don't understand why you can't do this!’ Then I try to read from the books. And the book- the book is always so wordy! I don't understand; it's a math class, hah! So I try to read from the book but the book always has complicated notations, complicated words, and uh, so I can't understand it on my own. I think about going to office hours but I'm afraid of going to office hours and looking stupid. (Cathy)
**Ignorer**

The second category was the Ignorer. The students in this category ignored their failure by treating it as inconsequential. They would justify the failure’s insignificance through some rationalization. As a result, they would not deem it necessary to alter or change their previous academic behavior. The participants whose transcript composed this category were Adam and Dan.

If I were to get a bad grade as a freshman, initially that, for me, it's like I didn't understand what it meant. I was like, “Oh bad grade. Okay, I'll do better next time.” But I didn't know how to do better. Because for one, I was not accepting this failure. I was just saying “Oh, it's normal; college is hard.” You know, all the usual things people say. (Adam)

In engineering, like- Oh yeah! Now we're getting some of our exams. I don’t even really trip about that. It depends on how bad below the average it is, but, as far as engineering is concerned, it doesn’t affect me that much, so I’m just like I know I’m going to get through this but I don’t really trip, ‘cause, you know, a lot of classes are like, the average are always super low, so you’re like, “Ahhh, I failed,” but it doesn’t really matter if everybody else failed. (Dan)

**Boxer**

The third category was the Boxer. The student in this category did not let failure keep him down. Ben viewed failure as part of an iterative process in which the end result would be positive. As a result, he would evaluate his failure so that the next iteration would prove to be successful. He even recognized aspects of his life that contributed to his failure and quickly resolved to fix them.

[Failure] doesn't [discourage me]… I think *pause* there's a little bit of me that is afraid to fail, but there's another part of me that doesn't care… There’s a saying that goes, ‘If you fall down, get right back up and keep going,’ because, uh, the world's kinda defined by failure, hah! How like, you know, not everything happens on its first try. Like, it very rarely does and when it does that that is really cool. But like, you know, everything has multiple iterations before it's truly nice and good… I would say that after you examine how you failed, just see how you can fix it. I realized that I was spending too much time on social media and going out at night instead of studying, and I got rid of both of those. I mean I still go out, but not every night, hah! (Ben)

**Sleeper**

The fourth category was the Sleeper. The student in this category was one who felt that failure awoke him from his slumber. Evan knew what it took to succeed but at some point started to slack off. As a result, when he experienced failure, he took it as a wakeup call to change his behavior. Like the Boxer, he evaluated the causes of his failure and chose to fix them.

I would consider last semester a failure. So, I mean that, that was sort of a wakeup call… And then from that, I started to think, “What did I do wrong? What are the things that I did wrong last year” … I mean, in the moment that I fail something, in that moment, that does discourage me, I’m like, “No nooo! No no nooo!” *laughs* A couple minute of panic, no? But then, I, after I think about it a bit, then I calm down, and I start thinking
about what do I need to do to correct that, no? … The first two semesters it's like, Ahhh, it's easy, no? But the thing is, the first two semesters I used to do absolutely everything that they, that professors assigned, and all the extra credit problems, non-graded homework, I did absolutely everything, eh? And then I did well, no? I came back for another semester, I started working like I normally did, then the first round of midterms came. I did very well, then after that it's like, oh this is easy, no? I don’t need to put in much effort! So I just stopped doing all the work I used to do. I started doing the bare minimum, and then pbbbt. Down. (Evan)

And so basically you went back to doing everything? (Interviewer)

Right now? Yes. (Evan)

Discussion

There is much more work to be done in creating categories and relationships between them, especially since there are 21 more transcripts to analyze. However, in the simplest sense, the categories encompass the three basic responses emotionally and behaviorally: negative, neutral, and positive responses. The negative emotional response to failure is expected as no normal individual intrinsically enjoys failing.

The category of students who are most negatively affected by academic setback is the Avoider. The Avoider’s attitude toward failure is to avoid the things related to the failure, by skipping class for example. This attitude comports with the entity theory of intelligence, in which the student sees a world of threats and puts up a defense10. On the other hand, the category of students who view academic setback in a more positive light is the Boxer, who holds the “get back up and keep going” attitude toward failure. This attitude is consistent with the incremental theory of intelligence, which promotes resilience11. In relation to grit, it may be that the Boxer category is most gritty and the Avoider the least gritty. This relationship will have to be investigated further in future analyses.

The Ignorer category does not seem to fit mindset theory because they do not see setback as an actual setback. When considering relationships between categories, we will have to determine how to interpret the Ignorer category because it may be that Ignorer student will fall into the Avoider or Sleeper category. For example, if an Ignorer student were to become more discouraged by academic setbacks, then they may become an Avoider student and begin engaging in adverse academic behavior. The reverse example would be if an Ignorer student were to recognize that they were slacking and then begin to engage in positive academic behavior, falling into the Sleeper category. These relationships between categories will need to be investigated more thoroughly in future analyses. However, if true, this finding suggests that academic setbacks are important times to intervene and help students develop strategies prevent the same mistakes.

Students in the Sleeper category responded well to an academic setback by changing their academic behavior, just like the Boxer. However, there is a clear distinction between how the Sleeper and the Boxer view academic setbacks. The Boxer students have an ongoing process where they “get back up and keep going” whenever they face academic setbacks, whereas the Sleeper students behave inconsistently. For example, a Boxer student may have a habit of positive academic behavior, whereas a Sleeper student may not engage in positive academic
behavior regularly and only begin putting more effort when they encounter failure. In either case, students in both the Boxer and Sleeper category would most likely do well academically and would not need as much support as students in the Avoider or Ignorer category.

One thing that must be iterated is that these categories were not constructed to classify individuals: they were constructed to describe responses to academic setbacks. Quotations from Adam were used in both the Avoider and Ignorer category, but these categories were constructed to be distinctly different from each other. A student should not be classified in a fixed category forever. When Adam’s interview took place, he was in his fourth year; Adam’s quotation in the Ignorer category was recalling his attitude from freshman year. This observation confirms that students grow and change over the years.

**Limitations**

This paper focuses on data from only five of the participants, and therefore, the categories resulting from the full analysis may not be consistent with the categories presented here. The preliminary results also represent the very early stages of iteration and comparison, and therefore, these naïve categories have much more room to develop, especially in identifying the relationships between categories. The biggest limitation was that the author was performing the analysis by himself. To address this limitation in future work, the author will maintain an audit trail and discuss iterated interpretations of results with critical peers to maintain interpretive rigor and increase credibility.

**Conclusion**

The goal of this work-in-progress study was to understand the variety of ways undergraduate engineering students responded to academic setbacks using phenomenography. We produced four, qualitatively different categories that captured this variation in responses: Avoider, Ignorer, Boxer, and Sleeper. The Boxer most represented gritty students while the Avoider most represented the least gritty students. In terms of Dweck’s mindset theory, the Boxer students most likely held the incremental theory of intelligence while the Avoider students most likely held the entity theory of intelligence. We assert that these categories do not map one-to-one with any individual students as they simply describe the variety of ways in which students respond to academic setback. We will need to test our preliminary results against future iterations of data analyses to confirm, contradict, or revise our claims. The finished analysis will provide insights to improving the retention of engineering students by understanding how to better support engineering students who have experienced academic setbacks.

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References


Appendix: Subset of Questions from the Interview Protocol

- Phrase: "I can succeed if I keep learning from my failures"
  - How much do you agree with this phrase?
  - What does failure mean to you in this phrase?
- How much does failure discourage you?
- What would you do to evaluate your failures?
  - What would you do if you didn’t know how to evaluate your failures?
- What are some failures you’ve experienced in the past?
- How would you recommend someone to go through failure well?