

First-Year Engineering Student Perceptions of Calculus Exams and Future-Oriented Motivation

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Abstract

This **research paper** describes an exploratory pilot study focused on uncovering first-year engineering (FYE) students' perceptions of the purpose of taking Calculus exams and how these perceptions of Calculus exams may be interacting with their perceptions of their future as an engineer. Calculus is considered an essential tool for engineers and engineering majors are required to take a sequence of Calculus courses. In these Calculus courses, students are typically assessed via exams that constitute a majority of their course grade. Therefore, it is imperative to consider what messages Calculus exams are communicating to these students about what is valued. It is also important to consider how those messages may be interacting with students' perceptions of their future as practicing engineers. Future Time Perspective (FTP) theory can help us understand how students make connections between present tasks (i.e. Calculus exams) and their perceived futures. FTP can help interpret students' perceptions of how their experiences might affect or even mediate their academic plans for the future and their future career paths.

An initial survey was given to all FYE students currently enrolled in Calculus I at a southern, land grant, R1 institution with the open-ended question, "What do you believe is the purpose of taking Calculus exams?" The data were analyzed through two coding cycles and several themes emerged depicting how students perceive the purpose of taking Calculus exams. These themes were translated into items that then appeared on a second survey that gave the same students the opportunity to indicate their level of agreement with these perceptions on a 5-point Likert-type scale. Additionally, this second survey included items from the Math Anxiety Ratings Scale (MARS-30) to measure levels of student math test anxiety. Students were also given a survey about their future-oriented motivation in their FYE course that uses a 7-point Likert scale to assess factors including students' perceptions, connectedness, value, clarity, and alignment of their future(s). These two survey data sets were combined to allow the simultaneous exploration of both their perceptions of Calculus exams and perceptions of the future.

After collecting and cleaning the data on students' perception of Calculus exams, we performed an Exploratory Factor Analysis. We found that students see the purpose of Calculus exams in four ways: with a future oriented purpose, with a performance driven purpose, with an external purpose, or with a negative connotation. We then performed a multiple linear regression analysis using Least Absolute Shrinkage Selection Operator (LASSO) variable selection and found ways that some perception of Calculus exams factors and math test anxiety are interacting with FYE students' future-oriented motivation.

Introduction

Calculus is considered an essential tool for engineers and, therefore, engineering majors are required to take a sequence of Calculus courses [1; 2]. In these Calculus courses, students are typically assessed via exams that constitute a majority of their course grade. Therefore, it is imperative to consider what messages Calculus exams are communicating to these students and how those messages may be interacting with students' perceptions of their future as practicing engineers. Future Time Perspective (FTP) theory can help us understand how students make con-

nections between present tasks (i.e. Calculus exams) and their perceived futures. FTP can help interpret students' perceptions of how their experiences might affect or even mediate their academic plans for the future and their future career paths. We conducted an exploratory pilot study at an R1 land grant university in the southeastern U.S. that focused on uncovering first-year engineering (FYE) students' perceptions of the purpose of taking Calculus exams and how these perceptions of Calculus exams may be interacting with their perceptions of their future as an engineer and report our initial findings in this study.

Literature Review

Future-Oriented Motivation

Theoretical foundations that fit in the realm of Future-Oriented Motivation include how one has formed ideas about their future possible selves [3], how one's goals may be dependent on each other [4], and how these goals and ideas of the future influence one's decisions in the present—commonly referred to as Future Time Perspective (FTP) [5]. Formally, FTP is, “the degree to which and the way in which the chronological future is integrated into the present life-space of an individual through motivational goal-setting processes” [5]. FTP Theory helps researchers capture how a person relates their future self, including their future career paths and perceived goals, and their present actions [5; 6; 7]. Researchers have identified several sub-constructs relevant to forming one's FTP, but we will look particularly at a few domain-general aspects: *perceptions of the future*, *value*, *connectedness*, *clarity*, and *alignment* for this study.

One's *perception of the future* is related to how one thinks about their future and what their future looks like to a degree of certainty [8]. For example, in the context of engineering and this study, how confident one is about pursuing engineering gives light to how they perceive themselves as an engineer in the future. *Value* is how much importance one places on thinking about the future and their future itself [5]. If someone places importance on goals in the distant future, that may tell us this person values planning for their future. Husman and Shell define *connectedness* as “the degree to which individuals believe they can exert control over the future that is connected to current activities” [6]. *Clarity* is how one's future goals are described and to what degree they are described (ill or well defined) alongside how far these goals are in the future contribute to the degree of clarity one views their future [9]. For example, some people may have a very clear idea of what their future will look like in the next ten years which exhibits a well defined perception of the future. *Alignment* refers to how closely aligned one's ideal and realistic futures are [9]. One's ideal future is what they desire to achieve and one's realistic future is one they believe is attainable. Sometimes these ideal and realistic futures are in sync and sometimes they may be very different. In the context of an engineering student, one's ideal and realistic futures out of sync may look like a student who would enjoy working at a large engineering firm, but acknowledge that in their own reality they are more likely to obtain a job as a smaller firm. For other students, working at a large firm may also be a realistic goal as well as their desired goal, indicating their ideal and realistic futures are aligned.

Math Test Anxiety

Math anxiety is when one feels “tension and anxiety” when mathematics is involved. Test anxiety, or in particular math test anxiety, is when one experiences these same feelings of tension when thinking about, studying for, or taking a math exam [10]. While math anxiety and test anx-

xiety are correlated and both are learned conditions, math anxiety has additional contributing constructs other than math test anxiety (i.e. numerical anxiety) that indicate the two can, and should, remain separate [11; 12; 13]. In this study, we will point our focus toward *math test anxiety* in the context of preparing for and taking Calculus exams.

Research Questions

Our goal was to examine how FYE students perceive the purpose of taking Calculus exams and how those perceptions may be interacting with their perceptions of their future(s) as engineers. We will address the following research questions:

1. How do first year engineering students describe the purpose of taking Calculus exams?
2. How do first year engineering students' perceptions of Calculus exams and math test anxiety interact with their perceptions of the future?

Methods

This is a mixed methods study with a qualitative strain followed by two quantitative strains. The first qualitative strain involved coding opened ended responses from students about their perceptions of Calculus exams with structural and thematic coding techniques. The resultant codes were used to create items on a subsequent quantitative survey again assessing students' perceptions of Calculus exams as well as their levels of math test anxiety. A second quantitative survey was administered to gather data on students' future-oriented motivation. Analysis of the perceptions of Calculus exams data involved conducting an Exploratory Factor Analysis (EFA) to determine the overarching purposes students describe when thinking about taking Calculus exams. This EFA also decreased the number of variables we were working with which was beneficial when conducting our multiple linear regression analysis. The purpose of conducting a multiple linear regression analysis was to observe any relationships between FYE students' perceptions of Calculus exams and their levels of math test anxiety with their perceptions of their future.

Data Collection & Analysis

We collected data using three surveys from FYE students that were currently enrolled in a Calculus I course at an R1 land grant institution in the southeastern U.S. The first was an open-ended qualitative questionnaire with 389 responses that helped us address RQ1. We then had a total of 100 students who completed the two subsequent quantitative surveys in full, were over the age of 18, and consented to being a part of this research study that helped us address both research questions.

First Survey (Perceptions of Exams): To gain initial insight about how students perceive the purpose of taking Calculus exams, we gave an open-ended questionnaire to FYE students currently enrolled in Calculus I that asked them to respond to the question, "What do you believe is the purpose of taking Calculus exams?" After collecting 389 responses, we coded the responses to determine items for a second quantitative survey. This involved coding these opened ended responses first with a structural coding technique, followed by a transition phase, then finally a thematic coding technique. The researcher tasked with coding the data made sure to exercise the use of bracketting to avoid inserting their own assumptions and bias they may bring to the qualitative data analysis process as well as the use of memoing to ensure they were analyzing the data

effectively and building a basis for the resultant codebook.

An example of an open-ended response that resulted in being coded as *Demonstration* is a response which read, “[The purpose of taking Calculus exams is] to prove to the professor that I understood the material.” Focus on the verb *to prove* here resulted in this response being coded as *Demonstration*, one of our themes of how FYE students describe the purpose of taking Calculus exams. *Demonstration* was a category that remained fairly consistent throughout both coding cycles; however, the second cycle of coding using a thematic coding technique paved the way for more explicit codes concerning the extension of the future. For example, the following responses were both coded as the same codes, *Gain Understanding* and *Future Preparation*, in our first round of structural coding:

“[The purpose of taking Calculus exams is] to gain a solid understanding of material that will be used throughout classes later in our college career.”

“I believe [the purpose of taking Calculus exams is] to help to retain and gain information to help you with your future career.”

However, moving into the thematic coding cycle where we leaned on Future Oriented Motivation theory, we noticed differences in how these responses mentioned the future. The first seemed to only extend to the courses to come in their time in college whereas the second extends into their idea of a career post college. This second round of coding, with Future Oriented Motivation in mind, allowed us to see discrepancies behind responses that created clearer boundaries between the codes.

The emergent themes from this coding process became 14 survey items is displayed in Table 1. These themes were checked and discussed within the research team as a means of procedural validity [14]. These 14 items were asked on a quantitative survey sent to all FYE students enrolled in Calculus I at this institution where they were asked to mark their level of agreement on a Likert scale (1- disagree and 5- agree).

Table 1: Perceptions of Calculus Exams Survey items and the code the items emerged from during qualitative analysis

Survey Item	Code
A purpose of taking Calculus exams is to ensure a student understands the material.	Accountability
A purpose of taking Calculus exams is to assess how well a student is able to understand the material.	Assess Ability
A purpose of taking Calculus exams is to assess a students' understanding of the material.	Assess Understanding
A purpose of taking Calculus exams is to demonstrate that a student understands the material.	Demonstration
A purpose of taking Calculus exams is to earn a grade to pass Calculus that is needed for a student's major.	Extrinsic Purpose
A purpose of taking Calculus exams is to gain understanding of the material being tested.	Gain Understanding
A purpose of taking Calculus exams is to test a students' memorization skills.	Memorization
A purpose of taking Calculus exams is to prepare a student for their future courses.	Future Prep: Coursework
A purpose of taking Calculus exams is to prepare a student for their future career.	Future Prep: Career
A purpose of taking Calculus exams is to prepare a student for their future, in general.	Future Prep: Vague Future
A purpose of taking Calculus exams is to prepare a student for solving real world problems.	Future Prep: Real World
A purpose of taking Calculus exams is to cause a student stress and anxiety.	Stress/Anxiety
I am unsure of the purposes of taking Calculus exams.	Unsure of Purpose
There is no purpose to taking Calculus exams.	No Purpose

Since these items concerning student perceptions of Calculus exams are new constructs developed as a part of this study, we wanted to make sure the items were being read by students as intended. We conducted a focus group with students who completed the survey as a subjective analysis to ensure face validity. The focus group showed that the perceptions of exams items were clearly stated and understood. The participants brought up the use of starting each question with “A purpose” rather than “The purpose” is more clear as students may identify more than a single purpose to taking Calculus exams, which the survey did use. The participants also noted that the consistent use of the word “understanding” allows the students to focus on the slight differences between items. Finally, the focus group participants discussed the items coded as “Future Prep” and agreed that the differences among the four items were clear.

We then performed an exploratory factor analysis (EFA) on the data collected on student perceptions of exams. There were a total of 333 FYE students who filled out the quantitative survey concerning perceptions of exams in full, were over the age of 18, and consented to being a part of this research study. The EFA revealed four significant factors made up from the Perception of Calculus Exam items. The four factors will be referred to as *Future Oriented Purpose*, *Performance Driven Purpose*, *Negative Connotation*, and *External Purpose* and the items that make up these factors can be found in Table 2.

Table 2: The resultant factors from the EFA and the perceptions of exams items that contributed to each factor

EFA Factor	Perceptions of Exams Items
Future Oriented Purpose (FOP)	Future Prep: Vague Future, Future Prep: Career, Future Prep: Real World, Future Prep: Coursework, Gain Understanding
Performance Driven Purpose (PDP)	Assess Understanding, Demonstration, Assess Ability
External Purpose (EXT)	Extrinsic Purpose, Memorization
Negative Connotation (NEG)	Unsure of Purpose, No Purpose, Stress/Anxiety

Second Survey (Perceptions of Exams and Math Test Anxiety): In a previous, unpublished pilot study, we found that math test anxiety may be playing a mitigating factor between student perceptions of exams and their perceptions of the future. Therefore, on this same quantitative survey asking about student perception of exams, we also included items from the Math Anxiety Rating Scale (MARS-30) [15] that concerned students' *math test anxiety*. These selected items can be seen in Table 3 and students were asked to mark their level of anxiety on a Likert scale (1- not at all and 5- very much).

Table 3: Math Test Anxiety items selected from the MARS-30 Survey that were included on the Perceptions of Exams and Math Test Anxiety quantitative survey

Survey Item	MARS-30 Item
Taking an examination in your Calculus course	MARS-30 1
Getting ready to study for a Calculus test.	MARS-30 15
Studying for a Calculus test.	MARS-30 10
Thinking about an upcoming Calculus test one week before.	MARS-30 2
Thinking about an upcoming Calculus test one day before.	MARS-30 3
Thinking about an upcoming Calculus test on hour before.	MARS-30 4
Thinking about an upcoming Calculus test five minutes before.	MARS-30 5
Waiting to get a Calculus test returned in which you expected to do well.	MARS-30 6

Third Survey (Future-Oriented Motivation): Students in a FYE course completed the Motivations and Attitudes in Engineering (MAE) Survey where they responded to several topics including items concerning their future time perspective on a Likert scale (1- strongly disagree and 7- strongly agree) [16]. From the MAE Survey, we were interested in responses to the items for *perception of the future, value, connectedness, clarity, and alignment*.

After data was collected, we performed a Confirmatory Factor Analysis (CFA) to determine alignment with the established theory. We compared the groupings of the items with the established factors to a one factor model and confirmed the FTP factors were a much better fit than the one factor model. The χ^2 value for the fitted model was much lower than the one factor model with a difference of only 10 degrees of freedom, the root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR) values were lower in the fitted model, and the Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) values were larger in the fitted model (Table 4). We also calculated Cronbach's alpha (α) for each established factor and they were all in the acceptable range as seen in Table 5 as a test for internal consistency indicating the tool remains a reliable measure of these FTP factors [17].

Table 4: CFA comparison of one factor FTP model and fitted FTP model

Model	χ^2	df	RMSEA	SRMR	CFI	TLI
One Factor	1696.238	405	0.179	0.187	0.332	0.282
Fitted	842.873	395	0.106	0.130	0.768	0.745

Table 5: Cronbach's alpha values for FTP factors as a means for checking internal consistency

FTP Factor	α
Perception of Future	0.870
Value	0.849
Connectedness	0.869
Clarity	0.820
Alignment	0.798

Multiple Linear Regression: The relationship we want to investigate is if students' future oriented motivation is related to students' perceptions of Calculus exams, their levels of math test anxiety, and the interaction of perceptions and anxiety. In particular, we looked at the regression model:

$$\hat{y} = \beta_0 + \beta_1x_1 + \beta_2x_2 + \beta_3x_{1,2}$$

where \hat{y} is future-oriented motivation, x_1 is perceptions of exams, x_2 is math test anxiety, and $x_{1,2}$ is the potential interaction between perceptions of exam and math test anxiety. To investigate this potential relationship, we will conduct a **multiple linear regression** analysis. We used averaged scores from several Likert items for each variable in our model. Since we are working with

data retrieved from Likert scales, we can still perform parametric tests [18; 19]. These scores can be used in a multiple linear regression analysis as a means of determining potential relationships. Table 6 is provided as a reference for the acronyms used in describing the results of this analysis.

Table 6: The acronyms used for each variable and interaction in our multiple linear regression models that will be described in results.

Future Time Perspective (FTP) Variable Names	
PF	Perception of the Future
VU	Value
CN	Connectedness
CL	Clarity
AL	Alignment
Perceptions of Exams (POE) Variable Names	
FOP	Future Oriented Purpose
PDP	Performance Driven Purpose
EXT	External Purpose
NEG	Negative Connotation
Math Test Anxiety (MTA) Variable Names	
MTA	Math Test Anxiety
Perception of Exams and Math Test Anxiety Interactions Variable Names	
EXT_MTA	External Purpose and Math Test Anxiety interaction
FOP_MTA	Future Oriented Purpose and Math Test Anxiety interaction

Results

The EFA performed on the perceptions of exams data revealed that students perceive the following as purposes of taking Calculus exams: *Future Oriented Purpose*, *Performance Driven Purpose*, *External Purpose*, and *Negative Connotation*. It is relevant to note that the survey item coded as “Accountability” was left out of these factor groupings as the EFA determined four factors as sufficient. When “Accountability” was added to the factor analysis with the restriction of four factors, it was grouped under *Performance Driven Purpose*, but its loading was weak and the p-value suggested we reject the hypothesis that four factors was sufficient. Attempting the factor analysis with five factors caused “Accountability” to come out as its own separate factor with a weaker loading than compared to the other four factors. After making the decision to omit “Accountability” and run the EFA with four factors (Figure 1), we established the four perception of exam categories (Table 2). Descriptive statistics for student responses within these four perception of exam categories can be found in Table 7 and Figure 2.

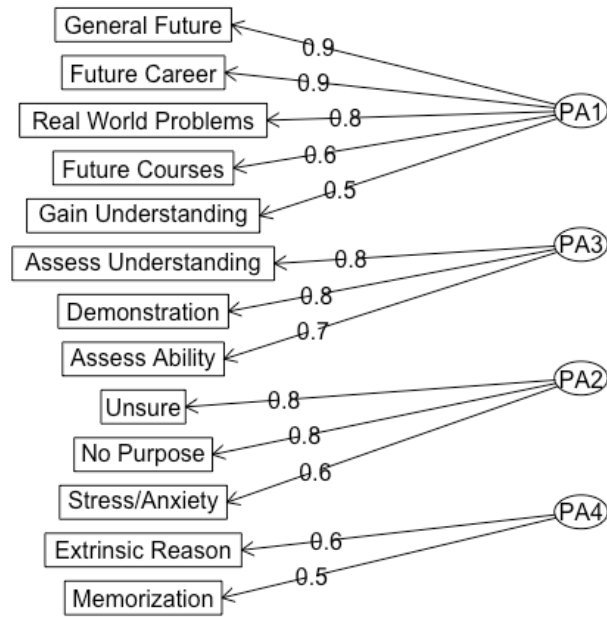


Figure 1: The results from the Exploratory Factor Analysis. This shows the Perceptions of Exams items and their loadings into each factor that became our four Perceptions of Exams variables: Future Oriented Purpose (FOP), Performance Driven Purpose (PDP), External Purpose (EXT), and Negative Connotation (NEG).

Table 7: Descriptive statistics from the quantitative survey concerning Perceptions of Exams (PoE) and Math Test Anxiety.

PoE Factor	min	1Q	median	mean	3Q	max
Future Oriented Purpose	1.60	3.40	3.90	3.86	4.60	5.00
Performance Driven Purpose	2.00	4.00	4.83	4.42	5.00	5.00
External Purpose	1.00	3.50	4.00	3.88	4.50	5.00
Negative Connotation	1.00	1.33	1.67	2.01	2.42	5.00
Math Test Anxiety	min	1Q	median	mean	3Q	max
Math Test Anxiety	1.00	2.75	3.75	3.50	4.25	5.00

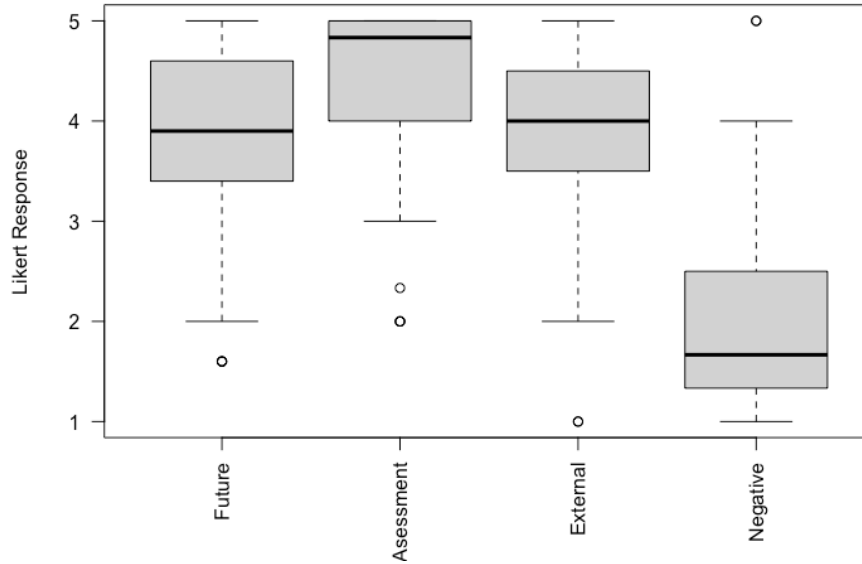


Figure 2: Boxplot representations of the descriptive statistics from the Perceptions of Exams Factors.

We then wanted to see if these perceptions of exams and level of math test anxiety could be predictors of students' FTP. First, we observed a correlation matrix of our explanatory variables, *perceptions of exams* and *math test anxiety*, to ensure they did not possess any multicollinearity among their factors. This allowed us to continue with a multiple linear regression with all the perception of exam factors (*Future Oriented Purpose*, *Performance Driven Purpose*, *External Purpose*, *Negative Connotation*), *math test anxiety*, and the *interactions* between these factors as our explanatory variables and a single FTP factor (*perception of future*, *value*, *connectedness*, *clarity*, *alignment*) as our response variable. The models that included all explanatory variables and their interactions against each response variable did not show any significance of prediction, but this could be due to the plethora of explanatory variables in this large model.

Since the full model did not suggest any of the perceptions of exams or math test anxiety scores were related to future motivated oriented scores, we performed variable selection. The purpose was to choose a subset of the perceptions of exams and math test anxiety scores that did suggest a relationship to FTP scores. The variable selection technique we chose was Least Absolute Shrinkage and Selection Operator (LASSO). This technique allows us to shrink coefficients of the perceptions of exams and math test anxiety variables that have little relationships to FTP to zero, and keep coefficients non-zero for perceptions of exams of math test anxiety scores that suggest a relationship to FTP scores. LASSO variable selection is also preferred as it possesses the stability properties found with other variable selection techniques (i.e. ridge regression), while also exemplifying easily interpretable results [20]. We performed this LASSO variable selection with each of the five FTP response variables against the five perceptions of exams and math test anxiety variables and the interactions between these explanatory variables. Results from performing this multiple linear regression with LASSO variable selection are shown in Table 8.

Table 8: Multiple Linear Regression models based on LASSO variable selection with FTP as response variables and perceptions of exams and math test anxiety as explanatory variables. Note that *FOP* is Future Oriented Purpose, *EXT_MTA* is the interaction between explanatory variables External Purpose and Math Test Anxiety, *FOP_MTA* is the interaction between explanatory variables Future Oriented Purpose and Math Test Anxiety, *NEG* is Negative Connotation, and *EXT* is External Purpose.

FTP Response Variable	Multiple Linear Regression Model	R^2
Perception of the Future (PF)	$PF = 5.97 + 0.08 \cdot FOP - 0.03 \cdot EXT_MTA$	0.068
Value (VU)	$VU = 4.67 + 0.03 \cdot FOP_MTA$	0.043
Connectedness (CN)	$CN = 6.10 - 0.30 \cdot NEG$	0.113
Clarity (CL)	<i>no significant explanatory variables</i>	-
Alignment (AL)	$AL = 5.99 - 0.14 \cdot EXT - 0.29 \cdot NEG$	0.122

Discussion

RQ1: FYE Students' Perceptions of Calculus Exams

The codes from responses to the initial open-ended questionnaire created the items on the first quantitative survey to help us answer our first research question. Based on results from our EFA, FYE students describe the purpose of taking Calculus exams in four ways: with a future oriented mindset, with a performance driven mindset, for an external purpose, or with a negative connotation. Students may resonate with several purposes among these four, as we can see in our descriptive statistics (Table 7; Figure 2), but it does appear that students agree less with the purpose of Calculus exams holds a negative implication.

RQ2: Interaction with FYE Students' Perceptions of Future, Perceptions of Exams, and Math Test Anxiety

We also see initial insight into our second research question in the results from our multiple linear regression models as well as some limitations to address. Our regression model shows that FTP factors *connectedness* and *alignment* can be predicted by some of our explanatory variables. *Connectedness* shows a strong negative relationship with the *negative connotation* perception of exams (coefficient = -0.30). This could mean that students who do not see a purpose in taking exams, unsure of the purpose of exams, or see taking exams as purposefully stressful are not apt to think about and plan for their future and have trouble connecting what they're doing in the present to what they want in their future. *Alignment* also shows a strong negative relationship with the *negative connotation* perception of exams (coefficient = -0.29) as well as a negative relationship with the *external purpose* perception of exams (coefficient = -0.14). This can be reasoned that students who have a more negative leaning perception of the purpose of exams and who view the purpose of taking exams as an extrinsically motivating factor (such as a way to simply test memorization or to just earn another grade in the gradebook) may have a lower degree of alignment in their ideal and realistic futures. It is important to note that our R^2 values tell us these models account for $\sim 11\% - 12\%$ of the variance we can observe. R^2 values less than 0.7 are not an indication that the relationships are not there, but rather an indication that there are other factors that can be contributing to our predictor variables, which we know is true here [21]. A students' FTP cannot be solely predicted by their perception of Calculus exams or their

current level of math test anxiety; we know from the literature that there are many other factors that contribute to a students' perception of their future. We plan to continue to investigate these relationships we see between the negative outlook and the externally motivated perceptions for the purpose of Calculus exams and these two FTP constructs in future phases of this study from these initial results. This will give evidence to how students are making connections between their present actions in their Calculus courses and their perceived futures as engineers to support existing literature on Future-Oriented Motivation, learning, and achievement as well as contribute new evidence to the limited sphere of Future-Oriented Motivation and assessments.

Additionally from our multiple linear regression model, we see that FYE students' *perception of the future* could be positively related to their *future oriented perception of exams* along with a negative relationship with the interaction between an *external purpose* perception and *math test anxiety* levels. However, the R^2 value for this ($R^2 = 0.068$) is lower than what we saw with the connectedness and alignment models and the p-values for these two explanatory factors, *perception of the future* and the *interaction between external purpose and math test anxiety*, were 0.589 and 0.083 respectively, which together indicates there are other contributing factors to students' perception of the future that our model doesn't account for. We also see from our multiple linear regression model that the *value* FYE students' place on their future could be positively related to their *future oriented perception of exams* and their level of *math test anxiety*, the R^2 value for this model is low. In other words, FYE students' valuing of their future has other significant contributing factors not present in our model. Finally, the FTP factor *clarity* may not be explained by students' perceptions of exams and math test anxiety since the regression model showed no significance among the explanatory variables.

Conclusions & Future Work

We are interested in exploring the relationships we see between connectedness and alignment and the perceptions of exams factors existent in the multiple linear regression models and are excited to continue building on these initial results from this pilot study. We intend to continue investigating these relationships at a similar land grant, R1 university in the southern U.S.. While we did not report demographic information of the participants in this pilot study, we do want to note that the institution we collected this data from has a predominantly white engineering student population. So, we wish to repeat this study at a second institution whose engineering student population is more reflective of the engineering degrees awarded nationally. The second phase of this work will involve repeating the initial open-ended survey and the quantitative surveys to assess students' perceptions of exams, math test anxiety, and perceptions of the future as well as additional qualitative data collection (interviews) to further explain the interactions between FYE students' perceptions of Calculus exams, math test anxiety, and perceptions of their future(s) as engineers.

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