ABSTRACT

The Influence of Engineering Identity, Harmonious Passion, and Obsessive Passion on Grit in Engineering Students

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Research has shown that individuals tend to remain committed to long-term goals when they are passionate about what they are doing and when some part of their self-concept is tied to their goals. This study uses engineering identity and two distinct passion types to answer the question *How does the extent of a student's engineering identity and type of passion for engineering influence their academic grit?*

Based on a review of literature related to identity, harmonious passion, obsessive passion, and grit, an online survey was distributed to engineering students at Virginia Tech and Baylor University. The results indicate that harmonious passion significantly influences girt. On this basis, it is recommended that engineering educators think critically about integrating efforts to strengthen students' harmonious passion for engineering throughout college. Further research is needed to identify other factors that could inspire harmonious passion and grit.

The Influence of Engineering Identity, Harmonious Passion, and Obsessive Passion on Grit in Engineering Students

by

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DEDICATION

To those who have believed in me.

CHAPTER ONE

Introduction

The implications of selecting a major permeate the entire college experience. As St. John (2000) argued, "There is, perhaps, no college decision that is more thought-provoking, gut wrenching and rest-of-your-life oriented—or disoriented—than the choice of a major" (p. 22). A student's academic major becomes a part of their identity (Garza & Herringer, 1987) and the focus of much of their time and energy. Once in college, students are encouraged to explore their interests and further discern what it is that they want to do when they "grow up." Sometimes this exploration and discernment leads them to pursue an alternate path to the one they selected prior to entering college.

For most traditionally aged college students, choice of major occurs around age 17 or 18. At this point in their lives, students are just completing high school. They likely have experienced limited exposure to the enormity of career options they could pursue; but if they decide to apply to college, they must have a somewhat formed idea of what they would like to study. Once in college, a student's academic major becomes a part of their identity (Garza & Herringer, 1987) and guides their activities and behaviors. Ideally, a student's choice of major will lead them to become academically successful in a field that aligns with their goals and passions. Therefore, they must have at least considered what those goals and passions are by the time college applications are due.

While it is generally supported in literature that changing majors can help students succeed (Micceri, 2001), there are some academic units that focus their attention more

heavily on achieving high retention rates within their majors. Overwhelmingly, engineering education research has centered around retention efforts (e.g. Davis & Finelli, 2007; Anderson-Rowland, 1996; Hall et al., 2015). Programs and support systems have been implemented on college campuses to aid students in completing engineering degrees. On the one hand, it is beneficial for students to be supported by their academic unit from matriculation through graduation. But on the other hand, a strong emphasis on retention can cause engineering students to feel pressured to stay in their major even when it does not align with their passions and goals.

This study seeks to understand the connection between engineering identity, passion, and perseverance in students' academic major. Data will be collected according to a framework designed to measure grit, or *passion and perseverance toward long-term goals* (Duckworth, 2016). Specifically, this study will focus on engineering-related goals and grit within engineering majors. The findings of this study may help engineering educators understand what is driving the retention rates they seek to promote. The nature of data sought by this study will support understanding of how important major-related identity and passion are to student success in engineering.

Conceptual Framework

Engineering Identity

Identity is a complex but vital construct used to explain the interplay of all social categories and characteristics that make up an individual (Fearon, 1999). When students enter college, their major becomes part of their identity (Garza & Herringer, 1987). In this study, the term *identity* will be interpreted through the lens of Oronato and Turner's

(2004) dualistic model of social and personal identities. Using this model, social identity refers to identification with—or membership in—a specific group with some defining characteristics. The social identity of "engineering student" is assigned upon matriculation based on students' membership in an engineering major.

Personal identity refers to the lower-level classification with self based on characteristics that stem from an individual's personal goals and desires. These are characteristics that individuals identify as defining some part of themselves. In this study, personal identity will be a starting point toward discerning how students' engagement with engineering informs their level of academic grit.

Within social and personal identities, *role identities* emerge when an individual is provided opportunities to engage in activities that are related to their personal and social identities. A role identity is the result of a positional designation within a group (Hoelter, 1983). An individual's role in engineering is influenced by their engagement in their major, both inside and outside of the classroom. In this study, *engineering identity* will refer to an individual's self-categorization with their role as an engineering student. This understanding of identity is derived from previous research on personal identity and role identity (Hoelter, 1983; Onorato & Turner, 2004). For this study, role identity is the designation of a student as an engineering student.

A student's perceived role within engineering may provide motivation to live into their engineering identity and continue in their major. Strong identification with engineering-related roles may also make it challenging for students to view themselves in contexts outside of engineering. Students whose engineering role identities are particularly strong may feel pressure from within themselves or from others to continue

in engineering. This pressure may motivate students to continue but could cause stress and other negative implications.

Passion

An individual's passions are the activities that they like or find important enough to devote time and energy toward (Vallerand, 2008). Individuals who are passionate about the work they do are more likely to continue projects through to completion (Vallerand et al., 2007). They also are able to overcome challenges along the way. Passion has been linked to motivation, with more passionate people demonstrating higher levels of commitment and motivation to the activities that align with their passion (Vallerand et al., 2007, 2008). In the context of engineering education, this means that passion for engineering can influence commitment to one's major and goals within engineering. When an engineering student is passionate about some facet of engineering, that student is more likely to remain motivated to achieve success in engineering even when met with rigorous coursework and other challenges. This is good for those seeking high retention numbers; passion enhances students' desire to continue learning engineering.

There are two types of passion that fuel individuals' desire to devote energy toward activities. These two types are connected but express different underlying rationale for one's commitment to a given activity. The types of passion utilized in this study are harmonious passion and obsessive passion (Vallerand et al., 2008). Both are commonly studied in a variety of contexts in research. Understanding the difference between these two types of passion can help engineering education researchers better

support students in their academic endeavors (Bonneville-Roussy et al., 2013). It may also enable educators to distinguish between students who should continue be encouraged to pursue engineering and those who should be supported in changing majors.

Grit

The term *grit* is a relatively new concept in psychological research. Duckworth (2016)–a psychologist who introduced grit as a psychological construct–defines the term as *passion and perseverance toward long-term goals*. Previous grit research has been conducted in a variety of fields and activities, including military training, work and careers, music, and athletics Carbonneau, Vallerand, Fernet, & Guay, 2008; Ratelle, Vallerand, Mageau, Rousseau, & Provencher, 2004; Rip, Fortin, & Vallerand, 2006; Vallerand et al., 2003, 2008). In multiple contexts, grit is consistently linked with achievement (Duckworth, 2016; Larson, 2015). The grittier an individual is in a certain area of life, the more likely they are to persist through challenges and ultimately achieve their goals. This study seeks to help researchers understand how the amount and type of passion an engineering student displays toward engineering influences their perseverance toward long term goals, or *grit*, in their academic pursuit.

Gaps in the Literature

Due to a strong focus on retention, researchers have consistently been interested in why some engineering students persist through engineering coursework while others do not (Geisinger & Raman, 2013). The level of grit individuals exhibit toward academics is one factor that influences student persistence (Duckworth, Peterson, Matthews, & Kelly, 2007). Little to no research exists, however, on the interplay of

engineering identity and passion type and their combined impact on grit. Rather, much of the research that currently exists on engineering education is focused on retention efforts without much attention to the grit required to meet retention goals.

Additionally, very little attention has been given to the different passion types that could influence grit. Duckworth's (2016) definition of grit does not distinguish between any types of passion; it is simply understood that passion of all sorts influence grit. While this may be true, there is a need for further investigation of passion types that contribute to engineering student grit, especially if educators want to understand the basic underlying motivations that keep students in their majors. When considering retention efforts, it may not make sense to keep a student in engineering if their underlying passion type does not align with their personal desired outcomes related to earning an engineering degree.

Purpose of Study

The purpose of this study is to discern whether there is a difference in students' academic grit based on the type of passion they have for engineering and the extent to which they self-identify as an engineering student. Ultimately, it is my hope that the findings of this study would encourage engineering educators to look beyond the numerical data and seek to understand the *why* behind their students' drive to achieve in engineering.

This study is not intended to offer subjective opinions regarding whether it is good or bad for students to demonstrate grit in their major when their passions are not in alignment with what they are studying. The terms "grit resulting from harmonious

passion" and "grit resulting from obsessive passion" will be used to differentiate between grit that results from different types of passions. Any positive and negative connotations associated with these terms are derived from research that has demonstrated significant impacts on personal well-being based upon different passion types (Schellenberg, Bailis, & Mosewich, 2016). Grit from harmonious passion, therefore, relates to a kind of passion that generally leads to well-being while grit from obsessive passion refers to a different passion type that can detract from well-being.

This study is also not aimed to dissuade any individual from studying engineering or persuade any student to pursue engineering. It is intended to highlight a need for a different kind of support for students whose grit may be detrimental to their self-concept. Specifically, this study uses quantitative methods to address the following research question: *How does the extent of a student's engineering identity and type of passion for engineering influence their academic grit?*

Definition of Terms

- *Identity* – Personal self-categorizations derived from distinct roles held by an individual.
- *Engineering Identity* – The extent to which an engineering student categorizes themselves by their academic major.
- *Grit* – Passion and perseverance toward long-term goals (Duckworth, 2016).
- *Academic Grit* – Passion and perseverance toward goals related to academic major.
- *Passion* – A strong inclination toward an activity that people enjoy, find important, and invest time and energy (Vallerand, 2008).

Harmonious Passion – A high level of interest or love for a given activity or subject (Vallerand et al., 2007 & Bonneville-Roussey, Vallerand, & Bouffard, 2013).

- *Obsessive Passion* – A high level of obligation or pressure to continue in a given activity or subject (Bonneville-Roussey et al., 2013).

- *Perseverance* – Persistence in doing something despite difficulty or delay in achieving success.

- *Long-Term Goals* – High-level goals that require significant time and dedication to achieve.

CHAPTER TWO

Literature Review

This chapter synthesizes related research conducted on identity, passion, and grit. The present study uses engineering student identity and passion for engineering to predict type and amount of academic grit in engineering majors. Thus, this chapter summarizes previous research on personal identity as it relates to engineering, different types of passion and their influences on student motivation, and the concept of grit as it pertains to students' academic pursuits.

Grit

Findings of Duckworth's (Duckworth, Peterson, Matthews, & Kelly, 2007) commonly cited study on grit among cadets at West Point suggest that "the achievement of difficult goals entails not only talent but also the sustained and focused application of talent over time" (p. 1). Sustained and focused application requires effort. An individual may be talented, but it is not possible for anyone to grow in their abilities without trying. In her book, *Grit: The Power of Passion and Perseverance*, Duckworth (2016) comments on the West Point study along with others that have similarly indicated that there is more to achievement than talent or innate ability.

In order to understand the importance of grit in the context of engineering academic programs, it is important first to distinguish between grit and talent. Talent is defined as natural aptitude or skill (Duckworth, 2016). Talent is commonly thought of as

something you either have or do not have. Extensive research conducted on talent development indicates that, while talent may be innate, there are active steps an individual must take to further evolve their talents (Von Culin, Tsukayama, & Duckworth, 2014). The difference between talent and grit is that grit does not assume natural ability. Rather, grit is a separate component that is necessary to the development of any skill or talent.

Many studies in the past have used pre-college aptitude measures such as high school GPA and SAT scores to predict success in college. Much of the research that exists on engineering education make similar predictions (e.g., Zhang, Anderson, Ohland, & Thorndyke, 2003). However, basing perceptions of a student's likelihood to succeed on such measures may assume innate talent. There is no context provided to tell the story of how much effort was devoted to achieving the scores students report. The scores alone may provide insight into a student's current ability level, but they cannot predict how hard that student will work in a college engineering program.

Even for the most academically gifted students, achievement requires effort. Duckworth contends that, when it comes to achievement, effort is twice as important as talent (Duckworth, 2007, 2016). If this is true, it means that with enough work, someone half as skilled but twice as hard-working might reach the same level of ability as someone who is twice as skilled but who does not work as hard. Therefore, it is not enough to focus solely on aptitude scores. Instead, it is important to understand students' levels of grit in order to be better equipped to help them succeed.

Long-Term Goals

When considering how to instill grit in engineering students, it is critical to understand the influence of goals. Not all goals are created equally, and not all goals inspire or require grit. Duckworth proposes that goals exist on a hierarchy, and that it takes more grit to achieve higher-level goals (Duckworth & Gross, 2014). On the goal hierarchy, lower-level goals serve to enact higher-level goals. The figure below illustrates Duckworth's goal hierarchy:

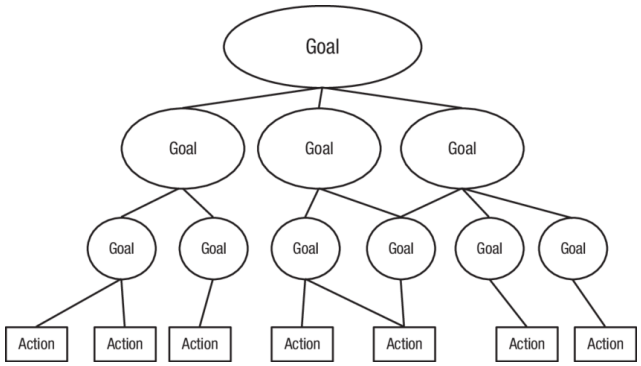


Figure 2.1. Goal hierarchy. Note: To access these resources visit this website: https://peer.asee.org/a-new-scale-for-measuring-engineering-identity-in-undergraduates

When an individual has one ultimate highest-level goal, most of that person's lower-level goals should work together to contribute to the accomplishment of mid- and high-level goals that ultimately support the topmost goal. When all of these lower and middle level goals are in alignment, there is no need to diverge from one's desired path. However, when lower-level goals have nothing to do with the ultimate top-level goal, there is need for redirection if the top-level goal is to be achieved.

Perseverance

Perseverance is defined as persistence in doing something despite difficulty or delay in achieving success (Duckworth, 2016). Perseverance is a critical component of grit and is an imperative factor in achieving the retention rates that so many engineering schools want to reach. In the context of education, perseverance generally refers to persisting to graduation despite difficult coursework and setbacks along the way. Engineering student persistence is well studied, and common themes have emerged from this research. Important factors that influence engineering student persistence can be categorized broadly in three groups: (a) academic resources, (b) climate and experiential effects, and (c) internalization and perceptions of the major and career (Hein, Onder, Rebb, Brown, & Bohmann, 2012).

Academic resources that support engineering student persistence include academic courses, labs, faculty and teaching assistants, academic and career advisors, and other programs and campus opportunities that support students in their academic endeavors. Students who persist in their majors are more likely to know about and utilize these academic resources than students who change majors or leave the institution (Hein et al., 2012). The second category is climate and experimental effects. Climate refers to overall experience on campus or within an individual's academic unit.

The third category of factors that influence persistence—internalization and perceptions of major and career—refers to an individual's identification with their engineering major. This category is most directly related to the current study. Internalization of engineering identity enhances self-confidence, self-efficacy, and intrinsic motivation to succeed (Hein et al., 2012).

Identity

The term "*identity*" encompasses a wide range of definitions. Identity can refer to a social category, a socially distinguishing feature that a person takes special pride in or feels defined by, or some combination of the two (Fearon, 1999). The first of these definitions refers to personal identity, and the second to social identity. Personal and social identities are distinct but intertwined, and it is essential to differentiate between them in order to understand how individuals identify themselves.

Social and Personal Identity

Social identity is based on interpersonal comparisons with others who share a high-order identity (Onorato & Turner, 2004). Examples of high-order identities include race, nationality, sex, and ethnicity. These are identities that are relatively unchanging (Fearon, 1999). An individual may view their social identities in terms of 'us' vs. 'them.' For example, a collective group of engineering students may draw from their social identity when comparing themselves to non-engineering majors on their campus. The key component of social identity is that it is derived from group membership (Onorato & Turner, 2004). A student's social identity within engineering begins with admission into an engineering program. From there, the student may embrace engineering as part of their personal identity to varying degrees.

In contrast to social identity, personal identity is a lower level of self-categorization. Onorato and Turner (2004) define personal identity as "the categorization of the self as a unique entity, distinct from other individuals." Personal identity stems from an individual's own goals and desires rather than from membership in a group or category. An individual views personal identity in terms of 'me' vs. 'not me.' An

engineering student whose personal identity is closely tied to their major will be more likely to identify themselves as an engineering student not because they have been assigned to that group, but because they feel that their individuality is distinguished in some way by their academic major. This is important because it may influence the way they engage with their major.

Role Identity

Role identity and role behavior are core tenants to both social and personal identity. Role identity refers to positional designations within groups (Hoelter, 1983). These designations carry expectations for behavior within a particular group. An individual's level of commitment to distinct role identities determines how they view "what is good, or valuable, or what ought to be done, or what [they] endorse or oppose" (Taylor, 1989 in Brophy, 2014). The culmination of commitments to elements that make up an individual's identity will shape their attitudes and behaviors in groups with which they identify (Ashforth et al., 2008; Mael and Ashforth, 1992; Tajfel and Turner, 1986).

Engineering Identity

The idea of identity commitment is described by identity researchers Stryker and Serpe as "the degree to which the person's relationships to specified sets of others depends on his or her being a particular kind of person" (Stryker & Serpe, 1982). For students in engineering majors, commitment to engineering determines how they interact with others around them based upon their understanding of self within the context of engineering. In order to assume an engineering role identity, students must actively

participate in activities and relationships related to their engineering major (Godwin, 2016).

In this study, engineering identity will refer to the extent to which students individually identify with their role as engineering majors in comparison to other identities they hold. Although a student may receive a social categorization as an engineering student upon matriculation into a college or university, that student may or may not embrace that categorization as a defining characteristic of their personal identity. Doing so can help shape an individual's motivation and goals (Oyserman, 2015) and can provide meaning to the extensive time and effort spent on academic work (Oyserman, 2009). The extent of a student's identification with their engineering major may influence their motivations for continuing in engineering (Patrick & Prybutok, 2018). It is in the best interest of educators to understand the influence of identity on motivation in order to better conceptualize students' academic grit.

Existing Research on Engineering Identity

Research on understanding engineering identity as a means to supporting student success is relatively new to the field of engineering education. Historically, researchers have emphasized the correlation of academic aptitude with academic success in engineering coursework. Studies have consistently demonstrated that high SAT scores, high school GPA, and class rank can predict academic success in college (Habley, Bloom, & Robbins, 2012). More recently, studies have shifted to a focus on the meanings that the individual attaches to the context of their social and cultural role within engineering, or their engineering role identity (Godwin, 2016). These meanings drive

students' sense of purpose within engineering, which contributes to the motivation and perseverance that drive the development of grit (Hill, Burrow, & Bronk, 2016).

In a 2016 study, engineering identity researcher Allison Godwin examined an existing set of items on a scale designed to measure underlying constructs of identity in science education. She then used that scale to inform the development of her own set of engineering identity criteria. Godwin identified three constructs that make up engineering identity: overall identification as an engineer, future engineering career performance, and students' engineering-related interest, recognition, and performance/competence beliefs (Godwin, 2016). Each of these indicators has a role in forming students' perceptions of themselves as engineers, and together they provide context behind how engineering identity can be shaped in practice.

According to Godwin's framework, performance/competence beliefs are related to self-efficacy, which is linked to engineering student persistence in prior studies (Cardon & Kirk, 2015). Compared with self-efficacy, performance/competence beliefs are less task-specific and more generalized to encompass broad ability within the context of engineering. Students' beliefs about their ability to achieve understanding of content in their curriculum impacts their ability to see themselves as people who belong in their majors (Godwin, 2016).

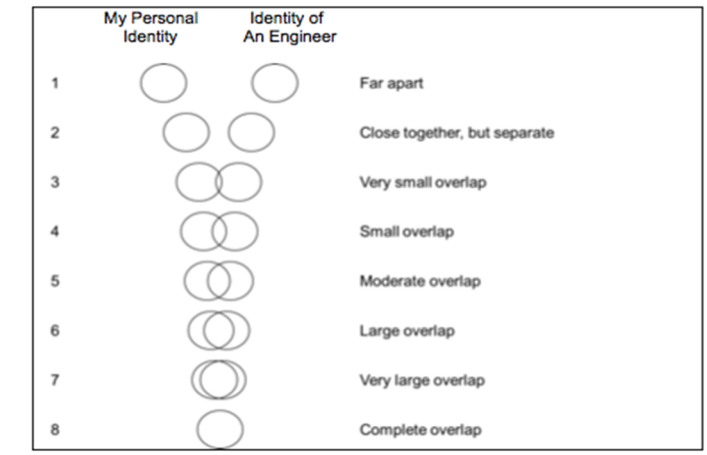
Interest in the subject of engineering influences how students frame their role identity (Verdin, Godsin, Kirn, Benson, & Potvin., 2018) and influences perseverance in engineering (Renninger, Nieswandt, & Hidi, 2015). Previous studies have found that individuals who are interested in specific tasks are likely to be able to adjust and persist

toward tasks even when they are challenged, whereas learners who are not as interested often have more difficulty engaging in tasks. (Renninger, Nieswandt, & Hidi, 2015).

Recognition refers to students' beliefs that they are seen as good and capable students (Godwin, 2016). This recognition can be self-given, but is stronger when reinforced by peers, parents, teachers, and friends. For some groups, recognition as an engineering major can be more challenging to come by. For example, females have historically held a minority representation in engineering. For women in engineering majors, it can be harder to feel accepted in an academic unit filled with men. Even women who are skilled at the tasks and concepts required by engineering can feel unrecognized by their peers and professors and have weaker identities as engineers (Godwin, 2016). In cases like this, individuals may feel less like they belong in engineering.

Measuring Engineering Identity

To measure engineering identity, researchers Borrego, Patrick, Martins, and Kendall (2018) developed a two-item scale to allow engineering students an opportunity to define themselves on the basis of their engineering identity, shown below:



14. To what extent does your own sense of who you are (i.e., your personal identity) overlap with your sense of what an engineer is (i.e., the identity of an engineer)?

(CIRCLE ONE RESPONSE)

Not at all							*To a great extent*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
1	2	3	4	5	6	7	8

Figure 2.2. Engineering identity items.Note: To access these resources visit this website: https://peer.asee.org/a-new-scale-for-measuring-engineering-identity-in-undergraduates

This scale contains one visual and one verbal item that provide students a very simple platform to express their level of engineering identity. With this scale, students can self-categorize themselves based on the extent to which engineering overlaps with their personal identity. This scale improved the reliability of the measure of engineering identity compared to previous engineering identity scales in existence (Borrego, Patrick, Martins, & Kendall, 2018). This scale was chosen as the primary way to assess engineering identity in this study because of its simplicity and reliability. Responses to these items will allow for comparison of academic grit among engineering students who express varying levels of engineering identity.

Passion

Passion is a vital factor in grit development (Duckworth, 2016). Passion is defined as a strong inclination toward an activity that people enjoy, find important, and invest time and energy (Vallerand, 2008). People's passions are what drive them to do good work; they are the forces that motivate individuals to devote the necessary time and effort to accomplish a goal.

Passion provides purpose and meaning to an individual's life (Zhang, Shi, Liu, & Miau, 2014). When an individual's passions and long-term goals align, they are more likely to persevere through challenges that arise along the way (Li, 2010). In other words, they are more likely to embody grit. This study seeks to differentiate between two types of passion as they influence academic grit. Both types are capable of driving students to persist, but with very different implications on the individual student.

Research conducted on passion to date has primarily focused on its motivational nature (Vallerand, 2008). Because of the strong motivational force it provides, the term passion generally carries a positive connotation. However, an individual can be passionate and work hard for a variety of reasons. The type of passion and how it is acted upon determines how beneficial that passion is toward accomplishing goals (Vallerand et al., 2007) and toward individuals' well-being (Schellenberg, Bailis, & Mosewich, 2016). The following sections will detail the two dichotomous passion types outlined by Vallerand et al. (2008): harmonious passion and obsessive passion.

Harmonious Passion

The term *harmonious* indicates a high level of interest or love for a given activity or subject (Vallerand et al., 2007 & Bonneville-Roussey, Vallerand, & Bouffard, 2012). A person who acts upon their harmonious passions chooses freely to engage in projects or tasks because they find meaning and intrinsic enjoyment in doing so. Harmonious passion elicits positive emotional responses and motivates an individual to keep trying as they simultaneously continue falling in love with whatever it is that their passion is rooted in. Someone with a harmonious passion for engineering will work hard either because they love what they are doing or because they are excited about a goal related to their studies.

Harmonious passion is freely incorporated into one's identity (Schellenberg, Bailis, & Mosewich, 2016) and provides the individual with a sense of purpose. Harmonious passions align with individuals' values and do not usually conflict with other life activities. When engaging in activities related to harmonious passion, individuals are likely to experience positive feelings and increased concentration.

Passion type has a strong influence on individuals' perceptions of themselves. When failure occurs in an activity in which individuals are harmoniously passionate, they are normally met with openness and a desire to accurately understand the failure experience (Hodgins & Knee, 2002, Vallerand, 2010). This openness characterizes a mindful approach toward viewing failure and is conducive to self-compassionate thoughts. Failures are more often considered as learning opportunities and are therefore less likely to be viewed with distortion, defensiveness, or criticism (Hodgins & Knee, 2002). This is not as often the case when an individual is driven by an obsessive passion.

Obsessive Passion

While harmoniously passionate people find personal meaning in the work they do, obsessively passionate people feel an obligation or external pressure to continue in the pursuit of their passion (Bonneville-Roussey et al., 2012). Individuals who are obsessively passionate may enjoy the activity in which they are engaging, but they continue to pursue it primarily because they think they should or feel they must. The free will element of harmonious passion that allows people to do things because they want to do them does not characterize obsessive passion.

Obsessive passion is the stronger and more uncontrollable passion type (Vallerand et al., 2003). Compared with the activities of harmonious passion, the activities of obsessive passion tend to become more important in the lives of individuals. Harmonious passions fit in with other activities in an individual's life, but obsessive passion leads to conflict between an individual's passionate activity and other activities in their lives. Those other activities may be neglected or put aside to create time and space for the obsessive passion.

In contrast to harmonious passion, obsessive passion can have a direct negative impact on performance attainment (Vallerand et al., 2007). People with obsessive passion may experience difficulty concentrating and may find engagement in their passion activity rigid and not fun (Mageau et al., 2005, Vallerand et al., 2003, 2008, Wang et al., 2008). Often, obsessive passion is acted on not because people love it but because for some reason they feel they must pursue it. When acting out of obsessive passion, the element of choice is removed and individuals act because they feel pressure to do so.

There are several outside influences that may cause someone to exhibit obsessive passion. For engineering students, these outside factors could be pressures from family members, friends, or academic departments seeking to increase retention. Students may feel locked into their major once they arrive at college and may feel there is a lot at stake if they decide to consider changing their course of study. However, it may not always be in the student's best interest to continue in a major. This is especially true when their reason for retaining is due to external pressure to work toward something they may not enjoy or find meaning in. The design of the current study will allow for a closer look at how obsessive passion compares to harmonious passion in terms of supporting student grit.

Implications on Well-Being

Well-being is known to influence student persistence (Simon, Aulls, Dedic, Hubbard, & Hall, 2015). It is therefore imperative to discuss the implications the different passion types have on well-being. Obsessive passion has been found to detract from self-compassion (Schellenberg, Bailis, & Mosewich, 2016). When obsessively passionate people fail at some element of their goal, they are likely to have a hard time forgiving themselves. Instead, obsessively passionate people may equate self-compassion with complacency and reduced performance. Therefore, they fear self-compassion and are more likely to turn to self-criticism, especially following instances of failure. Ultimately, obsessive passion is more likely to lead individuals to experience distress in difficult times, which in turn leads to maladaptive outcomes (Schellenbert, Bailis, & Mosewich, 2016).

In addition to detracting from self-compassion, obsessive passion can sway the self-concept of the obsessively passionate individual. When someone feels pressure to achieve in some activity, their successes and failures influence how they view themselves. This idea can be understood through the lens of self-discrepancy theory (Higgins, 1987). Self-discrepancy theory states that there are three basic domains of the self: the actual self, the ideal self, and the ought self. The actual self is the present image of oneself. It is how someone would respond when asked "Who are you?" The ideal self is comprised of the goals and aspirations the individual wants to reach. The ought self is the individual's view of who others think they ought to be.

Self-discrepancy theory (Higgins, 1987) states that it is human nature for individuals to merge their actual, ideal, and ought selves. In order to do this, the ideal and ought selves are used as motivators for growth and development of the actual self. Internal and external forces guide the individual's behaviors. When failures occur, discrepancies arise between the actual, ideal, and ought selves. This can cause agitation or other negative emotions such as guilt, shame, and anxiety.

Obsessively passionate engineering students may idealize a career in engineering or feel pressure from family, friends, professors, or other significant people in their lives to continue in engineering. While this pressure may serve as a strong motivational force toward graduating with a degree in engineering, it can also cause damage to students' self-concept. Students may work hard in classes they do not enjoy just so that they can please other invested parties. When obsessively passionate engineering students experience failure related to their engineering classes, they may have a hard time forgiving themselves and moving on. They may in turn dwell on that failure for a long

time, in which case it could take their focus away from other important activities in their lives.

Ultimately, obsessive passion is more likely to lead to burnout than harmonious passion (Vallerand, Paquet, Philippe, & Charest, 2010). Two related studies by Vallerand et al. demonstrated that burnout from obsessive passion can occur by two processes. In the first process, burnout occurs because of the conflict that obsessive passion causes between one's work and other life activities. In the second process, obsessive passion simply does not lead to work satisfaction, which can inherently cause burnout (Vallerand et al., 2010). The combination of these two processes—low work satisfaction plus conflict between work and other life activities—leads to eventual burnout.

Can Obsessive Passion Be Good?

Passion researchers generally agree that, while obsessive passion can lead to the achievement of positive outcomes and goal attainment, it is almost always detrimental to self-esteem (Forest, Mageau, Sarrazin, & Morin, 2011; Philippe, Vallerand, & Lavigne, 2009). If viewing passion solely for utility, it could be argued that obsessive passion can be a positive thing. When considering well-being, though, it is more generally equated with poor self-concept, lack of self-assurance, and low self-esteem.

Why Passion Type Matters

When focusing solely on the motivational aspect of passion, both types can contribute positively toward deliberate practice and goal attainment (Vallerand et al., 2007). This is the shared understanding of many researchers who study student motivation and academic success, especially in engineering education. If we are only

concerned with the end result (e.g., engineering student persistence to graduation), there is little need to distinguish between passion types. Both can influence perseverance and contribute to grit. If we are concerned with students' self-concept and well-being, however, understanding the type of passion that is driving them may help inform how engineering educators can better support students in their academic endeavors. And we should be concerned with students' self-concept and well-being, because both are key components of identity and key factors in promoting or detracting from grit.

Why It's Worth Studying

The temporal stability of harmonious and obsessive passion is moderately high but it is not static (Vallerand, 2010). An individual's passions can shift and change over time as they find new ways to engage with their passionate activities or as they discover new interests that may transform into new passions. Harmonious passion, in general, is less stable than obsessive passion (Lafrenière, Bélanger, Sedikides, & Vallerand, 2011). This is because, with harmonious passion, the individual can choose whether or not to engage in the activity and when to engage. Obsessive passion is more likely to result in rigid persistence because the activity of obsessive passion in some way controls the person and compels them to engage.

Despite the potential for fluctuation in harmonious passions, the relatively stable nature of both passion types renders them worth measuring. Neither is volatile enough to overlook. More fleeting ideas and interests exist alongside passions, but by definition passions are activities that are continually invested in for some extended period of time.

Therefore, they are worth studying because, unless passion activities change, passion is unlikely to change drastically.

The Good News

The good news, and the reason why this research is so important to engineering education, lies in the very nature of passion development. Harmonious passions are more malleable. This means that there is room for educators to influence students' love for and engagement with engineering activities, thereby contributing to higher levels of self-esteem and continued enjoyment of their majors.

While obsessive passion is more fixed and may be more difficult to intervene upon, an important caveat is that it is only more stable *once formed*. The more factors or voices there are contributing to a student's obsessive passion, the more solidified it becomes. There are familial and historical factors that cannot be changed when a student enters college, but there likely exist things that engineering educators can do to prevent students' obsessive passions from forming more fully. Simply being aware of students' levels of obsessive passion would allow educators to modify their practices so that they do not contribute to further development of a passion type that is to the students' detriment.

Related Research

In the many studies conducted on engineering students, one goal of engineering departments is to produce a high yield rate in engineering disciplines. Numerous studies have sought to understand various factors that drive students to succeed or persist in engineering programs (i.e. Cech, Rubineau, Silbey, & Seron, 2011, French, Immekus, &

Oakes, 2005). Much of that research has honed in on practical skills to help students persist, rather than attempting to discern students' underlying motivations for choosing engineering and staying in the major.

Schools want students who start out as engineering majors to earn their degrees in engineering. Systems have been implemented in order to promote engineering student success (e.g., Landis, 1997; Fletcher & Anderson-Rowland, 2000). The systems and policies that have resulted from research on engineering student perseverance and retention are certainly beneficial to students. Intentional efforts are being made to engage students with faculty and support their development outside of the classroom in addition to supporting their academic endeavors. The combination of these efforts keeps students in their majors at higher rates (Vogt, 2008). For students who have a harmonious passion for some aspect of engineering, this is a great thing. For these students, the support provided directly helps them engage in activities that bring meaning to their lives.

Obsessively passionate students, too, benefit from retention-driven support and services. They may persevere through graduation, but their work may not provide the same sense of meaning as it would to a harmoniously passionate individual. These are students who are more likely to burn out due to the demands of engineering. They may feel external pressure to participate and therefore may be less engaged in their studies than someone who is acting out of harmonious passion (Vallerand et al., 2003).

Passion research has been applied to a variety of domains, including work, education, sports, and music (e.g., Carbonneau, Vallerand, Fernet, & Guay, 2008; Ratelle, Vallerand, Mageau, Rousseau, & Provencher, 2004; Rip, Fortin, & Vallerand, 2006; Vallerand et al., 2003, 2008; Wang, Khoo, Liu, & Divaharan, 2008). However, few

studies use Vallerand's dualistic passion model as a basis for research in higher education. The few that do exist point to important findings that make a case for differentiating between the types of passions students display in order to support them holistically (Bonneville-Roussy, Vallerand, & Bouffard, 2013).

The current study examines the following research question: *How does the extent of a student's engineering identity and type of passion for engineering influence their academic grit?* The goal of this research is to quantify the influence of engineering identity, harmonious passion, and obsessive passion on grit. Depending upon what influences it, grit may not always have exclusively positive implications on one's self-concept and internal desires.

Need for this Study

While former studies have pointed toward the positive motivational impact of grit in the college setting, existing literature on grit does not distinguish between the types of passion as they influence grit. There is no distinction made between passions that align harmoniously with an individual's life and goals and those that result from external pressure or view of the ought self.

It is important to note that individuals can possess levels of both harmonious and obsessive passion. In many cases, it is likely that both types of passion influence grit in some way. The implications of lumping harmonious and obsessive passion together in one definition may be trivial from a standpoint of mere achievement, as both types of passion can provide the motivation necessary to overcome challenges in pursuit of long-

term goals. However, the manifestations of those passions in individuals who demonstrate grit can have significantly different effects on their well-being.

This study is designed to determine how much each passion type contributes to grit. In addition to the lack of differentiation between grit resulting from harmonious passion and grit resulting from obsessive passion, very little grit research has focused on engineering students specifically. This is a large research gap considering the difficulty of engineering majors and the amount of challenges students must overcome to earn engineering degrees. In general, research on grit in college students has predicted significant academic and nonacademic outcomes. Grittier students are more satisfied with college, have a greater sense of belonging, are engaged in more co-curricular activities, and reported more interactions with faculty (Bowman, Hill, Denson, & Bronkema, 2015). Perseverance of effort, as a component of grit, also predicts higher college GPA. In other studies, grit also demonstrated positive psychological outcomes (Datu, Valdez, & King, 2016). All of these factors related to grit have an influence on student success. If engineering programs desire to promote retention and harmonious passion among their students, it will helpful to specifically consider grit within the context of engineering.

Finally, research concerning passion born from engineering identity is extremely limited. Instead, much research on engineering identity and persistence focuses on external influences such as faculty support, academic and student support programs, and extracurricular involvement (i.e. Hackett & Martin, 1998, Knight & Cunningham, 2004, Dalrymple & Evangelou, 2006). All of these factors contribute to the engineering student experience, but there is a need for further exploration of their influences on students' identity and passion for engineering.

In summary, there is a need for research related to the interaction of engineering student identity, passion, and grit. Students who exhibit grit in their academics are more likely to graduate, which means that engineering programs with higher volumes of gritty students are more likely to achieve higher retention numbers. The type of passion that plays into a student's academic grit influences that student's self-concept and well-being. Harmonious passion toward grit in engineering is ideal because it adds meaning to students' lives and inspires a positive self-concept. Obsessive passion may help reach retention goals but may be of detriment to the student. It is therefore important to distinguish between the grit demonstrated by harmoniously passionate and obsessively passionate students who find their identity in engineering. That is the intention of this study.

CHAPTER THREE

Methods

A post-positivist epistemology was used to inform the methodology for this study. Post-positivism is a worldview characterized by the belief that an objective reality exists. Researchers using this epistemology seek to uncover understanding and knowledge about this reality. In doing so, post-positivist researchers acknowledge that the whole truth may not be discovered due to human error and limitations (Creswell, 2014; Sriram, 2017). This epistemology supports quantitative exploration of cause-and-effect relationships using statistics (Sriram, 2017). The current study uses a quantitative approach to help understand the relationships between engineering student identity, harmonious and obsessive passion, and academic grit.

Instruments for Data Collection

A Qualtrics survey was used to collect data for this study. Because this study seeks to help engineering education researchers understand how engineering identity and type and amount of passion for engineering influences engineering student grit, it was necessary for students to identify themselves as engineering majors. This was indicated on a preliminary demographic information segment of the survey, which also included items asking students to identify their race, sex, academic classification, and the institution they attend. Students' responses to the question "what is your major?" determined their eligibility for the study.

Following the demographic section was a brief and simple assessment of engineering identity. An engineering identity scale was developed in 2018 to combine and condense organizational identity scales for use in the context of engineering education. This two-item scale allows students to indicate the extent to which they feel their personal identity and engineering identity overlap (Borrego, Patrick, Martins, & Kendall, 2018). Compared to prior scales that measure engineering identity based on the question "Do you see yourself as an engineer," this scale has an improved reliability, with a Cronbach's alpha value of 0.84.

Type and amount of passion were measured based on a scale developed by researchers studying harmonious and obsessive passion (Vallerand et al., 2003). Items on this 12-item scale were modified to use language that better fits this study's population. An exploratory factor analysis was run on the existing scale, and acceptable levels of reliability were found for both the obsessive passion subscale (α=0.89) and the harmonious passion subscale (α=0.79). These items will be measured on a six-point Likert type scale.

Grit is a quantifiable measure of passion and perseverance toward long-term goals (Duckworth, 2016). Studies on grit have culminated in the development of a 12-item scale to measure grit in various contexts. The reliability of this scale has been tested in previous research. The scale demonstrated high reliability (α=0.85) for the overall scale and for each factor (Consistency of Interests, α=0.84; Perseverance of Effort, α=0.78). Additionally, neither factor was consistently more predictive of outcomes than the other, and in most cases, the two together were more predictive than either alone (Duckworth, Peterson, Matthews, & Kelly, 2007).

This study is focused specifically on grit within one's academic major. For the purpose of this study, this type of grit is being referred to as academic grit. Items on Duckworth's scale were modified to pertain specifically to the engineering disciplines of the students surveyed. For example, Duckworth's item "Setbacks don't discourage me" will be modified to read "Setbacks within my engineering major don't discourage me." Responses to these items were indicated based on a five-point Likert scale (1 = not at all like me to 5 = very much like me). After data collection and before further analysis was conducted, SPSS software was used to confirm the reliability of each scale used for this study.

Population, Sample, and Participants

Participants for this study were identified within the population of undergraduate engineering students across two different college campuses: a mid-sized private university in the South and a large, public research university in the Southeast. The sample selected for this study is comprised of students who responded to a survey that will be distributed through professional and faculty contacts at each institution. Surveys were sent to engineering education faculty members who agreed to distribute them at their respective schools. These faculty members were asked to distribute the surveys to students within the engineering department at their institution. This sampling method enabled surveys to reach a large sample and will represent the diversity of experience among engineering students at two very different institutions. Surveys were sent to at least 2,000 students.

Variables

Independent Variables

The independent or predictor variables in this study are students' engineering identity, harmonious passion, and obsessive passion. These variables were analyzed together to understand the impact their interaction has on academic grit.

Dependent Variable

The dependent variable in this study is academic grit. The grit scale was used to gather data on students' academic grit based on the two grit components: passion and perseverance (both toward long-term goals). The grit scale seeks to measure individuals' consistency of interests and perseverance of effort. The consistency of interests subscale contains questions related to goal commitment, distractions, and focus. The perseverance of effort subscale asks questions about work ethic, overcoming challenges, and sticking to goals for a long time.

Analysis

Multiple regression analysis was conducted in SPSS in order to study the relationship between engineering student identity, passion, and grit. Multiple regression takes into account all three independent variables (engineering identity, harmonious passion, and obsessive passion) and uses them to predict the singular dependent variable of academic grit.

Results were interpreted using statistical significance and effect size. Statistical significance indicates whether results from a study's sample can be inferred onto the

population that sample represents. When there is a 95% chance or higher that results from the sample can be inferred onto the population, the findings are statistically significant. This 95% corresponds with a p-value of 0.05.

Statistical significance tells whether a relationship exists among variables in the population. Effect size indicates how much of a relationship exists. Effect size is determined for each independent variable and for the overall model. These different effect sizes indicate how strong of a relationship exists between each of the variables and tells how much influence the combination of variables has on the dependent variable.

In a multiple regression, effect size for the overall model is denoted as R^2. R is a measure of correlation between variables. Squaring R gives the degree of variance of the dependent variable explained by the independent variables as a percentage (Sriram, 2017). Just as R^2 explains the variance of the whole model, the effect size of each individual independent variable is measured by Beta weights. Beta weights are standardized measures that use standard deviations from the mean to explain variance. This allows for effect sizes of variables to be compared to each other even when different units are used to measure the variables. The larger the effect size, the more meaningful the findings, so long as they are also statistically significant. To determine the strength of effect size, threshold values are used to mark low, medium, and high effect. These values are Beta = 0.06 (small effect), Beta = 0.12 (medium effect), and Beta = .20 (large effect) (Mayhew, 2016; Sriram, 2017).

Limitations

Several limitations to this study should be noted. The passion scale and the grit scale used in this study were not developed specifically for use in the context of education. It is possible that by modifying some of the questions on these scales to better align with this study, the validity of the scales may have been impacted. Additionally, time of year may influence students' responses to all questions in the survey. By nature, there are ebbs and flows within the school year. At some times of the year students may feel that their lives are more defined by their majors than they would at other times. For example, students may feel more defined by their engineering major while they are taking final exams then they would at the beginning of a new semester before their coursework load intensified. Finally, researchers have not previously differentiated between harmonious and obsessive passion as they influence grit. Therefore, there will not be a way to directly compare the results of this study with previous findings.

CHAPTER FOUR

Results

This study examined the influences of engineering identity, harmonious passion, and obsessive passion on academic grit in engineering students. The Grit Scale is a quantitative scale developed to measure passion and perseverance toward long-term goals (Duckworth, 2016). Engineering identity refers to the extent to which students define themselves based upon their engineering majors. The engineering identity scale allows students to quantify their level of identification with their major (Borrego, Patrick, Martins, & Kendall, 2018). The passion scale is made up of two subscales that measure levels of harmonious and obsessive passion, respectively (Vallerand et al., 2003). The purpose of this study is to determine whether or not the amount and type of passion that students have for engineering influences their academic grit.

Descriptive Statistics

College students at two institutions responded to a survey comprised of questions related to the extent of their engineering identity, passion, and grit for engineering, as well as questions about their individual demographic characteristics. Incomplete responses were removed, leaving 140 completed responses for analysis. Once in SPSS, demographic data was coded by race/ethnicity, sex, academic classification, and major.

Demographics

Out of the 140 respondents with complete responses, 7.9% were first-year students (n=11), 26.4% were sophomores (n=37), 37.1% were juniors (n=52), 23.6% were seniors (n=33), and 5% identified with a different academic classification (n=7). Students who selected "other" for classification indicated that they were either fifth-year seniors (n=4), sixth-year seniors (n=1), non-traditional transfer students (n=1), or did not identify with a traditional classification category (n=1). Respondents who identified as White made up 77.9% of the sample (n=109). Students of Color, therefore, comprised 22.1% of respondents (n=31). Males comprised 59.3% of respondents (n=83), and 39.3% were female (n=55), and 1.4% selected "other" or preferred not to answer (n=2). Finally, a majority of respondents were Mechanical Engineering majors, making up 55% of the sample (n=77). Electrical and Computer Engineering majors made up 10.7% of respondents (n=15), and 12.1% of respondents were General Engineering majors (n=17). All respondents attended either Virginia Polytechnic Institute and State University (Virginia Tech – 67.1%, n=94) or Baylor University (32.9%, n=46). Incoming engineering students at both of these schools are classified as General Engineering majors when they enter college. At Baylor, students are able to graduate with a General Engineering degree that is widely applicable to various fields. At Virginia Tech, a student must eventually select a specific engineering discipline to pursue. The remaining 22.1% of respondents identified with other specific engineering majors, including Industrial and Systems Engineering (n=19), Biological Systems Engineering (n=4), Construction Engineering and Management (n=4), Aerospace Engineering (n=1), Civil Engineering

(n=1), and double engineering majors (n=2). See Table 4.1 for all demographic sample characteristics.

Table 4.1. Demographic data.

Variable	N	%
Gender		
Male	83	59.3
Female	55	39.3
Other/Prefer Not to Answer	2	1.4
Year in School		
First Year	11	7.9
Sophomore	37	26.4
Junior	52	37.1
Senior	33	23.6
Fifth Year + /Non-Traditional	7	5.0
Race/Ethnicity		
White	109	77.9
Hispanic/Latino	9	6.4
African American/Black	2	1.4
Native American/American Indian	1	0.7
Asian/Pacific Islander	8	5.7
Other	9	6.4
Prefer Not to Answer	2	1.4
Major		
Engineering	17	12.1
Mechanical Engineering	77	55.0
Electrical and Computer Engineering	15	10.7
Industrial and Systems Engineering	19	13.6
Biological Systems Engineering	4	2.9
Construction Engineering and Management	4	2.9
Aerospace Engineering	1	0.7
Civil Engineering	1	0.7
Double Major	2	1.4
Institution		
Baylor University	46	32.9
Virginia Tech	94	67.1

Engineering Identity Descriptive Statistics

Two survey items were used to measure the extent of students' identification with engineering. These items were averaged in SPSS to calculate the total identity score. The minimum score for engineering identity was one and the max was eight. The mean response for engineering identity was 5.15 (SD=1.42).

Passion Descriptive Statistics

The overall passion scale was comprised of two parts. The first seven items on the 14-item scale measure level of harmonious passion and the last seven items measure obsessive passion. These items were measured on a seven point Likert scale. The minimum score for any item was one and the maximum was seven. The mean score for harmonious passion was 5.10 (SD=1.04). The mean score for obsessive passion was 3.01 (SD=1.39).

Grit Descriptive Statistics

The overall grit scale used (Duckworth, 2016) contains 12 items. Six of these items measure level of passion and the remaining six items measure perseverance. The minimum score for each item was one and the maximum was five. The mean overall score for grit was 3.55 (SD=0.55). The mean score for passion as a component of grit was 2.89 (SD=0.69). The mean score for perseverance as a component of grit was 3.98 (SD=0.59).

Table 4.2. Descriptive statistics.

Scale	Min Score	Max Score	M	SD
Engineering Identity	1	8	5.15	1.42
Passion				
Harmonious Passion	1	7	5.10	1.04
Obsessive Passion	1	7	3.01	1.04
Grit				
Overall Grit	1	5	3.55	0.55
Passion Component of Grit	1	5	2.89	0.69
Perseverance Component of Grit	1	5	3.98	0.59

SPSS Analysis

Preliminary data analysis conducted in SPSS began with running a principal components analysis to test the validity of the scales used in this study. Results of the principal components analysis suggested that a few of the items were not aligned with their respective scales. However, reliability analyses that were subsequently run on the original scales produced Cronbach's alpha values that were high enough to support utilizing the preexisting scales.

Multiple Regression

Several sets of linear regression analyses were conducted on the data from this study. The first was conducted in accordance with the main research question. This regression determined the influence of engineering identity, harmonious passion, and obsessive passion on overall grit. Subsequent regression analyses divided grit into its passion and perseverance components and predicted which of the same independent variables were significant contributors to passion and perseverance as components of grit.

Overall Grit

In predicting grit overall, the model was found to be significant (R^2=0.123, p=0.000), indicating that results found in the sample can be inferred onto the population. The R-Squared effect size indicates that the three predictor variables in the model account for 12.3% of the variance in the dependent variable of overall grit. In this model, however, harmonious passion was the only significant predictor of grit (p=0.004, β=0.300). Obsessive passion (p=0.818) and engineering identity (p=0.552) were not significant predictors. It is important to note that engineering identity did have a small but notable effect size (β=0.062), but these results were not statistically significant. Therefore, engineering identity had a small effect upon overall grit in the sample but that effect cannot be inferred onto the population.

Table 4.3. Regression for predicting overall grit.

Predictors	Model 1* R^2=0.123, p=0.000		
	β	*t*	*p*
Harmonious Passion	0.300	2.949	0.004
Obsessive Passion	0.022	0.231	0.818
Engineering Identity	0.062	0.596	0.552

Note. β=standardized beta; *=model is significant (p=<.05)

Passion as a Component of Grit

A second regression was run using the passion component of the grit scale. This analysis determined that none of the independent variables were significant predictors of passion as a component of grit. Harmonious passion had a medium sized negative relationship with passion in the sample, and engineering identity had a small negative

effect upon passion in the sample. Neither of these findings can be inferred onto the population, however.

Table 4.4. Regression for predicting passion as a component of grit.

Predictors	Model 2 R^2=0.040, p=0.133		
	β	*t*	*p*
Harmonious Passion	-0.169	-1.587	0.115
Obsessive Passion	0.038	0.391	0.696
Engineering Identity	-0.068	-0.619	0.537

Note. β=standardized beta; *=model is significant (p=<.05)

Perseverance as a Component of Grit

A similar analysis was run using the perseverance component of the grit scale. This analysis determined that harmonious passion was a significant predictor of perseverance (p<.001, β=0.357) with a large effect size. Obsessive passion (p=0.351) and engineering identity (p=0.723) were not significant predictors, but obsessive passion did have a small but notable effect in the sample.

Table 4.5. Regression for predicting perseverance as a component of grit.

Predictors	Model 3 R^2=0.180, p=0.000		
	β	*t*	*p*
Harmonious Passion	0.357	3.621	0.000
Obsessive Passion	0.084	0.935	0.351
Engineering Identity	0.036	0.356	0.723

Note. β=standardized beta; *=model is significant (p=<.05)

After preliminary multiple regression analyses were run to examine the primary research question, further tests were conducted to examine the influence of demographic factors on engineering academic grit. Several additional multiple regression analyses

were run to determine whether race, sex, major, classification, or institution attended accounted for variance in grit. None of these demographic characteristics were significantly correlated with grit.

Once it was determined that harmonious passion was the only significant predictor of overall grit and perseverance toward grit, a hierarchical regression analysis was run to see how much, if any, further influence obsessive passion and engineering identity contribute to variance in grit. Neither obsessive passion nor engineering identity had significant influence. See Table 4.6 for harmonious passion levels by demographic.

Table 4.6. Harmonious passion by demographic.

Variable	M	SD
Gender		
Male	5.07	1.03
Female	5.16	1.06
Other/Prefer Not to Answer	4.86	1.41
Year in School		
First Year	5.45	0.61
Sophomore	5.35	0.96
Junior	5.16	1.03
Senior	4.64	1.07
Fifth Year + /Non-Traditional	4.90	1.37
Race/Ethnicity		
White	5.07	1.06
Hispanic/Latino	5.46	0.87
African American/Black	6.00	0.40
Native American/American Indian	5.71	.
Asian/Pacific Islander	5.04	1.09
Other	5.11	1.06
Prefer Not to Answer	4.21	0.51
Major		
Engineering	5.50	0.86
Mechanical Engineering	4.93	1.10
Electrical and Computer Engineering	5.30	0.75
Other	5.19	1.05
Institution		
Baylor University	5.08	1.00
Virginia Tech	5.11	1.06

Levels of Passion and Grit

Multiple comparison of means and ANOVA tests were run to determine whether there is a significant difference between average levels of engineering identity, passion, and grit based on demographic characteristics. In this sample, none of the demographic traits included in the survey (race, sex, classification, major, institution) were significantly correlated with identity, passion, or grit.

CHAPTER FIVE

Discussion

The purpose of this study is to determine the influence of engineering identity and passion on academic grit in engineering students. Engineering identity refers to the extent to which students define themselves by their engineering majors. Research on passion has distinguished it into two types with separate but important implications. Harmonious passion is the kind that aligns with an individual's personal goals, interests, and desires. Harmonious passion brings joy and fulfilment to individuals who participate in their passion activities. Obsessive passion, conversely, is a result of external pressures or influences. Obsessive passion fuels goal achievement but may be detrimental to an individual's self-concept, often causing feelings of low self-esteem and strong emotional dependence upon goal attainment.

Whereas harmonious passion makes passion activities enjoyable, obsessively passionate people might not find the same level of joy or pleasure in the work they do or the activity they perform. The external pressures of obsessive passion can come from many different places. Pressures from other people may instill obsessive passion in someone, or the promise of financial reward that is often associated with engineering. An obsessively passionate engineering student may have the motivation to persist in their major due to these external pressures, but they likely do not find the same kind of meaning and value in engineering that a harmoniously passionate student would find.

The results of this study demonstrate that, of the three independent variables of engineering identity, harmonious passion, and obsessive passion, harmonious passion was the only significant predictor of overall academic grit in engineering majors. The large R-square value in the overall grit model (R-Squared=0.123) means that 12.3% of variance in students' levels of academic grit can be explained by harmonious passion, obsessive passion, and engineering identity. The effect size of harmonious passion in the overall model (β=0.300) means that as a student's level of harmonious passion increases by one standard deviation, overall grit level increases by 0.300 standard deviations. A similarly significant effect was found for harmonious passion as it influences perseverance as a component of grit (β=0.357).

Although harmonious passion significantly influenced overall grit and the perseverance component of grit, harmonious passion was not found to be a significant predictor of the passion component of grit. When the grit scale was divided into its passion and perseverance components, harmonious passion only significantly accounted for the variance in the perseverance side. A negative relationship emerged between harmonious passion and the passion component of grit that had a small effect size but was not statistically significant. The statistical significance of harmonious passion toward perseverance is likely due to the sustaining nature of harmonious passion. When individuals love what they are doing, they are less likely to experience the burnout that comes with obsessive passion and more likely to persevere. The small negative effect with the passion side of grit may be because harmonious passion does not necessarily contribute more to overall passion than obsessive passion.

Engineering identity and obsessive passion did not emerge as significant predictors of academic grit in engineering majors. However, obsessive passion displayed a small but meaningful effect on the perseverance component of grit that was not statistically significant. The small effect size without statistical significance means that obsessive passion did influence perseverance in the sample studied, but this finding cannot be generalized onto a population. The effect is notable enough to warrant future study with a greater sample size. Demographic characteristics were also not significant predictors of variance in levels of academic grit among the sample of survey respondents. Overall levels of grit were relatively stable across race, sex, academic classification, major, and institution.

Overall Academic Grit

Grit is a fairly new concept in the field of higher education, and there has been little research on grit in engineering students specifically. The research that does exist shows positive outcomes associated with grit, including perseverance in one's major and positive social and psychological implications. Research on grit in higher education has consistently shown that gritty students have more robust college lives, higher college GPAs, and more positive psychological health (Boman, Hill, Denson, & Bronkema, 2015; Datu, Valdez, & King, 2016). Additionally, gritty students are more likely to persist in their majors despite academic challenges. There is a need for further research on grit in the context of engineering, especially because it is a challenging major with substantial attrition.

Academic units that are concerned with retention and high academic achievement can do more than just seek to enroll gritty students. A score-based admissions system, in which students are granted or denied acceptance into an academic program on the basis of standardized test scores, is common practice (Zhang, Anderson, Ohland, & Thorndyke, 2003). This practice does not provide an opportunity to select gritty students. Without knowing prospective students and understanding their educational histories, it is difficult to tell whether high test scores were a result of hard work or simply high academic aptitude. Barring a revamp of the college admissions process, this means that it should fall on academic departments to develop grit in their students.

Involving grit in admissions decisions would allow educators to have a baseline understanding of how equipped students are to handle an academically rigorous program like engineering. This should not be the sole determining criteria used for admissions decisions, as grit can be and is developed throughout college. If considering grit for admission, it would be important to note that students' self-identification with grit levels are not objective measurements. If used, grit should be considered as part of a more holistic data set that shapes a robust understanding of prospective students.

Measuring grit in incoming students could be difficult without further context into their prior academic and life experiences. Perhaps in addition to scale items it would be appropriate to provide students with some opportunity to elaborate on why they feel they identify with certain measures on the grit scale. This would allow students to speak to their perceived capabilities.

Once students enter college, engineering departments can actively develop students' grittiness. Many introductory engineering courses are designed to challenge

students and help determine which students are “cut out” for engineering. This model utilizes “weed out” classes in which students are held to high standards in exceptionally rigorous courses as a means of determining who “has what it takes” and who does not. The “weed out” paradigm assumes that grit in students cannot be meaningfully changed through intervention. This is a wrong assumption, and one that could especially hurt students who face stereotype threat, such as Students of Color or women students (Mervis, 2011; Weston, Seymour, Koch, and Drake, 2019).

Even the most high-achieving students on college campuses find themselves challenged by a college level curriculum. Students for whom achievement in high school came more easily may find themselves having to work hard in college for the first time. These students have also not developed skills that contribute to grit. Even students who worked hard in high school may find that the expectations of college professors are more intensive than they previously encountered. When these students fall short of meeting the high expectations set forth for them, they may begin to view themselves as incapable, or the department may deem them as not being cut out for their specific major. When such students have not previously faced any major academic challenges, they likely also have not developed a level of grit that would help them overcome those challenges when they arise in college.

A major finding of this study is the role that harmonious passion can play in increasing grit in engineering students. If educators had some level of understanding of students’ grit, they could work to build grit in students by instilling confidence rather than using scare tactics. Students with lower levels of grit might require more attention in

order to build confidence in their abilities to achieve, but helping those students believe in themselves and their capabilities can help drive their motivation to succeed.

Harmonious Passion

Harmonious passion is developed through participation in an activity that an individual loves or finds joy and value in. Past research has shown that harmonious passion elicits positive emotional responses and motivates individuals to keep working toward goals that align with their passions (Vallerand et al., 2007 & Bonneville-Roussey, Vallerand, & Bouffard, 2012). The significance of harmonious passion in this study indicates that the more students love and are inspired by their engineering majors, the more likely they are to demonstrate grit in their academics. This should be encouraging to engineering educators who want their students to succeed academically.

A harmoniously passionate engineering student chooses their major for reasons that go beyond strong pressure from others. Because harmonious passions are freely incorporated into one's identity (Schellenberg, Bailis, & Mosewich, 2016) due to a strong like or love of the subject or activity, a sense of purpose arises from within the harmoniously passionate individual that can motivate them to persist.

Studies have shown that when harmoniously passionate people meet challenges with failure, they are more open to fully explore why the failure happened and to learn from it (Hodgins & Knee, 2002; Vallerand, 2010). This is not always the case with an obsessively passionate individual, for whom a failure can be detrimental to self-concept (Schellenberg, Bailis, & Mosewich, 2016).

An understanding of the role of passion type as it relates to failure can help inform the work of engineering educators. How educators respond to student failure should be out of a desire to empower students to improve in the future. Too often, engineering courses are unforgiving when it comes to grades and project-based assignments. It is sometimes impossible to come back from a failing grade, which can negate the need to learn from it in a student's mind.

The large significant effect of harmonious passion on academic grit indicates that educators can have a big impact on students' level of grit by providing opportunities and experiences that enhance students' love of engineering and desire to overcome challenges to reach their goals. This is exciting and mutually beneficial to students and engineering faculty and administration. The more students are able to find joy in their majors, the more likely they are to demonstrate grit. The more students demonstrate grit, the higher the likelihood that they will be motivated to overcome challenges and persist to graduation. When more students graduate in engineering, departmental retention goals are more likely to be achieved. This is good for all involved.

Shifting the culture of engineering toward one that regards harmonious passion as a critical factor toward academic accomplishment may be challenging. Although harmonious passion and accomplishment go hand in hand, the way engineering has been taught for much of its existence has focused more on mastering content than on inspiring students to *want* to master the content. As is the case with many structures and systems, it may be difficult to change the foundation upon which engineering teaching pedagogy was built.

Obsessive Passion

It seems intuitive that the sort of brute force pressure characteristic of obsessive passion would be strong enough to fuel students toward grit. Duckworth (2016) discusses West Point cadets in her book, saying that the expectations placed upon them by others fueled their desire to overcome the physical demands they faced. This sounds a lot like an obsessive passion - Duckworth does not say that the cadets enjoyed their experiences, but they did get through them successfully; their goals were accomplished.

In some ways, the practices and behaviors of engineering education departments mirror elements of the West Point cadet example. When a student enters engineering, external pressures emerge from all around. Families are excited that their students are entering such a highly regarded field. Professors talk about the high salaries associated with jobs in engineering industries. Academic departments celebrate students who excel in their classes and attain internships. The image of success in engineering has little to do with how much students love what they do. Instead, graduating without changing majors is applauded. Job offers from big-name companies are celebrated.

The lack of statistical significance and very small effect size of obsessive passion on grit indicates a need to reevaluate current practices in engineering education. The external pressures associated with pursuing a degree in engineering may not be the most beneficial forces contributing to the success of engineering students. Obsessive passion does not significantly contribute to grit in the way that harmonious passion does. This means there is a need to examine the possible implications of creating a culture of harmonious passion development rather than one characterized by accumulating pressures to succeed.

Engineering Identity

Identity and passion are intertwined. It is therefore important to consider a student's identification with engineering if we are to consider their passion for engineering. There are different types of identity—social and personal. Social identity refers to identification with a group. In the case of engineering students, engineering becomes part of their identity when they are accepted into an engineering program. Social identity is viewed in terms of "us" vs. "them." Shared attributes are at the center of social identity, and these attributes stand out when students compare their group (as a collective) to any outgroup (Onorato & Turner, 2004).For as long as students remain in an engineering major, they will feel a part of that social identity.

Personal identity, on the other hand, refers to students embracing their role as it pertains specifically to themselves. Personal identity is viewed in terms of "me" vs. "not me" and depends on the extent to which engineering influences their lives. Personal identity is developed based on an individual's own goals and desires rather than from membership in a group. Students with high levels of engineering identity feel that their individuality is distinguished in some way by their engineering major.

Previous research has shown that identity shapes individuals' attitudes and behaviors in groups with which they identify (Ashforth et al., 2008; Mael and Ashforth, 1992; Tajfel and Turner, 1986). In this study, engineering identity refers to the extent to which an engineering student defines himself or herself by their status as an engineering major. Identification with engineering shapes the way students engage with each other and with their daily activities and responsibilities. The fact that engineering identity did not arise as a significant predictor of academic grit in engineering students means that a

student's self-identification with engineering is not closely tied to the level of grit they demonstrate toward their majors.

These findings are meaningful because, often, engineering students are looked upon as being somehow academically superior to students in other majors. This kind of messaging can be internalized in different ways by different students. Some students may take pride in their ability to achieve goals related to such a rigorous major; others may feel isolated due to feeling unable to relate to people in different majors. For some, the challenges associated with such rigorous majors spark motivation. For others, especially those students lacking grit, the rigor may be discouraging and lead to feelings of defeat when failure occurs.

Engineering is challenging. When an engineering student tells a non-engineering student what they are studying, the response of the other student is usually "wow" or some similar form of praise or affirmation. This is especially true for women majoring in engineering. Societal stereotypes still associate engineering with masculinity, which leads to people being surprised when a female student is successful in her engineering major. The feedback engineering students receive from others regarding their engineering classification can shape how those students view themselves.

Implications for Practice

Research on passion type has demonstrated that harmonious and obsessive passion have significantly different implications on individuals' motivations, self-concept, and goal attainment. While both types of passion contribute to grit, harmonious passion is associated with more positive psychological and personal outcomes. Obsessive

passion has been found to be effective in motivating individuals to persist but is more likely to lead to burnout and other negative outcomes (Vallerand, Paquet, Philippe, & Charest, 2010; Schellenbert, Bailis, & Mosewich, 2016).

The strong connection between harmonious passion and grit found in this study, combined with research that tells us the benefits of harmonious passion compared to obsessive passion, should be encouraging to engineering educators who desire to support the dreams and long-term goals of their students. These findings necessitate further conversation regarding best practices for fostering harmonious passion as it relates to students' engineering majors in college.

The primary focus of engineering educators is to support students so that they succeed academically in their majors. Often, support for students comes in the form of academic advising, tutoring, or other academically-focused programs and interventions. Engineering departments often do a good job inspiring students to select engineering majors but, once students have done so, the job of getting them excited about their major typically ends.

Prior to major selection, engineering departments may hold informational sessions or other events to encourage students to choose engineering. In my undergraduate experience, first year engineering students were required to attend informational sessions about several distinct engineering departments. The goal was to help us explore options, and the sessions were created in a way that showed off the exciting things we could do with each respective major. I remember several upperclassmen speaking about their experiences working as Imagineers at Disney during one info session. The speakers

seemed to love their experience in the major and that, combined with the possibility of working for a fun company like Disney, ultimately led me to select that major.

Despite the efforts of engineering departments to garner student interest early on in college, those efforts dwindle as students rise in the ranks of academic classification. The cultivation of enthusiasm and excitement is replaced with a strict and rigorous academic curriculum that is designed to instill mastery. While mastering engineering skills and concepts is vital to the success of future engineers, learning those skills does not necessarily build a sense of harmonious passion in students. Students may find joy in solving complex problems, but it is easy to lose sight of the exciting practical applications of those problems that inspired them to choose their major in the first place.

In addition to being mindful of the shift from inspiration to technicality, educators should be mindful of the messages they convey by the way they talk to students about their majors. On the first day of my first in-major class, my professor stood in front of the room and talked about names we would be called as a result of the major we selected. Industrial and systems engineering (ISE) is the most people-focused engineering discipline offered by my undergraduate institution. Focused on process improvement and efficiency rather than technical design and building, ISE is often looked upon as "easy" engineering. We were warned that students from other engineering departments liked to give new meaning to the ISE acronym, saying it stood for "I suck at engineering," or "imaginary engineering." The pressure was on, we were told, for us to prove ourselves and the fact that our major was equally as important as other engineering disciplines.

This example from my undergrad experience certainly did not spark a joy-filled kind of passion for what I was learning. There is nothing empowering or exciting about

hearing the derogatory things people have to say about the career path you have selected. The results of the present study make a compelling case for finding a balance between overemphasizing the tough historical nature of engineering exclusively and cultivating a love of the subject. Educators should seek to inspire students' love of their majors so that they may develop grit derived from their harmonious passion for their majors.

Harmonious passion results from autonomous internalization of an idea or goal (Swimberghe, Astakhova, and Wooldridge, 2014). Faculty and staff can instill this type of passion in students by providing inspiration related to the fields they are entering. This could take the form of an intervention or program or could be as simple as facilitating goal-setting exercises that focus on possible big-picture outcomes. It is easy to get caught up in the day-to-day demands of a rigorous major; difficult classes take the focus off of the original reasons students were inspired to select their majors. Encouraging students to reflect on what their goals are after college can help keep their focus on the core of their harmonious passion.

Other ideas for cultivating harmonious passion include modifying curriculum to incorporate a heavier focus on the application of concepts being learned. As much as possible, courses should include real-world components. This could mean designing projects around real-world issues or bringing guest speakers into classes to talk about how they use specific engineering concepts in practice. Often, engineering guest speakers will tell students what they do but not how they do it. The *how* is important because it emphasizes the importance of the skills students are learning—even skills that may seem mundane on paper.

Finally, although engineering identity did not emerge as a significant predictor of academic grit, there are opportunities to positively contribute to students' levels of engineering identity while also cultivating harmonious passion to help students build grit. Godwin's (2016) three-pronged framework for determining engineering identity can help guide future practice for creating positive harmonious passion through the use of an identity theory model. Specifically, Godwin cites engineering-related interest, recognition, and performance/competence beliefs as core components of establishing engineering identity.

Using the tenants of Godwin's framework can help guide efforts toward harmonious passion development. Educators can utilize this framework to instill harmonious passion by helping students find value and purpose in their work and by recognizing accomplishments and reminding students that they are capable of overcoming challenges. Helping students strengthen their personal identities as engineering majors by inspiring harmonious passion will very likely lend itself well to producing grit.

Opportunities for Future Research

Is Grit Good? The definition of grit as passion and perseverance toward long term goals paints grit as a quality that is inherently good. Having and developing grit enables individuals to overcome challenges and accomplish goals. Studies conducted on grit to date focus on the positive qualities of the trait; little research has been done on potential negative effects of grit development. The present study shows that harmonious passion heavily influences students' levels of grit. In this study, scale items referred specifically

to long term goals related to engineering. Individuals possess harmonious passion for lots of things. What happens when someone's harmonious passions are rooted in things that are unhealthy or unproductive? Is the grit that may arise from those passions still good? What happens when someone becomes so focused on activities fueling their harmonious passions that they neglect responsibilities and roles in other aspects of their lives? Is this still good grit? These questions, and others like them, would benefit from further investigation in future studies.

Harmonious passion and passion toward Grit. Perhaps the most surprising statistical finding in this study was the emergence of a negative relationship between harmonious passion and the passion component of grit. While not found to be statistically significant, this finding should be investigated in future studies to explore what type of passion the grit scale is measuring. The strong statistically significant relationship between harmonious passion and the perseverance component of grit explains much of its influence on overall grit, but it is interesting that the same cannot be said for its influence on the passion component of grit. Further study of the grit scale itself and what type(s) of passion it accounts for could help explain the negative effect found in this study.

Biographical identity. Engineering identity was not found to be a significant predictor of academic grit in engineering students. However, the identity scale used in this study only measured students' present perceptions of themselves. Survey questions related to engineering identity did not provide insight into how that level of identity was developed or why it did not have a significant influence on grit.

According to identity development theory, students' backgrounds, experiences, and interactions with others and their environments are important elements to consider when studying identity (Jones, 1997; McEwen, 2003; Torres, 2003; Weber, 1998). Assessing these factors was outside the scope of the current study, but further attention to biographical identity development in future research could provide context for understanding the way engineering students come to view themselves.

There is an existing framework for understanding biographical identity that could be useful in future research related to engineering student identity and success. Goffman (1963) describes personal identity as being heavily reliant on biographical information that others know about that person (Silver, 1996; Alleman, Nelson, and Allen, 2019). Goffman's understanding of personal identity involves meaning making and interpretation of how prior life events have led present identities. The present study aimed to measure present levels of engineering identity in students. Goffman's framework could be helpful in future research for exploring what factors led students to their present identification with engineering.

Classification and Grit. While academic classification was not found to be a significant predictor of harmonious passion or grit in this study, there is a noticeable nonsignificant negative trend in students' harmonious passion levels across classifications. Among the students surveyed, those in lower classifications expressed higher levels of harmonious passion, and level of harmonious passion decreased by year among study participants. While the non-significance of this finding means it cannot be inferred onto the larger population of engineering students, the decline in harmonious

passion levels by classification warrants further attention. In future studies, collecting longitudinal data to track students' passion development throughout college could help identify related trends and potentially highlight critical spaces for intervention. Additionally, respondents in this study were majority first- and second-year students. Future studies should aim to reach more upper-class participants.

Gender and Grit. In this study, gender did not have a significant effect on students' levels of harmonious passion or grit. This is an especially fascinating finding, but is likely due to an overwhelmingly male respondent pool. Based on prior research about gender and engineering, it is unlikely that there is no difference between grit in male and female students. A future critical study would be necessary to truly test for gender differences in academic grit. This will require either surveying a larger sample of students or producing a study that only samples women.

Institutional culture. Respondents in this study attended either Baylor University or Virginia Tech. These two schools differ on many fronts. Virginia Tech is a large, public land-grant institution in the Eastern United States. Baylor is a mid-sized, private Christian university in central Texas. The two schools vary greatly in terms of size, student demographics, religious affiliation, institutional culture, academic focus, and other factors. Virginia Tech is known primarily for its engineering programs, whereas Baylor's liberal arts majors are its best-known academic offerings. While the present study did not find a significant difference in levels of harmonious passion or grit among students between these two respective schools, it would be interesting to further examine whether institution type plays a role in these outcomes. A larger-scale study of multiple

institutions could provide insight into how the culture of engineering departments, specifically, influence harmonious passion and grit in their students.

Grit and retention. The present study took place over the course of one academic year. Because of the limited timeline for a Master's thesis, there is no way to track which students who responded to the survey will persist in their majors through graduation. Future longitudinal research could be conducted to analyze the long-term impact of harmonious passion on grit as it relates to college engineering students completing their degrees.

Programs and practices. There is a need to more closely study how current programs and practices in engineering education influence grit development. This study found that harmonious passion has a significant and meaningful influence on academic grit, as well as perseverance toward academic grit, in engineering students. The large effect size of both of these relationships means that these findings are not trivial and warrant further exploration. Assessment and evaluation of existing programs should then be used to determine best practices for growing grit in engineering majors. Findings of this research should be used to inform the design of new programs that support students in fostering harmonious passion and, in turn, grit toward their academic majors.

Conclusion

The results of this study illuminate a strong correlation between harmonious passion and academic grit in engineering students. This result is important, especially in a field that is so academically rigorous and results driven. Engineering students face

pressures from all sides to persist in their majors. Sometimes those pressures are enough to motivate students to continue their academic pursuits even when they are met with challenges. Other times those pressures may have negative implications, such as adding stress and external expectations to students' lives, that may deter students from wanting to continue.

The findings of this study should encourage engineering educators to challenge traditional admission criteria such as academic achievement as the only factors that matter for engineering success. The data in this study present an opportunity to widen the scope of achievement and retention efforts to include a more humanistic component: love of one's major. When students love and find value in their engineering majors, they are more likely to demonstrate higher levels of grit. Higher levels of grit, in turn, should contribute to the higher retention numbers sought by college engineering professionals. Further study is needed, however, to analyze the long-term effects of harmonious passion on grit.

This research can be used to invite engineering educators to participate in active conversations regarding how to facilitate harmonious passion development among students. Investing in the cultivation of this kind of positive, affirming, value-enhancing passion in students will benefit faculty and students alike. As students grow harmonious passion for their majors, they will become more likely to simultaneously develop grit that will help them overcome challenges and achieve their goals. It may require creativity and innovation on behalf of educators to develop this kind of passion, but doing so can strongly benefit both faculty and students in engineering programs.

APPENDIX

APPENDIX

Researcher Positionality

On the topic of how identity, harmonious passion, and obsessive passion influence engineering students, I acknowledge that I possess identities, characteristics, and life experiences that inform the way I think about this study. As a former undergraduate engineering student, I formed my own understanding of what it means to embody engineering as a part of my identity. I also possess a strong understanding of which elements of my experience were helpful in maintaining motivation to persist even amidst challenges. My thesis topic was largely shaped by my own experiences as was my interpretation of results.

In addition, my experience working as a graduate apprentice in the School of Engineering and Computer Science at Baylor has allowed me to think about engineering student support from the angle of faculty and staff in the engineering academic department. I have seen programs that have worked well and others that have not been as effective in either garnering student interest or motivating students to succeed. This component of my experience influences the way I think about possible changes to current practice.

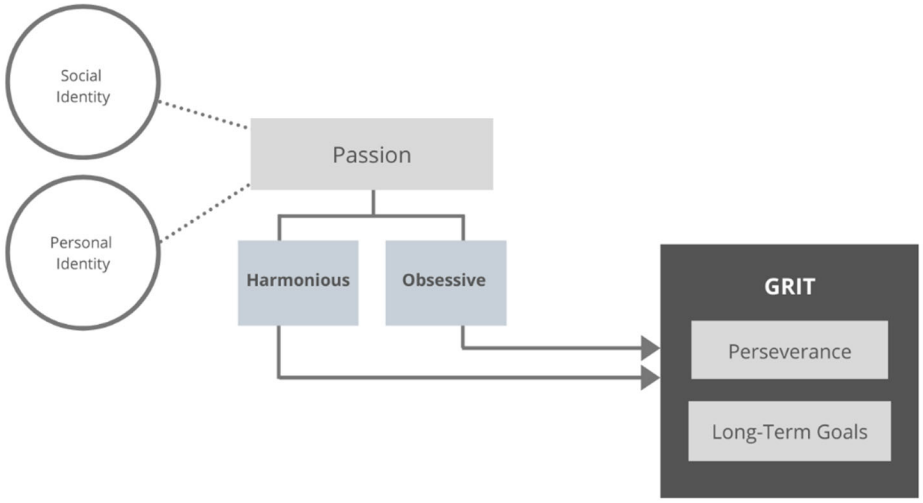


Figure A.1. Conceptual Model. This model outlines the connections between primary components of this study.

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