Provoked Emotion in Student Stories of Motivation Reveal Gendered Perceptions of What It Means to be Innovative in Engineering

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Abstract

Focus on the role of motivation and emotions as part of engineering entrepreneurial definitions pose an intriguing question: Might understanding how college students characterize a new graduate's entrepreneurial action be crucial for expanding a definition of innovation and infusing new elements in the curriculum? In this paper, we utilized students' interpersonal perceptions of another to parse out the definition of innovativeness, finding that gender matters for achievement motivation and affiliation motivation in conceptualizing an engineer/founder/CEO. The study included two independent elements (gender cue prompt and gender of participant) and studied effects of these variables on both the story-oriented dependent variable and mood scale reports for the characterization of the engineer/founder/CEO. Eighty-three participants on both coasts of the United States and in Northern Europe provide vivid action shots and stunning motivational characterizations. Findings indicate negativity manifests significantly in an individual's interpersonal perception of a new graduate's decision to step away from their founded company, revealing that interpersonal perceptions vary by gender for motivation and negative emotion.

I. Why Study Emotions and Motivation in Engineering

Why do emotions and motivation matter in any discussion about engineering students and innovation? Whether it is a feeling of comfort or discomfort, our students show us that emotion is a tangible ingredient in their work. Modern students discuss emotion regularly. We have heard students identity with extraordinary achievement and worry about it at the same time, "I cannot help but feel inadequate and behind." Or, they wonder if the daunting process of starting up something new is their downfall to maintaining relationships. Student comments parallel research suggesting millennials prioritize interactions and relatability while leading new work projects [1]. Thus, it is important for them as creators and innovators to understand how they feel and respond as they go about science and engineering work. It is also important they understand the emotion that becomes embedded with the work product itself. Moreover, for faculty and engineering educators, these emotional components pose a challenge with regards to expectations students have for learning in engineering classroom environments, and for professional and personal well-being. Surfacing what motivates students to select and study engineering and natural sciences has always been one of the fundamental concerns in STEM. The authors believe that understanding how college students characterize a new graduate's entrepreneurial action [34] adds to the discourse of engineering education and is crucial for expanding a path to innovation.

The purpose of the current study is to investigate the role of emotions and motivation in the storyline expectations to a prompt of the engineer/founder who decided to step down as CEO with two measures: validated coding of the projective storytelling and the positive and negative affect (PANAS) scale.

II. Theoretical Background

The role of motivation and emotions are part of engineering entrepreneurial definitions. Increasingly, engineering student entrepreneurial ventures begin as emotional connections,

artistic experiences, and high expectations for delivering on research teams [2, 3, 4]. We regularly hear students talking with purpose. They explicitly ask for guidance and reflect on their feelings attached to an idea in order to ensure clear communication about a question in their research, about a team conflict, about entrepreneurial dreams, or even to get closer to other people. Their requests embody a shift in an entrepreneurial mindset, revealing how students ultimately move forward with what they want to change in themselves and in the world. The importance of this shift is underlined by the fact that the next 10 years will bring more than a billion new young people to the global work force and their working lives are estimated to be even more entrepreneurial than previous generations [5].

Personal characterizations (emotions and motivation) of the modern engineering student have received limited research attention. Regardless of whether a student makes innovation or entrepreneurial career their primary goal, this paper introduces discussion to preserve a path of sustainable well-being and fairness for men and women entering the workforce [6]. There are many explanations of individual excellence and entrepreneurial mindset [7,8, 9] and multiple studies about engineering students [10,11,12] with an emphasis on a high need for achievement and potential for break-through innovation [13]. Since the late 1990's engineers and designers have been exploring moods and feelings and their connection to better solutions [14]. And while research links entrepreneurial status to personality theory [15] and personality to leadership [16], few studies focus on the impact of emotion on innovative success. This paper aims to begin filling that gap with a preliminary experiment to show how students experience a story of innovation.

The experiment is inspired by Radcliffe President Mattina Horner's historic study on the role of gender on success within the male dominated world of medicine [16]. In her research she asked: *After first term finals, Anne (John) finds herself (himself) at the top of her (his) medical school class.* Results indicated that women anticipated negative consequences for a woman's success with theoretical implications for achievement motivation. Her study has been validated and applied in various experiments regarding career development and occupational choice [17] with commonalities and differences in the original finding that women had a fear of success. Further studies found relational gender differences in the ways men and women tell stories about the motivation of entrepreneurial leaders [18, 19].

In this sense, there is widespread agreement that today's college student is not like the college student of yesterday, as modern studies have shown students feel an overwhelming pressure to perform. A premise for this particular experiment is the documented increase in unhappiness in students regardless of gender [20] and unease in the transition from college to life after college [21, 22, 23]. At the same time, the experiment pays attention to the emotional state of the engineering student who is striving for excellence and innovation while starting a company. We have developed an evolving approach with two measures for an exploratory analysis of feelings (the role of emotion) - and needs (the role of motivation) on an engineer's job choice.

Although there exists widespread belief in the engineering education community that emotional responses of modern students can have an enduring psychological impact, little is known about the factors of emotion and motivation on innovation endeavors and individuals' reactions to them. What different kinds of motivation do men and women ascribe to men and women achieving innovation success, and how do they vary in degree and/or in kind? And, how will interpersonal perceptions of innovation success vary when a leader/founder decides to step away from their success?

Two questions organize the preliminary focus for both this study and the larger research plan to develop a theory about the impact of emotion in engineering students regarding innovation:

1) *How does motivation surface in the themes and images of storyline expectations for the engineer/founder who decided to step down from their CEO position of their founded company?* 2) *How will preliminary findings inform the development of a research method to study the conception of emotion in an engineering student mind-set and experience of innovation in leadership?*

III. Methods

Participants

Eighty-three students from three universities were participants in the study. The current analysis includes the stories of seventy-seven of those participants and the affect scale reports of seventy-two of the participants after discarding four incomplete story responses, two participants with non-binary responses (self-identified as "other" rather than male or female), and eleven incomplete PANAS scale reports. Participants were students studying at a Northern European university, and private West Coast and East Coast universities in the United States. Students ranged in age from 18-29. The mean age was 21.2.

Measures

In this preliminary experiment, we gathered the stories and emotion scale reports of the 83 participants to examine discoveries in the emotional and motivational make-up ascribed to an engineer/leader/founder who decided to step away from their company. This examination presents two dimensions as measures for an experimental exploration of emotion and motivation. First, participants respond to a projective prompt with a story. Then, they respond to a short version emotion scale. The experiment included two independent variables (gender of the cue prompt and gender of participant) and studied effects of these variables on both story-oriented dependent variables and mood scale reports with regards to the characterization of the engineer/leader/founder.

Projective Picture Test Prompt: Cue Storyline

The first instrument, The Story, is a picture test prompt, based on the projective and diagnostic Thematic Apperception Test (TAT) [13, 25] and the Horner protocol [18] updated by others [19] and featured as a measure in leadership research [20 21]. The projective prompt methodology used for the storytelling cue scenario is based on the 1943 TAT. While the TAT was originally designed by Murray to clinically categorize unconscious images with a picture test [25, 26], Atkinson [12] successfully utilized it to measure achievement motives. The TAT has been demonstrated as a fruitful method for capturing underlying motives [25, 29]. In addition, it has more recently been acclaimed for validly testing compatibility, productivity and leadership in the workplace [28, 31].

The "cue storytelling line" prompt offers interpretations of actions, styles, narrative expressions, and symbols that provide useful projective data. Analysis is on events in the story and forces emanating from the central character and the setting. The images and themes in the participants' responses may be a tool in uncovering sensitive interpersonal perceptions not typically found in other qualitative or quantitative research tools. Controversy exists concerning whether the measure reflects how individuals perceive themselves, how they perceive others, how they actually behave, norms, gender-stereotypes, or some combination of these possibilities, yet researchers agree that the TAT is capable of capturing images not likely to be expressed with other techniques [25].

Emotion Scale (PANAS)

The second measure, used to supplement the story findings, is a short version of the PANAS mood scale that reports positive affect (PA) and negative affect (NA) [30]. High PA is a state of high energy and pleasurable engagement whereas low PA is characterized by sadness and lethargy. In contrast, NA is a general dimension of distress and un-pleasurable engagement and reflects the extent to which a person feels enthusiastic, active, and alert. NA refers to a variety of aversive mood states like anger, disgust, fear, and nervousness (low NA is a state of calm and serenity) [30]. The emotion scale measure provides a way for participants to review a number of words that describe different feelings and emotions [30] and indicate to what extent the person in their story, Jessica or Peter, feels pleasurable or un-pleasurable engagement at three points in time (moment, post-graduation, and years earlier).

Content for Analysis

The study had two between-subject factors crossing two independent variables (gender of participant: female and male, and gender of engineer in the cue prompt, female, male) which yielded four conditions, participant-cue: female-female, male-female, male-male, male-female. Six univariate ANOVA, each a two by two, produced four experimental conditions. Measures in two parts were reported: stories written by the participants coded for presence or absence of factors of motivation and of mood on a scale of low to high negative affect and positive affect.

Emotion Scale for Positive or Negative Affect

The second measure was the short version PANAS measure of emotion as Positive Affect (PA) and Negative Affect (NA). The instrument measures the two factors of PA and NA that emerged as distinctive dimensions which can be represented as orthogonal dimensions in factor analytic studies of affect [30]. The mood scale responses evaluate the extent to which participants characterized the person with positive feelings or negative feelings. The scores for each word associated with PA and NA in the scale [30] from each participant at each designated time were summed to create representative PA and NA numbers from 0 to 50. These sums were then compared using SPSS to perform univariate ANOVA.

For all six conditions, a Cronbach reliability analysis was computed. The overall Cronbach alpha coefficient reliability for the study sample was above 0.75.

Concepts for Story Coding

Each concept below can be represented by words and phrases in story themes and images. Story-oriented data results were computed as defined in Table 1. One co-author had extensive psychology training, including the projective picture test techniques [20, 21, 31] to measure motivation. A clinical research psychologist, blind to the assertions of the study, was consulted before and after the analysis about coding. After reviewing stories three times, the co-authors coded stories for presence or absence of themes in concept categories. While coders rated the number of times the concepts appeared in the stories, this analysis reports presence or absence of the concepts.

TABLE 1. DEFINITION OF FORCES IN STORIES IN RESULTS

Definitions of Forces as Motivations in the Story-Oriented Analysis
Achievement refers to a range of images and themes in the Stories that are characterized on a continuum of need to achieve as self-driven interactions: "striving for excellence," rigorous "goals" "creating," "work never done" to externally driven interactions [Atkinson, 1958; McClelland, 1964; 1987]. Refers to high need and capacity to strive for personal achievements [13],

striving for high performance, setting goals and objective for success, along with creative goals for making things [24, 28, 32].

Innovation is linked to Story images and themes that express a conception of ability and/or intrigue, interest, excitement for *questioning, observing, experimenting, networking, and developing* work with real and tangible applications for engineering innovativeness [Bandura,1977,1986; Schar,2017; Stefik & Stefik,2004; Ferguson & Ohland, 2012]. Includes phrases for innovation [33] and innovation self-efficacy [34] as a conception of self that express intrigue, interest, and excitement for observing and experimenting with new approaches. An overlap between achievement motivation and innovation exists since individuals with a high need to achieve also demonstrate a visionary sense and gain a sense of self-worth from excelling and doing something new. Dissimilar to achievement motivation, however, innovators have a creative competence [32] and a comfort with ambiguity [2].

Affiliation It tracks the extent to which a participant is personally capable of understanding the emotional make-up of other people and indicates ease of stepping into the feeling state of another [13, 14]. Presence of affiliation are indicated with mention of liking, caring, relatability, starting, sustaining and restoring relationships with family, friends, fiancées, etc. refers to Story themes as need for "family or friendship" and whether or not someone likes or doesn't like another individual, romance, attention to the make-up of others at work and treating others accordingly [McClelland, 2004; Cialdini,1998].

Negative Consequences represents a range of story images and themes that indicate behaviors that are characterized by stressful, worrisome, or bad outcomes, negativity, or negative consequences [17] to a job action, overall dissatisfaction, change, choice or decision, anticipation of negative consequences or denial of the success [Horner, 1970; Engle, 2004; Karanian, 1995].

Procedure

Four different individuals administered the study in three different university classroom group settings. Participants received one prompt for either the Jessica or the Peter scenario, with identical pages to avoid awareness of the differences in cue. Students did not receive credit or compensation.

The first measure instructions were written at the top of the page with one gender cue example: *"We are interested in your response to the scenario. Thank-you in advance for following the directions below on page one and page two. This won't take more than ten-fifteen minutes of your time." "Imagine that you can tell a story about Jessica. Write this down. Include a beginning, middle, and end."*

Jessica graduated at the top of her engineering class from university and founded a start-up. Six months later, the company was valued at millions of dollars. She decided to step down from her position as CEO and take an entry level engineering job in a large company.

The second measure included the following directions:
"The below scale consists of a number of words that describe different feelings and emotions. Indicate to what extent the person in your story feels a particular way at three points in time (moment, post-graduation, years earlier). Use the following scale to record your answers.

Read each word and then mark the appropriate number (1, 2, 3, 4, or 5) in the space next to that word."

IV. Results

Gender of Cue Matters for Presence of Motives in the Stories
To examine the presence of motivation in the stories we conducted a 2x2 Factor ANOVA to test the presence or absences of the concepts to compare the four conditions, with cue storyline versus participant gender and $p<0.05$ set as significant.

Achievement: Gender of the cue matters for Achievement (Figure 1). Male participants wrote stories significantly higher in Achievement when writing to the Male cue of Peter than to the female cue of Jessica. Female participants did just the opposite: they wrote stories higher in Achievement when writing to the Female cue of Jessica than to the male cue of Peter. Females wrote: "Jessica was a genius in class; She only chose perfection…" while males wrote: "He chose his love of engineering," "Peter was the one who understood the problems before everyone."
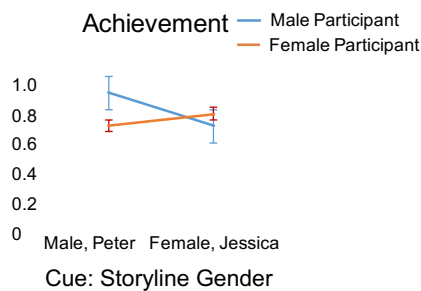

Figure 1 Achievement: Male and Female Participant responses to Male and Female Storytelling Cue, p=0.110.

Affiliation: Writing a story through the perspective of the gender that you identify with increases the affiliation themes (Figure 2). Gender of participant matters for stories containing need for Affiliation motivation.

Themes and images in the stories included twice as many need for affiliation references by female participants when the story cue was their same gender – Jessica (Table 2). "I was her friend," "Jessica began to feel that those who used to be her friends were now only co-workers," "Her father was sick and she needed to stay home and take care of him so she had to step down from the CEO position," Likewise, males wrote twice as many need for affiliation themes when the story cue was about Peter: "He was able to have fun with friends and take time for relaxation." A cluster of stories by both male and female participants attributed affiliation images – caring, sharing with others, being more relatable, or giving back to gain life meaning – to the reason Jessica or Peter decided to step away from the CEO position: "She decided the money didn't matter and gave it to charity, stepping down and taking an entry level job in a big company."

Some stories themes blended need for affiliation with Innovation, "Peter cared more about designing a prosthetic limb for people that couldn't afford it than making the money. When he made millions of dollars he gave most of it to a foundation."
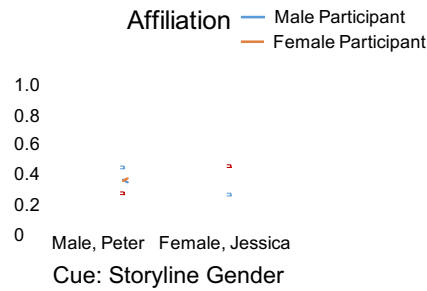
Figure 2 Affiliation: Male and Female Participant responses to Male and Female Storytelling Cue, p=0.101

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Innovation: In examining the presence of innovation, there was however, no significant interaction in stories by subject gender and cue gender. Both male and female respondents told stories with themes of innovation for both the female and male cue: "I always knew Jessica was a unique one of a kind individual,"

"Peter experimented on the new bike design for the company," "Jessica co-created the product…" Themes in stories included innovation being connected to the choice to step away from the CEO position for both the male and the female in the story: "He liked creating something new and that was no longer the case as CEO," "Became an entry level engineer because he was able to grow his dream again in the large company," "Loved tinkering," "Challenged to invent something." One male participant wrote about Jessica, "She stepped down… not knowing she would be promoted again for her novel approach to a leadership position in the large company." Analysis of the themes in the stories that fit the coding for the concept of innovation, were found to be similar to perceived need for achievement- as in themes or images of *performance,* and *setting creative goals.* Table 2 reveals story theme examples for all motivation concepts.

TABLE 2. MOTIVATION IN STORIES TO STORYLINE GENDER

INDEPENDENT ELEMENT	STORYLINE THEMES Jessica or Peter
Achievement	"Jessica always strived for excellence," "I knew she was a genius," "Peter was always great at math and science" "He had been a hard worker with goals since H.S." "She was a quiet genius in class." "She was driven."
Innovation/ Innovation Self Efficacy	"Jessica co-created the product," "She was not a typical girl," "Peter designed a one of a kind bike," "The more he realized what CEO meant he could no longer express his creativity."
Affiliation Motivation	"Jessica missed her friends," "She had no social life," "I was her friend," "Jessica had no time to be with friends," "Peter had a fiancée," "Now Peter had time for his wife," "Jessica took care of her sick Dad."
Negative Consequences	"Jessica had to step down because she knew she was getting fired," "She ruined the product," "He knew he would end up hurting his company's creation," "He just left and didn't tell anyone why, "Stress…," "…broke precious materials."

Negative Consequences: The gendered response continues into measures of negativity. Male participants were harsher on CEO Peter, and similarly female participants were more critical of Jessica. However, there is significant differences in how much negativity is displayed by male participants in response to the cue, regardless of Peter or Jessica, compared to female participants (Figure 3, $p=0.016$). Male participants are found to be more negative overall.
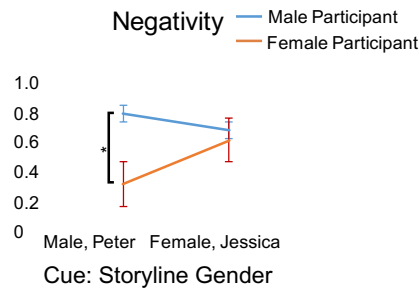

Figure 3 Negative Consequences: Male and Female Participant responses to Male and Female Storytelling Cue, $p=0.016$.

Overall males were more negative than women. Males are harder (write stories with more negative consequences) on their own gender. Men are also harder on women than women are on themselves (as a gender). Men show negativity towards women: the frequency of times that men told negative stories about the female in the cue prompt (Jessica) was high. Likewise, men are harder on themselves than women are on the male in the cue prompt (Peter) (Figure 3).

Of the four conditions in Table 3, only the men telling stories about the female cue suggested it wasn't Jessica's choice to step away from the CEO position: "She was going to be fired." Males referred to both Peter and Jessica as unable to cope with the job. One male's story features the plot point of tension for Jessica:

> "Jessica's overbearing parents pushed her towards being an all-work-and-no-play kind of girl. The start-up was the final straw that gave her a panic attack. She sold the company to the first buyer at much lower than valued. She moved to Colorado with her boyfriend who she's not that into and works a low stress entry level job. She spends most of her time backpacking in the mountains by herself."

The Females also told stories of Jessica's stress. In contrast to males, females were the only ones who told stories with negativity (for Jessica) that specified bias or harassment. One story: "Jessica originally enjoyed being CEO of her start-up in Silicon Valley. However, after dealing with a crazy work schedule-being CEO meant she was always working (took her cell everywhere and constantly responding to emails even on vacation) and putting up with the sexual harassment that was common in the male-dominated culture, she just wasn't happy. Jessica moved to a different state and got an entry level job. Now she only has to work at work-no more constantly on call. She now had more personal time and enjoyed her life now that she spent less time at work. Jessica's friends were supportive when they saw how much happier she was."

TABLE 3. NEGATIVE CONSEQUENCES IN STORIES

Negative Consequences Sentences from Stories for Each Condition
Male to Male Cue "He is offered a sell-out if and only if he resigns," "He was doing less and less what he loved, was unhappy," "His company flourished but he did not and couldn't handle the stress of being CEO," "He couldn't take it anymore," "He knew if he

stayed he would ruin the company's creation." "…stuff toppled onto Peter and he went into a coma-2 weeks later he had no recollection of his engineering background or wealth, so he applied for a crappy position, left, and was never heard from again," "He was unsatisfied with all that neither money or computer code could fill," "The stress was too much and the people annoyed him," "He contemplated suicide but figured a way out," "Then as an entry level engineer he got fired due to budget cuts," "Despite his initial success, the tedious process began to wear on Peter, and he decided to move to a new endeavor where he could be part of an engineering team again."

Male to Female Cue "Jessica started stealing from the company and not paying the employees," "She found the people tough to work with and couldn't take it anymore," "Jessica was overwhelmed with her situation, wasn't ready for the responsibility and left," "One day Jessica was working on a large project and she realized she had no idea what she was doing, her education didn't prepare her," "She was burned out and the doctors told her if she didn't slow down it would destroy her," "The stress was too much for her," "It wasn't her, she was only successful because of her team," "She was in no position to run a company," "She just quit," "She dropped a bucket of precious materials and they all broke, so they fired her," "She felt like she was at the worst point of her life, her best friend Sue and co-founder no longer had the same values, so she walked away," "She quit because she knew she was getting fired."

Female to Female Cue: "She realized what she once realized as true happiness had changed, many thought she was crazy, but she had to leave because it was the only way to restart," "She wanted a simpler task, being a CEO was more of tough task than a passion," "She didn't like getting all the attention, so she stayed quiet and left," "She was tired of putting up with the harassment that was common in the male dominated culture," "The bias got to her," "Those who were friends were now just co-workers ignoring her," "She ran into issues and sexual tensions that distracted her from her work."

Female to Male Cue: "He had to leave because he didn't have the communication skills," "As an entry level engineer, he could observe their CEO to see what he was doing wrong," "Peter didn't like the stress and the amount of worry," "He didn't feel bad in the beginning, but then he realized that there was nothing more he could do and had to leave," "He found himself feeling something was missing in his life, and felt disconnected from (friends) life.

Gender Differences in Positive Affect or Negative Affect (PANAS data)

Similar to the finding of negative consequences in stories, male participant negativity appear significant in emotion results. Findings indicate that males are harder on females than on males when reporting negative affect for the time period (Moment Figure 3). Over the Moment time period, PA (Jessica mean - 35.08; Peter mean - 34.55) was higher than NA (Jessica mean – 20.46; Peter mean – 18.85; p<0.001; Figure 3). Over the Post-grad time period, PA (Jessica mean – 37.95; Peter mean – 36.55) was also higher than NA (Jessica mean – 18.85; Peter mean – 19.15; p<0.001.

V. Discussion from Stories and Feelings Scale

Summary of Findings: The results of this study suggest that individuals self-identify with the leader/founder's actions revealing a high need for achievement (performance) and a high need for affiliation (relatability). Our results from the story data (Figure 4) and from the PANAS data also show that negativity features significantly in an individual's interpersonal perception of a new graduate's decision to step away from their founded company. In addition, analysis reveals that interpersonal perceptions vary by gender for motivation and

negative emotion. Males tend to be harder on their own gender stepping away from their founded company and taking an entry level engineering position than females are on either their own gender counterpart or for the male.
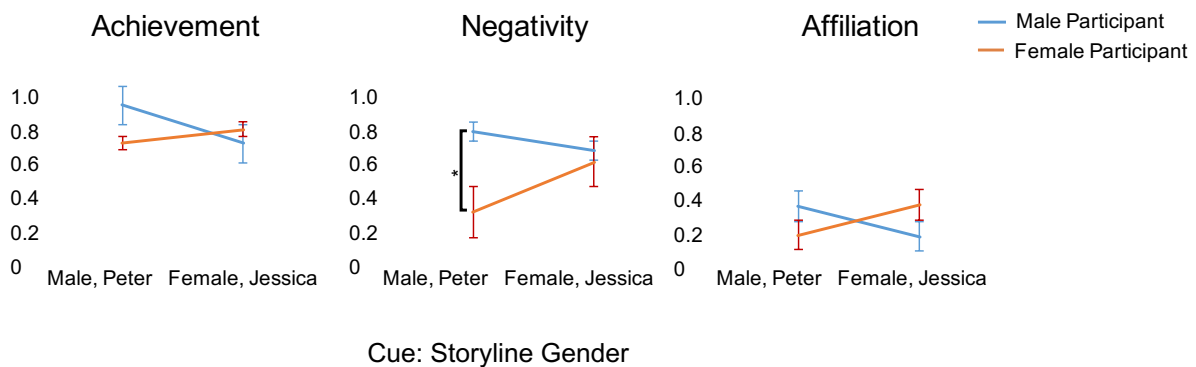

Cue: Storyline Gender

Figure 4 Participant responses to Storytelling across Achievement, Negativity, and Affiliation

In investigating three dependent factors, Achievement, Negativity and Affiliation, we found noteworthy interactions. People identify with their own gender as shown by a thread of gender response to achievement motivation and affiliation motivation and even in negative realizations (negative consequences or negativity) to the storyline cues of Peter or Jessica (Figure 4).   Responses of Genders in how they perceive the story prompt appears similar across Achievement and Affiliation and Negativity, and self-identification is at the same rate and categorization regardless of respondent gender and story gender, *except* for the case of negativity: men were more negative overall (regardless of story cue gender) than women (p=0.016).

Why will emotions and motivation matter in any discussion about a millennial engineering graduate on the path to innovation and leadership? Mention of innovation requires reference to research on self-efficacy [32, 33], innovation self-efficacy [34], entrepreneurial self-efficacy [50], entrepreneurial intention [36] and entrepreneurial behavior [37]. Uncovering students' perception of another will infuse their definition of engineering innovativeness and potentially offer a strategy for assessing and adding new elements in the curriculum [45].

Story findings begin our conceptual map to enhance awareness of a young engineer's need to perform or to innovate. This provides a preliminary response to our organizing question on a student's interpersonal perceptions: *How does motivation surface in the themes and images of storyline expectations for the engineer/founder who decided to step down from their CEO position of their founded company?*

As much of our research consists of qualitative data, we hold stories and insights from the analysis central in our discussion.

College students tell stories about the engineer who decided to step down as CEO with vivid action shots of emotion and stunning motivational characterizations. The story of the leader is brimming with both the need for achievement, including images about the challenge to make/do great engineering work and themes of innovation, and with a desire to do it over and over again. The tension is that obstacles emerge along the way in student stories when there is a collision between needs – like the need to achieve with the need for affiliation or high need for performance with a pessimistic inclination as they struggle to find

a system for repeatable success. One example of the tension is in a story a woman wrote about Jessica:

"After graduating Jessica went with friends to found a start-up based on previous work. While working on the start-up she ran into several issues that distracted her from doing the technical work before the project turned into a company. Some of the issues ranged from relationship tensions of friends turned co-workers and the stress of running a company without any business background. After working for six months she decided to leave her position and focus on a more technical role in a large company and build better business awareness and management skills over time."

Men and women tell stories with unforgettable images of negativity: unhappiness, friendship lost, confusion and distraction, and overwhelming stress. Memorable phrases include images of identification with outliers as innovators "outsider like all of us," "donating her millions to charity," "happier being ordinary, not extraordinary, doing entry level work." Surprising negativity was found in stories about an engineer's choice to step away from the CEO position. The abovementioned sheds light on students emotions through their stories. It also has implications on how we should organize our curricula and content so that students are ready to face the complex work life [51]. Details for stories highlighting motivation and feeling reports suggest more detailed insights and application.

Gender matters for achievement motivation as a conception of an engineer/founder/CEO. The finding that each gender had higher expectations for themselves and lower expectations for the other gender's success in work as a CEO deviates from findings that women fear success [17] yet aligns with research on motivation and gender where a belief in one's own ability plays a viable role [38]. Explicit discussion of this finding might be useful for Instructors engaging students in classroom discussion during technical and elective classes. Research shows negative stereotypes threaten gender or race identification with academic work [47]. Is the stereotype different than the student persona? How do stereotypes inform a persona? Do students see confirming evidence inside and outside of the classroom?

High Need to Perform Sounds like Innovation in the stories. A gender correlation to the innovation storyline cue didn't exist. Rather, themes emerged in stories about the loss of what they loved most about achieving as the reason they stepped away from their CEO position ("accomplishing" and "doing engineering"). Characterizations for Jessica and Peter indicated engineering innovativeness, "liked the challenge of inventing something" and building "a prosthetic limb" or working on "renewable energy," and were also constrained by the logistics as CEO and erased "hands-on" work. "He realized what being CEO meant he could no longer express his creativity." In a cluster of stories, innovation themes appeared similar to themes of a high need for achievement: no finishing line, not stopping at work, setting high standards for performance, and creative goals. Instructors planning course goals might continue to consider the value of adding new course competencies for technology innovators [48] like 'communicate effectively about career dreams' and 'develop abilities to analyze and enjoy emotional experience." Do modern students equate a high need to perform with innovative endeavors?

Revealing stories indicate gender alliance: Participants show gender alliance in the way they answer the prompt, each gender projects themselves onto their storytelling counterpart with images of motivation. Interestingly, writing a story through the perspective of the gender that you identify with increases the amount of affiliation themes.
Affiliation responses in general suggest respondents need to be relatable and care about their interactions with others. Story responses indicate a collision between a need to succeed with

a need to prioritize relationships. Emotional characterizations in stories and in the mood scale report show starkly contrasting emotions like "loved designing," "…the hands-on engineering" with negative emotions, "stressed, and overwhelmed," "It wasn't worth it anymore," by both genders in both gender cue conditions. Perhaps what it means to be a top engineer/founder/CEO is derived no longer from strong technology and novel approaches but rather from men and women weighing the emotional benefits and costs of being innovative. Meaningful "entry level work" may outweigh the frustration, stress, and exhaustion, lack of time for friends, and disappointment associated with lucrative founder success. Stories of the stress and low positive affect reports implied negativity associated with performance and innovative behaviors, especially by men for themselves and men about women. Is it more 'costly' for one gender to be innovative? The authors practice a design method approach in their classes, storytelling as rapid prototyping, to coordinate iterative development and shared vision. This practice has potential for innovation scholarship with concrete story application; the ability to represent novel concepts to all involved is critical to developing a common understanding especially when information is changing or ambiguous [46].

Men are more negative about themselves and others: We also found significant results with a gender correlation in how respondents perceive negativity in the stories   Men reported more negative emotional affect (scared, afraid, nervous) than positive emotional affect (enthusiastic, active, determined) about Founders/CEOs overall when writing about men than women did when writing about women. Self-identification is at the same rate and categorization regardless of respondent gender and story gender with achievement themes and affiliation themes, *except* for the case of negativity: men were more negative overall. This finding is informed by literature suggesting males tend to show a negative stance and express one emotion (such as anger) to indicate a myriad of other emotions (sadness or confusion) [39].

Some of the negativity overall suggests some unpleasant consequences for respondents' high need to perform and be perfect. A capacity to show vulnerability is part of what it means to be a successful innovator as an entrepreneurial leader/CEO [30]. In engineering, vulnerability is a dangerous word. In natural sciences, which value precision highly, ambiguity is regarded as dangerous or unprofessional. In engineering education vulnerability refers to the ability to openly reflect inwards and communicate outwards emotions and flaws that affect ones thinking. CEOs who show vulnerability create compassionate workplaces. Could negative stories and affect responses imply that men are not comfortable showing their vulnerabilities? Men may be suggesting it is a bad move to step down from the position of CEO. Do men and women see it as an equally bad move for women to give up the power/wealth earned from being innovative?

Women's stories about women were the only stories with themes of bias, sexual harassment, or sexual tension. Gender status beliefs may reveal more negative affect responses to the female who decided to step down since gender status beliefs are a specific component of gender stereotypes. They are beliefs that men are more socially valued and diffusely more competent than women at things that "count" [40, 41]. Use of routine check-ins might facilitate the Educator's process during project driven classes. Explicit discussion about gender composition impact on team development and learning overall is valuable and can lead to increased team and individual success both in the classroom and in the workforce. The negativity issues has implications for issues of social and emotional health in the workplace.

Work-life Innovation - Integration

An unsurprising insight from stories about Jessica or Peter stepping down may indicate college students today believe money will not bring happiness. Finding meaning appears to be a combination of performance at work with some need for innovation and a lot of need for balance. Could this result in a work-life innovation-integration goal? Story and emotion scale results correlate with Pew Center Research indicating that, for the first time in history, the younger generation is less happy than the older generation [42]. Pew research also finds that unhappiness may be more pronounced for men. One possible implication is that the costs of being innovative are high. CEO responsibilities eclipsed making and iterating in many stories. The stressful downsides of dealing with business operations or loss of friendships were beyond expectations. Caring and sharing with others was a more meaningful goal. Given the opportunity, study participants would invent and experiment for free, indicating a resilient willingness to start over and start-up again. The financial success of the founded company allowed them to "donate their millions to charity" and step away from their company to do what they love: engineering. One male's story is filled with images of an innovative, well-adjusted, Peter not seduced by millions and tired of business logistics:

"Peter grew up in an average size town on the east coast of the USA. Peter's parents loved Pater and his brother and established a structured but nurturing home in which to grow up. Peter always loved tinkering and solving problems, so he naturally went to university to study engineering. His novel approach to his thesis work developed into a successful start-up. Peter and his wife celebrated their first wedding anniversary with an offer from a competitor to buy out their business for millions of dollars. After several more weeks of dealing with administrative difficulties involved with scaling a new business, they sold the business. Peter now enjoys more free time with his wife, more financial security, and less work tension."

VI. Implications, Limitations and Future Research

This paper is a preliminary examination designed to introduce the emotional state of engineering students. In sum, our findings help to provide a more complete view of today's engineering student as leader/founder. Our approach is away from retrospective data collection techniques. The stories and affect data coincide with research on understanding that emotion within engineering identity formation is for a global, interdisciplinary profession, and important for evaluating the preparedness of engineering students for global work [49].

Multiple findings need to be examined further to consider our second organizing question:
How will preliminary findings inform the development of a research method to study the conception of emotion in an engineering student mind-set and experience of innovation in leadership? Five concluding issues need to be addressed in next research steps:

1) The authors knew that the concept of "motivation and emotional make-up" was complex and difficult to operationalize. Though careful attention was on design of the measures and survey instrument, there are some limitations. Gender is a salient variable in engineering education research, certainly future research must include other under-represented groups. Work might be extended to look at, for example, how the responses of practicing engineers differ from other non-engineering students. At the same time, results suggest it is necessary to narrow down the study for analysis. Coding for presence or absence of single concepts of motivation is a limitation in the current study. Therefore, we recommend combining the motives for analysis into a few narrow categories. Future study would place two or three motives in one scale (Achievement, Innovation, Negative Consequences; Affiliation, Innovation, Negative

Consequences; Achievement, Affiliation, Negative Consequences) because story-oriented data in our findings co-mingled need for achievement with negative consequences or need for affiliation and need for achievement with negative consequences. Research on personality theory linked to entrepreneurial success affirms the use of narrow categories [1,15] for predicting innovative behaviors.

2) Emotion reporting with the PANAS scales can be modified to investigate with further analysis the low positive affect by both genders and with detail on specific affect results: pleasurable or un-pleasurable engagement linked to achievement motivation as part of successful leadership patterns [43,50].

3) Another limitation was with the sample size. Future studies should populate the cells of F/F; F/M; M/M, M/F with enough subjects to create a statistically robust normal distribution, and representation of diverse student majors.

4) Some participants didn't understand the instructions or refused to complete the administered survey. Attention to and modification of methodology is necessary to minimize misunderstandings.

5) Future studies would add a non-gender specific "person" storytelling cue. This approach, while reducing the demand characteristic of the study, would change the value in the 'projective storytelling cue prompt" measure. Also, important to include other under-represented groups in the prompt.

We began with the goal to develop a research method in order to study the state of the engineering student striving for excellence and innovation while starting a company. In our experiment, men and women in engineering reflect on others' entrepreneurial successes with implications for what happiness [44], innovation in engineering, disappointment, and success as a leader in the workplace mean to modern students.

If engineering students act on conceptions of their individual emotional and motivational needs when forming aspirations for a career focus, characterizations of self will also impact the leader/founder relevant choices that men and women make in the ever more complex world. We seek to begin a conversation for understanding emotional and motivational characterizations of emerging leadership in innovation, specifically for women and men striving to perform on diverse engineering or design teams. For engineering education research, this paper provides a perspective to answer the unmet needs for our vulnerable "who" and consider the why in questions for learning that happens inside and outside the classroom in areas such as curriculum design, disciplinary, transdisciplinary intrapersonal working life skills, innovative learning methods, different settings of industry, and society-university collaboration. It also provides guidance for engineering education practitioners considering engineering innovativeness [52] on the "what" and how questions when they are developing their practice.

VII. References

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