# Entering the Engineering Pathway: Student Veterans' Decision to Major in Engineering

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## Abstract

As the engineering community seeks to widen the pathways toward engineering education, hundreds of thousands of military veterans are initiating their college studies at universities across the U.S. Given this trend, it is essential to better understand the factors that lead student veterans to choose to major in engineering.

We are conducting a comparative case study at four institutions enrolling undergraduate student veterans in engineering (SVEs). In this paper, we draw upon in-depth interviews conducted with SVEs at two of these institutions to: **(1) better understand the factors that shape SVEs' decisions to major in engineering and, (2) determine whether and how the military influences student veterans' decisions to major in engineering.** Our work provides insights into the timing of the decision as well as the extent to which military training and experiences provide a direct, or indirect, pathway into engineering.

We highlight student experiences to advance knowledge about SVEs' educational pathways on several fronts. Methodologically, our in-depth analysis allows us to capture the nuanced nature of SVE narratives that often remains hidden when using other approaches to studying engineering education. Theoretically, we draw from Cognitive Information Processing theory to more accurately reflect SVE decision making about majoring in engineering. Practically, the results can inform military transition assistance programs and improve university efforts to ensure that student veterans experience a successful transition from their military career to higher education and engineering studies.


## Introduction

Military veterans are becoming a more visible presence on college campuses across the U.S., with an estimated 5 million members of the armed services likely to enroll in universities by 2020.[1] Between 2009-2016, the U.S. Veterans Administration had paid $65.2 billion in educational benefits to more than 1.6 million veterans and their family members.[2] This investment represents a belief in the deep well of human and social capital that is embedded in student veterans' military experiences and in their potential for success.

As the student veteran pathway to higher education expands, there has been increased recognition that the veteran population holds potential for expanding, diversifying and strengthening the engineering workforce. Our research has revealed that student veterans perceive themselves to be more mature and motivated than the typical first-year college student, with unique tangible experiences and intangible characteristics that are highly relevant to engineering education.[3] Veterans have often developed abilities to handle complex tasks and technical skills that may be applicable to engineering practice, such as work with electronics and/or mechanical skills, teamwork, leadership, and communication skills.

Student veterans in engineering (SVEs) navigate into and through higher education via diverse pathways. For example, some enlist and serve prior to beginning their engineering studies. Others attend college or work before enlisting in the military and then pursue engineering studies. Such pathways have implications for student veterans' progression into and through the major. However, there is little information about how student veterans select their major area of engineering study.

Our prior work began to identify factors related to SVEs' choice of major and identifies the tangible and intangible influences of the military on entering the engineering educational pathway.[3, 4, 5] In this paper, we report initial findings about career intention based on in-depth interviews. Our analysis aimed to answer the following questions:

**(1) What are some broader influences on the decision to major in engineering?**
**(2) To what extent did the military influence the decision to major in engineering?**

Additional knowledge is needed about the career decision process for student veterans and their various entry points into engineering. Understanding career choice has important implications for ensuring that veterans are able to optimize their military experience and enter a career which best suits their interests and aspirations, whether or not such a career path matches their military occupational specialty (MOS). Specifically, research on the influence of military experiences on the development of an interest in engineering and on actual engineering education experiences can help strengthen the military-to-engineering pathway. Our comparative, qualitative case study provides us with a unique opportunity to learn more about the career intentions for pursuing an engineering degree.

## Literature Review

### *Student veterans in STEM and engineering*

After their service, veterans may choose to pursue higher education, possibly in Science, Technology, Engineering, and Math (STEM) fields. Indeed, a large number of veterans earned STEM degrees as a result of the original GI Bill, enacted after WWII.[6] Broadening the participation of veterans in engineering offers the possibility of enhancing diversity in the field in many needed dimensions since, compared to civilian students, veterans are more likely to be older, first-generation college students, disabled, African American, or Latino.[7] The U.S. House of Representatives has recognized the value of the military-to-STEM career pathway with the introduction of the bipartisan House Bill 748, *GI Bill STEM Extension Act of 2015*. Introduced in the 2015-2016 legislative session, this bill would authorize the Secretary of Veterans Affairs to pay up to 9-months of additional Post-9/11 educational assistance to veterans pursuing a STEM degree.[8] According to a representative of Student Veterans of America (SVA), encouraging veterans to pursue STEM degrees represents "another smart investment in education" that would result in significant gains to our economy.[9]

Several programs have been initiated to facilitate the connection between military experiences and STEM degrees. For example, the Florida Senate Committee on Military Affairs initiated an awareness campaign to encourage veterans to enter STEM fields and to encourage government

and higher education to collaborate on STEM programs for student veterans.[10] Some universities have established programs to encourage veterans to pursue STEM degrees, including the *Stern to STEM* program at Old Dominion University[11] and an effort at Virginia Commonwealth University to create a system to match military courses or experiences to college-level engineering course credits.[12]

A recent study on student veterans found that that 2/3 of respondents felt that their MOS nurtured their interest in STEM careers.[13] However, an SVA survey found that only 8% of student veterans are pursuing engineering degrees.[6] This situation may be the result of several factors. Military recruits may not be informed about a rewarding career path that can build on their military experiences and allow them to continue to contribute to our country. Veterans themselves may not perceive the engineering pathway as a good match for their military-related experience, although Zoli et al. found that 43 percent of service members indicated that their military training, specialization, or job, was STEM-related.[13] This same study also indicated that military personnel often did not have the requisite basic knowledge of STEM degree programs to be able to determine whether this would be a worthwhile career path to pursue.

Baumann indicates that higher education institutions may contribute to this disconnect as well, as they tend to designate any learning in the military as equivalent to only physical training or basic vocational training, thus extending the possibility of discounting the tangible and intangible qualities so important for engineering education.[14] Kester's study of career decisions of reintegrating military veterans revealed that both the military (e.g., through the Transition Assistance Program) and post-secondary institutions (e.g., through targeted career planning) could better assist veterans with making more proactive career decisions.[15]

Given that much of engineering research and practice has military roots and that the military relies greatly on engineers to achieve its objectives, we might expect more military veterans to pursue engineering careers. A significant opportunity to capitalize on military competencies and strengths and to promote engineering careers is missed. As a result, engineering education could lose out on a pool of talented leaders.

### *Career intentions and decision making of student veterans*

Mobley, Brawner, and Long showed that (non-SVE) transfer students' decisions to major in engineering varied in their level of intentionality and clarity regarding their major and educational pathway (i.e., whether to become a transfer student or not).[16] Students were classified into two categories: intentional engineers (those who decided to major in engineering earlier in life and who generally pursued an engineering/science/math pathway throughout high school and into college) and accidental engineers (those who "stumbled" into the engineering after high school, often after trying out another major and/or working in an unrelated field). Military veterans in engineering are often transfer students and thus may share commonalities in their decision processes with non-SVE classmates.

While these findings provide a starting point for understanding career intentions of SVEs, the military-to-higher-education pathway is quite unique. For example, in terms of career decision making, no other group of individuals experiences the intense socialization into, through, and out

of an institution like the military or is exposed to potentially life-altering experiences such as deployment and combat.[17] Additionally, service members are assigned to an MOS based on their scores on the Armed Services Vocational Aptitude Battery (ASVAB) and abilities demonstrated during training and most importantly, based on the needs of the military at the time of enlistment.[18] These assignments aim to build one's technical skills in a particular assignment (e.g., Combat Engineer), to augment certain "professional skills (e.g., teamwork, communication, and leadership), or both.[18] When leaving the military, student veterans desiring to pursue higher education may or may not choose an educational pathway that parallels their military training and experiences.

While in the military, service members are often consumed with the task at hand, perhaps even considering a lifelong career in the military. Although many leave active duty purposefully at the end of their enlistment contracts, the timing of the decision to separate from the service is not always up to the veteran. Some must retire due to injury or reductions-in-force and others are forced to stay on beyond their contracted times by stop-loss orders, particularly if they have mission-critical jobs. The timing of their separation may likewise not align well with the academic calendar. As Kester's study of career decision making among first-term veterans revealed, these and other factors may "suddenly thrust military members into transition, mandating them to make decisions regarding a civilian career, and many of them may do so unwillingly and with short notice" (p. 2).[15] According to Kester, the timing of career choice is essential as "making a poor choice in a first-career following military service can have dire consequences" (p. 5).[15] The results showed that the culture shock of transitioning out of the military may have delayed student veterans' career decisions, another indication of the unique nature of the content and character of SVE career intentions and educational pathways.

When transitioning out of the military, military personnel are concerned about how their military skills will translate to the civilian world more broadly, and to a field of study in higher education in particular.[17, 19] Researchers have identified the challenges experienced by student veterans in translating their military experience to specific civilian career paths.[19, 20] As Hayden and Scholl contend, career development for military veterans needs to more effectively integrate experiences, job skills, and personal characteristics gained through military experiences itself.[21] Considering the unique career pathways of veterans, there is limited research on how student veterans decide to major in a particular field, to make career choices, and whether student veterans' military experience shapes these decisions.[15, 22] Without fuller understanding of the dynamics of career development, administrators and educators could likely give inadequate consideration to the knowledge and skills that student veterans bring to higher education and to engineering education.[23]

Following Minnis and Wang's research on military veterans' career decisions[17] and Musgrove's investigation of career planning of military veterans enrolled in college,[24] our study draws on Sampson et al.'s Cognitive Information Processing (CIP) approach to career intentions and decision making.[25] This theoretical framework has been used to better understand veterans' transitions into the workforce.[20] Our student interviews highlight how two elements of this approach, Developing Self-Knowledge and Building Occupational Knowledge, may apply to SVE's decision to enter the engineering education pathway. As a foundational step, developing self-knowledge results from individuals' own values, interests, and preferences for a particular

career path as well as their pre-existing skills.[26] Building occupational knowledge refers to the tangible facts that an individual may have about an occupational position. Such knowledge results from personal research, actual exposure to a career path, and training opportunities.

Research shows that student veterans are most concerned about finding a job after graduation and thus want to major in fields that will assist this goal.[27] Greater understanding of SVEs' career intentions and decisions could boost the graduation rate of student veterans, a trend that has improved in recent years, according to the Million Records Project.[28] We anticipate that our qualitative study of SVEs will provide an insightful complement and important context to these and other quantitative efforts to explain student veterans' pathways in higher education.

## Methods

Kato et al. describe a need for more qualitative studies on student veterans that will ultimately allow for more informed policy development to support veterans in higher education.[29] Our qualitative study of SVEs attempts to fill this gap by allowing veterans to narrate their own stories about their military service and educational experiences in ways that would "shed light on needed pathways for post-service transitioning into careers and professions that may leverage attributes and skills gleaned in service" (p. 44).[13] The qualitative approach allows for the development of narratives that provide insights into the military's role in shaping SVEs' educational choices and experiences.

We recruited students to our study through campus staff and by posting flyers in engineering departments. Interested students were then asked to complete a qualification survey that asked for information about their military service, educational history, demographic characteristics, and scheduling. After being accepted to the study, and prior to the interview, students were asked to complete a "life history" survey that included information about various key events in their lives since the age of 18, such as being deployed or getting married. The information from this survey provided a starting point for the actual face-to-face interview and context about the timing of career decisions, among other life events.

The individual interviews were audio-recorded and lasted between 60 and 90 minutes. We used a common interview protocol across all sites; this protocol was developed in consultation with the project's external advisory board, which includes several military veterans. The questions were designed to elicit rich and deep student narratives and included questions about: (1) reasons for entering the military; (2) reasons for selecting their engineering major; (3) role of the military in selecting engineering studies; (4) centrality (or otherwise) of the veteran identity to their engineering experiences; (5) influence of the military on current engineering education experiences; and (6) university-based efforts to serve student veterans. The study was approved by the relevant Institutional Review Boards.

## Sample Selection and Participant Characteristics

Our study is taking place at four institutions in the U.S. Preliminary findings reported here are based on the data collected from 15 participants from two institutions where interviews were conducted in the Fall of 2016. We selected these two institutions as our interviews at these sites

were complete. A total of 33 interviews was conducted at these two institutions. For this paper, we focused on participants who were no longer serving on active duty nor were in the National Guard, resulting in a sample of 15 participants. Participants included one female and 14 male student veterans. Twelve identified as White, one as African American, one as African American/West Indian, and one as American Indian/Alaskan Native. The age range was 25-34 years, with an average age of 29. Nine participants were under the age of 30; six were 30 years of age or older. Eight participants had served for five or fewer years, six for 6-10 years, and one for 15-20 years. Eight participants indicated they had experienced a service-related disability; four said that they had significant family responsibilities and four indicated they were first-generation students. All but one respondent indicated they had attended other postsecondary institutions prior to attending our study institutions.

Table 1 shows the branches of service and engineering majors represented in this sample. Participants reported they worked in a variety of military jobs, including aircraft electrical and environmental systems mechanic, amphibious assault vehicle crewman, aviation electrician mate, combat engineer, ejection seat mechanic, heavy equipment operator, nuclear electronics technician, nuclear machinist mate, mechanic for Bradley vehicles, reconnaissance and surveillance leader, signals intelligence foreign translator, and V22 flight Osprey mechanic.

Table 1. Interviewees' Branches of Military Service and Engineering Majors

| | **Air Force** | **Army** | **Marine Corps** | **Navy** | **Total** |
|---|---|---|---|---|---|
| Aerospace | 1 | 1 | 1 | | **3** |
| Civil | | | 1 | 1 | **2** |
| Electrical/Computer | | | | 1 | **1** |
| Mechanical | | 1 | 5 | 2 | **8** |
| Nuclear | | | | 1 | **1** |
| **TOTAL** | **1** | **2** | **7** | **5** | **15** |

When reporting the results, we have edited student quotes for clarity, to remove digressions and fillers, and to eliminate any identifying information. To ensure anonymity, we have assigned a participant identification code to each participant that includes the institution (A or B), interview number, branch of service (N=Navy; M=Marine Corps; A=Army; AF=Air Force), and engineering major (AE=Aerospace Engineering; CE=Civil Engineering; EC=Electrical and Computer Engineering; ME=Mechanical Engineering; and NE=Nuclear Engineering). To protect the confidentiality of the female participant, only masculine pronouns are used.

**Data Analysis**

We engaged a five-stage process of framework analysis to ensure deeper analysis of the emerging themes.[30] As framework analysis capitalizes on both inductive and deductive reasoning, we used both *a priori* and emergent codes as we analyzed the data.[31, 32] During stage 1, familiarization, we reviewed the transcripts of the interviews we conducted to become immersed in the student stories, which allowed us to begin to identify a thematic framework (stage 2) as it pertained to our overarching goals regarding (1) key decision points to enter the

engineering major; and (2) the role of the military in influencing SVEs' educational choices. Through indexing (stage 3), text was coded to indicate the specific themes that correspond to these objectives. These codes were then organized into a document that categorized each quote by theme (charting, stage 4). The more in-depth analysis in stage 5 (mapping and interpretation) consisted of analyzing patterns, similarities and differences between the SVEs' engineering education pathways.

## Results

Participants described a variety of reasons for choosing engineering and expressed a diversity of entry points into the major. As is the case with such an important decision, participants described multiple influences on their decision to major in engineering.

### Research Question # 1: What are some broader influences on the decision to major in engineering?

#### *Theme 1: Decision to major in engineering was made prior to military service (n=7)*

This group of participants indicated that they were already interested in engineering prior to entering the military. A self-described "late bloomer," B1AAE performed well in science and math during high school and took classes in drafting and architecture which he says "*kind of molded me in that direction [of engineering] as far as a major."* At the end of his first military rotation, he decided to pursue engineering as a life path. In this case, his military experience as a combat and aerospace engineer *"kept the aircraft fascination alive."*

Another participant indicated that "*[my] desire to be an engineer drove me to do what I did in the Navy [more] than the Navy drove me to be a civil engineer"* (A5NCE). Similarly, A4NEC said his military experience paralleled his of engineering, claiming that a pre-existing *"…engineering mentality drove me into the Nuke field in the military…So, the nuke field just simply reinforced that in me."* B6AFAE developed an interest in aerospace engineering as a child when he was *"all about aircraft, I always had toy planes and anything that flew just fascinated me, that's why I became an aircraft mechanic in high school."* He described specifically choosing the Air Force to further pursue his love of planes. Fortunately, his MOS provided him with that opportunity: *"Being in aircraft maintenance for 10 years reinforced the idea that that's still what I want to do. So, they were very complementary of one another."*

Similarly, A6NME said he decided to pursue engineering during middle school. As a teenager, he then worked in construction, which stimulated his interest in civil engineering. He subsequently began working on cars and turbines, activities that nurtured his interest in the energy sector. He ultimately joined the Navy, where he became a Nuclear Mechanic. A7NME's motivation for entering the engineering pathway reinforced his long-standing inclination for technical work: *"I've always been a gear head. Ever since I was a little boy, I've always liked cars and motorcycles."* Although, at that time in high school, he was not entirely certain just how he would ultimately put those preferences into practice; he knew, though, he wanted to *"try to turn [his] hobby into a career."*

***Theme 2: Decision to major in engineering was prompted by encouragement from other individuals (n=4)***

These participants selected engineering only after being encouraged to do so by someone else, such as a teacher or advisor. For example, B3MME described having to work harder to connect military experiences to a potential career in engineering. Although he was not assigned to his preferred MOS of combat engineer, he nonetheless was intrigued by the engineering aspects of his assigned military job as a heavy equipment operator: *"It's kind of where it all started…[I developed a] really strong interest in the engineering aspect."* This experience allowed him to learn the "mechanical mindset" necessary to accomplish his job, which he felt paralleled engineering. He was able to apply this line of thinking to practical and important tasks, such as building a *"post out in the middle of nowhere with the resources you have behind you…creating everything from scratch."* When he was deployed to Afghanistan, his nascent interests were reinforced by working alongside combat engineers for nine months: *"when there is a whole spectrum of build it, blow it up…I learned a lot of engineering stuff from them."* After getting out of the military, while attending community college, an advisor helped him to make the direct connection between his military job and the engineering major: *"I just thought of it as my job and I was a heavy equipment operator [who] worked with a bunch of engineers. I didn't realize that I did engineering things [while in the military]."* In other words, he had to forge his own career path, connecting his emerging interest in engineering to an actual career path that was worth pursuing: *"The Marine Corps didn't really gear me towards engineering. I just kind of figured it out as I went along."* Ultimately, B3MME only considered engineering after encouragement from his academic advisor; then, his post-military work experience at NASA put him firmly on the engineering education pathway.

A1MCE also benefitted from encouragement from others outside the military and after his military service. His military experiences nurtured his love of "field work", something he hoped to pursue in his engineering studies and ultimately, in his profession. In this respect, he saw similarities between his Marine Corps experiences and his current civil engineering studies: *"In the military…our job entailed being out in the field a lot, training, and that was the best part about the Marines… that's what being a Marine was, is being forward deployed. And, then, being in civil engineering is like [that]."* However, these experiences as an amphibious assault vehicle crewman did not immediately prompt him to consider engineering. Rather, he decided on this career path after leaving the military, when his physics professor encouraged him to consider engineering. The professor "connected the dots" for him between his military experiences and engineering and *"knew I was up for the challenge."* Prior to that, A1MCE admitted that he *"didn't even know the difference between engineering and science."*

A2MME was inspired by one of his fellow Marines who was interested in mechanical engineering. His friend and colleague, who was killed in combat, encouraged A2MME to *"look at engineering in a different way."* In particular, A2MME *hated [and didn't understand]math.* Through his friend's encouragement, A2MME broadened his perspective on the field of engineering beyond the stereotypical view of the "typical engineer": *He's the one who got me to look at engineering in a different way because I pictured my CAD teacher in high school wearing his short-sleeved white buttoned down shirt and black tie and his little pencils and everything…So that's what I pictured and I didn't want to do that."* A2MME emphasized the

power of peer influence in the choice of career path versus other sources of influence: *"I mean I could've had my dad talking to me about the exact same things my whole life and it wouldn't have meant as much as it did when you're going through other things and it's somebody your age that you can relate to where you all have a lot of similarities, and he's interested in this."*

***Theme 3: Decision to major in engineering shaped by concerns about financial security (n=6)***

Several participants described choosing engineering primarily because of the financial security that such a path offered. More specifically, engineering offered a clear pathway toward a higher paying job and away from the "grunt work" (A7NME) and "shiftwork" that characterized much of some participants' MOS (A5NCE). A8MME, who performed "low-level" work in the military, wanted to avoid the possibility of working in a blue-collar job for the rest of his life: *"I was pretty dead set on engineering. I knew that as I get closer to 40 or 50 [years old] I wouldn't want to be bending down turning wrenches"* as he was doing in the military. B5MME was also attracted to the potential financial stability offered through an engineering pathway, saying that he was quite strategic in selecting the Marines Corps; he felt that his work as an Aviation Mechanic would provide him with a solid foundation for moving beyond "blue collar" work.

A2MME's frames his time in the military as *"grunt work",* describing himself as a "*0311 Infantry Rifleman, just a regular old gunslinger, grunt, ground powder.* He said his *"job was not very technical; a lot of times, I was just a body, I was just there, I just take orders, I do what I'm told."* He described wanting to escape the menial work that he did while in the military: *"The only thing…the Marine Corps specifically inspired me [to do] was just to not fail school so I'd have to go back [into the military and] deal with some of the day-to-day things [that characterize military work]."* This financial motivation and desire to avoid what he felt was monotonous work interacted with his pre-existing interest in technical pursuits. He decided to major in engineering after his military service, when he had a chance to reflect on his passion for *making stuff, and making it work, and understanding how the machines worked. That's always interested me. I like building things. So, I [thought] what job can I do with that?*

**Research Question # 2: To what extent did the military influence the decision to major in engineering?**

***Theme 1: Military experiences influenced the decision to major in engineering (n=9)***

A majority of participants indicated that the decision to major in engineering was made while the respondent was serving in the military, either as a result of hands-on experience with engineering-related tasks or the exposure to the "engineering mindset," which is characterized by problem-solving and developing technical solutions to problems in the field. These participants described a direct connection between their military occupation and their engineering studies. In several cases, the SVEs' assigned MOS exposed them directly to engineering-related work, thus seemingly providing a more direct path toward engineering education. For example, B4MAE's military occupation encouraged him to explore the field of engineering: *"Once I was in the military as a combat engineer, [the work] at least got me thinking about what civilian engineers do."* He completed a variety of tasks that he felt were directly related to engineering, such as construction and demolition, explosives and ordnance disposal, mine clearing, and laying

bridges, saying these activities were *"pretty much the only thing that put the idea [of engineering] in my head,"* He ultimately chose aerospace engineering after attending community college as it was more "*interesting and cool*" than mechanical engineering.

For others, their military experiences expanded their vision of what engineers actually do on a day-to-day basis. That is, the general nature of their work in the military inspired them to learn more about engineering. A6NME said he developed an interest in many different facets of engineering as a child and teenager; however, his experience as a turbine specialist gave him *"a better idea of what type of mechanical engineer I would want to be."* In this case, there is an interaction between a pre-existing inclination toward engineering and military experiences. Similarly, B2NNE's job in the Navy and the intense training and hands-on experience as a nuclear mechanic opened his eyes to possibilities beyond "standard engineering": "*Like when you think of engineering you think of like, "Oh, just mechanical, or you're flying airplanes, or you're designing some neat electrical motor or whatnot."* This experience in the nuclear Navy demonstrated that "*There's this other branch called nuclear, and this is what nuclear technology can do. It's like not just building bombs and blowing things up, but we can use [nuclear technology] to power our plants."*

Several participants described a direct connection between their assigned MOS, engineering-related work, and the "engineering, problem-solving mindset." For example, an Army veteran, currently majoring in mechanical engineering, described his attraction to the *"trouble-shooting mindset"* of engineering that he experienced through his work on military vehicles which he said *"are made to be fixed…there's not like cosmetic things. It doesn't matter how pretty it is in the Army. It just matters how effective it is*" (B7AME).

A8MME said that his military-based problem-solving experience as an Osprey Flight Mechanic stimulated his interest in engineering: "*Once I got out [of the military], I realized more that I wanted to come out with better fixes and design it right the first time, so there aren't problems later down the line."* These sentiments were driven by his frustrations with engineering-related problems he witnessed while in the military: *"…looking at the plane, you could [see]…it's got 100 flight hours; we will need an engineer soon. The drag pin is going to have to fall out. We are going to tear apart half the plane to get this one part out. So, there has got to be some way…that it needs to be fixed."*

B5MME echoed these thoughts, indicating that his interest in engineering was due in large part to *"my frustration [while serving in the military] with the way things were designed, or built, or put together."* These experiences sharpened his problem-solving and critical thinking skills: *"There were so many times [in the military] that we were working on something, or we're trying to troubleshoot or fix something, or we're trying to put something together or take something apart. [We'd] spend man-hours, upon man-hours, upon man-hours trying to accomplish this task and you're like 'why is it like this?'"*

***Theme 2: Military experiences did not influence the decision to major in engineering (n=6)***

Several participants made it clear that they saw no direct connection between their military experiences and choices of major. While they also described a variety of motivations for

choosing the engineering major, they reiterated that their military experiences did not point them toward the engineering pathway. According to a Marine Corps veteran who served as an infantry rifleman, *"in the grunt world and combat arms, nothing correlates directly [to engineering]. I didn't do any advanced math. I did not have a technical job that taught me any skills. And even then, a technical job in the military [doesn't]…correlate …to anything, really"* (A2MME). In a similar way, although B1AAE's military training and military tasks occasionally required mathematical calculations, there was *"nothing really specific in the military that said, 'Oh, hey. This is just like engineering. I really want to go back to that.'"* When A4NEC, a Navy nuclear electronics technician, was asked if the military influenced his choice of engineering, he replied *"I didn't know what I wanted to do, I didn't even know how my skills [would translate]."* Interestingly, his boss at his current job prompted him to consider engineering, based on his experience as a Navy nuclear electronics technician. However, A4NEC still claimed that his military experience did not influence his choice of engineering, but rather *"I'd always been a computer nerd, and I always knew my life would take me somewhere along the lines of science and math, or computer science.* More research is needed to understand this group.

**Discussion**

The current study is timely given the dual concerns about ensuring that student veterans optimize their GI Bill benefits and about widening engineering pathways to encourage diverse groups such as student veterans to major in engineering. Considering that the U.S. Department of Defense is one of the largest engineering organizations[33] and that much of science and engineering has a critical role in the success of the military, it is essential to expand knowledge about engineering pathways for student veterans. Our project responds to calls for more research on the transition from the military to higher education,[34] post-service educational experiences and the SVEs' motivations for selecting an engineering major.[6, 13]

Our prior work found that pursuing engineering studies makes sense for military veterans who have had significant technical responsibilities as part of their service; this training provided the veterans with a practical understanding of some aspects of undergraduate engineering classwork, potentially giving them an advantage over their non-veteran peers.[5] The current study reinforces these themes and introduces new factors for consideration. The results support Zoli et al.'s finding that military experiences contribute to success in higher education.[13] Tangible, engineering-related experiences put several participants further along the pathway toward engineering. For these more "intentional" engineering majors, the military is a source of "career capital"[35] in that they experience a sense of agency and empowerment through their recognition of the connection between their military experiences and their engineering education.

Participants showed evidence of both elements of career planning outlined by Sampson et al.'s CIP approach to career intentions.[25] Regarding "Developing Self-Knowledge," participants described how their decision to major in engineering was shaped by pre-existing interests and preferences for certain kinds of learning and experiences. In "Building Occupational Knowledge," participants described some tangible (and intangible) military-related influences on choice of major, resulting from actual exposure to engineering while in the military and a connection between their military training and engineering education. However, the decision to

enter the engineering pathway is quite complex as illustrated by several participants' descriptions of a variety of influences on their choices.

The finding that pre-existing interests and inclinations in science and math and "building things" supports prior research on the decision to enter the engineering education pathway, especially for African Americans.[36, 37] In some cases, our participants felt their military experience reinforced these interests; for others this was not the case. Indeed, for several participants, the decision to major in engineering was inevitable and in the words of one respondent was *"bound to happen",* regardless of any diversions they may have experienced along the way. However, several participants indicated they were not particularly oriented toward engineering careers until after leaving the military, well after high school graduation. Prior research on traditional students showed that students who are not initially oriented toward science or engineering careers could benefit from receiving information and encouragement to consider these fields during their first year of college.[38] Future studies could highlight how and when military recruits could benefit from such career-related information, especially given their often discontinuous and episodic pathways, and for many, the subsequent delay in entering college due to their military service.

Engineering education could benefit from additional investigations of those SVEs who perceived that their military training was not related to their engineering major, even though their MOS was, in fact, related to engineering. For example, one of our participants, who worked as a nuclear electronics technician, saw no connection between his military MOS and engineering education. Some participants discovered such a link well after they left the military and matriculate at college. Additional studies on these "accidental" engineers is needed to facilitate a smoother and timely entry into engineering education, as some participants described spending GI Bill on credits (in an unrelated major) that ultimately did not apply to their engineering studies.

The results have several implications for various stakeholders who influence the career intentions of military veterans. These "niches of opportunity" can be optimized in order to more effectively promote engineering careers. In light of the findings about the influence of the military on choosing engineering, the military can focus on both tangible experiences and intangible characteristics that are especially pertinent to engineering education. Although assignment to a particular MOS is dictated most by the immediate needs of the military, it may be the case that certain occupational specialties can be more explicitly connected to a variety of engineering pathways. Our additional analyses revealed this to especially be the case for Navy veterans, who often received direct advice from their supervisors to consider an engineering career.[39] Also, by recognizing that the military provides much more than technical training to its recruits,[14, 23] to encompass personal qualities and work traits essential for professional success, there is a greater likelihood of a match between veterans' aspirations and motivation to pursue their educational goals. Research indicates that student veterans for whom there is a match between their military careers and their future career plans experience higher levels of career decision self-efficacy.[40]

The Transition Assistance Program (TAP) was recently revised to better incorporate information about higher education options. The TAP, required in some form for all separating service members, must provide training for the service members and their families on a range of topics such as career counseling, Veterans Administration (VA) benefits, educational pathways,

medical and mental health services, and financial planning in a relatively short period of time. Not only is the time devoted to educational options relatively short, but the military is required to walk a fine line that informs service members about their options without advocating for any particular one. The range of options can be confusing and leaves a void that may be filled by both scrupulous and unscrupulous players. Research has identified some challenges and shortcomings with the TAP program,[15] although recent changes to the program have sought to remedy these gaps. For example, there is now a separate session specifically designed to provide information about higher education opportunities. As reported here and in a previous study,[5] given the link between a desire for financial security and choosing the engineering pathway, perhaps this session could include explicit information about salary and long-term career opportunities in engineering fields, among others.

Universities can also assist in this process. Zoli et al.'s study found that 84% of veterans felt that the skills they learned in the military would contribute to an educational setting; however, just over half (53%) also indicated that the institutions of higher education they either hoped to attend or actually attended did not recognize the value of their military-related experiences.[13] Thus, as campuses across the nation strive to become "military friendly," greater efforts could be made to connect student veterans to specific career paths. Engineering departments, in particular, could proactively recruit student veterans to their majors, emphasizing the parallels between military training and engineering education and drawing attention to how engineering education can benefit from their leadership abilities and discipline gained while in the military. Also, groups like Student Veterans of America (SVA) can also assist in making the engineering pathway more explicit. As a boundary-spanning organization, with influence in both the military and in higher education, the SVA is in a unique position to promote a variety of career paths, including engineering, to student veterans. The organization's existing career resources provide a solid foundation for doing so.[41]

**Limitations and Future Research**

Our work did not uncover the specific challenges (e.g., battling stereotypes and adjusting to civilian culture) faced by SVE's in higher education that have been identified in previous research.[29] This could be the result of our focus on those students who have remained in engineering and those who were willing to be interviewed. Indeed research shows that identifying a career can provide life meaning to student veterans and encourage them to stay in school; this is especially the case for jobs that are related to military experiences.[29] Our study does not include those who dropped out of engineering or who may be facing challenges that would dissuade them from participating in our study; we also recognize that some of the participants may yet change their major away from engineering as they continue their educational journeys.

Future analyses will allow us to more fully address how the transition to engineering education may vary by military branch or by type of connection to the military (e.g., National Guard, Reservist, regular active duty, etc.).[42] We will also explore the possibility that time since discharge and combat experience influences engineering identity development [43] and the extent to which identity transitions shape career decisions and progression through fields of study.[44, 45] And, we will investigate differences related to first-generation status, considering the relatively

prominent theme in the current study about selecting engineering because of the belief by student veterans from low socioeconomic backgrounds that an engineering career offers financial stability.

## Conclusion

Our study on key decision points for entering the engineering pathway begins to break new ground about student veterans in the disciplines. There are few in-depth case studies that advance understanding of the finer details of SVEs' career decisions that otherwise may not surface through quantitative methods of research. While this paper highlights preliminary results from 15 of our interviews, our data analysis is ongoing and includes 62 SVE interviews across four study institutions.

When studying career decision making, student veterans are a unique population. They have distinctly different postsecondary experiences from traditional students; such experiences influence the choice to major in engineering.[46] A majority of student veterans spend their formative work lives in an institution (the military), which may need to assign them to a specific job (or MOS) that is not particularly related to the recruits' own interests or career goals. This stands in contrast to traditional students, who have the opportunity to either enter their preferred career pathway right after graduating from high school or who choose a college environment that encourages such exploration until they find a major aligned with their preferences. As student veterans transition into engineering, investigations of student veterans' pathways into engineering majors can facilitate SVEs' success and ensure that they not only optimize their GI Bill benefits, but that they are also valued and rewarded in return for their service to our country.

## ACKNOWLEDGMENTS

The authors would like to thank all of the SVEs who participated in our interviews, our External Advisory Board, and the National Science Foundation for support of this research (Awards 1428512 and 1428646). The views expressed herein are solely the authors'.

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