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Identity in engineering adulthood: An interpretative phenomenological analysis of early-career engineers in the United States as they transition to the workplace

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Abstract

Prior research has established emerging adulthood to be a time characterized by robust identity explorations in professional and non-professional domains. However, extant literature provides little contextual explanations in relation to how these identity explorations are experienced by early-career professionals. This manuscript presents idiographic findings from a qualitative study that used interpretative phenomenological analysis on interviews with seven engineering students as they transitioned to their respective workplaces. These findings describe how the participants experienced a strong sense of commitment to their career identities while also exploring features of their identities that were unrelated to their careers. Additionally, we discuss how women participants also experienced a gendered form tension in managing their career and family roles. In sum, this manuscript contributes detailed insight regarding coherence and complexity of personal identity development as lived by early-career professionals.

> I feel more professional [than non-engineering peers], I guess, because I have that
>
> full-time job and put my college degree to use and have taken it somewhere. . . I
>
> feel like I've taken the next step in life, and they're still trying to get to that step
>
> (Haden [pseudonym], recent civil engineering graduate).

This quote accentuates the focus of this article, which probes how early-career engineers in the United States come to experience their identities as emerging adults in their professional and non-professional contexts. Although extant literature generally portrays emerging adulthood as a period where identities are explored, Haden's quote highlights how early-career engineers experience a perceived early arrival in reaching adulthood, especially in relation to non-engineering peers. Indeed, engineering degree programs are marked by a tight sequence of courses, necessitating that students commit in their first year of college to a professional degree that typically propels them immediately into a career after graduation (Downey, 2005). This aligns with Arnett's (2004) observation about "people with technical abilities" who seem to "know what they want to do from an early age and stick with it all the way" (Arnett, 2004, p. 148).

This focused and intentionally trodden path toward a commitment to their career identities, with little exploration of alternative possibilities during their undergraduate years, suggests that engineering students and early-career engineers might be following a pattern of foreclosure in relation to the individual experience of their identities (Kroger & Marcia, 2012). Certainly, members of pre-professional programs, such as engineering, find themselves in a psychosocial place not fully explained by generalized human development theories of identity commitment and explorations in emerging adulthood. Indeed, the normative and striking pattern for this developmental period is that emerging adults typically undergo "identity explorations . . .

[or] trying out various possibilities, especially in love and work" (Arnett, 2004, p. 8). Haden's quote above highlights his observation that exploration of career identity is a normal pattern among those around him but, as an early-career engineer, he distances himself from this phenomenon.

How is one's trajectory into adulthood specifically affected when they find themselves committing to a career identity much earlier than their peers? We consider this question in our study of seven engineering students who went on to become full-time engineers at different workplaces. The findings of this study depict these persons as those who adopted a noticeable identity commitment to being engineers. However, as they became more committed to their career identities, they experienced a more holistic form of human development in ways that were complex. Specifically, in some regard, their overall experience of identity might be characterized as fixed and dedicated paths that were intertwined with their increasingly crystallizing career identities. Yet, in other ways, they distinguished their experience of non-professional identities as features that they were still learning and exploring.

Furthermore, we highlight two important contextual considerations associated with our findings. First, this study was carried out in the U.S., where educational systems typically avoid the rigid "tracking" of students into different kinds of programs (e.g., academic versus vocational) in the primary and secondary levels of schooling. This may in turn defer or dampen pre-college explorations of career identity. Second, the subjects in this study all obtained undergraduate engineering degrees, which remain widely accepted as the first professional degree for U.S. engineers. By contrast, students interested in many other professions (e.g., law, medicine, and the clergy) have more flexibility during their undergraduate years since practice in

these fields requires graduate-level training. Given these two considerations, engineering students in the U.S. may experience a uniquely compressed timeline for career exploration.

Against the contextual backdrop of engineering education in the U. S., the findings of this investigation provide an in-depth, textured snapshot of the emergence of seven individuals as they experienced, in part, a transition into adulthood. Research regarding the relationships between career identity and human development is often informed by studies that adopt a more nomothetic focus on generalizable models for emerging adulthood. We suggest that our idiographic focus on particular persons offers contextual and robust insights that complement findings of previous research in emerging adulthood and advance future research into the relationships between personal identity development in professional and non-professional domains.

Professional Identity in Engineering

Prior research in engineering identity research tends to emphasize aspects of how students become engineers that are external to individuals. These studies point to a collective identity that is socially constructed rather than examining individual's personal identities. For example, in her ethnographic research on gendered patterns of engineering workplaces, Faulkner (2000a; 2000b; 2007) depicts a clear dualism of the technical and social, noting that "engineering professional training, identities and practice are permeated by a strong sense of the technical which specifically excludes the social" (2000a, p. 764). In other words, the dominant, collective identity among engineers is marked by a notable attentiveness to mathematical and scientific (i.e., "technical") knowledge while neglecting social elements that are, in fact, deeply intertwined with engineering work (Trevelyan, 2007; Bucciarelli, 1994; Bovy & Vinck, 2003). Faulkner and others (e.g., Acker, 1990; Akpanudo, Huff, Godwin, & Williams; 2017; Collinson, 2011; Simon,

Wagner, & Killion, 2016) point further to how this collective engineering identity is particularly welcoming for White, male individuals and marginalizing to women and persons from historically underrepresented racial and ethnic backgrounds.

Against this backdrop of research that characterizes a technical mindset of collective engineering identity, some studies have investigated how individual engineers or engineering students tend to feel marginalized as engineers (e.g., Cech & Waidzunas, 2011; Martin et al., 2013; Walden & Foor, 2008). Collectively, these investigations accentuate patterns of tension that individuals must navigate when they do not identity with features of dominant images engineering identity that are particularly connected to the majority representation of White men.

Moreover, some prior research in engineering education has examined the construct of engineering identity, often in the interest of understanding how students are motivated to pursue an engineering career. For example, in their study on how first-year engineering students come to identify with engineering, Godwin, Potvin, Hazari, & Lock (2016) found that first-year engineering students' felt identity in, or deep connection to, math and physics subjects predicted their choice to major in engineering careers. Additionally, Matusovich, Streveler, & Miller (2010) qualitatively examined students' underlying motivations to pursue engineering as a career. In their study, they found that engineering students were motivated to persist in their degree when they found engineering to be highly "consistent with sense of self" (p. 294). They elaborate that for students who struggled to find this consistency, their experiences of persistence to obtaining engineering degrees were notably more arduous than students who found engineering to align with their personal identities.

Additionally, there is some research that, as in the present study, has examined the identity trajectories of individuals as they transition from engineering degree programs to

workplaces. Jungert (2013), for example, conducted a longitudinal interpretative phenomenological analysis (IPA) investigation on how engineering students developed in their social identities as they progressed through their shared degree program at a highly esteemed institution. He found that the ways that they categorized themselves socially were highly dependent on their context of coming from a prestigious program, particularly in relation to engineering peers that did not graduate from their university. Moreover, findings continue to emerge from a large-scale longitudinal research that traces the pathways of engineering graduates into their careers (Brunhaver, Korte, Barley, & Sheppard, forthcoming; Sheppard, Antonio, Brunhaver, & Gilmartin, 2015). The foci of these investigations have been to make known how engineering competencies that are emphasized in degree programs are relevant (or not) in the workplace. Yet neither of these longitudinal investigations have closely examined the developmental experiences of personal identities in individual engineering students as they transition to the workplace.

Beyond engineering, other professions have critically examined how its members come to develop identity commitments to given professions. Similar to existing studies of engineering identity, this research tends to investigate professional identity development of individuals with the overarching aim of advancing particular goals in a particular profession. For example, in a grounded theory study, MacIntosh (2003) found that as early-career nurses transitioned from their education to the workplace, they underwent a process of reconstructing their professional identities as nurses. Specifically, they navigated the stress of newfound expectations in the workplace to finding themselves as individuals who advanced the goals of the nursing profession. Additionally, literature related to professional identity development of teachers tends to focus on how training programs can and do contribute toward the professional identity of

commitment of pre-service teachers (Beauchamp & Thomas, 2009; Sachs, 2001). Similar to engineering identity, such investigations of professional identity generally view identity achievement within a particular career as a positive outcome that advances the effectiveness of professionals and broadens the representation within the profession. Furthermore, this research tends to take a focused perspective on the identities of individuals in relation to a particular profession and a limited perspective on identity outside of this domain. However, Syed and McLean (2015) contend that contextual identity integration, which "involves the fit of multiple identity domains that individuals either consider important to them or are forced to deal with due to socio-structural factors" (p. 111), is understudied in developmental psychology. Thus, in the present investigation, we have sought to investigate the lived experience of identity in individuals who are all connected to engineering practice. However, we have intentionally taken steps to regard the research participants as holistic individuals who experience their personal identities in domains beyond their profession.

Qualitative Research in Emerging Adulthood

Although this study contributes to theoretical understanding of how engineers experience their personal identities in transitioning to the workplace, we also contend that the findings of this investigation are important for theoretical advances in emerging adulthood literature. First, as a qualitative investigation, this study provides findings that highlight important contextual features of the experience of transitioning through emerging adulthood. As put by Schwab and Syed (2015), inquiry that uses qualitative research methods "allows for and highlights intricacies of the human experience and so is particularly suited to unpack the nuance and depth of emerging adults' lives" (pp. 397). Additionally, Robinson and McAdams (2015) have argued for research in emerging adulthood to include idiographic theory development, which is based on detailed

understandings of individual cases, in addition to nomothetic findings that are quantitatively investigated. Some prior qualitative research in emerging adulthood has embraced studies requiring deep immersion into particular phenomena that occurs in specific contexts. Examples of such studies include investigations that focus on Belgian emerging adults departing their home (Kins, De Mol, & Beyers, 2013), experiences of volunteering by university students (MacNeela & Gannon, 2014), and how young adults experience recovery in self-harm practices (Wadman et al., 2016).

Moreover, the findings of the present study capture the complexity of the path of emerging adulthood, which is one that involves multiple identities of a whole person, not just one's career identity. Indeed, Kroger, Martinussen, and Marcia (2010) described that exploration and commitment occur in three key dimensions of identity: vocational, ideological, and sexual. While students and early-career professionals from pre-professional undergraduate programs might experience a direct path to realizing their career identity, we know little of their holistic development across all of these pillars of identity. A growing but limited body of scholarship has probed the interactions between explorations in love and work identities (e.g., Mayseless & Keren, 2014) and work and worldview identities (e.g., Sumner, Burrow, & Hill, 2015; Yonker, Schnabelrauch, & DeHaan, 2012). Such research suggests that the development of one's career identity cannot fully be understood in isolation from other forms of identity development.

Motivated to fill gaps by prior research on engineering identity and emerging adulthood, our investigation closely examines individual experiences of personal identity in engineering students as they transition to new roles of early-career engineers in the workplace. In the backdrop of prior research, we organized this study around the overarching research question: How do students psychologically experience identity trajectories of becoming engineers?

Methodology

As the research question focused on nuanced, psychological phenomena, we employed interpretative phenomenological analysis (IPA) as a methodology that was well suited to the investigation. IPA is a qualitative approach that uses interview data to develop insight related to personal lived experience of psychological phenomena. Philosophically grounded in phenomenology and hermeneutics (e.g., Gadamer, 1975/2013; Heidegger, 1953/2010), the methodology is designed to enable the researcher to generate theoretically coherent psychological knowledge claims that are sensitive to the context in which they are experienced (Smith, Flowers, & Larkin, 2009). IPA is well cited and used in many fields of applied psychology such as health psychology (e.g., Eide, 2007; Hutton & Perkins, 2008; Toye, Barlow, Wright, & Lamb, 2006), counseling (e.g., Allan, Eatough, & Ungar, 2016; DiGiacomo, Lewis, Nolan, Phillips, & Davidson, 2013; Gianakis & Carey, 2011), and education (e.g., Barss, 2012; Humphrey & Lewis, 2008; Kirn & Benson, forthcoming). The philosophical commitments of IPA require that the researcher is attentive to the particular rather than the general when investigating within the realm of that which is experienced. The outcome of IPA research is a collection of robust, inductively generated, psychological themes, representing coherent yet idiosyncratic patterns that are shared by a set of participants (Smith et al., 2009; Smith & Osborne, 2003).

Data collection

In order to gain insight into how engineering students experienced their personal identity as they transitioned to the workplace, we conducted interviews with seven engineering students on two separate occasions. Specifically, we conducted the first interview one month before they received their bachelor's degrees and the second interview five months later, when they were

two to three months into their new engineering career. This investigation and our interactions with study participants were approved by the Institutional Review Board at both Purdue University (Protocol #1211012982) and Harding University (Protocol #2015-067).

The seven interview participants were selected from a larger set of respondents to a web-based questionnaire. Specifically, we recruited senior engineering students who were in their final term before their graduation. The questionnaire solicited demographic information, including gender, racial and ethnic background, year of graduation, academic major, country of citizenship, and whether or not they would be willing to be interviewed. Furthermore, respondents were asked to provide information related to their intent to pursue engineering as a career (items adapted from Sheppard et al.'s (2010) APPLES survey), whether or not they had received an offer of employment from a company, and an open-ended item that asked them to explain how they prioritized what should be considered in engineering design (e.g., technical, environmental, social factors). The prompts for this item were taken from terms listed in the US engineering accrediting agency's list of factors that students should consider in engineering design (ABET, 2011). The items from this questionnaire informed us of the participants' demographics as well as the salience of the participants' identities as engineering students. The open-ended item also provided an indication of how likely it was that we could access participants' thinking of engineering identity through interviews. In sum, fifty participants completed the questionnaire and indicated that they would be willing to participate in an interview.

However, because IPA requires detailed attention to particular phenomena, it was important to establish homogeneity in the sample of research participants to allow for more

Table 1

Summary of Participants

Participants (Pseudonym)	Gender	Race/Ethnicity	Country of Citizenship	Engineering Major	Institution
Alice	Female	White	U.S.A.	Civil	Purdue
Haden	Male	White	U.S.A.	Civil	Purdue
Naomi	Female	White	U.S.A.	Mechanical	Purdue
Parker	Male	White	U.S.A.	Mechanical	Purdue
Rachel	Female	East Asian	U.S.A.	Mechanical	Purdue
Warren	Male	White	U.S.A.	Electrical	Purdue
Trixie	Female	South Asian	U.S.A.	Civil	Purdue

credible transferability of knowledge claims (Smith et al., 2009). As shown in Table 1, a sample

of seven participants was selected from the pool of fifty eligible participants. These seven

participants were all citizens of the United States and pursuing mechanical, electrical, and civil

engineering degrees from Purdue University, a large, research-focused institution. Moreover, the

participants identified as East Asian, South Asian, or White—racial and ethnic backgrounds that

are overrepresented in engineering (Yoder, 2012). Additionally, all participants had been offered

a job at the time of the first interview and were 2-3 months into this same job at the time of the

second interview. However, based on the wealth of research suggesting that women engineers

undergo a substantially different identity experience than men (e.g., Faulkner, 2007; Jorgensen,

2002; Tonso, 2006), we stratified our sample by gender to gain insight as to how men and

women engineers experienced identity trajectories as they began their careers. Finally, through

their responses to the open-ended item, the seven participants indicated that they could provide detailed articulation of how they experienced their identities as engineers.

In conducting the interviews with each of the seven participants, we followed a semi-structured approach to elicit descriptive content concerning the participants' individual experiences of identity. The overall goal of the interviewing strategy was for the interviewer to play the role of a curious listener for the participants, guiding them to provide rich and personal accounts of identity in their engineering contexts rather than descriptions of generic experiences (Smith et al., 2009; Weiss, 1994). In the first interview, we carefully guided the participants from describing holistic self-concepts to considering how they experience their personal identities as engineering students. The participants' responses guided the flow of the interviews, with the interviewer probing further on content that was explicitly discussed by the participant in order to gain deeper insight into how they understood their engineering identities. The protocol for this semi-structured interview is detailed in Appendix A. All interviews with engineering students were conducted in-person by Dr. Huff, the first author, and recorded at Purdue University. They ranged in length from 76 to 154 minutes.

As with the first interview, we adopted a semi-structured approach to the second instance of interviewing. When we interviewed the participants in this instance, they had been employed as engineers for two to three months. Our approach in this second iteration was to begin the interview by remaining open to changes in how the participants may have experienced their identities, in light of their newfound status as early-career engineers. Thus, we were cautious to avoid probing the participant on explicit statements regarding salient identity experiences that they made in our first interviews with them. However, toward the end of the second interview, we prompted participants with specific follow-up questions that were inspired by their responses

from the first interview (e.g., "In the first interview, you mentioned ____. Is this still the case? How so?"). At the time of the second interview, participants were in scattered regions across the United States. Therefore, the interviewer used Skype to conduct the interviews, which ranged in length from 86 to 127 minutes, and captured the sessions in audio files. The protocol for this second interview is detailed in Appendix B. Following the two interviews with participants, the authors did not sustain contact with the participants.

Data analysis

Data analysis for the transcript was in line with standards for high-quality IPA research (Smith et al., 2009; Smith, 2011a; Smith, 2011b; Smith, 2011c). The recorded interviews were transcribed and then analyzed by a detailed examination of each participant and each transcript. Specifically, we began analysis of a given participant by re-reading the first interview transcript while listening to the audio file. We then made another pass through the same transcript, annotating descriptive, linguistic, and conceptual features of the participant's statements. Following this, we made an additional pass through the transcript to note what Smith et al. (2009) refer to as emerging themes, or statements that capture the psychological nature of particular excerpts within the interview transcript. Finally, to conclude our analysis of a single transcript, we organized these emerging themes, approximately 50 to 150 within a single transcript, in order to highlight clear psychological patterns of identity that were demonstrated in the transcript. We then repeated these procedures for the second interview transcript of a participant. When both transcripts for a single participant had been thoroughly analyzed, we noted patterns of consistency or divergence for a single participant. We have described this process in more detail elsewhere (Huff, 2014; Huff, Smith, Jesiek, Zoltowski, Graziano, & Oakes, 2014).

We repeated this analytic process for each of the remaining participants in the study. After each individual participant had been analyzed as a case, we carefully examined the entire data set and our analysis of each case to generate themes that captured shared experience of identity. The goal of our cross-case analysis was to highlight robust patterns of coherence that were shared among the participants while taking care to not reduce the individual patterns of meaning. Thus, the psychological patterns that were found through this investigation resulted from a detailed understanding of how engineering identity was experienced within each individual research participant.

Findings

As the participants transitioned from their education to the workplace, we noticed three particular patterns regarding how they identified as engineers in relation to their overall identity development. First, the participants felt a shared sense of arriving at adulthood, particularly in relation to how they compared themselves to their non-engineering peers. They attributed this experience of adulthood to both their perceived status as early career engineers and to having obtained a degree that they identified as difficult. As they were prodded by social forces to rush their career identity development as engineers, they also became attentive to who they were outside of the workplace, which we discuss in the second theme. As a third and final theme, we describe how the three female participants also indicated feeling isolation based on their new identities as early-career engineers, particularly in terms of how these roles were an unwelcome intrusion on their bonds with family. We examine these three patterns in the sections that follow and then discuss how these themes relate to the extant literature on identity development.

Theme 1: Embracing the Career Identity of an Engineer – Feeling the Distinct Shift to Adulthood as Engineers

As the participants were becoming engineers through their early-career roles, they also felt that they were arriving at a new stage of human development. In three particular cases, participants demonstrated how they felt unique in their transition into adulthood because of their engineering backgrounds. We begin our discussion of this pattern with the case of Haden. He had graduated with a degree in civil engineering and then went on to work as an engineer in a civil engineering corporation. As a student, much of Haden's identity as an engineer was strongly connected to his relationship with his parents. In the first interview, his sense of an engineering identity was a culmination of his childhood experiences of "building K'NEX" and being "good at math". Moreover, he was walking a path that his father had already trod in becoming an engineer. Thus, his decision to major in civil engineering, in his mind, was connected to his childhood experiences. He also tied his responsibility to "perform well" in his education to feeling obligated to his parents, based on their financial investment in his education.

Yet, Haden's motivation to be an engineer did not rest entirely in his sense of duty to his parents. Engineering was a pathway to "get [him] more money" or "a better life." Thus, money was a symbol of his dependence on his parents, in that they were "paying for [his] school". But money also represented something that was ahead of him by becoming an engineer, giving him a perceived independence from his parents.

As Haden transitioned into the workplace, he also returned to his parents' home and paid a small amount of rent to live in his childhood house. Though this living arrangement might suggest that Haden perceived that he was still dependent on his parents, we found that he had, in fact, experienced a definite sense of becoming more of an adult. In fact, his career as an engineer afforded him the opportunity to "have a job right out of college", which is something that he felt was "pretty rare" among his non-engineering peers:

I like the status of it [engineering]. People look highly upon engineers, so that's

nice . . . It's nice having a full-time job and seeing how blessed I am, I guess. . .

Like when somebody asks, 'Did you get a job out of—' or like 'Where did you go

to school?' and I'll say, 'Purdue.' And [they'll ask] 'What'd you go for?' and I'll

say, 'Engineering,' and they'll be like, 'Oh, wow, you know, that's impressive.'

I don't know. To me, I never saw it that way, just because it was always the

standard for me . . . but other people are impressed by it—and especially that I

have a job right out of college, people are impressed, too."

The above excerpt shows that not only did Haden feel exceptional in securing a full-time job, but

he also came to feel elevated in status from attending Purdue, a university that is well known for

its engineering programs. This excerpt also illustrates that Haden's perception of "status" as an

engineer captured how he had reached a personal level of commitment to his career identity that

other peers had not. This conclusion is evinced more clearly as Haden elaborates on his felt

status. We revisit his quote from the epigraph of this article: "I feel like I've taken the next step

in life, and they're still trying to get to that step." To Haden, having a job meant that he had

reached "the next step in life" that his peers were still trying to reach. Through his engineering

degree, notably at an institution that he understood to be prestigious, he felt that he had advanced

into a new life stage.

Similarly, Warren, an electrical engineering graduate, felt that his degree in electrical

engineering afforded him an elevated status when compared to his peers. At the time of our first

interview, he described how his major in electrical engineering enhanced his overall self-esteem:

"In terms of my self-worth, I really hold electrical engineering as one of [the hardest], if not the

hardest, major, certainly at Purdue. So in terms of self-worth, I would say that it boosts it and I'm

proud." In this same interview, he stated his belief that his engineering education as a way of "becoming more mature" more than it was a mechanism to learn particular concepts.

During our second interview, after he had begun his career at a computer hardware corporation, Warren additionally elaborated on how he perceived a personal sense of elevated maturity in relation to non-engineers:

> I've definitely grown an appreciation for people's value . . . of people with an engineering background, especially electrical engineering, because the reality is, it is difficult. You know, it's not an easy degree to get . . . But it's definitely in the, you know, whatever the real world is, at this job it's apparent that, you know, it is a differentiator and—there is a difference.

However, as Warren elaborated on his viewpoint, it was clear he understood that the "differentiator" between engineers and others, in part, was a perceived maturity that had been obtained through a difficult education. On multiple occasions in the interview, he described how the demands of his engineering degree helped cultivate a strong work ethic and dedication to completing tasks—traits that he did not see in people who were not engineers.

Warren's increased, self-described sense of maturity, based on his engineering education experiences, was a felt example of how he had personally grown. Additionally, he felt that he had received respect and credibility from others by being an engineer. According to Warren, he had experienced maturity through the experiences of his education, not merely as an engineer, but holistically. Such growth signaled that he was approaching adulthood, especially because of the difficult experiences of his education.

Like Warren, Naomi, a mechanical engineering graduate, described her elevated sense of self-esteem based on her difficult engineering degree. For her, however, this difficulty was

salient because she had struggled with obtaining an engineering degree. As she stated in her first interview: "I kinda got my butt kicked [during my] sophomore year, once I actually went into the mechanical engineering program. So, I think just knowing that I made it through one of the hardest programs in engineering in the country is something that I'm really proud of."

Naomi went on to work as a mechanical engineer in a consumer products corporation. Her commitment to her career identity was strong because of her perceived investment in obtaining her degree. In her second interview, she discussed an eventual possibility of becoming a manager at her corporation. But she was certain to point out how she first wanted to spend more time in detailed engineering work: "So I definitely am very interested in getting more technical knowledge before I go into that managerial role eventually . . . I worked my butt off being at Purdue, and I want to have something to show for it, too (laugh)." Naomi showed a significant commitment to her identity as an engineer, partly through the perceived exceptional difficulty she had experienced in her education.

All of the participants in this study also demonstrated a pattern of internalizing a newly experienced autonomy and maturity as they transitioned to the workplace. While they did not all accentuate the felt uniqueness in their life stage development, they did acknowledge its presence as brought on by the newfound experience of responsibility in beginning a new job. As put by Rachel, at the time of her second interview, transitioning from college to the workplace brought new motivations in "being responsible, in the sense of having bills to pay and everything like that." Thus, their engineering careers not only affected their experienced professional identity but their identity overall. As we discuss in the next theme, in their transition to the workplace the participants employed intentional strategies to manage identities both inside and outside of their engineering contexts.

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Theme 2: 'After five o'clock, it gets to be me' – Developing identities in and out of the engineering context.

The participants of this study deepened their commitment to being engineers as they graduated and then began careers in their respective workplaces. Not only had the academic degrees enabled them to be recognized as engineers, but their newfound employment had strengthened their commitment to this common professional identity. In their workplaces, they were getting the opportunity to practice the expected ways of being in engineering roles.

It is intriguing how they managed this new identity amidst their experiences of identity outside of the workplace. When they were students, they felt that their engineering major defined much if not all of their everyday activity. However, when the participants came into the workplace, they found an opportunity to develop new identities outside of work. But this identity development, related to their newfound interpersonal relationships or shared activities with romantic partners, did not easily co-exist with their engineering identity. In order to construct their individual, holistic experiences of identity, the participants employed conscientious strategies to demarcate their identities along professional and non-professional lines.

Parker demonstrated this bounded sense of identity in our first interview. Having worked on vehicles with his father and brother when he was a child, Parker's pursuit of a mechanical engineering degree was the culmination of his childhood experiences. He indicated that engineering was "almost, like, an obvious choice" when he needed to decide on his academic major. And Parker committed to being an engineer in his years as a student. His major formed the basis of his friend group, which primarily consisted of other mechanical engineering students. He described this group as "all nerds and geeks in our own sense." Moreover, he

further demonstrated his commitment to being an engineering major by getting a tattoo of a (de-identified) mechanical device. As he described:

> Whenever I look in the mirror and see myself, I see myself as an engineer, just because typically, whenever I look at myself in the mirror, I don't have a shirt on, and I have a tattoo of a [mechanical device], which helps me remind myself of just the fact that, you know, engineering, it's something you can see. . . [This device] is, in my opinion, one of the greatest engineering accomplishments and that sort of thing.

Parker's commitment to being an engineer went beyond a mere academic choice. It comprised a robust depiction of who he was and how he could recognize himself. Engineering provided not only an outlet of academic interest but also social belonging and continuity from childhood experiences. However, despite his profound commitment to being an engineer, Parker's interpersonal relationships, and particularly his relationship with his fiancée, challenged him to manage multiple roles. Continuing the same excerpt in the transcript, he turns to consider his embodiment of these roles:

> So, I physically see an engineer, but then I also see a lot of love [that] I have for both my friends, my family, as well as my fiancée, and I see myself as being a provider for all of them in whatever way possible. You know, with my friends, it might just be a friend to have fun [with] and support them whenever—like, say, they get broken up with or lose their job, something like that, or share laughs and that sort of thing. And that role is completely different from me being with my fiancée and that sort of thing. So, I see myself—I guess holistically, not just as part this, part that. So, it kind of just all helps define me. . . I'm [Parker] the

engineer, I'm [Parker] the tinkerer. I just see [Parker], and then that is all part of

me.

In spite of his dedicated commitment to engineering, Parker intentionally sought to bound this professional way of being from roles that required him to attend to his interpersonal relationships.

This pattern continued the second time we interviewed him. In between these two interviews, Parker had not only started an engineering job, like the other participants, but he also demonstrated further identity commitments by becoming married to his fiancée and becoming confirmed in the Catholic faith. His commitment to his faith and his spouse deepened by the time of the second interview, and he described how he would intentionally seek to "leave work at work," particularly if he had a difficult experience in the workplace. As he elaborated, when coming home, he attended to his relational identity as a partner to his spouse. He would intentionally "shed all of the emotions and everything aside for whenever [he would] come home."

What is interesting here is that Parker came to find the time boundaries of a workday as a device that would allow him to bound his identity as an engineer. This pattern was demonstrated in several other cases as well. In our second interview, Naomi described her efforts to develop a form of identity beyond her professional role, one that was outside of the workday. As she stated:

After five o'clock, it gets to be me. . . It's definitely nice that my work day ends at

five o'clock, you know, 5:30 at the worst, and then I get to do whatever I want. . .

I felt like when I was an undergrad, I never turned off mechanical engineering.

As she elaborated in the interview, her form of identity outside of work was more of an exploration than a fixed set of activities. Living in a new place, she was developing new

friendships, testing out new activities such as motorcycle riding, and generally exercising control over her everyday activities. Notably, she contrasted this newfound sense of agency to her felt lack of control of her identity as an undergraduate student. Indeed, in our first interview when Naomi was still an engineering student, she stated how her activity in engineering defined her regular schedule and how she anticipated when she could "[get] back into a good amount of things that [she] used to do a lot before engineering took over [her] days and nights."

Likewise, all of the participants spoke with considerable detail regarding their desire to explore and maintain robust identities beyond who they were as engineers. In contrast to their committed professional identities as engineers, the participants sought to take a more exploratory posture regarding the hobbies, affinities, and friendships that defined their non-professional domains. For example, having begun work in a new city as a manufacturing engineer, Rachel described her heightened attention that was focused on developing a new group of friends beyond her co-workers. Warren, who was given freedom to develop his own work hours, struggled to navigate how he could continue to execute required assignments at work while also exercising personal agency in choosing to play tennis:

> A challenge has definitely been, when do I work? Because, you know, I want to play tennis, right? . . . And also, it's important to be in the office, it's important that people see that you're working hard. I mean, at the end of the day, results are very important, but, you know, you don't want your office to be empty the whole day.

Alice and Trixie, who had each taken on jobs as civil engineers at two different consulting firms, each spoke of their desire to find social relationships in their respective new environments. Alice enjoyed exploring multiple facets of the city through attending social gatherings and going to

restaurants, while Trixie struggled to find this same sense of control over developing new social relationships. And Haden discussed his intentional strategy to switch out of "engineering mode", where he attended to technical detail in his environment, to a form of identity that would enable him to thrive in interpersonal relationships: "I switch out of engineering mode and I switch into, you know, just friendly, compassionate, talkative, relationship-builder mode so that I can just hold a conversation."

The participants, who had effectively committed to an engineering identity all held that they wanted to be considerably more than just engineers. This pattern was idiosyncratic in how it lived in each participant, but it resonates with a poignant statement voiced by Alice in our first interview, "I would say I'm an engineer, but that isn't the only thing that defines me." Alongside a committed identity of being an engineer, the participants sought to explore and develop coherent forms of identity in their social and relational contexts. At times, however, this was a particularly difficult form of identity management. In the following theme, we examine three particular cases where participants struggled to reconcile their professional identities with their connection to their families.

Theme 3: Finding tension between the engineering identity and family roles.

The final theme that we discuss appeared to gendered patterns within our data set. As three of the female participants graduated with their engineering degrees and transitioned to their respective workplaces as engineers, they increasingly felt both distance from and fondness for their families. Even if they had already moved away from home to attend college, the move to the workplace indicated a more permanent move away from their families than they had experienced as students. In some cases, receiving engineering degrees also affected the social connection that they felt with their families.

As these interviews were designed to encourage the participant to discuss salient features of identity, these discussions were not prompted by the interviewer. With this in mind, the absence of felt tension between career and family roles in the male participants is conspicuous. In this section, we probe how female participants identified tension between their engineering and family roles.

We begin our description of this theme by examining the case of Trixie. Of all the participants, she was the only one that grew up in the state of Indiana, the location of Purdue University. Her family lived close enough for her to frequently visit them while attending college. After moving out of her home state to enter the workplace, her connection to her family became noticeably more important. Trixie viewed her move as "being on [her] own", which felt difficult without her family. As she elaborated in our second interview:

> Well, this is my first time actually being away from home for a long period of time. . . So it is kind of hard to adjust to being on my own, not just because, um . . . Like, for example, I think I—my windshield wipers weren't working the other day, and my first instinct was to call my dad and ask him what was wrong, because I have no idea (laugh) what to do. . . It's not even that aspect; it's more of just like it's nice to have a good support system when I'm away . . . other than my family and my friends, I can't think of anything else that's that exciting in my life (laugh).

As she adjusted to beginning her career as an engineer, she attended to the support system she had left behind. But more than adjusting to the practicalities of living on her own, she gradually disclosed in the above excerpt how, in absence of family and friends, she "[could not] think of anything else that's that exciting in [her] life." Certainly, her engineering role did not provide her

with excitement. She had been granted few vacation days as a new employee, and her organization unit provided little flexibility on when she could take off of work. Although she was able to return to her family home for some brief visits, she went on to reflect how she became "depressed" on the trip back to return to her job:

> Every time I've actually gone home, like, it makes me realize, like, what I'm missing out on when I am in town, and every time I have to fly back, I just get so depressed because I know what my life is like here and I know I'm not completely enjoying the work I'm doing.

Trixie's transition to self-reliance, coupled with the rigid environment of her new job, caused her to look back more fondly on the home that she left behind. She felt alone without a "support system" as she navigated the journey to becoming an engineer, and more broadly, emerging into her own sense of adulthood.

In contrast to Trixie, Naomi moved out of state to attend Purdue in order to pursue a mechanical engineering degree. In doing so, she went against a pattern set by her extended family to remain in their home state in order to attend college. When she was a mechanical engineering student, Naomi's parents had been a pillar of support, especially through her difficult journey obtaining a bachelor's degree. She described in the first interview how coming to the university had given her a new sense of purpose from what she had known in her hometown. As she stated, "I just realized that there were a lot more things than [my hometown] and that I can do so many more things, and I wanted to do so many more things."

However, upon beginning her career at the product manufacturing firm, she became more aware that her distance from family, which included her aging grandparents, was more permanent than it had been during her time at the university. By her more committed move into

the workplace, Naomi described in the interview how she experienced a strange feeling that life among her family was continuing without her. But the geographical expanse between them was not the only distance that Naomi felt with regard to her family. As she elaborated:

I'm the only engineer so far out of the family . . . They'll just be like, 'I can't believe that she's doing that. Like, I would never be able to take those classes or understand all that math.' So I think that a lot of the time they're, like, impressed by it, which—is kind of weird for me, because I'm used to, like, being around engineers all the time and being with all these technical, math-minded people . . . but then if I was trying to do what their job is, I would probably be like, 'Whoa, what's going on over here?'

By becoming an engineer, she had accomplished something that was unknown to her relatives. What had become so familiar to Naomi now made her an anomaly within her family. In the above excerpt, she expresses mutual respect toward her family members' careers as a way to seemingly close the gap that now separated them. Through her engineering degree, she had become somewhat separate from them and was following a specific identity trajectory that was not fully understood by her relatives.

Like Naomi, Rachel focused in her second interview on how she felt the absence of her family amid her identity as an engineer. She reflected on how she could not fully share the experience of developing her career with them. Though they validated her accomplishments and her degree, she had been growing in a professional domain that was foreign to the remainder of her family:

I mean, they brag about it [my being an engineer] because, you know, I'm the engineer of the family. But whenever I go into detail about it, they're like, 'Give

me the big picture. You know, I don't understand it.' And I mean, it sucks, too,

sometimes, because, you know, I'm proud of what I did, and I want to share it

with them.

To Rachel, becoming an engineer had introduced an undesirable distance between her and her family. At the time of the second interview, this distance felt tolerable to her. However, she envisioned that in the next ten years, her desire to return to her family home might interfere with her trajectory as an engineer. As she later elaborated in this interview, she even considered the possibility of leaving her engineering career for the sake of being closer, in proximity, to her family.

In sum, these three participants demonstrated a clear pattern of feeling a tension between their career identities and their roles in the families that they had moved away from. And notably, this perceived distance was not merely caused by the lack of geographical proximity. Indeed, two of the participants had already moved out of their home states when they had come to college. There was something about the transition to the workplace, however, that seemed a more permanent move away from home than college. In at least two cases, by becoming engineers, they had become something that their families did not fully understand. Moreover, as the participant journeyed into the workplace, they seemed to feel as if they were taking a developmental step in life, that of becoming an adult. In response to navigating this phase of emerging adulthood, they looked back on the family homes that they left.

Discussion

The findings of this investigation provide a contextual depiction of how the participants were undergoing intertwined and holistic forms of identity development rather than simply developing in their career identities. Their identities as engineers were certainly not disconnected from their

more general transitions into adulthood. Indeed, some participants described how their status as engineers had advanced their development into adulthood faster than that of their non-engineering peers, both by making them more resilient through a difficult education and by providing them a defined career role rather than a temporary job.

As earlier referenced, Arnett (2004) has described one feature of emerging adulthood, identity explorations, as a time of "trying out various possibilities, especially in love and work." (p. 8). This tenet of Arnett's theory connects with Marcia's work (Erikson, 1959; Marcia, 1966; Kroger & Marcia, 2012) regarding identity statuses. According to identity status theory, when someone commits to a certain identity with scarce exploration, the person is in a status of identity foreclosure. Identity achievement occurs with high exploration and commitment. And when identity trajectories are characterized by high exploration and low commitment, this is known as moratorium.

The participants in this study were noticeably not experiencing a time of exploring their identity in relation to their careers. On the contrary, they spoke of who they are in relation to their engineering identities with noticeable commitment to this professional trajectory (Theme 1). And considering the trajectory of their professional identities, this steadfast journey to an engineering identity makes sense. From the time that they were nineteen or twenty, the nature of their engineering degree programs required that they were committed to particular engineering disciplines. Although many individuals tend to abandon the pursuit of an engineering degree (Seymour & Hewitt, 1997), these particular participants had persisted in their education through the point of launching an engineering career.

We suggest that the participants' committed path to a career identity promoted a form of identity development that provided an overall sense of autonomy and control in how they

approached their career. As described by Seiffge-Krenke, Persike, & Luyckx (2013) in their study on German adults that transitioned into their careers, commitment making to an occupational identity positively contributed to one's sense of agency in pursuing career goals. Additionally, Gianakos (1999) has found that stable career patterns, "in which a career is chosen and entered both early and permanently" (p. 245), are related to higher levels of self-efficacy in relation to one's choice in a career. Likewise, the participants in this study did exhibit a strong commitment to being an engineer, and a growing ownership of their career goals and decisions. Although their choices to become engineers were perhaps locked in from the time that they had first entered college, they had come to interpret their experiences in engineering degree programs and workplaces as platforms to author their own particular identities as engineers. The participants were committed to being engineers, while recognizing challenges that came with their early-career status in the workplace. One way to makes sense of these identity trajectories is by understanding that, for the participants, identity exploration within the domain of engineering was conducted within fixed parameters. While they made a career choice as first-year college students, their educational and workplace experiences provided the needed mechanisms for emerging into feeling more secure in who they were as professionals. Thus, the path toward achieving their career identities incorporated elements of commitment and exploration. Building on Marcia's conceptualization of identity statuses (Marcia, 1966), the nature of the participants' identity exploration might best be captured as what Luyckx and colleagues describe as exploration in depth, that is, "an in-depth evaluation of one's existing commitments and choices to ascertain the degree to which these commitments resemble the internal standards upheld by the individual" (Luyckx et al., 2008, p. 59; Luyckx, Goosens, Soenens, & Beyers, 2006).

However, while the participants demonstrated strong commitment with respect to their career identities, they also exhibited powerful motivations to explore their overall identities outside of the workplace (Theme 2). At a first glance, this seems like an inconsistency in the individual participants who were both committing to career identities and exploring other ways of being, outside the parameters of their work. Yet we suggest that this compartmentalized identity exploration is complex, with strategic advantages and drawbacks in relation to identity development. Regarding how this compartmentalization was advantageous to participants, the findings described how the participants exhibited a striking commitment to career identity positively enabled the participants to adopt postures of exploration toward other forms of self. In other words, as they became more secure in who they were in their careers, they could question and examine about other features of their identities, such as cultivating their relational identities in the new social context of their career locations.

Naomi's statement, "After five o'clock, it gets to be me," captures a robust insight that was shared by these participants. While in their degree programs, their difficult academic major defined much of their identity thinking. We note how this finding connects to Downey & Lucena's (2003) ethnographic study on engineering students' problem-solving, observing how would-be first-year students in their context were told by their associate dean that "engineers have to learn how to have fun . . . efficiently" (p. 170). Similarly, for the participants in the present study, their interpersonal relationships and activity choices were made with deference to the overarching demands of their identities as engineering majors. As early-career engineers, however, the participants now experienced dedicated time outside of their work where they could attend to these important features of themselves. With the participants' professional identities

temporally bounded by their workplaces, they were now able to devote time and attention to identity exploration, beyond their professional identities.

While entry into the workplace facilitated a shift in boundaries that advantageously allowed the participants to explore non-professional forms of identity, their compartmentalized and delayed explorations were not without their drawbacks. As highlighted in Theme 1, some participants described how their rigorous education in engineering was, in itself, an experience that cultivated a perceived sense of maturity in relation to other peers who were outside of engineering. The participants' asserted sense of advanced development lived alongside conscious choices to demarcate and, at times, devalue their attention to interpersonal relationships while pursuing their engineering education (Theme 2). However, Loevinger's concept of ego development (Hy & Loevinger, 2014) challenges the perception of developing maturity through persistence in difficult coursework. Certainly, the difficult education did support the participants' conscientiousness, an important construct in ego development. However, Loevinger's concept of ego development characterizes the highest stages (i.e., Individualistic, Autonomous, Integrated) as an individual being profoundly aware of oneself in relation to his or her social environment and interpersonal relationships. By connecting identity development to their performances in difficult courses, the participants might have missed opportunities to holistically develop in the context of their interpersonal relationships. Therefore, while the participants' commitment to their professional identities did enable them to freely explore other features of who they were upon their entry into the workplace, we also maintain that their common strategy to compartmentalize non-professional forms of identity, particularly in the context of their interpersonal relationships, might have also limited their overall development.

We also note that, at times, the interaction between professional and non-professional identities was a tenuous experience. For example, Theme 3 describes the difficult journey of women who were early-career engineers as they struggled with the newfound sense of distance from their families. This theme connects with prior research that describes how women professionals feel tension between expectations in the workplace and societal expectations related to familial obligations. While prior research has broadly focused on this gendered pattern in relation to motherhood roles (Benard & Correll, 2010; Ross, 2016; Waldfogel, 1997), elder care (Earl & Taylor, 2015; Ettner, 1996), and general conflict between work and family roles (Poms, Fleming, & Jacobsen, 2016), we are not aware of prior research that has examined the tension between profession and non-professional identities for emerging adults who are not under expectations of care toward their family members.

One explanation for the tension that these women participants felt while launching their engineering careers comes from existing research in narrative identity. This body of literature emphasizes the constructs of agency and communion as dual motivations that individuals attempt to fulfill while forming their identities (Abele & Spurk, 2011; Adler, 2012; Bakan, 1966; McAdams, Hoffman, Mansfield, & Day, 1996; Frimer, Walker, Lee, Riches, & Dunlop). McAdams et al. (1996) characterize *agency* as related to the themes of "(*a*) self-mastery, (*b*) status, (*c*) achievement/responsibility, and (*d*) empowerment" (p. 345) and *communion* as related to themes of "(*e*) love/friendship, (*f*) dialogue, (*g*) care/help, and (*h*) community" (p. 346). Reflecting on the findings in the present investigation, Theme 3 might capture a particular gendered pattern of tension that women participants felt when achieving a strong sense of agency in relation to their professional identities (as explored in Theme 1) while experiencing a delayed form of identity development with respect to their interpersonal relationships (as explored in

Theme 2). In other words, they found the agent-oriented goals of fulfilling their identities as engineers at odds with a powerful felt need to further develop their relationships within their families.

In summary, these findings provide contextualized evidence through extensive qualitative research related to how early-career professionals develop in their identities. They suggest that these particular participants, as they transitioned to their first careers as engineers, experienced a transition to adulthood in ways that were connected to their career identities. While their strong commitment toward their engineering identities affected their felt development as persons, they also sought to explore and develop more comprehensive identities than that which was defined by their career choices.

This particular pattern of identity development in early-career professionals provides an expanded perspective on findings from earlier referenced research in engineering identity (e.g., Faulkner, 2007; Godwin et al., 2016; Jungert, 2016), and identity in other domains that provide opportunity to be recognized as a professional after completing a bachelor's degree (e.g., nursing – MacIntosh, 2003; teaching – Sachs, 2005; social work – Weiss, Gal, & Cnaan, 2004). Specifically, while literature in professional identity tends to evaluate identities of professionals in order to advance various goals of particular professions, in the present study we have closely examined the personal identities of individuals as they were experienced both inside and outside of their professional domains. In doing so, we have been able to provide contextual insight into templates for how identity might be integrated across career and interpersonal domains in early-career professionals. By studying members of professions as holistic individuals with identities experienced across multiple domains—rather than exclusively as professionals—researchers

might advance key understanding of how individuals integrate identity across multiple contexts (Syed & McLean, 2016; van Hoof & Raajimakers, 2003).

Implications and Future Research

The findings of the present investigation also highlight important implications on master narratives in engineering. McLean and Syed (2015) define *master narratives* as "culturally shared stories that tell us about a given culture, and provide guidance on how to be a 'good' member of a culture" (p. 320). In the context of engineering education and practice, Faulkner (2000a; 2000b; 2007) has depicted the master narrative to be predominantly occupied with technical competence at the exclusion of social concerns. Our investigation nuances Faulkner's claims by highlighting that individuals within engineering do, in fact, value their personal social context. However, the participants in our study also demonstrated a compartmentalized exploration of their identities in the context of social relationships while also treading an unwavering path toward achieving technical competence in their identities as engineers.

Thus, a key implication of this investigation is that engineering degree programs can provide core forms of support to their students' identity development by providing opportunities to integrate social concerns with their professional identities. One strategy for this integration is to incorporate human values in the engineering curriculum, for example, through service-learning courses (e.g., Swan, Paterson, & Bielefeldt, 2014; Huff, Zoltowski, & Oakes, 2016) or courses that unpack the relationship between engineering and society (Riley, 2011; Lucena, Schneider, & Leydens, 2010; Kabo & Baillie, 2009).

Further, the findings of this investigation support the recommendations given by Allendoerfer et al. (2012) that encourage faculty and administrators in engineering education to nurture the students' sense of belonging by attending to how relationships can be cultivated

while pursuing an engineering degree. Degree programs might foster a sense of belonging within engineering by attending to how the pathway to graduation might cultivate relational experiences. This could be accomplished in multiple ways, including, for example, by connecting to national societies intended to support the relational needs of engineers (e.g., Society of Women Engineers, National Society of Black Engineers, Tau Beta Pi). Additionally, courses might attend to how existing engineering design projects can cultivate relationships. Lima & Oakes (2006) make a simple but important recommendation to incorporate time for celebration when a design project is completed for a semester. Such small but important experiences likely nurture and strengthen a student's sense of professional identity if they feel that they might enact their other ways of being, including through cultivating relationships.

We further aim for this investigation to advance future research on the holistic identity of professionals specifically by focusing on goals of human development, such as personal well-being, rather than exclusively focusing on how individual career choices benefit broader goals for advancing a profession. While goals of enhancing professions are certainly worthy of pursuing, attending to the holistic needs of professional individuals in their identity development can advance professional and societal outcomes by promoting the formation of prosocial individuals who are competent in their professions.

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Appendix A: Interview Protocol – Graduating Seniors (Time 1)

The following interview protocol was used for conducting semi-structured with participants when they were in their final semester before graduation. The protocol is organized as a series of goals with example questions that might be asked to elicit data that would fulfill each goal. During the interview, the researcher maintained a posture of walking with the participant and carefully probing to elicit deep information regarding how the participant experienced their personal identity, and particularly, how they experienced this identity in the context of engineering. Thus, the questions below represent a repertoire of possible items that the interviewer used to elicit data. However, they were not sequentially asked by the researcher.

Goal 1: Review consent with the participant

- Do you confirm that you have read and agreed to the consent form emailed to you earlier? (if yes, continue the interview)

- Do you have any questions about anything you read in the consent form?

- Participation in this interview is entirely voluntary. You are free to stop your participation at any time. Do you understand this?

Goal 2: Elicit an overall sense of the participant's self-concept and how they experience their particular context. Identify salient contexts of identity for the participant, listening (not guiding) for the role of engineering in the participant's sense of identity.

Example Questions:

- Tell me about yourself. What types of things are important to you?

- What types of activities are important for you? Which are most important to you?

Goal 3: Elicit descriptive information about how the participant came to choose their engineering major.

Example Questions:

- Tell me about your experiences as a student. Why did you want to go into engineering?

- What do you plan to do after graduation? If you close your eyes and imagine yourself 10 years from now, what would you be doing?

- How important is being an engineer to how you view yourself as a person? Help me understand a bit more why...?

- How important is becoming an *engineering student* to how you feel about yourself? Help me understand a bit more why...?

- How does being an engineer interact with these other things [cite from earlier] that are important to you?

Goal 4: Elicit information about how the participant experiences their personal identity as an engineer.

Example Questions:

- In your own words, what is an engineer? How do you see yourself in relation to this definition?

- What aspects of engineering do you like? Help me understand a bit more why you like these aspects.

- What aspects do you not like? Help me understand a bit more why you do not like these aspects.

Goal 5: Elicit information about how the participant mentally models what it means to be a competent engineer.

Example Questions:

- What types of characteristics are needed to be a good [electrical, mechanical, or civil] engineer? Why are these important? Of these, which ones are you strongest in? How did you develop these skills?

- In general, what types of considerations should engineers think about as they develop system, processes, or products? Help me understand a bit more why...? How did you come to learn that these considerations are so important? How does your response to this question compare to what it might have been before you were engineering major? Help me understand a bit more why...

- Tell me about this [technical object or system that they designed in a course]. What considerations were important in designing this project? Help me understand a bit more why...? How did take these considerations into account in your design?

Goal 6: If not already discussed, elicit the participant's explicit views of how technical and non-technical considerations enter their identities as engineers.

Example Questions:

- When you think about what it means to be a good engineer, how important are *technical* knowledge and skills (whatever it means for you)? Help me understand why…?

- How important is it to consider the *technical* dimension of engineering problems? Help me understand why…?

- How important is it to consider the *social* dimension of engineering problems?

- How important is it to consider the *[other non-technical if it has come up in the interview]* dimension of engineering problems? Help me understand why…?

- How do you understand and incorporate technical, social, environmental, and other considerations of engineering?

Goal 7: Concluding the interview

- Thank you for your time. Do you have any questions of me?

Appendix B: Interview Protocol – Early-Career Engineers (Time 2)

The following interview protocol was used to conduct a second iteration of semi-structured interviews with participants in the study. Like the first interview protocol, the present version is organized as a series of goals with example questions that might be used to elicit data that would fulfill each goal. We do note that, in this interview, we began by approaching the individual with no prompting from data learned in the previous interview. We made this choice in order to not guide the participant into linking their present lived experiences to their past narratives. However, as we concluded the interview, we probed on each participant's salient lived experiences that were elicited in the first interview.

Goal 1: Review consent with the participant

Example Questions:

- Do you confirm that you have read and agreed to the consent form emailed to you earlier? (if yes, continue the interview)

- Do you have any questions about anything you read in the consent form?

- Participation in this interview is entirely voluntary. You are free to stop your participation at any time. Do you understand this?

- *Acknowledge the previous interview that was held. Discuss how I want to get a sense of his or her experiences now that she or he has been in working as an engineer for a couple of months.*

Goal 2: Elicit an overall sense of the participant's self-concept and how they experience their particular context. Identify salient contexts of identity for the participant, listening (not guiding) for the role of engineering in the participant's sense of identity.

Example Questions:

- Would you give me a snapshot of your life, as it is right now? (Possible probes: Please tell me about living in [city]. Please tell me about your job at [company]).

- What type of work do you do in your job?

- Please walk me through a typical work day.

    - If you can walk me through your mind during these moments, what types of things are you thinking about in the workday? What types of things are you feeling?

- What are some of the challenges that you've faced with this job? (Probes: Can you help me understand why [situation] has been a challenge? How have you responded to this challenge?)

- How do you feel about your job?

Goal 3: Elicit information about how the participant mentally models what it means to be a competent engineer in their workplace.

Example Questions:

- In your own words, what does it mean to be an engineer?

- What does it mean to be an engineer where you work? (Probes: How does your company regard engineers? How do your coworkers regard engineers?)

- What have you learned about being a competent engineer?

- How does your company understand what it means to be a good engineer?

Goal 4: Elicit information about how the participant experiences their personal identity as an engineer.

Example Questions:

- How important is being an engineer to how you view yourself (as a person)? Help me understand a bit more why...?

- What does it mean for you to "do engineering"? (Probes: What types of considerations are most important when you do your engineering work? What does it take to "do engineering" well?)

- What have you learned about engineering from your experiences in your new job?

Goal 5: Elicit data that calls for the participant to directly reflect on how their identity has changed since the last interview [varies for each participant]. NOTE: This must only be done when the Goals 1-4 of the interview have been fulfilled.

Example Questions:

- Can you update me on life since the time we last interviewed?

- Has your sense of what it means to be an engineer changed since we've last spoken?

- In our last interview, you had mentioned that you expected work to be _____. Has this turned out to be the case?

- How well would you say your educational experiences have prepared you for the workplace?

- How does your experience of working as an engineer compare with how you expected it to be when you were a student?

- In our last interview, you had mentioned that these types of considerations were most important in engineering design work: _____. Has this changed since our last interview?

- In our last interview, you had mentioned that these types of *abilities* were most important in engineering design work: _____. Has this changed since our last interview?

Goal 6: If not already discussed, elicit the participant's explicit views of how technical and non-technical considerations enter their identities as engineers.

Example Questions:

- How would you describe a "technical dimension" of engineering work? How would you describe a "social dimension" of engineering work? How would you describe an "environmental dimension" of engineering work?

- What do these dimensions of engineering work have to do with one another?

- How have your undergraduate experiences affected your views of engineering?

- How have your experiences in the workplace affected your views of engineering?

Goal 7: Concluding the interview

- I am trying to understand how people come to understand themselves as engineers as they transition from school to work. Do you feel like you have spoken to this?

- Thank you for your time. Do you have any questions of me?