Accounting for Occupational Identity Work in the Attrition of Newcomer Civil Engineers: Theoretical Model

Kacey Beddoes[1]

Abstract: Early-career engineers leave the profession at high rates, and much remains unknown about why that is so. Consequently, there have been calls for more research to better understand newcomer engineers' experiences and attrition. The purpose of this article is therefore to examine the experiences of newcomer engineers from different universities and engineering firms around the US. The research questions addressed are as follows: (1) How do newcomer engineers characterize engineering work? and (2) What insights can their characterizations provide about newcomer attrition from engineering careers? A longitudinal study was conducted with recent civil engineering graduates in the US. Three sets of semistructured interviews were conducted in 2019 and 2020. Open coding methods were used to answer the first research question. Based on those emergent findings, the data was then analyzed through the lens of expectancy-value theory to answer the second research question. Misalignments between subjective task values created and/or reinforced in school were a prevalent source of dissatisfaction. There was a need for participants to engage in occupational identity work to reconcile the meanings of engineering and align their identities as engineers with workplace realities. Implications for future research and the engineering education system are discussed.
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Introduction

Attrition among newcomer engineers is strikingly high. Prior research has shown that attrition rates from the engineering profession ultimately reach as high as 65% to 81% for women and 47% to 61% for men in the US (Corbett and Hill 2015; Frehill 2010). Much of the attrition occurs among early-career engineers (Brunhaver et al. 2018; Fouad et al. 2012; Frehill 2010; Glass et al. 2013; Kahn and Ginther 2015). Exact early-career attrition rates vary somewhat from study to study and are difficult to compare because data-collection methods and definitions of an engineering career vary from study to study. One US study found that by 7–8 years after graduation, only 54% of men and 45% of women engineering graduates are still practicing engineers (Kahn and Ginther 2015). Another reported that 2 years after graduation, 28% of 2008 and 2009 graduates were not engaged in engineering careers (Brunhaver et al. 2018).

A research gap around this problem remains because the reasons for high attrition rates among newcomer engineers are not well understood (Dlouhy and Froidevaux 2022; VanAntwerp and Wilson 2015), and additional research on engineering workplaces is much needed (Brunhaver et al. 2018; Stevens et al. 2014). Korte et al. (2019) discussed the importance of job satisfaction to retention in today's workplaces, and a limited amount of research has pointed to some reasons for the attrition. One study found that newcomer engineers most often leave to pursue more interesting options elsewhere (Frehill 2010), and another found that the inability to use the math and science learned in school was a leading cause (Fouad et al. 2017). Although newcomer engineers typically lack understanding and accurate expectations for what engineering practice entails (Faulkner 2007; Fouad et al. 2017; Korte et al. 2019; Stevens et al. 2014), the relationship between this gap in expectations and attrition is not well-established. For women specifically, family and children are not the primary reason women leave engineering, nor are lower confidence levels (Fouad et al. 2012), and differences between science, technology, engineering, and math (STEM) and non-STEM attrition cannot be explained by patterns seen in other professions or factors such as demographic profile, family size, hours worked, or job flexibility (Glass et al. 2012, 2013). Certainly, gender biases and discrimination in engineering are well-documented (Beddoes 2021, 2022; Mills et al. 2014; SWE 2021; VanAntwerp and Wilson 2015), but their relationship to newcomer attrition is also not well-understood. In short, there remain unexplained factors in this phenomenon that need to be accounted for and better understood.

One factor contributing to limited understanding of this phenomenon is that nearly all prior research has relied on surveys to the exclusion of qualitative data (Brunhaver et al. 2018). Brunhaver et al. (2018) contended that there is a need for more studies that move beyond surveys to develop deeper, more contextually-sensitive understandings of newcomer engineers' workplace experiences. Interview studies that present deeper understandings are needed to advance explanations of newcomer engineers' attrition.

This article takes up that call by analyzing the experiences of newcomer civil engineers from 18 engineering firms around the US. It adds to a growing body of recent research on the experiences of newcomer engineers specifically (Brunhaver et al. 2021; Buckley et al. 2022). It advances the body of literature on engineering career dissatisfaction and attrition by highlighting a leading source of dissatisfaction and theorizing a connection between that source of dissatisfaction and attrition by engaging expectancy-value theory. The research questions addressed in this article are as follows:

- How do newcomer engineers characterize engineering work?
- What insights can their characterizations provide about newcomer attrition from engineering careers?

[1]Project Director, Charles W. Davidson College of Engineering, San Jose State Univ., San Jose, CA 95192. Email: kacey@sociologyofengineering.org

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Answering these questions advances theorizing about early-career engineering attrition and suggests new explanations to better understand this phenomenon in all its complexity.

Literature Review

Tensions in Engineering Identities

Those who study engineering work have long noted that social tasks constitute a large part of engineers' jobs in many engineering disciplines (Anderson et al. 2010; Bucciarelli 1994; Faulkner 2007; Johri 2012; Trevelyan 2007, 2010, 2019; Vinck 2003; Williams et al. 2014). Indeed, many have noted that engineers spend much more time on social tasks than technical tasks. For instance, an ethnographic study of six different types of engineering firms in the US revealed that communication and coordination (e.g., report writing, meetings, emailing, presentations, and negotiations) comprised a significant amount of engineers' time (Anderson et al. 2010). Similarly, interviews and field observations from Australia and Asia revealed that engineering is a "much broader human social performance than traditional narratives that focus just on design and technical problem-solving . . . the foundation of engineering practice is distributed expertise enacted through social interactions between people" (Trevelyan 2010, p. 175).

Despite the large amount of time spent on the social, however, it is the technical that maintains its status as real engineering (Anderson et al. 2010; Brunhaver et al. 2018; Faulkner 2007; Korte et al. 2019; Stevens et al. 2014; Trevelyan and Tilli 2007). For example, Trevelyan (2010, p. 175) found that "engineers not only relegate social aspects of their work to a peripheral status but also many critical technical aspects like design checking that are omitted from prevailing narratives." Faulkner (2007) likewise found that engineers conceptualize real engineering as calculations, drawings, and sums. Such findings from individual studies are supported by a literature review of research on engineering work in different engineering disciplines (Trevelyan and Tilli 2007).

The privileging of the technical over the social in conceptualizations of engineering is directly related to engineering education. Engineering education is where perceptions of engineering as reduced to math- and science-based analytical problem-solving are developed and/or reinforced (Brunhaver et al. 2018; Bucciarelli 1994; Faulkner 2007). Engineering professors conceptualize engineering identity in "universalized narratives" as applied math and science, problem-solving, and making things (Pawley 2009). The highly social nature of engineering practice is obscured in engineering education programs. As Brunhaver et al. (2018, p. 149) succinctly stated, "engineering work is much more variable, complex, and social than most engineering curricula convey."

Consequently, newcomer engineers perceive that they spend much of their time not doing real engineering work because it is not the math and science that their engineering education emphasized and that they came to associate with an engineering identity (Faulkner 2007). Upon entering the workforce, they encounter work that differs in significant ways from what they spent the last 4-plus years doing and cultivating identities around. This disconnect is a direct result of professionalization efforts undertaken in the twentieth century that restructured engineering education around mathematical problem solving and analytical engineering science and resulted in the technical core of current engineering curricula that prioritizes, almost exclusively, math and science throughout the 4 years (Downey 2005, 2009, 2021; Jesiek and Beddoes 2009; Seely 1999).

Occupational Identity Work

Occupational identity work entails changing the meanings members of an occupation associate with that occupation or group of which they are a part (Barker Caza et al. 2018). It encompasses how individuals identify with an occupation and the work done to change the meanings that occupation holds for them (Barker Caza et al. 2018). Across various occupations, occupational identity work has taken a variety of forms, or modes, including cognitive, discursive, physical, and behavioral (Barker Caza et al. 2018). Cognitive occupational identity work is characterized by a focus on mental processes, such as cognitive reframing of meanings associated with an occupation and sense-making around aspects of an occupation perceived as negative.

Discursive occupational identity work is characterized by a focus on the words and concepts that employees use to express or portray their identification with an occupation. Physical occupational identity work is characterized by a focus on employees' physical appearance or objects they design or use. Behavioral occupational identity work is characterized by a focus on ways in which actions taken in the workplace strengthen identification with an occupation or distance employees from parts of a job they do not want as part of their identity. Given the tensions in engineering identities described previously, it seems that examination of newcomer engineers' occupational identity work is needed. Approaching such an analysis through the lens of expectancy-value theory offers a means of connecting the findings to broader attrition patterns.

Theoretical Lens: Expectancy-Value Theory

Expectancy-value theory (EVT) posits that achievement and related choices are determined by two interrelated factors: (1) expectancy for success; and (2) subjective task values (Eccles 1983, 2009; Wigfield and Cambria 2010). Expectancy for success is confidence in one's ability to be successful at a given task or activity and is often equated with self-efficacy. Subjective task values are values, such as importance, enjoyment, or utility, one attaches to that task or activity that determine whether or not one wants to pursue it. In other words, subjective task value is the "quality of the task that contributes to the increasing or decreasing probability that an individual will select it" (Eccles 2009, p. 82). As summarized in Table 1, there are four types of subjective task values: attainment value, intrinsic value, utility value, and cost.

Attainment value is how important the task is perceived to be for one's identity or sense of self. One's identity and self-image influence the value they attach to achievement-related choices in education and career (Eccles 1994, 2009). Intrinsic value is how enjoyable or interesting the task is perceived to be. Utility value is how useful or relevant the task is perceived to be. Cost is undesirable negative psychological, financial, or temporal impacts, such as stress or loss of time. It refers to

Table 1. Subjective task values

Subjective task value	Essential meaning
Attainment value	Is this task important to my identity?
Intrinsic value	Is this task interesting or enjoyable?
Utility value	Is this task useful or relevant?
Cost value	Does this task negatively impact me?

Source: Data from Eccles (2009).

the cost of engaging in the activity in terms of financial and emotional costs, as well as in terms of the potential meaning of the behavior for either disconfirming a salient personal or collective identity or preventing one from engaging in other behaviors that are key to confirming a salient personal or collective/social identity. (Eccles 2009, p. 82)

Thirty years of empirical research have supported EVT's subjective task values suppositions that

(1) individuals seek to confirm their possession of those characteristics central to their self-image and both personal and collective identities, (2) various tasks provide differential opportunities for such confirmation, (3) individuals place more value on those tasks that either provide the opportunity to fulfill their identities or are consistent with their identities and long-range goals, and (4) individuals are more likely to select tasks with high subjective value than tasks with lower subjective value. To the extent that individuals have different self-images and identities, various activities will come to have different subjective value for them. (Eccles 2009, p. 83)

In these ways, subjective task values are known to directly influence persistence and attrition and to connect them to identity (Eccles 2009, 1994; Eccles et al. 1998). Thus, although EVT is labeled as a theory, there is significant empirical evidence showing that its concepts are related to attrition across a range of contexts. However, examining occupational identity work in early-career engineering through the lens of EVT has not previously been done. Doing so is the contribution of this article.

Methods

Participants and Recruitment

The participants in this study were early-career engineers in the US. Eighteen participated in the first set of interviews: 12 identified as women and six identified as men. Sixteen participated in the second and third sets of interviews: 10 identified as women and six identified as men. They graduated and began their positions in 2017 and 2018. One had a degree in environmental engineering and the rest had degrees in civil engineering, all from ABET-accredited programs. The universities they attended were a range of different types, including public and private, large and small, Ph.D.-granting and Bachelor's- and Master's-granting only. Six participants had also completed, or were pursuing, Master's degrees. They worked in seven different states and at different civil and environmental engineering companies that spanned all major civil engineering specialties. Their companies were a range of different types, including small family-owned firms with one office to large international firms with well-known acronyms, and everything in between. Further details about participants are provided in the Appendix. The names used in this article are pseudonyms.

The primary means of participant recruitment were listservs and social media of national and local engineering organizations, including the ASCE Younger Members groups, the Society of Women Engineers, and Solar Decathlon. Numerous minority engineering organizations were also contacted and serious efforts made to recruit as diverse a participant group as possible. However, only those organizations listed in the preceding sentence helped with recruitment. Several individual engineering professors and departments also helped notify recent graduates about the study. An email or posting notified potential participants that early-career civil engineers were being recruited to participate in a longitudinal study about their workplace experiences. It invited them to contact the author if they were interested in participating. Institutional Review Board (IRB) approval was received for this study. Participants received a $250 stipend in the first year and a $350 stipend in the second year for their participation.

All participants who contacted the author were included in the study. As is the case with any study of this type, researchers cannot control who wants to participate in a study. The demographics of study participants therefore do not mirror those of the civil engineering workforce. Specifically, women were overrepresented in this study.

Data Collection

Three sets of semistructured qualitative interviews (Singleton and Straits 2010) were conducted approximately 6 months apart beginning in 2019. The interviews ranged in length from 30 min to over an hour, averaging 45 min. The interviews were conducted online, audio recorded, and transcribed. Participants were asked about first impressions of their workplace, the biggest challenges they had faced in their job, the most important things they had learned since beginning or since the last interview, the most surprising thing about their jobs, how their education had prepared them to do their jobs, the biggest change they experienced since starting their jobs, how they would describe the culture or environment of their workplaces, and if they thought there was anything unfair or unjust about their workplaces. Findings on other aspects of the data are reported elsewhere (Beddoes 2019, 2021, 2022, 2023; Grajdura and Beddoes 2022).

Data Analysis

Data analysis began with an open coding approach (Charmaz 2006) with no predetermined codes. Open, or inductive, coding is appropriate when past research has not yet provided sufficient explanations about a phenomenon. As mentioned, the first goal of this analysis was to examine how participants characterized their work. As the interviews were conducted and analyzed, concerns about engineering identity and values emerged as a salient themes. Although not present in every interview, the majority of participants expressed some version of these themes in at least one of their interviews.

Following the open coding and identification of those emergent themes, in order to better understand the contents of the identity work, the identity work data were coded through the lens of EVT by asking which, if any, of that data related to components of EVT. Expectancy-value theory was utilized to answer the second research question because of EVT's resonance with the data on specific types of values and EVT's empirically grounded explanation of that data's importance for workplace attrition.

Quotations were edited for readability by removing false starts and crutches of speech, such as "like" and "you know." Text in square brackets in quotations was added by the author for clarity. In some longer quotations, particularly salient statements are italicized. Throughout the "Findings" section, the questions participants were asked that elicited their response are provided to allow readers to see how the responses emerged.

Findings

The need for occupational identity work rooted in a disconnect between school and workplace subjective task values emerged across all sets of interviews and in response to multiple different questions. Often, it was in response to questions about their biggest challenges,

the most important things they were learning, and how well school had prepared them for their jobs. Quotations are presented at length in order to provide context for the responses.

One set of statements highlighted the need for occupational identity work in ways that clearly attached specific values to the statements. For example, in her second interview, Natalie described her biggest challenge as having to spend time on "general business stuff" and writing proposals, which she contrasted with "actual work" that made her feel productive:

> Interviewer: What have been some of the biggest challenges you've encountered in the last few months?
>
> Natalie: Well, during the month of December we were kind of less busy than we normally are like in all the other months because the way that a lot of projects work their fiscal year doesn't start until 2020 . . . So it's hard for me. Like my personality is I have to be doing something at all times to feel productive. So that was hard because I had to do like general business stuff and write proposals. That was a big challenge was like, I know those things are important, too, but it doesn't feel like actual work to me. So that was something I had to figure out and realize was important.

Similarly, Danielle expressed annoyance that she did not always feel like an engineer, which she equated with doing technical work and problem solving, because she often had to do "stupid" tasks like writing and putting reports together:

> So, some days I definitely feel like I fall under the "engineer" title because I do a little bit more technical work or the tasks I'm given require a little bit more thinking and a little bit more problem solving. So in that aspect, yes, I feel like an engineer; This is what I went to school for, and this is why I think the way I do think. But . . . on the other days, like in every job, you're given tasks that just have to be done. Whether it be writing, just like something stupid like that, it has to get done. So on those days, you know, anybody could do this work. You didn't have to go to school for civil engineering to, you know, put a report together or whatever it may be. So on days like that, I feel like, "Oh, am I even considered an engineer?" because this is such bogus work.

Voicing a different perspective on what actual engineering work entailed, Laura contrasted troubleshooting in her modeling tasks for load reading (taking measurements of forces, such as weight or pressure from water, wind, or soil, that act upon a system or structure) with design, which was the actual engineering. This emerged in her second interview when asked what had been the biggest challenge she had encountered in the last 6 months. Laura described being put on jobs she did not enjoy and did not want to do because they were stressful. She was then asked for further clarification:

> Interviewer: And what kind of jobs were you put on that you didn't want to do?
>
> Laura: So it's load reading, which is a lot of what we do. We do design work, and we do analysis. Load reading is more analysis, but it's definitely more dry than say a design where you might have to be more innovative and creative. Load reading is basically you could be faced with you can model this bridge, and then you can be troubleshooting your model for 2 weeks, not even doing engineering—well that might be considered engineering, but just trying to figure out why this model isn't working, and the code of it, and things like that. And you could be stuck on that for 2 weeks, which prevents you from doing the actual engineering analysis on that work.

A second set of statements further elucidated the need for occupational identity work but without such clear values attached to the statements. One example was Nina's statement that she has barely applied any of her engineering (education) to her engineering (job). She equated engineering with "pure math" and distinguished that from the teamwork skills:

> Interviewer: Do you feel like your bachelor's degree in civil engineering prepared you for your job?
>
> Nina: No.
>
> Interviewer: Can you tell me more about why not?
>
> Nina: I feel that, okay, in a way, yes, because I feel like, for me, the main things that I got out of college was kind of like using your resources and networking because I had a lot of friends in my classes and we would work together, study together, do classes together, lab, lab groups, and stuff like that. Which I feel translates over to being an employee, being an engineer as well, because you're working in groups, are working in teams, you have deadlines and stuff to do together. *But I mean I've barely applied any of my engineering to my engineering job. Like, purely math and stuff like that, I haven't really applied all that much.*

Similarly, when asked if she felt her education had prepared her for her job, Kari discussed how she had learned technical engineering skills in school but she does not use them in her job because nearly all of her time is spent using software. She equated engineering with hand calculations and theory and contrasted that with what she spent the majority of her time doing:

> Interviewer: Do you feel like your bachelor's degree in civil engineering prepared you for your job?
>
> Kari: Not very well. [My university] in particular doesn't do any software training . . . I don't know how common you'll find that across the board, because I know other universities are better about it. So I feel like at least for software—and that's 90% of what I do, sitting on a computer using some kind of software—I feel like I wasn't prepared for that. *But on the side of technical, like engineering, I had a pretty good understanding. My design class was pretty hands-on. So I did learn some engineering skills, but not really what I was actually going to go out and do . . . I mean, there's still some times that I have to do a hand calculation or input a formula into Excel and I feel like I at least understand the background of those things from school*. We run most things through software, but someone programmed that software with some equation that was in a textbook I saw at some point. So it gave me a good theoretical understanding, but I don't think I got a good feel for a day-to-day workplace, you know, what I was going to be doing.

When asked about the most important things she had learned since beginning her position, Becky distinguished engineering from "working with people," even though working with people was the most important thing she was learning in her job as an engineer:

> After like 2 months, when you kind of start gathering all the information, you start to learn you have more challenges with team dynamics and who likes what which way and, like, how do you work with this person, and how do they like to run meetings, and how do they like workflow. *So I think I've learned just as much about engineering as I have about working with people*.

Other participants when asked what the most important thing they had learned in the last 6 months was, asked if I meant technical or professionally, socially, or culturally. They framed the most important things learned as nontechnical or nonengineering. As seen in Becky's response that "Last year was a really big year for me. I think I learned more about the nonengineering side of working. Like my lead getting fired. I'm working with different leadership styles, because when he got fired . . . we had two leads instead of one . . . " She went on to describe challenges associated with having two supervisors with very different working styles.

Beth, when asked in the second interview what the most important things learned in the last 6 months were, made a distinction between technical and nontechnical things learned, said the nontechnical things were "basic," and she had not learned anything she considered technical:

> I think working with different project managers. I guess it sounds a little basic, but I've learned how different people work. And how to adjust to those people and be more patient with some, and more pushy with others. And more to just speak up for myself and what I want to get out of my career . . . But [as far as] technically, I don't think I've really learned much.

There was one exception to the aforementioned findings. One participant stood out from the others in his characterization of real engineering work. Tom was also dissatisfied with his work, but had a different perspective on what "actual" engineering work is. For him, actual engineering work was not plan production, which was how he spent his time, but rather what would be considered the business or managerial side of the job, coordination, and reaching out to people. The following exchange happened in the first interview when Tom was asked what his days looked like, or how he spent his time at work. He said, "Pretty much, I'm a CAD technician, not an actual engineer. However . . . my job was supposed to be more engineering work but instead I mostly do CAD. That's about it."

Finally, one participant demonstrated the need for occupational identity work when discussing an "engineering personality" and explaining that to do her engineering job, she had to overcome her engineering personality. Liz explained that she was "very much an engineer" because of certain personality traits, but had to not use those traits in order to successfully do her job:

> Interviewer: So when you think back to where you are now compared to when you started, what have been the biggest changes that you have gone through?
>
> Liz: Hmm. Definitely I've learned to be flexible, like figuring out—kind of what I was saying with having to do seven different projects within 10 min of each other. You have to be very agile and quick thinking and very flexible, which I'm not *not* flexible, but I'm very much an engineer, like I'm very much a linear thinker, very to the point. So it took a little while for me to be able to accommodate some of the flexibility aspects of my job. And I am so much better with people [now]. Obviously, being an engineer, like I'm an INTJ, like I'm sharp [tongued] and rough around the edges to normal people. So I definitely had to learn and actively teach myself how to communicate with others. People that are above me, people that I'm working for, including my clients . . .

What Liz is paradoxically saying here is that in order to perform an engineering job, one cannot have an engineering personality.

Discussion

Misalignment between subjective task values from school and workplace realities were a source of dissatisfaction. As pointed out, satisfaction is key to retention in today's workplaces (Korte et al. 2019). The need for newcomer engineers to engage in occupational identity work to overcome that misalignment is clear in their responses. They are practicing engineers, but more often than not, they did not see themselves as real engineers. The fact that these statements often emerged from questions about participants' biggest challenges and the most important things they were learning suggests that the need for occupational identity work is not trivial in their work lives. It supports prior assertions that "there is a deep technical/social dualism at the heart of engineers' identities as engineers" (Faulkner 2007, p. 332). More specifically, the type of occupational identity work most needed was cognitive [per Barker Caza et al. (2018)'s typology]. The newcomer engineers need to cognitively align their school-based identities as engineers with the workplace realities they encountered by changing their subjective task values if they are to feel like engineers in the future. It is the work of reimagining and revaluing what it means to be an engineer.

The need for such occupational identity work is occurring because the subjective task values formed in school are not aligned with engineering practice. As summarized in Table 2, using subjective task values to further elucidate the contours of newcomer engineers' identity work revealed that the biggest disconnects, or where the most identity work was needed, was in the categories of attainment value and intrinsic value. Further, attainment value and intrinsic value seem to be closely linked in participants' responses. In Tom's case, he did not feel like an engineer because he did CAD work and plan production only. In Natalie's case, she had to spend time doing tasks that did not feel like actual work, such as writing proposals. That made her feel unproductive, which was counter to the personality she identified with. In Danielle's case, she did not feel like an engineer when she had to do tasks such as writing reports, which she considered "stupid" and "bogus."

Recall that attainment value is the perceived importance a task has for one's identity. The statements that certain tasks and personality traits make participants feel like not real or actual engineers clearly link those tasks to participants' identities as engineers. Present in those same statements is a lack of enjoyment and interest related to those tasks, which is the definition of intrinsic value.

Table 2. Summary of findings

Subjective task value	Contribution to dissatisfaction	Manifestation in findings
Attainment	High	Many tasks make newcomer engineers feel like they are not engineers
Intrinsic	High	Many tasks are not interesting or enjoyable
Cost	Lower	Some tasks detract from real engineering work
Utility	Low	Some tasks are necessary but are not real engineering work

Labels such as "stupid," "bogus," and "unproductive" are clear indicators that these tasks are not seen as enjoyable or interesting for participants.

Cost value is associated with perceptions of wasted time, loss of valued alternatives, and negative psychological or emotional experiences, such as stress. It also refers to "the potential meaning of the behavior for either disconfirming a salient personal or collective identity or preventing one from engaging in other behaviors that are key to confirming a salient personal or collective/social identity" (Eccles 2009, p. 82). Cost value was less prevalent than attainment and intrinsic value but was explicitly evident in one instance. Recall that Laura described troubleshooting a model for load reading as wasted time that prevented her from making progress on design, which was the "actual engineering" work. She considered this work stressful because it was wasted time. Thus, the loss of time component and negative psychological/emotional experiences components of cost value were evidenced in her response.

Utility value emerged in a way that was interconnected with the attainment value and intrinsic value statements previously. Some participants who expressed disconnects with attainment and intrinsic value also explicitly recognized, albeit somewhat begrudgingly, that the tasks they considered not real engineering work were nonetheless important and had to get done. In other words, they understood the utility value of tasks even though they did not consider them part of their engineering identities (attainment value) and did not want to do them (intrinsic value). For example, Tom recognized that his work was a "necessary step." Natalie recognized that "those things are important too." And Danielle recognized that "it has to get done," even while calling them "bogus" tasks.

As Eccles (2009, p. 82) explained, subjective task values are "directly related to personal and collective/social identities and the identity formation processes underlying the emergence of these identities." Images of what one should be like as a member of a certain group (e.g., engineer), or what certain identities ought to entail are a key component of attainment value (Eccles 2009). Attainment value is aligned with reality when engaging in an activity "is consistent with one's self-image and personal and collective/social identities" (Eccles 2009, p. 82). Therefore, creating consistency between attainment and intrinsic values and occupational identity is a leading part of the identity work that needs to be done among participants in this study. Continued misalignments between school-based values and workplace realities have also recently been documented in other studies (Brunhaver et al. 2018; Lutz et al. 2019). For example, echoing Danielle's question of whether or not she was even an engineer when she was writing reports, Rohde et al. (2020, p. 11) quoted a newcomer environmental engineer who felt that most of their job "could easily be done by someone without any engineering experience or degree" because it was mostly paperwork.

It is worth noting that the participants in this study had completed at least one internship, and most had completed two or even three. Even these multiple internships had not set expectations correctly or countered civil engineering education's influence on participants' subjective task values. Internships are often seen as a leading way to better align school and work (Brunhaver et al. 2018). They may be in some cases, but these findings suggest that, currently, civil engineering internships are not successfully aligning all students' subjective task values with workplace realities.

EVT is useful here not simply as a lens with which to categorize the findings, but rather for its predictive value for attrition and retention outcomes. As noted, a large body of empirical evidence demonstrates that EVT can explain persistence and attrition decisions. We know that disconnects between expectations and reality lead to attrition in other contexts. The findings in this article show how values and expectations set in engineering education programs influence subjective task values in ways that are likely to contribute to workplace attrition. The tasks and activities they expected to be doing are not what they are actually doing, and this influenced the values they attach to their work. Similar conclusions about "value conflicts" created through educational structures that conflict with workplace practice have been identified by Trevelyan (2019). Certainly, EVT and occupational identity work are not the whole picture; however, this analysis points to subjective task values and the need for occupational identity work as an underexplored explanation for dissatisfaction and subsequent attrition among early-career civil engineers. Theorization of this phenomenon is depicted in Fig. 1.

This analysis has focused on the subjective task value component of EVT. The other component of EVT, expectancy for success, did not emerge as a salient issue in this study. Participants did not express much doubt or worry that they had the ability (or could learn) to successfully accomplish their tasks or perform their jobs. For them, the question was not could they do this work (expectancy for success), but rather, did they want to (subjective task values). This would suggest that for newcomer engineers, self-efficacy or confidence is less of a contributing factor to attrition than subjective task values. Future research on early-career attrition would likely be more impactful if it further explored questions related to subjective task values than expectancy for success. This finding presents a contrast to research conducted with engineering students, which found that professional role confidence is salient for persistence in engineering programs (Cech et al. 2011). Surfacing that difference between education and workplace contexts presents an opportunity for exploring the prevalence of this difference in future survey research.

The findings in this study also differ from those of VanAntwerp and Wilson (2015) who found that most women expressed intrinsic motivation for the business and social, rather than the technical, aspects of engineering work. They concluded that in order to retain more women engineers, employers and academia should focus on increasing women's intrinsic motivation for the technical aspects of

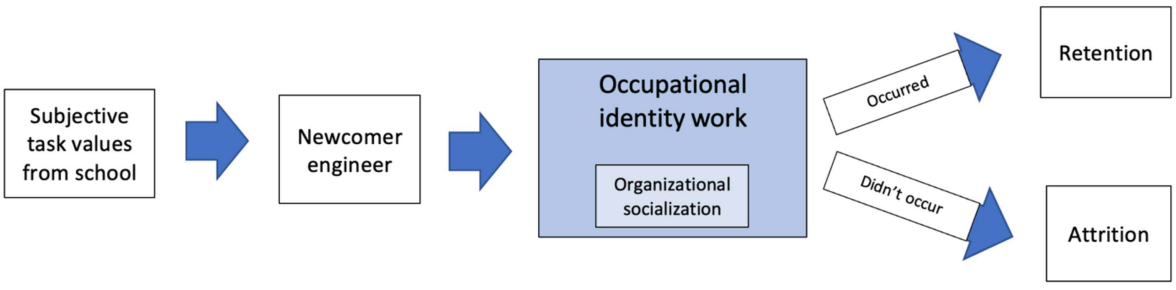

Fig. 1. Theorizing the salience of occupational identity work in newcomer engineers' attrition.

the job. The findings presented in this article raise a flag of caution about that as a universalized recommendation. It is perpetuating the very problem that made the participants in this study not feel like engineers. Thus, attempting to convince future and current engineers that technical tasks should be their primary interest may be counterproductive and misaligned with the realities of engineering workplaces. In future research, the author plans to explore these, and other, open questions about the roles that gender plays in the occupational identity work of newcomer engineers.

Conclusion

By connecting occupational identity work to specific subjective task values, we may better understand the tensions newcomer civil engineers encounter and causes of attrition from the engineering profession. The rich quotations from interview data help characterize the occupational identity work that newcomer engineers must do, which contributes to the deeper, more contextually sensitive understandings of newcomer engineers' workplace experiences that have been called for (e.g., Brunhaver et al. 2018). Values created or reinforced through the engineering education process are negatively influencing the experiences of newcomer engineers. That misalignment between values created or reinforced through engineering education necessitates the need for occupational identity work when they begin their careers. The school-based subjective task values result in newcomer engineers devaluing their work and questioning their identities as engineers.

These findings provide evidence for an empirically and theoretically grounded hypothesis of attrition from engineering careers that can be explored in future studies. Although certainly not the only explanation, nor a contributing factor for all former engineers, the analysis contributes new insights that fill in a piece of the picture by adding to other explanations captured elsewhere (Beddoes 2021, 2022; Fouad et al. 2020; Dlouhy and Froidevaux 2022). The outcomes of organizational socialization at individual organizations should be understood in the context of this larger phenomenon affecting the occupation at large.

This analysis suggests several implications for future research. First, it identifies which parts of EVT are most salient to newcomer civil engineers' experiences and should be the focus of future research that engages EVT: the subjective task value components of EVT rather than the expectancy for success component. More specifically within the subjective task value component of EVT, it could be useful to look at which types of values are correlated with which types of career successes and outcomes, and how and where those specific value types get created. Second, and relatedly, research should not begin with the assumption that what is true of students is true of practicing engineers. As mentioned, although professional role confidence is important for student retention (Cech et al. 2011), the findings presented here suggest that it may not be a leading source of tensions or challenges for all practicing engineers.

Third, occupational identity work and/or subjective task values should be incorporated into organizational socialization survey instruments for research on engineering socialization. Existing organization socialization surveys have not accounted for the role that occupational identity work may play in organizational socialization. The findings in this article, as well as those of others (Brunhaver et al. 2018; Korte et al. 2019; Lutz et al. 2019; Trevelyan 2019), support the incorporation of occupational identity work into a survey of engineering socialization to test its prevalence and generalizability. Because nearly all occupational identity research has been qualitative (Barker Caza et al. 2018), incorporating these findings into future quantitative surveys would advance the occupational identity work research landscape in new methodological directions.

In addition to those research implications, the findings hold implications for the engineering education system as well. The fact that the biggest disconnects lie with attainment value and intrinsic value has implications for civil engineering education because engineering education programs are where their beliefs and values related to engineering are created and/or reinforced. For some students, the values and expectations are created after entering an engineering program. For others, the values and expectations may have been established prior to beginning an engineering program and are reinforced throughout the 4 years. In either case, the outcome is the same: engineering education programs solidified those values rather than challenging them or aligning them with workplace realities. In many ways, this situation is an accomplishment. The education system is doing what it was designed to do: prioritize engineering science and math (Downey 2005, 2009, 2021; Seely 1999).

However, if newcomer civil engineers' expectations and subjective task values are a salient source of dissatisfaction, and dissatisfaction leads to attrition, then it would seem that those expectations and values need to change if they are to be better prepared for their jobs and retained at higher rates. Otherwise, the engineering education system is preparing a large number of students for jobs they will not actually want and that many will leave. Such alignment work would mean changing what students learn and are taught to value in engineering courses and programs. It would mean aligning engineering education with engineering work such that students have accurate expectations about what their work will be like. More specifically, it would mean creating engineering education curricula and assessment that cultivate subjective task values that match those of civil engineering workplaces.

What then of recommendations to facilitate that alignment? It seems clear that ABET, ASCE, curriculum committees, college leadership, and individual faculty members would all have various roles to play. It does not seem likely that piecemeal changes or adding another project-based course here and there would be sufficient to counter the fundamental disconnect caused by prioritizing the technical core and analytical engineering science for 4 years. Some have suggested internships as a key mechanism to create better alignment (Brunhaver et al. 2018), and yet even multiple internships were not sufficient to create that alignment for participants in this study.

Others have suggested that the values created in engineering education would be less problematic if more faculty members had work experience outside of academia (Trevelyan 2019), and similar recommendations emerged from other parts of this project (Beddoes 2023). Again, however, it seems unlikely that individual actions would have much impact on systemwide values-change without more fundamental and systemic changes. A small number of programs in Australia, perhaps most notably Swinburne University and Charles Stewart University, have tried implementing such systemic changes in recent years. They have implemented curricula in which students spend the majority of their time every year working on engineering projects, either in actual work settings or in projects created by clients for the students, with supplemental self-paced math and science modules whereby that knowledge is learned as needed (Lindsay and Morgan 2021; Mann et al. 2020). It is too early to tell if, and in what ways, such undertakings will be successful, lasting, or influential however. Only time will tell.

For now, we can return to questions about the present. Unlike other calls to better align school with work, the point here is not necessarily about better preparing graduates so that they can do

their jobs. The participants in this study could do their jobs, and were employable. Rather, the point is: do they want to? Or, is what they spent 4 plus years being taught to expect, value, and identify with so out of alignment with engineering practice that they do not want to do the job once they get there?

Appendix. Participant Characteristics

Name	Gender[a]	Race or ethnicity[a]	Highest degree
Kari	Woman	White	Bachelor's
Liz	Woman	White	Bachelor's
Natalie	Woman	White	Bachelor's
Beth	Woman	White and Latina	Master's
Nina	Woman	Latina	Bachelor's
Laura	Woman	White	Master's (in progress)
Amy	Woman	Arab and White	Bachelor's
Lynnette	Woman	White	Bachelor's
Becky	Woman	White	Bachelor's
Danielle	Woman	White	Bachelor's
Patrick	Man	White	Bachelor's
Steven	Man	White	Master's
Tom	Man	White and Hispanic	Bachelor's
James	Man	Hispanic	Bachelor's
Liam	Man	Hispanic	Master's (in progress)
Carl	Man	White	Bachelor's
Margaret	Woman	White	Master's
Helen	Woman	Black	Master's

[a]Self-identified, with no predetermined categories provided by the researcher.

Data Availability Statement

Some of the deidentified qualitative inductive coding data and metadata that support the findings of this study may be available from the corresponding author upon reasonable request.

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