From Capstone to Cubicle: Does Engineering Education Prepare Students to Move from High-Agency Educational Contexts to Lower-Agency Career Roles?

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From Capstone to Cubicle: A Situated Expectancy-Value Theory Analysis of Early-Career Engineering Transitions and Their Implications for Leadership Development

Abstract

Engineering graduates often transition from high-agency academic environments to early-career roles characterized by constrained agency and ambiguous expectations. This paper uses Situated Expectancy-Value Theory (SEVT) as a lens to examine how this shift impacts motivation, identity, and professional persistence in early-career engineers. By synthesizing literature on the "school-to-work" transition, gaps are identified between the structured feedback and individual agency found in undergraduate programs and the sociotechnical systems of distributed authority found in industry. The analysis suggests that "preparedness" should be reframed within engineering education to include navigating ambiguity and sustain professional identity under constraint. The paper concludes with design principles for engineering leadership educators to better calibrate student expectations for the sociotechnical realities of practice.

1. Introduction

Engineering graduates enter early-career environments that impose many sociotechnical, relational, and high-ambiguity demands, often under conditions of incomplete context and limited agency and authority (Trevelyan, 2010; Korte, 2009; Lutz & Paretti, 2017), within which they learn to interpret expectations, exercise judgment, and position themselves within the sociotechnical systems of engineering work. To examine how new engineers engage with these conditions and demands, we consider what skills and capacities undergraduate engineering education tends to develop, including leadership and interpersonal skills, and where preparation is less consistent, especially since considerable variations exist in individual learning trajectories and differing institutional approaches to professional preparation (Stevens et al., 2008; Winberg et al., 2020; Craps et al., 2021).

While graduates' formative experiences vary widely across programs and institutions, the ABET-accredited undergraduate engineering degree remains the most common point of entry into early-career engineering roles. It therefore functions as the dominant shared credential and a defensible baseline for examining the transition into early-career practice. (Atman et al., 2010; Stevens et al., 2008; Lutz & Paretti, 2017)

This review uses Situated Expectancy-Value Theory (SEVT) to examine how undergraduate engineering education prepares students to manage perceived costs, sustain expectancy and value, and maintain identity alignment as they enter early-career engineering environments (Eccles & Wigfield, 2020), which also shape how they engage with authority, responsibility, and professional contribution.

Research Question: Given that undergraduate engineering education is widely presumed to prepare students for engineering practice, what preparation factors become visible when SEVT is used to compare educational experiences with conditions of constraint and ambiguity that can affect expectancy beliefs, identity, and motivation during transition into early-career engineering practice?

2. Analytic Framework

This review uses SEVT as an analytic lens to explain how motivation and the developing professional identity can become structurally vulnerable across the transition from undergraduate engineering to early-career engineering work. SEVT is used to impose a structure on the familiar problem of graduates entering practice with a strong signal of capability from their academic preparation, yet sometimes struggling if they encounter reduced decision latitude and context, uneven feedback, or inconsistent recognition. It explains that situational conditions shape intrinsic, identity, and utility expectancies for success, as well as subjective task values, while also increasing subjective costs in the realms of effort, opportunity, emotions, and identity (Eccles & Wigfield, 2020). This framing provides the ability to make predictive claims about when and how misalignment between preparation and practice will plausibly result in a loss of motivation rather than growth, and provides coherence for identifying preparation gaps that affect persistence and identity.

By preparing students to manage such transitions, we don't just train employees, but develop the foundational resilience they will need as engineering leaders to eventually reform their workplace cultures from within. Thus, SEVT is used to frame early-career agency and meaning as the outputs of the sociotechnical systems of tasks, structures, and relationships which shape the limits of what new engineers learn, do, and are recognized for.

Starting with foundational works covering school-to-work transitions and early-career engineering practice, sources were iteratively assembled through backward and forward citation chaining, and were supplemented with targeted keyword searches in university library databases and American Society of Engineering Education society proceedings. The goal was not exhaustive capture of all studies, but sufficient coverage to support an analysis and synthesis.

3. What Engineering Education Prepares Students For

In the early years of the 21st century, engineering education's preparation goals were subjected to questions of whether the undergraduate curricula accurately represented engineering practice. For example, in 2011, Trevelyan argued that common educational texts and learning tasks didn't expose students to enough central features of professional practice, including uncertain and incomplete information, distributed expertise, work that focused on coordination and influence, and explicit considerations of how their engineering work creates value. He warned that this risked an expectation that engineering consisted of precise, individual problem solving, and direct technical contribution in ways that did not reflect most commercial engineering positions.

The World Economic Forum, drawing on reporting from Mourshed at McKinsey, noted in an international diagnosis that employers, education providers, and students "often live in parallel universes and are not engaged with each other" (World Economic Forum, 2014; Mourshed et al., 2013), framing this disconnect as part of the broader context shaping expectations for graduates. Against this background, preparation goals of engineering education have increasingly moved towards employability, with additional attention on graduates' immediate display of professional capabilities rather than just technical knowledge (Craps et al., 2022; Winberg et al., 2020).

Burke et al. (2016) also describe how "employability" became a dominant discourse in higher education, and institutions were incentivized to focus on graduate employment outcomes. Using the context of the UK, they noted growing emphasis on universities' responsibility for graduate employment and the use of employment data as proxy measures for educational value and institutional success. They argue that employability was often held as an objective outcome, with metrics prioritizing a "returns on education" perspective over more holistic and multi-actor views of labor markets. This provides a plausible explanation for why employability often became a central feature of discussions of competence, rather than one data point among many.

In a review of ten years of publications in the *European Journal of Engineering Education*, Winberg et al. (2020) detail how the increasing focus on employability, transferable skills, contextual judgment, and authentic interactions with industry practitioners developed. Across this period, curricula are described as incorporating additional team- and project-based learning, oral communication and presentation skills, interaction with industry, and reflective components intended to prepare students for the complex engineering environments they are about to enter (Winberg et al., 2020; Craps et al., 2021). However, Winberg et al. also show that this shift toward employability and broader bases of competence does not imply that engineering education has achieved either a settled or consistently enacted model for academic preparation. Only around a quarter of the studies they examined tried to find a balance between engineering knowledge and professional skills, and the review discusses "disciplinary and dispositional barriers to understanding engineering as a socio-technical field" (p.174). Thus, even when broader professional capacities are intentionally included in curricula, many students may rely on the technical competencies they practiced in academia as more reliable indicators of competent performance, and may enter practice with expectations of demonstrating competence through technical ability rather than developing and demonstrating the coordination and communication skills that early-career roles demand.

4. Conditions of Early Career Engineering Practice

4.1 Mismatch of Expectations

Early-career transitions across multiple professional contexts are characterized by recurring mismatches between newcomer expectations and organizational realities (Bauer et al., 2007), and within engineering, these "unmet expectations" (Korte et al. 2015, p. 188) involve constrained agency, limited decision latitude, diffuse authority, and ambiguous role expectations, which all occur even as responsibility for outcomes increases (Howe et al. 2019, p. 11; Korte, 2009). Across multiple studies, early-career transitions are marked by both new task demands and reduced clarity of what these tasks should entail, and recurring mismatches between expectations and experiences for both newcomers and managers. Korte et al. (2015) show that these two sides often assume different norms for many aspects of early practice, including initiative, feedback, and social integration, and these “negatively affected the quality of learning, performance, and satisfaction during socialization.” For example, “manager[s] wanted their newcomers to demonstrate a high level of initiative or proactivity, and most managers were disappointed with the actual level that most newcomers demonstrated” (p. 195). By contrast, there is “a significant positive correlation between the concepts of met expectations and job satisfaction” (p. 188).

Because these patterns recur across so many domains, this review views these mismatches as a cross-sectional condition that intensifies the effects of all aspects of early career practice described in this review. Similar mismatches can be seen in the contrast that some graduates make between senior-year experiences characterized by ownership and discretion, and early workplace conditions marked by constraint and externally set priorities (Howe et al., 2019), which helps frame how role expectations develop, and how agency, feedback, and legitimacy are experienced by graduates.

4.2 Task Boundaries, and Ambiguity

Early-career engineering work is described by Atman et al. (2010) as “more complex and ambiguous than the problems they solved in school” (p. 5). This ambiguity is not accidental, but arises from conditions where organizational socialization processes distribute definition and prioritization of tasks through informal norms across roles and hierarchies (Van Maanen & Schein, 1977). As Korte et al. (2015) notes, “learning and interpreting the underlying values and norms of an organization can be a difficult process prone to conflict, misunderstandings, and misinterpretations” (p. 189). Communication is often ambiguous, not just in what tasks they are assigned, but in the boundaries around those tasks: what “done” looks like, who owns adjacent work, which constraints are negotiable, and what initiative is appropriate without stepping out of bounds (Korte et al., 2015). For example, “[e]very manager wanted their newcomers to demonstrate a high level of initiative or proactivity, and most managers were disappointed with the actual level that most newcomers demonstrated,” (Korte et al., 2015, p. 195), and these expectations and assessments are often communicated indirectly through hierarchy or through relationships rather than explicit instructions (Howe et al., 2019).

This ambiguity does not reside only within information, but is often social and political as well, since task definition is distributed across roles, hierarchies, and informal norms. Organizational research into entry conditions shows that information seeking, feedback seeking, and relationship building are common ways that newcomers try to reduce uncertainty; however, these behaviors can be considered inappropriate depending on organizational norms (Ashford & Black, 1996; Wanberg & Kammeyer-Mueller, 2000). As a result, “being proactive” can be interpreted either as competent self-direction or as misaligned behavior, depending on local expectations and a newcomer’s standing (Korte et al., 2015, p. 201). Korte et al. (2015) also discovered repeated mismatches between newcomer and manager expectations, including initiative and information seeking, and report that these mismatches negatively affect learning, performance, and satisfaction during socialization, and participants in Howe et al.’s 2019 study contrasted these conditions with senior-year university contexts they saw as defined by student-owned authority over projects and problem framing. Taken together, these studies support a view that early-career task execution is shaped not only by technical demands, but also by uncertainty about what is expected, what counts as appropriate initiative, and how to interpret organizational cues.

4.3 Decision Latitude, Authority, and Accountability

Studies of early-career engineers suggest that responsibility for outcomes often increases early in professional roles (Baytiyeh & Naja, 2011), even as the engineer often has less ability to affect the "resources, authority, opportunity, and motivation to do one's work" (Brunhaver et al., 2021). This imbalance was described by Brunhaver et al. (2021) in terms of empowerment, where they concluded that empowerment is affected both by the engineer's perceptions about themselves and about the organization they work for, and is consistent with Karasek's 1979 Job Demands and Decision Latitude model, where the psychological toll of responsibility without authority is predictable and measurable across a cross section of industries.

4.4 Workplace Learning and Onboarding Mechanisms

Several studies characterize early workplace learning as a sociotechnical process that occurs through experience in the flow of work rather than through structured instruction. For example, Korte et al. (2015) report newcomers describing learning mostly through trial and error, and Li et al. (2021) describe workplace learning as occurring through performing real tasks, communicating with mentors, observing others, and reflective summarizing of work. Reber, et al. (2022) note that "[i]mportant direct outcomes of new engineer socialization include understanding one's roles and responsibilities, learning the knowledge and skills required to perform one's job, understanding one's company culture, and gaining acceptance into one's workgroup." Succeeding at these outcomes requires access to contextual information and feedback that early-career engineers may not know how to obtain, thus reinforcing that sociotechnical processes can both constrain agency and shape expectancies for competence.

These accounts view the transition environment as a context where learning opportunities depend heavily on access to people, information, and work assignments rather than whether the student completed a specific curriculum. They also suggest that varying learning mechanisms are embedded in everyday organizational practices, and these mechanisms provide signals to employees about their performance and competence (Korte et al., 2015; Howe et al., 2019). Especially when organizational constraints prevent learning from occurring without help-seeking, informal coaching, and access to knowledgeable peers, availability and safety of these interactions affect employees' interpretations of how well they are learning and performing.

4.5 Feedback, Evaluation, and Performance Signals

Early-career engineers learn whether they are performing competently and progressing appropriately through both clear, formal evaluation systems, as well as implicit and explicit performance signals embedded in everyday organizational practices such as feedback availability, recognition, promotion transparency, access to mentoring and networks, and increasing responsibility (Korte et al., 2015)

However, Korte et al. (2019) found that "[r]egarding career guidance, experienced hires mostly described the ambiguity of career feedback. They reported limited information given about the promotional process and how to succeed in the organization, leading to uncertainty about what they needed to do and how to do it; as one reported, 'Yes, I still need to figure out what they're really looking for,'" and Howe et al. (2019) described workplaces as places where feedback, evaluation, and guidance were infrequent or absent unless the employee actively sought it. This combination can result in reduced ability for employees to predict whether they will have future opportunities to confirm competence, calibrate performance, and exercise discretion, even as they perceive that their level of accountability for outcomes outside of their control increases after entering early-career engineering. However, Howe et al. emphasize that these conditions were not experienced uniformly, with transition experiences differing by role, by context, and by interpersonal climate, but regardless of source, these feedback mechanisms do shape engineers' self-efficacy, outcome expectations, and decisions whether to persist in their career trajectories.

4.6 Social and Interpersonal Climate

Studies of early-career engineers consistently document mismatches between newcomers' expectations of social integration and the interpersonal realities of work groups, which corroborate established findings from engineering identity research that show identity development is shaped through recognition, belonging, and social positioning within communities of practice (Patrick & Borrego, 2016). For example, Korte et al. (2015) found that many newcomers expected high levels of camaraderie, while actual experiences varied widely and were affected by larger-than-expected differences in age and lifestyle differences that reduced the ability of newcomers to integrate, while Howe et al. (2019) reported certain situations where "transition to work was characterized by more reported challenges with coworkers, including both not getting along with one individual and experiencing overt sexism from several others." In cases where workplace interactions were interpreted as gendered, Howe et al. frames subjective legitimacy as especially sensitive to interpersonal dynamics that assisted or constrained participation and credibility, rather than technical accomplishment alone.

4.7 Coordination and Communication Demands

Research emphasizes the importance of non-technical skills such as coordination and communication in early-career engineering work. For example, in Li et al.'s 2021 study of early-career engineers, participants saw workplace learning as occurring primarily through real-life tasks, communication with mentors, imitating what they see others doing, and reflective summarizing of their work (pp. 6–7). They also emphasize high levels of communication; for example, one IT engineer reported that communication comprised over 40% of his tasks (p. 6).

4.8 Stress, Career Shocks, and Commitment

Howe et al.'s 2019 longitudinal study of women transitioning from capstone design into professional engineering practice is an excellent example of this shift. Participants moved from capstone environments marked by a need to "to tackle the unfamiliar and learn through multiple channels," (p. 23) ownership, problem framing authority, and iterative decision-making into workplaces where tasks were narrowly scoped, priorities were externally set, and discretion was restricted by hierarchy and procedure (Howe et al., 2019). Importantly, this was not experienced simply as "learning the ropes," but as a structural change in how work could be engaged. Engineers were held accountable for deliverables, timelines, and ethical consequences, yet often lacked the authority to shape goals, select approaches, or challenge constraints. This combination of responsibility without authority produced uncertainty about expectations and diminished clarity about how competent performance is defined in early roles.

Howe et al.'s results, however, suggest that an undergraduate degree does not function as an identity signal in early practice. Instead, the participants' self-identification as engineers was closely tied to their immediate conditions, including whether they felt trusted with meaningful responsibilities and opportunities to exercise independent judgment, and if they felt their work was considered useful or valuable by supervisors, peers, and external stakeholders.

These examples paint a picture of early-career engineering identity not as assumed from degree completion, but shaped by repeated negotiation through everyday interactions and assignments. In a complementary project-based engineering study, Ahmad and Imam (2022) describe early-career conditions in a context where career competencies were insufficient to sustain career commitment by themselves. Instead, existing technical competencies are mediated through unexpected career events, labeled as "career shocks," and career satisfaction. When analyzed with Howe et al., this work supports a perspective that early-career engineering practice is a conditional environment marked by uncertainty and variable support, and that episodic events can prompt deliberate reappraisal of a person's career commitment and intentions.

Other studies show this pattern across other disciplines and organizations; for example, research on psychosocial work environments consistently shows that work combinations consisting of either high demands with low reward, or high psychological demands with low decision latitude, are associated with erosion of perceived mastery, increased psychological strain, and perceptions of working conditions as adverse (Stansfeld & Candy, 2006), and this pattern is consistent with Karasek's 1979 Job Demands and Decision Latitude measure. Organizational knowledge theories reinforce that meaningful learning depends on opportunities to participate and contribute in meaningful ways, which are often limited for early-career engineers (Nonaka et al., 2006).

5. Predictions of Situated-Expectancy Value Theory (SEVT) Under These Conditions

This review uses Eccles & Wigfield's 2020 SEVT to predict that motivation during and after the transition from undergraduate engineering to early-career engineering work will change when there is a change in a graduate's expectancies for success, subjective task values (including intrinsic, attainment, and utility values), and perceived costs of achieving the expected level of success change in response to workplace conditions (Eccles & Wigfield, 2020; Wigfield & Eccles, 2020). In SEVT expectancies, values, and perceived costs are not internally generated, fixed traits, or derived from personality, but are shaped over time via socialization and experiences and varying across contexts (Eccles & Wigfield, 2020; Wigfield & Eccles, 2020). Because these transitions typically occur during emerging adulthood, which is a period marked by active and ongoing identity exploration and consolidation, identity-related components of SEVT such as attainment value and identity-related costs are likely to be especially sensitive to workplace cues and social positioning dynamics in first- or early-career engineering roles (Arnett, 2000; Eccles & Wigfield, 2020; Louis, 1980).

5.1 Expectancies for success

When graduates encounter reduced decision latitude and unclear task boundaries and performance standards, SEVT predicts that expectancies for success will be more difficult to sustain because expectancy beliefs depend on being able to identify what successful performance requires (Eccles & Wigfield, 2020). Thus, when autonomy is constrained and ambiguity is high, efforts engineers invest may not improve their ability to predict whether that effort will map to desired outcomes, which reduces expectancies over time. This pattern is consistent with occupational health research findings showing that combinations of high psychological demand with low decision latitude, and high effort with limited rewards, are associated with increased strain and reduced perceived mastery, which can undermine employees' expectancies for success (Karasek, 1979; Stansfeld & Candy, 2006).

5.2 Task values

While expectancies for success are critical to a person's assessments of their competence and ability to form credible judgements, Wigfield & Eccles noted in their 2020 review of 35 years of subjective task values and motivation that "beliefs about competence are not the same as [a person's Subjective Task Values]," which they define as being comprised of intrinsic value, attainment value, utility value, and perceived cost. When applied to conditions within early-career engineering where task scope is narrower than expected, priorities are set more externally than expected, and opportunities to exercise and be recognized for judgment are lower than expected, SEVT suggests that intrinsic value, such as enjoyment and interest, and attainment value, such as identity-related importance, may weaken even when the utility value to the graduate remains nominally high, e.g., situations where the graduate feels that job is helping them build experience (Eccles & Wigfield, 2020; Wigfield & Eccles, 2020).

This is because intrinsic value is sensitive to whether the tasks assigned support interest and engagement, and attainment value is sensitive to identity alignment, i.e., is the work subjectively aligned with the type of person they see themselves being today or becoming in the future (Eccles & Wigfield, 2020). Thus, when work problem framing and discretion are lower than expected, employees are less likely to experience the work as interesting or identity-affirming.

5.3 Costs

When conditions of ambiguous expectations and inconsistency of feedback and access to information exist, SEVT predicts that employees can subjectively feel higher effort costs, emotional costs, opportunity costs, and identity costs. Within the SEVT paradigm, these are collectively referred to as "perceived costs." While the perception of these costs are affected by both expectancies and values, "cost relates more strongly to individuals' expectancies rather than their values" (Wigfield & Eccles, 2020, p. 171). Wigfield & Eccles (2020) further predict that when costs rise, an individual begins to expect an increase "in terms of the amount of effort needed to succeed and the increased likelihood of failure," and motivation will decline. Therefore, when work requires higher-than-expected efforts to succeed, such as while locating information, interpreting manager expectations, or managing personal and professional risk, and especially if the expectations of future recognition or developmental payoff is limited or unclear, then perceived cost plausibly increases and subjective-value-based motivation may become more difficult for an employee to sustain.

These predictions are because SEVT, rather than as using cost as a barrier to or a mediator of expectancy, treats cost as a core component of subjective value (Wigfield & Eccles, 2020; Eccles & Wigfield, 2020), and these predictions are consistent with previously discussed findings from occupational research (Karasek, 1979; Stansfeld & Candy, 2006).

5.4 Identity support and Recognition

Under ambiguous feedback and evaluation conditions, where formal evaluation systems, feedback, and task outcomes provide insufficient information to a newcomer about whether they are performing competently (such as those described in Section 4.5), sensemaking strategies must rely more heavily on the remaining cues; this increases reliance on interpersonal and social signals to help form expectancy beliefs for success and determine whether they are performing and progressing in a competent and appropriate way (Louis, 1980; Eccles & Wigfield, 2020; Korte et al., 2015; Howe et al., 2019).

Under the recognition, belonging, and social positioning dynamics described in Section 4.6, the lens of SEVT implies that identity costs increase, and attainment value decreases if these conditions undermine the ability of early-career engineers to have their capabilities recognized and participate as legitimate engineers in their workgroup or professional community of practice (Eccles & Wigfield, 2020; Patrick & Borrego, 2016; Stevens et al., 2008; Howe et al., 2019).

6. What preparation gaps emerge?

6.1 Expectancy Beliefs

Undergraduate engineering education is commonly structured around relatively coherent and legible instructional methods, including well-defined problems using familiar formulas, explicit performance criteria via syllabi and rubrics, and structured assessment and feedback practices, particularly in experiences shaped by accreditation requirements and assessment norms such as core coursework and capstone design (ABET, 2025; Stevens et al., 2008). These types of high-legibility environments can inadvertently develop a mental image of engineering as the practice of individual technical problem solving aiming to meet clear success criteria, even though many professional roles are dependent on coordinating, influencing, or creating value using incomplete and ambiguous information (Trevelyan, 2011). As students advance towards graduation, they may not naturally reflect on or reassess whether the skills and competencies they are learning in university will count as competent engineering performance once they enter practice.

For example, in Atman et al.'s Academic Pathways study, while college seniors more consistently identified teamwork, problem solving, and communication as key engineering competencies, and used engineering-specific language more adeptly, they "did not perceive professional and interpersonal skills (e.g., leadership, teamwork, communication, and business ability) as being any more important than did their first-year counterparts, even having had project-based learning, design experiences, and, possibly, co-op or internship experiences"

(Atman et al., 2010). This suggests that typical courses of study, while strengthening students' technical and competence discourse, does not consistently shift students' internal priorities toward evaluating the broader context of engineering problems, assessing the sociotechnical expectations of the environment and organization, and the recognition of the value of one's work that are most visible and central to success in many early-career roles (Atman et al., 2010).

6.2: Task Values

In undergraduate engineering education, student utility value can remain high due to being anchored to the engineering degree as a pathway to high returns to education (Burke et al., 2016; Eccles & Wigfield, 2020). However, academic environments where students develop intrinsic and attainment values tend to emphasize forms of engagement that may not occur in early roles, such as ownership of problem framing, visible and individual technical contributions, and clear performance criteria. However, Atman et al.'s 2010 research indicated that even in programs where most engineering students saw sociotechnical skills as key engineering competences and used more engineering-specific language to express technical ideas, they did not perceive professional and interpersonal skills as being any more important than did their first-year counterparts. Thus, even when students consistently learn enough sociotechnical skills to succeed, students may still see technical problem solving as their best path to success because it consistently worked in their preparation experiences (Winberg et al., 2020; Stevens et al., 2008).

If graduates enter early-career environments where task scopes are narrow, priorities are set by others, and there is limited discretion or judgment, SEVT implies that intrinsic value becomes harder to sustain because the work does not consistently support interest, curiosity, or judgment-based engagement (Eccles & Wigfield, 2020). Attainment value also becomes more fragile when early roles provide fewer opportunities for the engineer to live out their undergraduate identity of "engineer as problem definer" or "engineer as solver of consequential problems," especially when recognition depends on coordination and relational positioning rather than technical accomplishment alone (Howe et al., 2019; Patrick & Borrego, 2016). This results in a preparation gap not in the learning teamwork or communication, but whether these skills are seen as relevant engineering contributions rather than as a distraction from "real engineering."

A similar gap is that under conditions where students have a high conditional or deferred utility value for engineering, such as "this job will build experience," they may not have had the mentally preparation to support persistence through the reduced motivation that can accompany work low in intrinsic interest and identity affirmation. Thus, motivation can erode from rising perceived costs or lower expectancy, even if utility value stays high (Wigfield & Eccles, 2020).

6.3: Ambiguity and Sense-Making

Academic engineering typically provides technical problem-solving consisting of bounded problems, defined criteria, and explicit forms of evaluation (such as syllabi and rubrics) that enable students to understand how successful performance is defined (Trevelyan, 2010; Trevelyan, 2011) While these features support learning, there is a gap between contexts where expectations are specified, and contexts where expectations must be inferred through sensemaking, relationship building, and interpreting of ambiguous cues.

For example, early-career engineering environments commonly require newcomers to interpret ambiguous task boundaries, negotiate what "done" means, and determine what initiative is appropriate without violating local norms (Korte, 2009; Korte et al., 2015). These are not merely communication challenges, but competence-definition challenges, since they require different kinds of cognitive work: identifying the real problem, identifying the relevant stakeholders, testing hypotheses about priorities, and taken actions under uncertain conditions. SEVT implies that because expectancy beliefs depend on understanding what successful performance requires, ambiguity can reduce expectancy even when the capability to fulfill the requirements is present (Eccles & Wigfield, 2020).

Thus, students may graduate with strong technical skills but have had limited opportunities to practice interpreting organizational expectations, navigating distributed authority, or learning how to test assumptions about priorities and standards. In early roles, this gap increases both effort costs and emotional costs, because daily work depends on searching for information and feedback seeking, and managing relationships, and depending on local norms, all of these may or may not be welcomed (Ashford & Black, 1996; Korte et al., 2015).

6.4: Feedback

Academic feedback systems are typically frequent, structured, and legible, where students receive grades, rubric-based evaluations, and repeated opportunities to test understanding (Stevens, et al., 2008). These systems shape students' expectancy calibration by linking effort, strategy, and outcome more predictably. However, early-career engineering feedback is often intermittent, indirect, and uneven between different managers and teams, and newcomers frequently report learning through trial and error, and they receive limited guidance about what success looks like or how they can progress (Korte et al., 2015; Korte et al., 2019). When feedback is scarce, newcomers must then by necessity rely more heavily on informal performance signals, access to mentors, and interpersonal recognition to determine whether they are performing competently (Howe et al., 2019; Louis, 1980). SEVT predicts that such environments can increase perceived costs and undermine expectancies because engineers cannot reliably infer whether additional effort will improve outcomes or recognition (Eccles & Wigfield, 2020; Wigfield & Eccles, 2020).

Thus, the preparation gap is not just that new graduates want more feedback than they currently receive, but also that due to years of operating under a structure of clear, frequent, and structured feedback, students do not have sufficient practice operating under conditions where competence signals are delayed, ambiguous, or diffused through lenses of organizational politics. Students also may not have sufficient practice in resisting the low motivation present during long periods of low visibility work, scarce developmental guidance, or tasks where visible indicators of their competence are hard to find. This gap is especially consequential during emerging adulthood, when identity and belonging are still actively developing, and when recognition cues carry outsized weight (Arnett, 2000; Patrick & Borrego, 2016; Howe et al., 2019).

6.5: Practice Under Constraint

> Author Note: The following example is used to illustrate an example of implementing SEVT design features and is not intended to generalize across contexts. This section draws on the author's experience only to provide a practice-informed illustration of how structured feedback and assisted sensemaking may buffer expectancy declines and identity-related costs under conditions where SEVT suggests motivation is at risk.

A useful contrast to the structured, high-legibility environments common in undergraduate engineering is the U.S. Navy's Civil Engineer Corps Officer School (CECOS) Basic Course, where new officers perform coordination, planning, and decision-making in realistic field training exercises, such as planning and conducting a foot reconnaissance patrol under combat conditions and using the information to plan the construction of a helicopter landing zone (Naval Education and Training Security Assistance Field Activity, 2022; U.S. Navy, 2022). These exercises deliberately show ambiguity, resource scarcity, and time-constrained decision-making as core components of engineering practice, while also sustaining mechanisms for evaluation, feedback, and legitimacy. The intent is not for student to achieve technical "success," but to participate in guided, supported practicing of military engineering, including judgement under stress, ambiguous expectations, and conflicting demands. Thus, novices can make decisions, experience consequences, and participate in structured, individualized sensemaking (e.g., debriefs and After-Action Reviews) where students practice how to interpret weaknesses, manage role conflict, and internalize that being unable to meet all demands does not necessarily mean incompetence as an engineer or failure as an officer. In terms of SEVT, this design supports resilience of expectancy beliefs under pressure by making the basis of success interpretable, and plausibly containing emotional and identity costs by treating struggle as expected, thus preserving attainment value and commitment to the engineering role. An additional benefit is countering unrealistic expectations about authority, clarity of instructions and expectations, and resourcing that, absent the CECOS preparations, might otherwise result in early experiences being interpreted as personal failure rather than predictable outcomes of structural constraints.

Importantly, the Basic Course assumes new officers have prior preparation in engineering and teamwork, as without competence in these areas, the exercise cannot function as designed. Thus, the implication is not that engineering education must replicate military training, or a contrast between "good" and "bad" preparation, but that the conditions of how novices are able to practice are an important factor in keeping competence and professional identify resilient during the transition from undergraduate education to early-career practice.

6.6 Synthesis

Common educational structures shape expectancies for success, task values, and identity-related costs, and these patterns can result in risk to motivation if graduates enter lower-agency early-career roles. Table 1 maps four recurring features of undergraduate engineering education to the implied expectations they cultivate, to contrasting conditions frequently encountered in early-career practice, and to specific vulnerabilities SEVT implies will occur under those conditions.

These features are not defects, since many are necessary for instruction and assessment, but can unintentionally calibrate motivation to rely on conditions that often do not exist after graduation.

Interpreting Table 1 across rows, a recurring mechanism is mismatched calibration rather than skill deficits. Undergraduate education can create strong links between the amount of effort and positive outcomes, and prioritize short durations between student efforts and the response of competence signals such as grades. However, early-career roles can delay the link between effort and response, or shift feedback from direct to more social or opaque channels. SEVT sees beliefs of expectancy and costs as being formed through prior experiences; since prior "success" was learned under conditions of high visibility and instructor feedback, ambiguity and social risks in early roles can more quickly inflate perceived costs and undermine expectancies before intrinsic or attainment values can support newcomer motivation. This helps explain why motivation can decline even when graduates possess the technical competence and teamwork capacity required
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Feature of Engineering Education	Implied Expectations about Competency	Common Early-Career Condition	SEVT-Predicted Vulnerability
Frequent structured feedback	Effort and strategy reliably produce interpretable feedback	Feedback is delayed, uneven, or must be actively sought	Reduced expectancies, higher effort and costs
Bounded technical problems with clear success criteria	Problems are well-defined; "complete" and "good" solutions are knowable conditions	Scope, quality, and completeness are negotiated and variable	Reduced intrinsic & attainment values; higher cost due to ambiguity
Focus on individual achievement (even in teams)	Competence is shown through individual technical contribution	Competence is shown through coordination, influence, and judgment within sociotechnical systems	Identity tension and cost, uncertainty of recognition
Consistent academic evaluation (grades, rubrics)	Competence is recognized in understandable and predictable ways	Recognition is often delayed, social, or opaque	Higher identity cost; Lower expectancy due to ambiguity
Senior-year high-agency experiences (capstone, projects, research)	Engineers define the problem and get to choose solution paths	Low decision latitude; goals and approaches are set by others	Lower attainment value and expectancy; higher costs due to reduced autonomy

Table 1: Misalignments between preparation & practice, and SEVT-informed risks

7. Discussion and Implications

7.1 Core Conclusions

This paper uses a novel application of Situated Expectancy-Value Theory (SEVT) and applies it to the school-to-engineering-work transition to argue that many difficulties observed during this transition are best interpreted, not as a deficit in technical preparation, but as a misalignment between the conditions where students calibrated their abilities to notice and evaluate incoming signals and certain conditions in early-career work that affect their sense of competence, motivation, and identity. The literature reviewed indicate that preparation consists of more than technical knowledge and discrete skills, and includes practice in sustaining expectancies, task values, and identity alignment within conditions where decision latitude is constrained, ambiguity is high, and performance signals are delayed, absent, or socially dispersed.

Using SEVT, preparation can be seen as a problem of calibration, where graduates don't just prepare to perform, but to interpret constraint, ambiguity, and limited feedback in ways that do not threaten identity, competence, or expectancy. SEVT thus allows reframing "preparedness" in a way that weaves the following aspects into the teamwork, problem decomposition, iterative improvement, and engineering "identity" work that engineering education already develops well:

1. Calibrating expectancy under ambiguity: Graduates can infer what successful performance requires, even when tasks or criteria are either incomplete or negotiated.

2. Managing cost under constraints: Graduates can sustain effort even when links between effort and outcome are delayed or hard to see, and buffers escalations of emotion and identity cost.

3. Identity stability under sociotechnical conditions: Graduates treat coordination, influence, and relationships as legitimate engineering contributions, not as distractions from "real engineering."

These findings have direct implications on engineering leadership development; early-career engineers not only adapt to organizational systems but are being implicitly socialized into "what counts" as legitimate contribution, authority, and initiative. Without advance preparation to interpreting and navigating these constraints, graduates may internalize limited agency as a stable, career-long expectation rather than a developmental stage, thus reducing their likelihood to learn system-level influence skills and rise into leadership positions.

7.2 Theoretical Contributions

While prior research has identified gaps and mismatches in skill and socialization, SEVT helps clarify why this misalignment matters, i.e., beliefs about expectancy and costs are calibrated from prior experiences, and an individual's task values depend on whether their work is aligned with their identity and sustains their interest. In this way, SEVT enables a predictive framing of motivational vulnerabilities, including when to expect declining expectancy, increased perceived cost, and impacts to identity when graduates accustomed to freedom, clarity, and high levels of feedback encounter constrained, ambiguous, and feedback-poor early-career environments.

Instead of placing blame on students or employers, this analysis concludes that these outcomes are the predictable results of system misalignments.

7.3 Design Implications for Engineering Education

The goal of engineering education is not to make undergraduate education resemble industry, but to provide instructionally fair and psychologically safe opportunities to practice excelling under conditions that affect expectancy, value, motivation, and identity. Since SEVT predicts that these are shaped by how students interpret ambiguity, constraint, and feedback, educational design must intentionally expose students to these conditions while also preserving the interpretability of feedback and support. Therefore, the following SEVT-derived design principles are intended not only to promote immediate workforce preparation, but to more importantly contribute to the development of future engineering leaders who can operate effectively under conditions of constraint, ambiguity, and distributed authority:

1. Add ambiguity while maintaining understandable evaluation: While keeping evaluation criteria explicit and understandable, provide opportunities to make defensible judgments under uncertain conditions. Maintain technical correctness as an assessable outcome, and add emphases on quality of logic and reason, justification of tradeoffs, and negotiating boundaries.

2. Sensemaking as an engineering competence: Require students to identify stakeholders, judge the priorities of inaccessible groups, test assumptions about whether a problem or project is completed, and document how incomplete information was interpreted. This grounds sensemaking as core engineering work, rather than as reflection for its own sake.

3. Normalize feedback scarcity: Design experiences where feedback is intentionally delayed and add self- or peer-evaluation tools and structured debriefs. This protects expectancies by teaching students to create and interpret performance signals on their own and within their relationships.

4. Highlight sociotechnical competence: Coordination and influence are central in early roles, so they must be practiced. Assessing and rewarding coordination work, influencing stakeholders, and integrating distributed expertise teaches that these are legitimate areas of competence.

5. Prepare students for changes in agency: When senior-year experiences increase student agency, programs can highlight that early roles often reduce it, explain why it happens, and teach students to interpret those conditions as development stages instead of competence assessments.

These principles define what educational experiences should accomplish in terms of expectancy, value, and identity calibration, but they cannot function without being translated into concrete instructional activities and structures. The following implementation options therefore illustrate how these mechanisms can be effected across a range of engineering education contexts:

1. Low-Definition yet Explicit Rubric Projects: While ensuring grading criteria stays focused on justification, decision quality, and risk tradeoffs, assign projects where the problem definition evolves, constraints shift, and the definition of “complete” must be negotiated.

2. Deliverables for Sensemaking: Require full documentation of assumptions, stakeholder maps, and boundary statements where students explain what they believe success will require and why.

3. Delay Feedback: Require students to use peer review, checklists, or self-assessment to proceed, followed by debriefs to ensure students have stayed within appropriate boundaries.

4. Give credit for coordination work: Include graded components for peer and cross-group integration, implementing communication plans, and use of “influence” strategies.

5. Exposure to industry norms: Use panels and short interviews that focus on expectations of initiative, real-world challenges of providing feedback, and constraints on recognition.

7.4 Limitations and Future Research

This review provides a generalized framework for understanding the transition into early-career engineering practice, but does not fully account for variation across disciplines, roles, or institutional contexts. For example, early-career experiences may differ significantly between domains with relatively high autonomy, such as software engineering, and highly regulated environments, such as civil or aerospace engineering. Similarly, students may enter the workforce with different expectations and levels of exposure to sociotechnical practice depending on whether they studied at a research-intensive university, polytechnic institution, or a program with extensive co-op opportunities. The described SEVT mechanisms suggest that responses to misalignments may differ depending on context, and particularly in how expectancy beliefs and perceived costs are affected.

Future research should examine how these contextual differences influence the relationship between preparation and early-career experiences, including how specific curricular structures, internships, or workplace conditions affect expectancy, value, and identity development. Incorporating the concept of “anticipatory socialization” may provide additional information by examining how expectations are formed prior to workforce entry, and how early interventions in engineering education can help better align student expectations with the sociotechnical realities of practice.

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