

Investigating the Adaptation of Socialization Processes Scales in Engineering Education Context*

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Socialization is an important concept for understanding how students gain the knowledge and skills necessary to become effective in the college community. In this paper, we adapted two scales taken from the organizational behavioral literature for the engineering college context. We used structural equation modeling to validate an instrument measuring socialization processes using survey data collected from 934 engineering students at a large, public, Midwestern university. We find that for institutional tactics, which is a socialization process having to do with how the institution itself socializes newcomers, our data did not match the originally proposed factor structure. On the other hand, our data was consistent with the model for proactive behaviors, which describes how individuals learn about their new environment, suggesting that the adapted proactive behaviors scale may become a useful indicator for detecting students who do not acquire important socialization processes during the college transition.

Keywords: confirmatory factor analysis; socialization processes; institutional tactics; proactive behavior

1. Introduction

There is ample literature showing that participation in engineering-centered co-curricular activities is beneficial in building a number of important skills and behaviors – including, for example, academic engagement, communication and leadership skills, and establishing a solid engineering identity (see, for example, [1, 2]). Furthermore, patterns of participation are often related to student demographic characteristics such as gender, ethnicity, and socioeconomic status. For instance, women tend to participate more in activities other than school work [3–5], and first-generation college students are less likely to participate in co-curricular activities [6–9]. Other predictors for participation are experiences before arriving to college, such as participating in science-related summer camps in high school [10].

Weidman [11] suggested that the process by which students learn how to become effective members of the college community (i.e., the socialization process) is important for understanding how college influences various outcomes. For instance, many studies [12–15] show that students who participate in learning communities that teach them how to become academically and socially integrated into the institution perform better than students who do not. Weidman's model provides a useful conceptual framework for understanding the process of socialization

students undergo as they enter and move through college, but it does not provide a means to measure socialization explicitly for empirical validation. In this work, we examine two specific scales taken from the organizational behavior literature – Institutional Tactics and Proactive Behaviors – adapt them for the engineering education context, and validate their use.

2. Conceptual Model

The conceptual framework that guides our work is based upon Weidman's model of undergraduate socialization [11], which is itself an extension of Astin's Input-Environment-Outcome model of student involvement [16]. Astin's basic model posits that both students' background characteristics (the inputs) and their experiences while in college (the environment) influence collegiate outcomes. It serves as a template for a wide range of studies on college outcomes, including overall retention [17, 18], retention of specific student populations [19], and academic, social, and personal competence [20–22].

Using a modified model template (shown in Fig. 1 in all caps), Weidman suggested that socialization within the college environment is important for understanding the impact of college. He further suggested that upon entering college, students are influenced by various socializing groups, including

peers, faculty, employers and parents. Weidman's conceptual framework has been applied in a variety of contexts including graduate education [23, 24] campus diversity [25, 26], and the influence of parents during college [27], among others.

Weidman's model, while valuable for understanding college students' socialization processes, does not provide a means to measure socialization explicitly for empirical validation. In the study of organizational behavior, the process of socialization has been operationalized in two major ways: as organization-driven *institutional tactics* [28, 29] and as individual-driven *proactive behaviors* [30]. Van Maanen and Schein [28] proposed a set of bipolar institutional tactics through which organizations socialize newcomers, which were further refined and operationalized by Jones [29]. At one end of the spectrum is *institutionalized* socialization, in which newcomers are intentionally brought through a formalized onboarding process, and on the other end is *individualized* socialization, characterized by an absence of structure that leaves newcomers to "sink or swim" [31]. Proactive behaviors, on the other hand, are actions taken by newcomers to learn about the expectations, norms, values, and rules within their new organizational contexts [30]. Although these two sets of socialization processes are often considered separately, several studies have investigated the joint influence of institutional tactics and proactive behaviors on outcomes such as newcomer learning [31] and perceptions of person-organization fit [32].

Although institutional tactics and proactive behaviors have been widely studied in the context of newcomer adjustment in the workplace, few researchers have used these socialization processes as a means to understand first-year students' transition to college despite the obvious parallels between the two contexts. We chose to operationalize Weidman's conceptual framework by integrating specific mechanisms to understand not only how the institution shapes undergraduate socialization (through institutional tactics) but also how students themselves take an active role in the socialization process (through proactive behaviors). While there are many papers in the higher education literature where portions of either the institutional tactics [24, 28, 29, 33, 34] or proactive behaviors [35–37] scales are used to examine their relationships to various outcomes, to our knowledge there are none that attempt to measure both.

3. Research Questions

In our larger research efforts, we are examining various portions of the model shown in Fig. 1. But in this paper, we focus on two goals:

- to describe our adaptation of two specific socialization processes scales – institutional tactics and proactive behaviors – for a college setting;
- to provide evidence for the validity of our scales in the context of an undergraduate college of engineering.

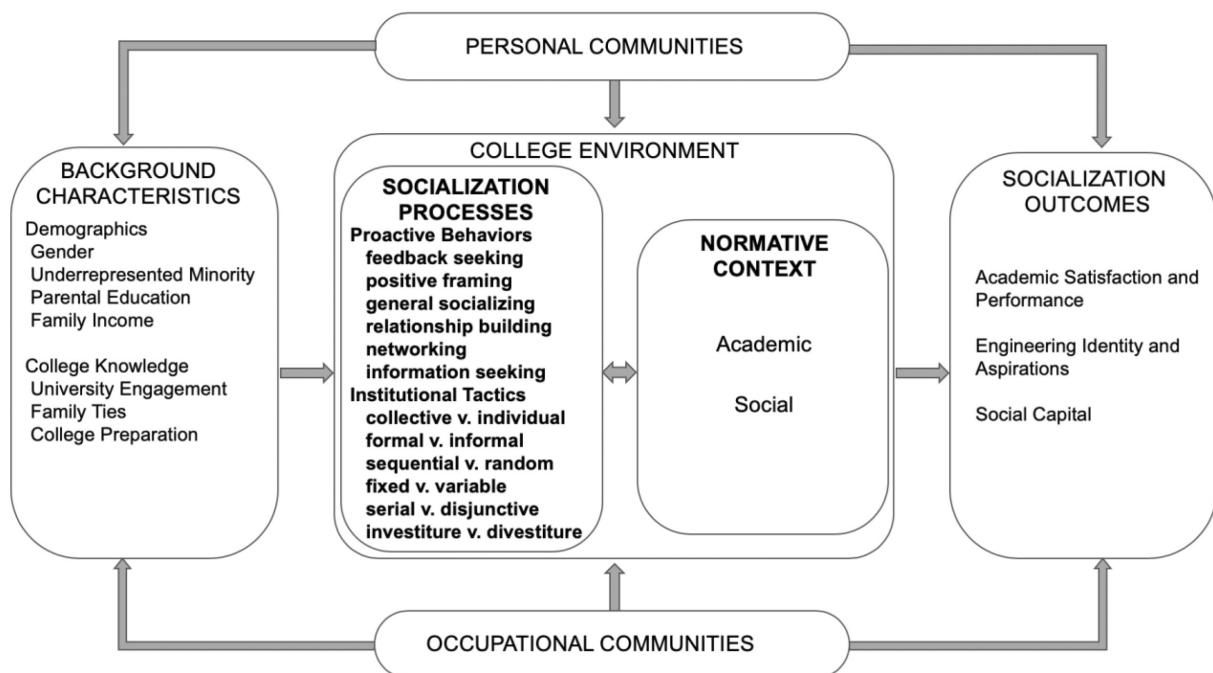


Fig. 1. Schematic diagram of the conceptual framework used in this study. The capitalized items indicate the portions of the framework taken from Weidman [11], and the bolded items indicate the portions examined in this paper.

The remainder of the paper will describe the specific socialization processes and how they were adapted for our context, how the sample was collected and analyzed, and the results and limitation of the study. We anticipate that examining socialization via institutional tactics and proactive behaviors together will shed light on the impact of these experiences on student outcomes in a more holistic way than studying them individually, and may aid institutions to develop more targeted and evidence-based programs to improve those outcomes.

4. Socialization Processes

4.1 Institutional Tactics

The institutional tactics model of socialization [28, 29] posits that the socialization process is driven by the organization and that newcomers are passive participants. Van Maanen and Schein [28] proposed six bipolar dimensions that describe various institutional tactics, which were later refined by Jones [29]: *collective vs. individual*, *formal vs. informal*, *sequential vs. random*, *fixed vs. variable*, *serial vs. disjunctive*, and *investiture vs. divestiture*. Each of these dimensions represents an aspect of a continuum from more institutionalized socialization (i.e., more *collective*, more *formal*, more *sequential*, more *fixed*, more *serial*, more *investiture*), where the institution itself provides various means for socialization into the culture, to more individualized socialization (i.e., more *individual*, more *informal*, more *random*, more *variable*, more *disjunctive*, more *divestiture*), whereby the individual is left to his or her own devices. Table 2 lists the original items, and provides more insight into the meaning of each dimension.

The first two dimensions, *collective vs. individual* and *formal vs. informal*, pertain to the contexts in which organizations provide information to newcomers [29]. With *collective* socialization, newcomers within an organization as a group are brought through common learning experiences designed to standardize knowledge and behaviors. *Individual* tactics, in contrast, entail unique learning experiences of individuals on their own. *Formal* tactics involve the separation of newcomers from more experienced members of the organization into cohorts, while *informal* tactics promote the integration of newcomers into existing groups. For example, an orientation session that is attended by for all first-year students in the beginning of the semester would be collective and formal, and an orientation attended by a single transfer student arriving as in their third-year would be considered more individual and informal.

The second two dimensions, *sequential vs. random*

and *fixed vs. variable*, relate to the content of the information given [29]. *Sequential* tactics involve providing newcomers with explicit information about activities and processes that they will experience in their new organizations. Conversely, in *random* socialization, the organization does not tell newcomers about the order of these activities and processes. With *fixed* socialization, the organization provides newcomers with information about the timetable associated with completing each stage in the entry process. *Variable* tactics, in contrast, involve no such information about timing. In higher ed, the curriculum is often very regularized, and is thus sequential and fixed, but participation in student organizations can be more random and variable.

The final two dimensions, *serial vs. disjunctive* and *investiture vs. divestiture*, pertain to the social aspects of socialization [29]. In *serial* socialization, experienced institutional agents serve as mentors to newcomers, while newcomers are left to develop their own understanding of the institutional context in *disjunctive* socialization. *Investiture vs. divestiture* concerns the degree to which socialization tactics affirm newcomers' identities, strengths, and capabilities in the organizational environment (*investiture*) or denies those identities and skills until newcomers integrate into the organization (*divestiture*). For examples, students who interact strongly with advisors may feel socialization processes that are more serial and invested, while those without good mentorship would feel the processes as disjunctive and divested.

Several studies in higher education have used these institutional tactics [28, 29] as a lens through which to view college student experiences. Weidman himself discussed Van Maanen and Schein's institutional tactics in a report on graduate and professional student socialization [24]. However, the discussion in this work was purely theoretical. Bergerson [33] integrated multiple conceptualizations of socialization, including both Weidman's model and Van Maanen and Schein's institutional tactics model, in a qualitative study of how first-year college students experience institutional socialization efforts. More recently, Chen and Yao [34] drew on Van Maanen and Schein's conception of institutional tactics to understand how new students respond to socialization pressures coming from three different sources: administrations and departments, older students, and peers. Similarly, McNeil and Beebe [38] used these concepts to study how easily students transitioned between co-ops and the university.

4.2 Proactive Behaviors

While the institutional tactics model of socialization

[28, 29] assumes that newcomers are passive participants in a socialization process that is driven by organizations, the proactive behaviors model of socialization [30] assigns agency to newcomers in the socialization process as they learn about their new institutional context. Ashford and Black [30] proposed that proactive behaviors may be measured across seven dimensions: *feedback seeking*, *negotiation of job changes*, *positive framing*, *general socializing*, *relationship building*, *networking*, and *information seeking*.

First, *feedback seeking* behaviors allow newcomers to understand how they are being perceived by superiors and colleagues, and the behaviors provide them with information about how to alter their behaviors to meet expectations. Second, *negotiation of job changes* refers to a new employee's efforts to change her new role to better suit her skills or interests. Third, *positive framing* behaviors involve recasting potentially challenging or discouraging experiences in a more optimistic light, allowing newcomers to gain confidence and self-efficacy as they perceive more control over a situation. Fourth, *general socializing* with others (e.g., attending parties and social gatherings) can help newcomers develop a situational identity and adapt to the social norms of the organization. Fifth, engaging in *relationship building* behaviors to develop a positive relationship with one's boss can alleviate uncertainty about expectations and help newcomers gain a sense of control. Sixth, *networking* refers to active engagement with people outside of the newcomer's department or segment of the organization. Finally, engaging in *information seeking* behaviors about the norms, rules, and expectations of the organization tells newcomers "what they should be doing to survive in their new role and setting" [30].

Several of Ashford and Black's [30] proactive behaviors have been adapted for college students and studied in the context of higher education. For example, Wang et al. [37] used *feedback seeking*, *general socializing*, and *relationship building* with instructors in a study of how proactive student behaviors mediate the pathways from Five-Factor Model personality traits such as conscientiousness and extraversion to outcomes such as GPA and extracurricular participation. Cho and Li [35] considered the role of *feedback seeking* behavior on international student satisfaction in college. In addition, Geertshuis et al. [36] investigated the relationships between proactive personality and proactive behaviors (using a set of items based only loosely on those proposed by Ashford and Black) in a college preparatory program for students who are older than the typical college-going population.

5. Methods

5.1 Sample

The institution in our study is a large, public, research-intensive university in the Midwest. It has a large undergraduate engineering population (~7,000 students) with ~50% in-state students and ~10% international students. There are 12 different academic departments in the college of engineering that offer 14 different majors. Incoming first-year engineering students do not declare a specific major until after their first year. Therefore, the engineering college has a number of programs and activities designed to orient students, which include a formal orientation, a required introductory course in engineering design, an elective survey course on the various majors, and campus-wide fairs and activities that highlight the wide range of extra- and co-curricular activities available on campus.

During the Fall semester of 2017, we invited all 4,022 third- and fourth-year undergraduate engineering students at the university to complete an online survey. We surveyed upper-level students rather than incoming students because our cross-sectional survey also included questions about experiences and attitudes students had after the first year of college and about outcomes such as post-graduation aspirations.

A total of 998 students responded to the survey, of whom 934 (93.6%) submitted completed responses (i.e., made it to the final page of the survey), yielding a response rate of 23.2%. Of the 934 respondents, 916 (98.0%) answered all of the items relating to institutional tactics and 906 (97.0%) answered all of the proactive behaviors items. Table 1 presents demographics drawn from institutional databases for the 934 students who submitted responses (study sample) and the 4,022 students who received the survey (sampling frame). The study sample was approximately representative along race/ethnicity, parental education level, and family income. Women were overrepresented in the study sample compared with the population of engineering students at the university, consistent with the finding of Porter and Whitcomb [39] that female college students are more likely to take part in surveys.

5.2 Measures

Our survey asked students to reflect on their first-year experiences regarding the two different types of socialization processes: institutional tactics (17 items) and proactive behaviors (20 items), which were measured using adapted scales published by Jones [29] and Ashford and Black [30]. Specifically, students were asked to reflect back on their first year of college and respond accordingly. All items mea-

Table 1. Demographics of study sample, sampling frame, and national population of undergraduate students studying engineering at Research Universities

	Study Sample (%) N = 934	Sampling Frame (%) N = 4,022	Research Universities ^a (%)
Sex			
Female	382 (41)	1,033 (26)	(24)
Male	552 (59)	2,989 (74)	(76)
Race/Ethnicity			
Asian/Asian American	310 (33)	1,234 (31)	(16)
Black/African American	25 (2.7)	128 (3.2)	(6.5)
Hispanic/Latino	49 (5.3)	217 (5.4)	(10)
Native American	14 (1.5)	36 (0.9)	(–)
White	579 (62)	2,512 (62)	(64)
Nationality			
Domestic	873 (93)	3,618 (90)	(91)
International	61 (6.5)	404 (10)	(8.8)
Socioeconomic Status			
Parental ed. < Bachelor's	115 (12)	578 (14)	(31)
Family income <\$75K	136 (16)	586 (16)	(32) ^b

^a National data from U.S. Department of Education, National Center for Education Statistics, 2015–16 National Postsecondary Student Aid Study (NPSAS:16) for graduating seniors from a bachelor's degree program in 2015–16 with a major field of study in engineering or engineering technology.

^b Estimate represents percentage of students who are financially dependent on their families. Financially independent students, who comprise 28.9% of the engineering student population at research universities, are excluded from this estimate.

Table 2. Sample questions for the original institutional tactics items from Jones [29] and the adapted items for the college context in this work

Dimension	Original items	Adapted items
Collective vs. individual	Other newcomers have been instrumental in helping me understand my job requirements. There was a sense of “being in the same boat” amongst newcomers in this organization.	Other first-year students were instrumental in helping me adapt to college. There was a sense of “being in the same boat” amongst first-year students in engineering.
Formal vs. informal	I have been through a set of training experiences which are specifically designed to give newcomers a thorough knowledge of job related skills. I have been very aware that I am seen as “learning the ropes” in this organization.	I went through a set of experiences that were specifically designed to give new students a thorough knowledge of the University. I was very aware that I was seen as “learning the ropes” in the College of Engineering.
Investiture vs. divestiture	I have been made to feel that my skills and abilities are very important in this organization. Almost all of my colleagues have been supportive of me personally.	I was made to feel that I had great academic potential in the College of Engineering. Almost all of my peers were supportive of me personally.
Sequential vs. random	There is a clear pattern in the way one role leads to another or one job assignment leads to another in this organization. The steps in the career ladder are clearly specified in this organization.	There was a clear pattern in the way that I was expected to move through the engineering college experience. The steps in the student experience in the College of Engineering were clearly specified.
Serial vs. disjunctive	Experienced organizational members see advising or training newcomers as one of their main job responsibilities in this organization. I have received little guidance from experienced organizational members as to how I should perform my job.	Experienced people in the College of Engineering (e.g., older students, staff) believed helping first-year students was important. I received little guidance from more senior students as to how to succeed in the College of Engineering.
Fixed vs. variable	I can predict my future career path in this organization by observing other people's experiences. The way in which my progress through this organization will follow a fixed timetable of events has been clearly communicated to me.	I could predict my future path in engineering by observing other students' experiences. The way in which my progress through the College of Engineering will follow a fixed timetable of events was clearly communicated to me.

Table 3. Sample questions for the original proactive behaviors items from Ashford and Black [30] and the adapted items for the college context in this work

Dimension	Original items	Adapted items
Feedback seeking	To what extent have you sought feedback on your performance after assignments? To what extent have you asked for your boss's opinion of your work?	I often sought feedback on my performance after assignments. I often asked for professors'/ instructors' opinion of my work.
Job change negotiation	To what extent have you negotiated with others (including your supervisor and/or coworkers) about desirable job changes?	[Not applicable to collegiate context.]
Positive framing	To what extent have you tried to see your situation as an opportunity rather than a threat? To what extent have you tried to see your situation as a challenge rather than a problem?	I tried to see being an engineering student as an opportunity rather than a threat. I tried to see my engineering major as a challenge rather than a problem.
Relationship building	To what extent have you tried to spend as much time as you could with your boss? To what extent have you worked hard to get to know your boss?	I tried to spend as much time as I could with more senior students. I worked hard to get to know more senior students.
General socializing	To what extent have you participated in social office events to meet people? To what extent have you attended office parties?	I attended social gatherings to meet new people. I attended parties with friends I met in engineering.
Networking	To what extent have you started conversations with people from different segments of the company? To what extent have you tried to socialize with people who are not in your department?	I started conversations with people from different academic majors than my own. I tried to socialize with people (faculty, students, or staff) who are not in engineering.
Information Seeking	To what extent have you tried to learn the (official) organizational structure? To what extent have you tried to learn the important policies and procedures of the organization? To what extent have you tried to learn the politics of the organization? To what extent have you tried to learn the (unofficial) structure?	I tried to learn the official organizational structure of the College of Engineering. I tried to learn the important policies and procedures of the University of Michigan. I tried to learn the politics of the College of Engineering. I tried to learn the unofficial structure of the College of Engineering.

asuring students' experiences with institutional tactics and proactive behaviors were measured using a seven-point Likert scale (where 1 = Strongly Disagree and 7 = Strongly Agree). Examples of Jones's original items measuring institutional tactics and our adaptations are shown in Table 2. Examples of Ashford and Black's original items for proactive behaviors and our adaptations are shown in Table 3. For proactive behaviors, *job-change negotiation* was excluded because there was not a clear parallel between this dimension and the experiences of new students at a university.

Prior to survey deployment, we tested and refined a preliminary questionnaire using two separate processes, as recommended by experts in questionnaire design and validation [40, 41]: expert review and focus groups. First, a set of expert researchers and student affairs practitioners reviewed the instrument for clarity and construct validity. Second, we conducted several focus groups with engineering students to identify points of confusion. Survey items were revised following both rounds of

review. Consistent with the strategies employed by Jones [29], several institutional tactics items were reverse-coded prior to model building.

5.3 Analysis

One of the goals of this paper is to provide evidence for the validity of our socialization process scales in the context of an undergraduate college of engineering. A socialization process cannot itself be measured. Instead, we postulate that a series of behaviors, attitudes, or opinions are related to particular socialization processes. This is called a construct. The validity of the construct is the degree to which it actually measures the factors under consideration [42]. We used structural equation modeling (SEM), which is a form statistical modeling to fit networks of constructs to data, to establish construct validity for factors representing institutional tactics and proactive behaviors. Since items representing institutional tactics and proactive behaviors were adapted from existing scales, we began by conducting a confirmatory factor analysis

(CFA) using *a priori* factor structures as detailed by Jones [29] and Ashford and Black [30]. Separate models were created for the institutional tactics (N = 916) and proactive behaviors (N = 906) scales using Stata IC 15.1 (StataCorp. 2017. Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC). The maximum likelihood (ML) estimator was used to fit the measurement model. Model fit was assessed by examining the model chi-square test statistic and by comparing absolute and incremental model fit statistics with established cutoff values: root-mean-square error of approximation (RMSEA \leq 0.06) [43], standardized root-mean-square residual (SRMR \leq 0.08) [43], comparative fit index (CFI \geq 0.95) [43], and Tucker-Lewis index (TLI \geq 0.95) [43]. After the factor structure was finalized, we computed scale reliability coefficients (Cronbach's α) for each factor.

6. Limitations

This study has several limitations that may reduce the generalizability of our findings. The largest is that this work was conducted at one institution that has a population that differs significantly from national trends along demographic lines (Table 1). For instance, this institution has a higher percentage of Asian students, and a lower percentage of Black, Hispanic, and low-income students. Thus, these findings may not be replicated at schools having different demographic and socioeconomic profiles. The premise of our overall study is that background characteristics matter for how students are socialized. At a school where students' background characteristics are very different, different findings would be expected. Therefore, these results will need to be replicated first at other research-intensive engineering institutions, and then to a broader array of types of institutions.

A second limitation is that female students were overrepresented in our survey, comprising 41% of our sample compared with just 26% of the population of undergraduate students in engineering. Although overrepresentation of female students is not a problem in and of itself nor unexpected [39], it may limit the generalizability of our findings to the student population, especially if male and female students differ significantly in terms of socialization.

Another limitation is that several sections of the survey instrument asked the upper-level student respondents to reflect on their experiences during their first year of college. Any retrospective reflection of this nature may introduce measurement error into survey responses, as respondents may mistakenly attribute current feelings and experiences to the period of time that is being measured

[44]. While it would have been preferable to survey first year students, this work is part of a larger study that investigates how background characteristics and socialization are related to participation in co-curricular activities [10, 45–47], which is why we focused on the more senior students.

7. Results

First, we fitted the six-factor models for institutional tactics (N = 916) and proactive behaviors (N = 906) as specified by the original authors. In the institutional tactics model, the covariance between the *fixed vs. variable* and *sequential vs. random* dimensions was greater than 1 (1.03) suggesting that the two constructs were highly collinear. Kline [48] argues that highly correlated variables in SEMs should be addressed by either combining or eliminating variables. In this study, we chose to eliminate one of the two highly correlated factors. To decide which to eliminate, we fitted two five-factor models for institutional tactics – one omitting *fixed vs. variable* tactics and one omitting *sequential vs. random* tactics – and determined which of the two highly correlated latent constructs should be removed based on model fit statistics. Results indicated that the model that omitted *fixed vs. variable* tactics was a better fit to our data. Thus, we retained the *sequential vs. random* factor and removed the *fixed vs. variable* factor from the model.

Even after removing the *fixed vs. variable* dimension, some fit indices in the five-factor institutional tactics model (RMSEA = 0.082, SRMR = 0.085, CFI = 0.710, TLI = 0.672) indicated poor model fit, and fit indices for the six-factor proactive behaviors model (RMSEA = 0.055, SRMR = 0.057, CFI = 0.941, TLI = 0.929) indicated that there was room for improvement. We examined factor loadings in the two models and removed items with loadings less than 0.40, which included eight items in institutional tactics and one item in proactive behaviors. This led to an improvement in fit overall, although the fit indices for the reduced institutional tactics model were still suboptimal (RMSEA = 0.066, SRMR = 0.061, CFI = 0.891, TLI = 0.863).

Our results also show that international students responded to these scales differently than domestic students. There are several reasons why this is so. Some of our survey items may have been difficult for international students (N = 61) to understand due to the presence of colloquialisms within the survey items, such as “being in the same boat” and “learning the ropes.” In addition, international students coming from other cultural contexts may perceive institutional tactics and engage in proactive behaviors quite differently from their domestic peers. We tested our hypothesis by using multiple indicator

Table 4. Confirmatory factor analysis results for institutional tactics of domestic students (N = 855) with scale reliability coefficients (α). Due to multi-collinearity with other items, “fixed vs. variable” was not included

Institutional Tactics Latent Variables & Indicators	Factor Alpha	Standardized Estimate	Standard Error
Collective vs. Individual	0.64		
I was extensively involved with other first-year students doing common, first-year experience activities (e.g., first-year seminars).		0.604	0.029
Other first-year students were instrumental in helping me adjust to college.		0.711	0.028
There was a sense of “being in the same boat” amongst first-year students in engineering.		0.720	0.026
Formal vs. Informal	0.49		
I went through a set of experiences that were specifically designed to give new students a thorough knowledge of the University of Michigan.		0.601	0.035
The College of Engineering ensured that I was thoroughly familiar with institutional procedures (e.g., registration) before I started classes.		0.564	0.035
I was very aware that I was seen as “learning the ropes” in the College of Engineering.		0.376	0.043
Investiture vs. Divestiture	0.63		
I was made to feel that I had great academic potential in the College of Engineering.		0.578	0.034
Almost all of my peers were supportive of me personally.		0.639	0.030
People went out of their way to help me adjust to the College of Engineering.		0.635	0.029
Sequential vs. Random	0.65		
There was a clear pattern in the way that I was expected to move through the engineering college experience.		0.584	0.035
The movement from class to class and activity to activity to build experiences and a track record was very apparent in the College of Engineering.		0.630	0.035
The steps in the student experience in the College of Engineering were clearly specified.		0.715	0.032
Serial vs. Disjunctive	0.74		
Experienced people in the College of Engineering (e.g., older students, staff) believed helping first-year students was important.		0.512	0.039
I gained a clear understanding of how to succeed in the College of Engineering by observing more senior students.		0.623	0.030
* I received little guidance from more senior students as to how to succeed in the College of Engineering.		0.701	0.033
* I had little or no access to more senior students in the College of Engineering.		0.675	0.030
* I was generally left alone to discover how to succeed in the College of Engineering.		0.553	0.031

Note: * indicates the item was reverse-coded. All standardized estimates were significant at the $p < 0.001$ level.

multiple cause (MIMIC) models to detect differential item functioning (DIF) between international and domestic students. The MIMIC models revealed DIF for three institutional tactics items and four proactive behaviors items. Based on these findings, we made the decision to exclude international students from the analysis and interpret the socialization processes models for domestic students only as our final measurement models.

Standardized factor loadings and scale reliability coefficients are displayed in Table 4 for institutional tactics (N = 855; domestic students only) and in Table 5 for proactive behaviors (N = 847; domestic students only). The chi-squared (χ^2) test statistics for both models were statistically significant ($p < 0.05$) indicating that the models were not a perfect fit for the data, but this is neither an unusual nor

damning finding given the large sample size [49]. Absolute fit indices for the domestic student institutional tactics model indicated poor-to-fair model fit. Specifically, the RMSEA was 0.063, which exceeds the cutoff value of 0.06 suggested by Hu and Bentler [43] for good model fit, yet falls within the cutoff of 0.08 for mediocre fit recommended by MacCallum, Browne, and Sugawara [50]. The SRMR was 0.059, indicating good model fit [43]. However, the incremental fit indices for the institutional tactics model indicated room for improvement. Specifically, the CFI (0.897) and TLI (0.872) did not meet the cutoff values of 0.90 [51] and 0.95 [43] respectively. Scale reliability coefficients for the five institutional tactics ranged from 0.48 (*formal vs. informal*) to 0.74 (*serial vs. disjunctive*). With the exception of the chi-squared statistic, absolute and incremental fit

Table 5. Confirmatory factor analysis results for proactive behaviors for domestic students (N = 847) with scale reliability coefficients (α)

Proactive Behaviors Latent Variables & Indicators	Factor Alpha	Standardized Estimate	Standard Error
Feedback Seeking	0.89		
I often sought feedback on my performance after assignments.		0.808	0.021
I solicited critiques from my professors/instructors.		0.800	0.023
I often sought out feedback on my performance during assignments.		0.813	0.021
I often asked for professors'/instructors' opinion of my work.		0.789	0.021
Positive Framing	0.78		
I tried to see being an engineering student as an opportunity rather than a threat.		0.812	0.023
I often tried to look on the bright side of things.		0.663	0.030
I tried to see my engineering major as a challenge rather than a problem.		0.759	0.027
Relationship Building	0.89		
I tried to spend as much time as I could with more senior students.		0.799	0.018
I tried to form a good relationship with more senior students.		0.853	0.017
I worked hard to get to know more senior students.		0.841	0.027
General Socializing	0.66		
I attended social gatherings to meet new people.		0.799	0.023
I participated in social events on campus outside of the College of Engineering to meet people.		0.853	0.030
I attended parties with friends I met in engineering.		0.841	0.027
Networking	0.78		
I started conversations with people from different academic majors than my own.		0.755	0.024
I tried to socialize with people (faculty, students, or staff) who are not in engineering.		0.784	0.026
I tried to get to know as many people as possible in non-engineering majors on a personal basis.		0.670	0.030
Information Seeking	0.81		
I tried to learn the important policies and procedures of the University of Michigan.		0.666	0.026
I tried to learn the official organizational structure of the College of Engineering.		0.848	0.018
I tried to learn the politics of the College of Engineering.		0.687	0.023
I tried to learn the unofficial structure of the College of Engineering.		0.780	0.023

Note: All standardized estimates were significant at the $p < 0.001$ level.

indices for the domestic student proactive behaviors model indicated good model fit. With respect to absolute fit indices, the RMSEA was 0.048 and the SRMR was 0.041, both within cutoff values proposed by Hu and Bentler [43] for good model fit. The incremental fit indices CFI (0.960) and TLI (0.950) were both equal to or greater than Hu and Bentler's [43] minimum cutoff value of 0.95. Scale reliability coefficients for the six proactive behaviors ranged from 0.67 (general socializing) to 0.89 (feedback seeking).

8. Discussion

Overall, we find that the factor structure proposed by the original authors for the institutional tactics scale was suboptimal, while that for the proactive behaviors scale fit our data well. A major finding of this work is that the adapted institutional tactics

scale does not appear to be appropriate in the context of an undergraduate college of engineering. Even after we excluded international students from our sample, eliminated the *fixed vs. variable* dimension, and removed individual survey items with low factor loadings, fit indices for the five-factor institutional tactics model revealed that the fit to our data was still suboptimal. Scale reliability coefficients (Cronbach's alpha) for the five dimensions were also relatively low, ranging from 0.48 (*formal vs. informal*) to 0.74 (*serial vs. disjunctive*). There are several reasons that the scale performed poorly. The first is that our implementation of the scale was faulty. That is, the way in which we adapted the survey items was inappropriate or did not capture the original intent of the items. One issue may be that the items in the original scale had mixed referents, meaning that the subject within each item was not consistent (e.g., "I went through a set

of experiences . . . ,” in which the individual is the referent, compared to “Experienced people in the College of Engineering (e.g., older students, staff) believed. . .” in which the referent is other individuals). This mixing of referents can lead to poor performing measures [52]. The second is the general lack of compatibility between the institutional tactics model of socialization as it was originally devised and the context of the college first-year transition. Perhaps some institutional dimensions developed in a business context are not directly applicable to the socialization experiences of undergraduate students. For example, our data indicated that the *fixed vs. variable* and *sequential vs. random* dimensions were highly collinear. In a workplace, understanding the sequence of steps over the course of a job trajectory (*sequential vs. random*) and the timeline by which a new employee can expect to proceed through those steps (*fixed vs. variable*) may be independent. On the other hand, all full-time undergraduate students move through a highly linear process of promotion from freshman to sophomore, sophomore to junior, etc. at essentially the same rate. Therefore, these two dimensions are not separate in the higher education context. It is also worth noting that even in the original context of newcomers in a workplace, model fit statistics for the institutional tactics model failed to meet accepted cutoffs for good fit [29, 31] and the six factors were found to lack both construct and predictive validity in a meta-review conducted by Bauer et al. [53].

For all of these reasons, and in alignment with Chen and Yao [34], we therefore recommend that the institutional tactics survey items and factor structure proposed by Van Maanen and Schein [28] and Jones [29] be used merely as a guideline for studies of student experiences in higher education, if at all. While institutional tactics are no doubt an essential component of the undergraduate socialization experience during the first year of college, further exploratory work may be necessary to develop a suitable set of measures for institutional socialization tactics in this context.

In contrast, we were encouraged by the fact that the original six-factor proactive behaviors model fit our data well. Although Wang et al. [37] and Cho and Lee [35] previously adapted parts of Ashford and Black’s [30] proactive behaviors scale for the college context, to our knowledge this work is the first to adapt and validate the measure in its entirety. Having a reliable measure of proactive socialization behaviors will help the higher education research community and college administrators alike gain a more complete understanding of the social aspects of the college transition on a large scale. In turn, studying how first-year students engage (or fail to

engage) in proactive socialization behaviors may shed light on patterns of extracurricular involvement, academic achievement, emotional wellbeing, and other factors contributing to overall college success. For example, Wang and colleagues [37] showed that engaging in *general socializing* behavior mediated the relationship between extraversion and participation in extracurricular activities, while *feedback seeking* behavior partially mediated the relationship between conscientiousness and GPA. Results such as these could inform the evidence-based design and evaluation of interventions promoting beneficial proactive behaviors that contribute to desired outcomes. In addition, having a reliable metric for detecting students who fail to engage in proactive socialization behaviors at appropriate levels during the college transition could help advisors and instructors identify students who are at risk for attrition. Our future work will explore the relationships between proactive socialization behaviors, student background characteristics, extracurricular involvement, and college outcomes such as post-graduation aspirations, academic achievement, and social capital.

MIMIC models revealed DIF between international and domestic students for multiple items belonging to both the institutional tactics and proactive behaviors scales. For example, international and domestic students who engaged in the same level of *relationship building* behavior overall responded differently to the specific item within the behavior “I tried to form a good relationship with more senior students,” with international students showing a lower level of agreement with this particular item. The finding that international students respond differently may have many possible explanations. One is the language barrier, in that differences in understanding the meanings of questions between native and non-native English speakers may have introduced measurement error. In future work, this source of error might be mitigated by including students for whom English is not a first language in the survey pretesting process to identify discrepancies in comprehension. Another explanation could be that international students and domestic students quite literally experienced different institutional tactics during the transition to college (e.g., through separate orientation programming for domestic and international students). In addition, even the same experience may be perceived, interpreted, and subsequently reported in very different ways depending on the cultural context and values of the observer. While all first-year students experience a social and cultural transition as they adjust to college life, the transition may be particularly dramatic for international students who are simultaneously adjusting to American

culture more broadly [54]. Finally, it is worth noting that the international students in our sample are a diverse group. Although most hail from either China ($N = 26$, 43%) or India ($N = 10$, 16%), the remaining 25 students represent 18 different countries. It would be unwise to attempt to characterize the college transition and socialization experiences of international students at this institution based on these limited survey data alone.

9. Conclusions

The goals of this work were to describe the adaptation of scales from the field of organizational behavior measuring institutional socialization tactics and proactive behaviors to engineering students, and to provide validity evidence for the use of these scales in a college context. The analysis revealed that international students as a group answered the items on the survey differently than domestic students as a group. These results suggest that there is a gap in understanding the experiences of international students. More specifically, researchers should pay attention to how students from various backgrounds might interpret survey items when developing new scales. Model fit statistics for the proactive behaviors scales taken for the domestic students met commonly accepted benchmarks for good model fit, and are a promising means for understanding how domestic engineering students orient themselves within the college environment. Several fit indices for the institutional

tactics scales for domestic students did not meet cutoffs for good fit despite numerous modifications; thus, we recommend that the published institutional tactics survey items and factor structure be used merely as a guideline for studies of student experiences in higher education. Future work may uncover important relationships among student background characteristics and engagement with proactive behaviors, as well as relationships between proactive behaviors and outcomes including academic achievement, extracurricular participation, and professional identity formation.

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Appendix

Listing and definitions of acronyms used in the paper

Acronym	Definition
CFA	confirmatory factor analysis
CFI	comparative fit index
DIF	differential item functioning
MIMIC	multiple indicator multiple cause
ML	maximum likelihood
RMSEA	root-mean-square error of approximation
SEM	structural equation modeling
SRMR	standardized root-mean-square residual
TLI	Tucker-Lewis index

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