The Role of Identity in Understanding Graduate Teaching Assistants: A Mixed Methods Analysis*

RACHEL L. KAJFEZ
Department of Engineering Education, Ohio State University, Columbus, OH, USA. E-mail: kajfez.2@osu.edu

HOLLY M. MATUSOVICH
Department of Engineering Education, Virginia Tech, Blacksburg, VA, USA. E-mail: matushm@vt.edu

Despite widespread reliance on Graduate Teaching Assistants (GTAs) in higher education, little is known about their identity as teachers and motivation toward teaching. To begin closing this gap, we conducted a sequential mixed methods study focused on GTAs in large first-year engineering programs. Our goal was to establish profiles of current GTAs based on key features of identity and motivation. Our analysis yielded three teaching identity profiles: strong, transitional, and weak. The data reveal that motivation constructs matter to GTAs individually but perhaps do not contribute to profiles. A key finding was that identity is the strongest driver of clustering and grouping across the quantitative and qualitative data. We describe potential implications of current teaching development practices for GTAs in each profile.

Keywords: graduate teaching assistants; motivation; identity

1. Introduction

Many disciplines in higher education rely on Graduate Teaching Assistants (GTAs) to assist with classroom education. GTAs fill a variety of roles, including lead instructor (instructor of record), lab supervisor, or grader. Despite widespread reliance on GTAs, little is known about GTAs' experiences, especially with regard to their identity as teachers and motivation toward teaching. This study begins filling that gap by establishing profiles of current GTAs based on key features of identity and motivation; these profiles are useful for informing GTA preparation and training programs. We narrowed our focus to GTAs in first-year engineering programs (FYEPs), recognizing that there are pedagogical and epistemological differences among disciplines in higher education (e.g., [1]). Engineering was chosen because it is a field ripe for educational transformation as continually noted in several special issues of the field's most prominent journal [2]. FYEPs were chosen because they tend to be large in size, have multiple sections of the same class, and draw on a common content that links the sections together [3, 4]. This similarity among sections is ideal for examining GTAs' teaching experiences as it provides larger numbers of possible participants in settings where many potential differences across classes (i.e., content, teaching responsibilities) are reasonably controlled. At the same time, we believe our findings are relevant and transferable to other contexts because we intentionally mix qualitative and quantitative data to get a breadth and depth of participant experiences.

1.1 Purpose and Objectives

The purpose of this study was to understand GTAs' motivation to teach and their identity development as teachers to inform the creation of profiles that can be used to generate targeted training for GTAs. Our GTA profiles broadly define different types of individuals, based on motivation and identity that commonly work in FYEPs. Through this work, we ultimately hope to improve the quality of GTA teaching in FYEPs by enabling the future development of research-based training programs for GTAs that are grounded in motivation and identity.

This work is part of a larger research study with an overarching research question: *How do graduate students' motivation to teach and future identities as teachers develop when serving as GTAs in FYEPs?* For this analysis, we answered the following sub-question:

- What teaching profiles can be constructed that distinguish between different GTA teacher motivations and identities?

We approached this analysis through a sequential mixed methods design [5] because it best addressed our research question and allowed us to guide the analysis of our qualitative data through the results of the quantitative data. A mixed methods design also allowed us to obtain more information through both surveys and interviews, which provided deeper insights into our research question. Mixing of the data facilitated the creation of complete identity/motivation profiles of the GTAs.

1.2 Theoretical Framework

For this analysis, we combined Self-Determination Theory (SDT) [6, 7] and Possible Selves Theory (PST) [8, 9] to take a holistic approach to GTA motivation and identity, respectively. The combination of these two theories is detailed in our previous work [10]; however, we provide a brief overview below to help contextualize our work.

For motivation, we used SDT, which is founded on the principle that people act in ways that lead to the satisfaction of basic psychological needs [6, 7]. SDT is a holistic theory in that it is intended to apply across life domains. Consequently, there are many interconnected aspects to this theory, and SDT has been considered a collection of mini-theories [11]. For this research, we focused on the three psychological needs that are foundational to the theory: competence [12, 13], autonomy [14, 15], and relatedness [16, 17]. In general terms, competence equates to knowledge, autonomy is defined as decision making power, and relatedness encompasses a feeling of community or belonging [6, 7]. Satisfaction of these needs leads to autonomous self-regulation and higher quality motivation. SDT has a rich history within education (e.g., [18]) so we drew on this literature to operationalize the three basic needs to the unique context of GTAs in FYEPs.

For identity, we used PST, which is based on the notion that future-oriented actions are guided by individuals' thinking to the future and envisioning who they would like and not like to be [8]. Additionally, PST requires the future views to be connected to the current identity, congruent with current goals, and possible to achieve [19]. This theory was appropriate for examining the identity of GTAs because GTAs are in a transitional life stage moving from students to professionals.

Through this work, we argue that identity and motivation are connected where PST captures the present context. Through PST, a GTA imagines their future possible teacher self, serving as the basis for understanding a GTA's motivation and identity development. We presume that in the role of GTA, the GTA moves toward a possible future teacher self which she or he might enact after graduation or at any point in the future. As a GTA progresses, she or he gains or experiences competence, autonomy, and relatedness, which serve as the connections between motivation and identity development.

2. Methods

We used a sequential mixed methods design [5] to gather data about the experiences of GTAs in FYEPs. The data included interviews and surveys with GTAs at multiple universities. Fig. 1 depicts the steps of the project including the qualitative and quantitative phases, which were sequential, and the analysis, which was both sequential and concurrent (i.e., the results of the survey informed further analysis of the interviews and vice versa). The research project was conducted in accordance with procedures approved through the Institutional Review Board.

To ensure a well-crafted study by mixed methods standards (e.g., [20, 21, 22]), mixing occurred in all phases of the study from design through discussion. However, we ultimately gave the qualitative strand priority because of the richness of the data itself and the uniqueness of the findings within disciplinary literature that led to a natural domination of the qualitative data in the analysis and results.

2.1 Study Participants

We identified study participants in multiple ways. First, we identified schools with an FYEP as opposed to direct matriculation into a major, two common organizational structures of engineering programs [3]. From the universities with an FYEP that responded to an informational survey, we
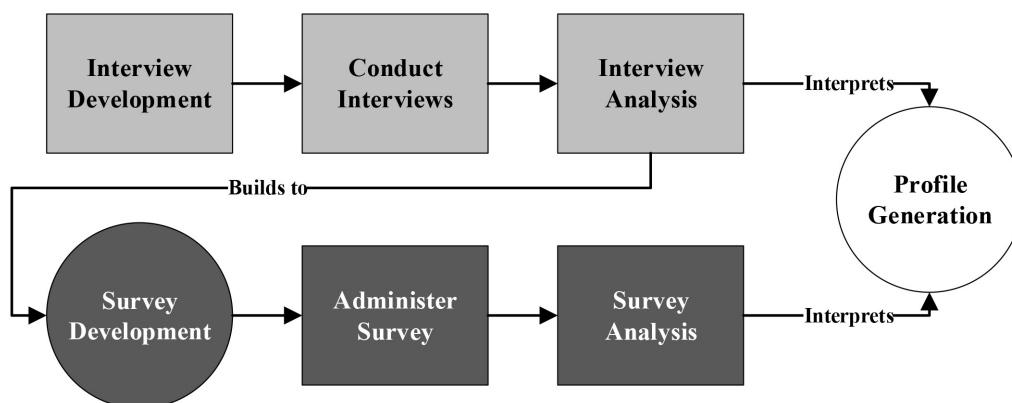

Fig. 1. Study Design.

recruited GTA interview participants and GTA survey participants. Importantly, the GTA interview participants were not necessarily the same GTA participants who took the survey; it is possible that an interview participant took the survey, but we did not intentionally connect these data strands.

2.1.1 Participating Universities

GTA participants came from a total of seven universities (pseudonyms U1–U7). The seven came from a sample of 15 that responded to the online informational survey designed to gather information related to the size of the FYEP, the program structure, and the responsibilities of both GTAs and Undergraduate Teaching Assistants (UTAs) [23]. This informational survey provided basic understanding of FYEPs in the United States, and the

roles and responsibilities of TAs (graduate and undergraduate) within those programs. Table 1 provides demographic information about the universities and their FYEPs drawing on information from the informational survey, a regional map, and classifications from The Carnegie Classification of Institutions of Higher Education [24]. Interview participants came from U1–U5, and survey participants from U1–U7.

2.1.2 Interview Participants

We recruited a total of 12 interview participants from a potential pool of 50 by contacting the pool through emails with permission from the five participating schools. The details of the interview recruitment and the interviews themselves have been reported elsewhere [25]. Table 2 summarizes key

Table 1. Basic University Information

University	Basic University Information			Basic FYEP Information		
	Public/ Private	Approximate Student Population	Region	Program Structure	FYEP Student Enrollment 2011–2012	Employ GTAs or Both GTAs and UTAs
U1	Public	40,000	Mid-West	2 Course Sequence, Honors Track	1800	Both
U2	Public	55,000	Mid-West	2 Course Sequence, Honors Track	1600	Both
U3	Public	30,000	South	2 Course Sequence, Honors Track	600	GTAs
U4	Public	20,000	Southeast	2 Course Sequence	700	GTAs
U5	Private	10,000	Mid-West	2 Course Sequence, Honors Track	460	Both
U6	Public	30,000	Southeast	2 Course Sequence	1400	GTAs
U7	Public	30,000	Southeast	Unknown	Unknown	Both

Table 2. Interview Participant Demographics

Participant	University	Gender	Major	Degree	Teaching Experience		
					First Year Teaching or Less in FYEP (9)	Second Year Teaching or More in FYEP (3)	Other Experience Before FYEP (6)
Brent	U1	Male	Aero	Master's		X	
Ingrid	U1	Female	EngE	PhD	X		X
Jillian	U1	Female	EngE	PhD	X		
Sam	U1	Male	ECE	Master's	X		
Susanne	U1	Female	CSE	Master's	X		X
Zachary	U1	Male	EngE	PhD	X		X
Dan	U2	Male	ECE	Master's	X		
Gordon	U2	Male	Civil	Master's		X	
Wesley	U2	Male	BioMed	PhD	X		
Corey	U3	Male	Civil	Master's	X		X
Roberto	U4	Male	Civil	PhD	X		X
Maurice	U5	Male	ISE	Master's		X	X

information related to the 12 interview participants, including the randomly assigned pseudonym for each participant, the institution he/she attended, and relative teaching experience.

2.1.3 Survey Participants

In total, we invited 134 GTAs from the seven FYEPs to participate in the survey and received 33 completed responses for a response rate of 25%. Although U1 opted to contact their GTAs directly, they followed the same survey advertisement procedures and the same email protocols that we used to contact the other institutions. While 25% is a relatively low response rate, it is consistent with other phases of the study and Nulty [26] who reported a 20–40% response rate for online teaching surveys. To maximize our response rate, we sent two reminder emails and offered an incentive of a chance to win one of four $25 Amazon gift cards. An incentive of a $20 Amazon gift card was also provided to those directors and administrators who supplied email addresses of their GTAs. Table 3 shows demographic and other key information about survey participants.

2.2 Mixing

Creswell and Plano Clark [5] define mixing, or integration, as "the point in the research procedures where qualitative research interfaces with quantitative research" (p. 220). Mixing occurred in all phases of our analysis, starting with the initial design and moving through the study discussion:

- *Design Phase:* As shown in Fig. 1, both quantitative and qualitative components were planned from the beginning and intentionally kept in mind through all phases of the study.
- *Data Collection:* In each of the major phases, we collected both qualitative and quantitative data. For example, each interview was mostly qualitative with open-ended questions, but a set of quantitative questions gathered data on years of experience teaching and rating levels of several research constructs. For the survey, open-ended questions gathered additional qualitative data.
- *Analysis:* Although the two data strands were initially analyzed separately, mixing in the analysis occurred in the form of connecting [5, 21], where the results of the quantitative phase guided the analysis of the qualitative data (i.e., the finding of identity being the most salient construct that guided the profile development).
- *Discussion:* Both the qualitative and quantitative findings were compared to the literature, together identifying similarities and differences between the data sets.

Consistent with our approach of mixing across all

Table 3. Survey Participant Demographics

Item/Response	Percentage	Number Out of 33
Gender		
Male	58	19
Female	30	10
No Response	12	4
Age		
30 or Younger	70	23
31 to 40	15	5
41 or Older	3	1
No Response	12	4
Race		
White	52	17
Asian	12	4
Black/ African American	6	2
Hispanic/ Latino	9	3
Other	6	2
No Response	15	5
Degree		
PhD	67	22
Master's	33	11
Discipline		
Traditional Discipline	48	16
Engineering Education	27	9
Other	9	3
No Response	15	5
General Experience		
Prior Experience	82	27
No Prior Experience	18	6
FYEP Experience		
First Term in FYEP	42	14
Not First Term in FYEP	58	19

Notes. "No Response" includes those who selected "Prefer Not to Answer" and those who simply did not select an option. "Traditional Discipline" includes engineering majors such as civil, mechanical, aerospace, etc., and "Other" includes disciplines that were not provided on the list.

phases of the study, the interview and survey data are mixed for the balance of this manuscript.

2.3 Data Collection

2.3.1 Interviews

Interviews were conducted during the summer of 2012 using a protocol informed by pilot data and current literature. A draft protocol was piloted with two GTAs, one male and one female, who were both outside of the sample for the balance of the study and who both taught in an FYEP in spring 2012. As

a result of the piloting, a pre-interview questionnaire was added to collect basic demographic information about the participants and their role within their FYEPs. The questionnaire was sent out to the participants a day or two before their interview and was used in the interview to guide the initial discussion. The interviews were semi-structured, lasted approximately 1 hour, and were conducted over the phone. The lead author conducted all of the interviews allowing for consistency across participants. Interviews were audio-recorded and transcribed.

2.3.2 Survey

Drawing on interview findings, similar to Crede and Borrego [27] exploratory sequential mixed methods design, and current literature, we created survey questions to target the unique experiences of GTAs in FYEPs. There were three types of questions in the survey:

1. Scaled questions (some of which were developed from existing instruments relative to SDT such as the Basic Psychological Needs Scale and the Perceived Competence Scale [28]).
2. Open-ended questions designed to capture a range of information in the participants' words (some of which were developed from the PST Next Year Possible Selves interview questionnaire [29].
3. Uniquely formatted questions directly related to outcomes of interview analysis.

As a pilot test to ensure a well-crafted survey [30], two GTAs (one female who did not enjoy teaching and one male who was passionate about teaching) outside of the sample completed the survey as a think-aloud where they discussed the survey as an actual participant commenting on what they thought each question meant including any sources of confusion [31]. Based on that first round of pilot testing, the PST question was reformatted to break up the question into multiple sub-questions to improve the usability of the survey. For the second pilot test, two additional individuals (again one male and one female) outside of the sample took the survey independently online to provide feedback about timing and question wording. Based on that second round of pilot testing, editorial issues were fixed, and it was determined that the survey should take no longer than 20 minutes to complete.

2.4 Analysis

2.4.1 Interview Analysis

Analysis of qualitative aspects of the interviews had four components: (1) initial *a priori* coding, (2) open coding, (3) code categorization, and (4) theme/ pattern generation. This approach loosely follows coding as described in framework analysis by Srivastava and Thomson [32] and Ritchie and Spencer [33]. We analyzed the data using both an *a priori* and opening coding approach, organized the data into a meaningful format, and discussed the data in reference to the findings of past research. In the *a priori* approach, the major constructs of the framework served as the codes (competence, autonomy, relatedness, identity). Following the *a priori* coding, a round of open coding allowed for an inductive examination of the interviews. Open coding involved an iterative process where the transcripts were reviewed multiple times to ensure each transcript was coded for all open codes developed from the transcripts. The approach used was guided by the techniques described in Rossman and Rallis [34] and Patton [35]. Once the open codes were developed and finalized, they were categorized based on the *a priori* constructs established through the literature review and framework [35]. After multiple passes through the data, the codes were reviewed for overarching themes that described a GTA's motivation to teach and identity development as a teacher.

2.4.2 Survey Analysis

Before analysis, the survey data was cleaned to remove incomplete cases when appropriate, according to the recommendation of Rea and Parker [36]. Cases were removed if a participant only answered the first few demographic questions or if an individual did not fully answer a set of questions related to a construct. If they answered all the questions related to one construct, but not others, they remained in the sample. Also, reverse coded questions were re-scored for alignment with other items.

Once the data was clean, the analysis of the quantitative results included descriptive quantitative statistical techniques that provided information such as general response to the constructs, standard deviation of responses, and common patterns. To determine the general response to the constructs (competence, autonomy, relatedness, and identity), the responses to the questions related to each construct were averaged to create a construct score. None of the constructs displayed normal distributions so the analyses that followed only looked at means, standard deviations, percentages, and other statistics that helped to describe the results. The reliability of the construct questions was assessed using Cronbach's Alpha (Table 4). All of the Cronbach's Alpha scores were over 0.7, which is an acceptable measure of internal consistency confirming the reliability of the instrument [37].

2.5 Profile Development by Mixing

Mixing the data enabled us to create identity/

Table 4. Cronbach's Alphas for Constructs

Construct	Alpha	Number of Questions
Competence	0.78	9
Autonomy	0.73	9
Relatedness	0.84	11
Identity	0.89	6

motivation profiles of GTAs who teach in FYEPs. The overall profile development included clustering the quantitative response, applying the salient cluster components to the qualitative data, and reviewing the qualitative data for patterns by clusters. If it were not for both types of data, these profiles could not have been developed.

2.5.1 Clustering Quantitative Responses

A cluster analysis was performed on the survey data using the construct scores for competence, autonomy, relatedness, and identity to develop groupings of participants. For this particular analysis, a two-step clustering technique was used in SPSS following the procedures and recommendations of Norušis [38]. This analysis resulted in three distinct clusters where the strongest contributing construct to the clusters was the identity construct. Table 5 summarizes the mean scores for each construct by cluster.

In Table 5, the colors correspond to a high (grey), medium (white), or low (black) ranking and have been used to simply capture visual patterns in the data. The ranking was determined by taking the highest and lowest individual scores for each construct and splitting that range into three equal segments. For example, for identity, the highest rating was a 5 and the lowest a 2.8. The difference between these is 2.2 so those who ranked 2.8 to 3.5 were low, 3.6 to 4.2 were medium, and 4.3 to 5 were considered high. This same methodology was applied to all of the constructs determine how the averages for each cluster and each construct related to the rest of the sample responses rather than how they compared to each other. For example, when relatedness is examined, you will notice that the averages for both Cluster 1 and Cluster 3 fell into the medium ranking when compared to the large

sample, even though compared to each other Cluster 1 had a higher relatedness score than Cluster 3. This shows how the clusters were compared to the entire sample, not just the clusters that were determined from the analysis.

2.5.2 Applying salient cluster Components to Qualitative Data

Because identity was the main construct for determining the clusters based on the two-step clustering technique in the quantitative analysis, identity was used to group the interview participants in the qualitative data. Looking at the qualitative data, the interview participants were grouped based on a high, medium, or low self-reported rating of their identity as a teacher. During the interviews, the participants were asked to score themselves in relation to the constructs:

- On a scale from 1 to 10, where 10 means you are an expert regarding content and teaching practices, what is your level of competence?
- On a scale from 1 to 10, where 10 means you are in complete control of your class, what is your level of autonomy?
- On a scale from 1 to 10, where 10 means you feel like you are extremely connected to your students and colleagues, what is your level of relatedness?
- On a scale from 1 to 10, where 10 means you are a teacher, how much is being a teacher part of your identity?

The answers to these questions were used to determine whether the participant had a self-reported high, medium, or low ranking in relation to the other participants for each construct, following the same ideas discussed for the quantitative data. Each participant's category was determined by taking the highest and lowest scores for each construct and splitting that range into three equal segments, as was done with the quantitative data. Those individuals who fell into each segment served as the groupings to examine the construct more in depth. For example, for identity, the highest rating was a ten and the lowest a four. The difference between these is six so those who ranked 4 to 5.9 were low, 6 to 7.9 were medium, and 8 to 10 were considered high. This same methodology was

Table 5. Results from Survey Data Cluster Analysis

Cluster	Teacher Identity	Teaching Motivation		
		Competence	Autonomy	Relatedness
Cluster 1	4.7	4.4	3.4	4.1
Cluster 2	4.1	3.8	2.4	3.3
Cluster 3	3.4	3.4	3.1	3.6
Response Range	(2.8 to 5.0)	(3.0 to 5.0)	(2.0 to 4.1)	(3.0 to 4.8)

Table 6. Interview Participant Self-Reported Construct Score

Participant	Teacher Identity	Teaching Motivation		
		Competence	Autonomy	Relatedness
Dan	9	7.5	6.5	10
Maurice	9	7	4	8
Sam	10	9	4	8
Susanne	10	6	4	8
Wesley	9	7	7	5.5
Gordon	6.5	8	7.5	10
Roberto	6	7	5	9
Ingrid	7	6	1	5
Jillian	7	7	2	6
Zachary	8	7.5	2	4
Brent	5.5	8	7	6
Corey	4	8.5	6	7.5

applied to all of the constructs. The scoring for both the quantitative data and the qualitative data was not normalized (i.e., scaled from zero to one) because the analysis of this data was simply to show clusters and general patterns, as opposed to proving statistical findings.

Table 6 shows the scores reported for each construct by interview participant, where the color-coding highlights visual patterns (grey = high, white = medium, black = low). Notice that for Tables 5 and 6 the color patterns between the constructs do not match (i.e., those with high identity do not always have high competence, high autonomy, and high relatedness). Also between Tables 5 and 6, the color patterns do not match (i.e., the pattern observed in Table 5 for the combined clusters of high identity, high competence, high autonomy, and middle relatedness does not match the pattern observed in Table 6 for the individual participants of high identity, middle competence, middle autonomy, and high relatedness). These disagreements suggest that for this data set identity can be used to classify participants but that the motivational constructs are perhaps more nuanced or individual-dependent.

2.5.3 Reviewing the Qualitative Data for Patterns by Clusters

Once the groups were established, the transcripts and codes from the qualitative analysis were reviewed to identify patterns among the groups (i.e., the interviews were already coded but the codes were re-reviewed for specific patterns within each grouping). Because identity was the construct driving the clusters, it served as the overall categorization for the profiles (teacher identity profiles). After reviewing the qualitative data, the high,

medium, and low categories were renamed (not regrouped) to better align with the findings in the data. We used strong, transitional, and weak as opposed to high, medium, and low for the identity profile names to better align with the participants' experiences. By combing the qualitative and quantitative results in this manner, a holistic view of GTAs' teaching identities was observed.

3. Results

Our mixed methods analysis yielded three distinct teaching identity profiles: strong, transitional, and weak. These three identity profiles are distinct from each other and capture a range of GTA identity development experiences. Because we also found that the motivation constructs were not as consistent across the quantitative and qualitative data, we focus on the identity aspect in creating and discussing the profiles. Importantly, the data do reveal that motivation constructs matter (see [25]), but perhaps not to the profiles; a key finding of our study is that identity is the strongest driver of clustering and grouping across the quantitative and qualitative data sets. Table 7 summarizes the findings for each identity-based profile.

3.1 Strong Teacher Identity

The strong teacher identity profile includes GTAs who self-identify as having a strong identity as a teacher. From the qualitative phase of this work, Dan, Maurice, Sam, Susanne, and Wesley exemplify this profile. In general, these individuals believed that teaching was integral to who they are and they have a drive for a future career that involves teaching.

Table 7. Profile Summaries

Teacher Identity Profile	General Trends	Future Careers
Strong	Teaching is something they are meant to do	Teaching is a direct component of their future career
Transitional	Teaching is something they are just considering as part of who they are	Teaching is something they will consider for the future but they are also considering other options
Weak	Teaching is something they enjoy doing but it does not define them	Teaching is not something they see themselves doing in the future

3.1.1 Teaching as Part of the Strong Identity Profile

In this profile, GTAs believed that teaching was something you do beyond the confines of a classroom, integrating teaching into various aspects of their lives. They also believed that there is some kind of natural fit to teaching. As stated by Sam, a new GTA but a past student of the program:

> "I can relate to the teaching aspect of things. So I think it's something I don't know if, it's genetically even possible, but I do feel in a sense that it's there, you know the teaching gene."

For this group, teaching was a natural fit, as shown in the quote above, and was something they were meant to do. As Dan stated:

> "The thing is, I generally like teaching, and I feel, it feels natural to me, standing in front of a class. . . I like the feeling of trying to help students out, and all of that."

Echoing Dan's statement of teaching being a natural fit, Wesley, who was also a new GTA, stated:

> "It goes along with the fact that it's part of who I am. And it was, it was interesting that I discovered this experience, which it kind of helped me know, part of me that I was unfamiliar with. I always knew I had to you know, teach in order to be happy, but I did not know it was that much."

These quotes demonstrate that people in the strong identity profile see teaching as a key aspect to who they are and what they do.

3.1.2 Strong Identity Future Possible Careers

In terms of possible future careers, these individuals explicitly mentioned their future careers involving either some degree of teaching or as a direct consideration of teaching as a long-term option. Susanne and Dan, both master's students in traditional engineering disciplines, are examples of students who want to pursue academic careers that include teaching. Susanne stated, with regard to a future possible career:

> "I think I would like maybe to direct a first-year program or something like that. I really like the idea of having students work on problems such as open-ended problems, design problems."

Like others in this profile, Dan wanted a research-based faculty job, but also wanted teaching to be a part of that. When asked what kind of balance he would like between research and teaching in a faculty position, Dan discussed the importance of teaching to a faculty role:

> "So from a student's point of view, like right now, when I see my professors, I would hope that they would have 50–50 percentage. And yes, that would be ideal, to have 50–50, because then when I teach, I profess, I have come across professors who prioritize their research over academia, you know teaching, and that's, that doesn't seem very fair to the students, from my point of view, anyway. So I would definitely try to make it as close to 50-50 as possible, if I had the opportunity, that is."

The only participant in this profile who did not desire a faculty position was Sam. When asked about his future career, Sam first mentioned that he wanted to go into electrical engineering consulting, but when specifically asked about teaching, he saw that as a definite option for his future even if it was not what first came to mind. This suggests that for this profile, teaching is a viable option for these individuals even if it is not the first ideal job.

3.2 Transitional Teacher Identity

The transitional teacher identity profile includes GTAs that self-identify as having a middle identity as a teacher, i.e., their self-reported survey rating fell between the strong and weak identity profiles. Including the qualitative phase of this work, Gordon, Roberto, Ingrid, Jillian, and Zachary exemplify this profile. Originally, this profile was called the "medium" profile to align with the way the profile was developed. Later, the title was changed to "transitional" as the participants were clearly in a transformational phase transitioning to or away from a teacher identity. The interviews provided possible explanations for the transitional identification.

3.2.1 Teaching as part of the Transitional Identity Profile

Participants categorized as "transitional" have recently considered or reconsidered teaching or

being a teacher as part of their identity. Typically, a recent happening led them to consider teaching to be a salient part of who they are (or are not) and they were able to articulate that change clearly.

The transition happened at different times for different people. For example, the segment of the interview with Roberto below exemplifies an identity transition currently taking place.

> "*Interviewer:* So then, thinking about everything that you want to do in the future and everything that you have done in the past, um, would you say being a teacher is part of your identity?
>
> *Roberto:* Uh I think it is becoming part.
>
> *Interviewer:* It's becoming part? So could you talk a little bit more about that? Kind of in that evolution it sounds like you are going through?
>
> *Roberto:* Well, it's just, I've transitioned from like student to the faculty, I think it's sort of, I don't know, I think I'll be able to identify less with being a student and eventually more with being a teacher."

Here Roberto, a PhD student, stated that in his role, he is now transitioning to that teacher identity and that in the future he will be even less connected to his own student identity. Jillian, a new GTA and an engineering education PhD student, went through a similar transition that actually took place in the interview. When asked about her teacher identity, Jillian said:

> "I'm not sure actually. I haven't really thought about this. I would think so. Um, just because it's a role I was proud to take on and one that we still continue whenever I run into students and they have problems and, you know, if they have questions about any content I definitely still can help them out. So yeah I would consider it, um, a significant portion of my identity now that I think about it."

In this quote, Jillian goes from not thinking of teacher as part of her identity to seeing it as a "significant portion" of who she is. She experienced the transition milestone in the interview. Jillian and many of the other members of this group consider teaching an important part of their identity now that they have actually been a GTA and taught.

3.2.2 Transitional Identity Future Possible Careers

Participants in this group have a mix of desired future careers, but teaching was mentioned in some way. Exemplifying the transitional aspects of this profile, when asked what job he would like to hold in the future, Zachary stated:

> "Ok, it keeps changing. So I came in with, I came from an electrical engineering background and my goal was to be an electrical engineering faculty member, who did engineering education research and you know, tenure track, that kind of thing. But the more I spend teaching and the more I spend doing educational research, the more I want to be able to have opportunities to teach in a classroom environment. So right now I'm leaning

towards something more at a teaching college, where I still have the opportunity to do research and mentor students but definitely more classroom and those types of experiences."

Even with regard to his future job, Zachary, a PhD engineering education student, demonstrates a transitional mentality where his connection or even interest to teaching is shifting.

Within this category overall, the other participants had more solid views of their future careers than Zachary, and they all had an educational focus. Participants ranged from the strong end of the spectrum, e.g., Roberto who currently has a full-time job teaching, to the weak end of the spectrum, e.g., Gordon who is now working in industry but sees teaching as a possible career for himself in 20+ years after he retires from industry.

3.3 Weak Teacher Identity

The weak teacher identity profile includes GTAs who self-identified as having a weak identity as a teacher on the survey. Drawing on the qualitative phase of this work, only Brent and Corey belong to this profile. In general, participants in the weak profile have a strong drive to go into something other than teaching and often see being a teacher as something they just do right now.

3.3.1 Teaching as part of the Weak Profile

The two participants in this identity profile saw their GTA responsibilities as simply work. When asked about their identity as a teacher, they often hesitated and said that other areas of their identity were more salient. This is exemplified by Brent who was both a past student and UTA in his FYEP. When asked why he did not score himself higher with regard to his teacher identity, Brent said:

> "I think there's more [to who I am]. There's more to just being a teacher. So I think in addition to that I kind of like being a designer and that kind of thing."

Brent is a master's student in a traditional engineering discipline, which explains his drive to be a designer. In this quote, he sees himself as a teacher, but he believes it is only a part of who he is. He also sees himself as a designer or more generally an engineer. Corey, who is also a master's level student in a traditional engineering discipline said, with regard to his teacher identity:

> "Because I guess I am a teacher. I'm teaching but I wouldn't, in my psyche I don't see myself as being, 'oh yeah I'm a teacher.' Sometimes I have to remind myself that's really what I am doing but I'm at the university all of the time. Part of the time I'm teaching, a lot of the time I'm taking classes, doing homework so it's an integrated thing. I don't go there to teach. I go there to go to school, even though at the same time, I am teaching."

His response exemplifies that GTAs are not only teachers, they are also students, researchers, husbands, parents, etc. Corey's views on teaching and being a teacher are also highly influenced by his wife who has been educated as a K-12 teacher. In Corey's mind, being a "teacher" means educating children, and even though he is a Graduate "Teaching" Assistant, he does not see being a teacher as a strong part of who he is, it is something that he does.

3.3.2 Weak Identity Future Possible Careers

Considering PST in the context of this identity profile, these individuals wanted their future careers to involve working in industry. When specifically asked about a job teaching, they saw it as something to fall back on, but it was not what they wanted to do for a career. Also in this profile, the fallback teaching appointments were not in higher education. Regarding what he wanted to do after graduation, Brent initially said:

> "I'm still trying to figure that out. I'm not really sure yet. I kind of want to [get] into product development, see if I can do that. Still trying to figure that out actually, right now."

When specifically asked "do you see teaching being part of your future career at any point?" he said:

> "Possibly. Possibly, yeah. That might be something I look into too as well, like teaching software at an industrial level."

These quotes demonstrate that Brent is very unsure about his future career in general, but that teaching is not going to take a primary role. Similarly, when asked about his future career, Corey said:

> "My ideal job right now would be to get a job at an engineering firm and to be a design engineer."

When specifically asked if he saw teaching as part of a future career, he said:

> "My wife would kill me if I did this, but I would almost like to try to teach high school math, maybe at like a private school or something where it would be a part-time thing. I do enjoy teaching; I would just like to have more of an atmosphere where I control the curriculum, and I control more of the grading rubric and have a little bit more freedom in that. I do enjoy teaching and wouldn't mind doing something like that but that wouldn't necessarily be my ideal full-time job."

From this quote, it is clear that while Corey enjoys teaching, it is not part of his future plans. He plans to pursue a career in industry. The experiences of Brent and Corey help explain possible future careers for those who have a self-reported weak identity as teachers where they often see themselves going into something other than teaching for their long-term career.

4. Discussion

Recall that the purpose of this study was to understand GTAs' motivation to teach and their identity development as teachers to inform the creation of profiles that can be used to generate targeted training for GTAs. In support of this purpose, our results showed that identity was the driving factor in differentiating participants into profiles and three different identity profiles emerged. Given our desire that this work inform training for GTAs, the discussion is presented through implications for developing teacher identities. Specifically, we have situated the findings from this study against existing or recommended practices for GTA development and described how GTAs fitting different profiles could benefit from these practices. While the findings are situated in FYEPs as the context for this research, the implications may be applicable to other settings as well, considering other fields' epistemologies and disciplinary differences.

4.1 Future Professoriate Programs

Many universities already have programs to prepare students to be future academics. In addition to a focus on preparing graduate students for research [e.g., 39], many of these programs include elements that help foster scaffolded teaching experiences. Example programs include the Future Professoriate Certificate at Virginia Tech [40] or Preparing the Professoriate at North Carolina State [41]. In these programs, graduate students take classes related to pedagogy and contemporary issues in higher education. Future professoriate programs are likely to benefit GTAs with strong or transitioning profiles, though in different ways. GTAs with a weak teacher identity might benefit more from less intensive development. Research has shown that teacher development programs benefit new engineering teachers [e.g., 42], though it has not looked at differences based on differences in teacher identities.

GTAs with strong teacher profiles want to teach and see it as a salient part of who they are. With certainty, many of them see their future careers involving teaching in some capacity and preparatory programs would allow these GTAs to continue to develop knowledge and skills through coursework and other formalized means. In fact, professoriate programs emerged because many disciplines do not offer formal training in teaching, yet many graduate students become teachers as part of being professors. Particularly in engineering, outside of the field of Engineering Education degree programs, teaching skills are not often discussed as part of disciplinary degrees.

GTAs in the transitional teacher identity profiles enjoy teaching but are moving towards or away

from an identity as a teacher. Future professoriate programs could help students with transitional teacher identities understand teaching at a deeper level, including formal learning about pedagogies and practices.

GTAs in the weak identity profile ultimately have a life goal other than teaching and therefore have a weak identity as a teacher. In terms of training and development, a future professoriate program might be a bigger commitment than these GTAs want to make. Nonetheless, these individuals would benefit from discussions related to the skills developed while teaching that translate to other settings and general professional development. While the skills they learn in an FYEP might be teaching focused, the leadership and communication skills they obtain will be transferable to any setting. By providing them with concrete translations for their skills, they will be able to see the value in their appointment, even though it does not relate to their ultimate life goal or career.

4.2 Appointment Structures

Just as teaching appointment structures or roles can impact GTA motivation to teach [25], we believe they can impact teacher identity development across all three profiles. For GTAs fitting a strong identity profile, advanced positions related to their teaching, such as leadership roles, curriculum development roles, or mentoring positions, might be beneficial. Such positions could provide the opportunity to expand their interest and passion beyond their single classroom environment if they are interested in doing so. For example, by serving as a leader in some capacity, they are able to not only impact the learning of their students, they are also impacting the learning and development of their fellow GTAs and the FYEP. This impact contributes to improving the quality of engineering education as a whole. In K-12 teacher education, similar approaches have been taken where select K-12 teachers are involved in leadership roles to help with overall education reform at the school and district level (e.g., [43, 44]). We believe that those GTAs who have a strong teacher identity may be ideal candidates for similar advanced positions with FYEPs. By incorporating GTAs into these types of advanced positions where they have the opportunity to have an impact outside of their class, engineering education as a field can continue to evolve with GTAs with a strong teacher identity leading the way.

To help GTAs currently expressing a transitional teaching identity, providing a range of experiences could help them further explore what being a teacher means to determine if this is a future role that could work for them. To accomplish this, we suggest they be given various teaching responsibil-ities in the classroom ranging from lecturer to curriculum developer to supervisor, so they can fully explore teaching in multiple contexts. Through this exploration, they may be able to strengthen their teacher identity or they mind find a true calling in some other area.

GTAs with a weak teacher identity profile are valuable to the teaching team in an FYEP because they enjoy teaching and provide a unique applica-tion-based perspective. These individuals might best contribute to the overall mission of the FYEP by participating in projects that they find interesting beyond normal classroom routines, such as design-ing class projects, speaking about the engineering disciplines, or even bringing their technical research into the classroom. By contributing in these ways, their identity as an engineer is being supported through a teaching context.

4.3 Mentoring

All GTAs balance a variety of roles [45, 46], but proper mentoring can help establish an appropriate balance. The mentoring could take the form of peer mentoring such as a cohort (e.g., [47]) or mentoring from faculty members (e.g., [48]). Either way, men-toring will help these students navigate this transi-tional period and hopefully strengthen or weaken their view of their teacher identity, moving them out of the transitional phase and allowing them to better understand who they are. Mentoring might be particularly appropriate for GTAs with transitional and weak teacher identities. GTAs with transitional identities may be balancing multiple roles, aside from the teacher role, which seem more prevalent or more conflicted in this profile than the others. GTAs with a weak teacher identity would benefit from mentoring programs where their involvement could be observed by fellow GTAs and faculty. Based on the findings of this research, these GTAs do enjoy teaching but need an outlet for connecting their work to their future aspirations. Through a mentoring program, we believe they will stay con-nected to teaching and excel in it, even if it is not their end goal after graduation.

5. Conclusions

Through our research, we identified identity as more salient in determining profiles of GTAs than com-petence, autonomy, and relatedness. Using quanti-tative and qualitative data and identity as the primary construct for grouping GTAs, we identified three distinct profiles: strong, transitional, and weak teaching identities. We also identified potential implications of current teaching development prac-tices for people in these profiles.

GTAs in the strong teacher identity profile serve

as a valuable resource to the FYEP through their passion and long-term interest in teaching. Offering them advanced teaching experiences could enhance their teaching knowledge and aid in the further development of engineering education as a field.

GTAs in the transitional teacher identity profile have a passion for teaching, but for one reason or another they question its value in their lives. GTAs who connect to this profile do not have a clear sense of what role teaching plays or will play in their lives. Through various teaching responsibilities and mentoring, they can be supported to work through this transitional stage. While strengthening their teacher identity is not necessary to their success, we believe it is important to move them out of the transitional group to help them better understand who they are and who they want to be.

GTAs in the weak teacher identity profile serve as a valuable resource to the FYEP. For example, they could assist in connecting concepts to the real world and can assist in the development of new technical labs and materials. To further enhance their experience, it is essential to remind them that the skills they are obtaining as GTAs are transferable. It should also be noted that these GTAs are extremely important to FYEPs because most of the students in the FYEP will go into industry-type jobs. Thus, GTAs with industry interests can directly relate and connect with their students regarding future careers.

5.1 Future Work

As a whole, the experiences of graduate students in engineering are under-studied and therefore not fully understood. This work is a first attempt at better understanding graduate students through their teaching experiences so that they can be better supported. In many cases, GTAs are future faculty. So if we want to see changes in higher education teaching, we need to be providing the best training possible for GTAs that is grounded in their experiences.

In future phases of this work, we plan to expand other aspects of graduate education beyond teaching responsibilities. We also would like to add a richer quantitative component to this work that allows the findings to be more generalizable. This current research has laid the foundation for future investigations and developments that can support graduate students more broadly.

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Rachel L. Kajfez is an assistant professor in the Department of Engineering Education at Ohio State University. Her research interests focus on the intersection between motivation and identity of undergraduates, graduate students, and faculty, first-year engineering programs, mixed methods in research, and innovative approaches to teaching. She is a co-director of the Toy Adaptation Program and leads the Research on Identity and Motivation in Engineering (RIME) Collaborative.

Holly M. Matusovich is an associate professor in the Department of Engineering Education at Virginia Tech. Her research expertise includes using motivation and related frameworks to study student engagement in learning, student retention in engineering undergraduate programs, graduate programs and careers, and faculty teaching practices specifically associated with intersections of motivation, metacognition, and learning strategies. She is an Assistant Department Head for Undergraduate Programs and runs the Studies of Motivation and Identity in Learning Engineering (SMILE) Research Group.