

Collegiate service engagement correlations with engineering job selection and satisfaction

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Abstract – Curricular and co-curricular service programs are becoming more common in engineering education. For some students, these experiences align with preexisting desires to use engineering to help others; for others it instills these expectations for one’s career. To date, there has been a lack of research on the long-term impacts of these service experiences on engineers’ career pathways, including satisfaction with an ability to help others through one’s career. A survey asked engineering alumni to describe characteristics of their most and least satisfying jobs with respect to an ability to help others or society. Results showed that for individuals in their first job since graduation, undergraduate collegiate service correlated with an ability to help others as a motivator for job selection, and graduate level collegiate service correlated with satisfaction with an ability to help others through one’s job. For participants who had worked at more than one job, graduate service correlated with their least satisfying job with respect to helping others. The results point to the formative effect that service can have on career aspirations and perceptions, but also highlight the complexity of these issues and the need for more in-depth and nuanced assessments of the effects of collegiate experiences on post-collegiate pathways.

Index Terms: Job motivation, job satisfaction, pathways, service-learning

INTRODUCTION

There is a growing recognition among engineers and professional organizations that more diversity in terms of skills and competencies are needed in order to successfully engage in solving many issues affecting society. The social context in which engineers work, the global issues they will have to face, and the skills needed to address those issues are discussed in the Engineer of 2020 document by the National Academy of Engineering¹. The Engineering Accreditation Commission of ABET similarly recognizes a breadth of skills that are necessary for engineers in their revised Criterion 3 provisions (1-7), including functioning effectively on teams (7), recognizing professional and ethical responsibility and considering the broader impacts of engineering work (5)². Many professional societies hold similar values, often highlighted in vision statements, codes of ethics, and bodies of knowledge^{3, 4, 5, 6}. Developing these skills in already overcrowded engineering curricula, however, is difficult.

Learning Through Service (LTS) has been shown to be one pedagogical approach which can dovetail with current engineering programs and have positive effects on the development of teamwork and communication skills⁷, global competency⁸, and attitudes toward social responsibility⁹. LTS is a term which encompasses both curricular and extracurricular forms of engineering service¹⁰. The presence of LTS activities in U.S. engineering programs has grown rapidly in the last 20 years through the development of new programs (e.g., Purdue University's EPICS), through student clubs focused on engineering in developing communities (e.g., Engineers Without Borders (EWB) and Bridges to Prosperity), and through the growing adoption of service-learning by engineering educators¹¹. The incorporation of LTS may help to attract a more diverse population into engineering by catering to a stronger desire to serve others through engineering among women and minority students^{12, 13, 14}. Additionally, in an effort to help attract a more diversity population of students to engineering, the NAE promoted messaging that emphasized that "engineers make a world of difference"¹⁵.

With the growth of LTS in engineering education and with LTS speaking to a subgroup of engineering students who desire to use engineering to help others, there remains little discussion about how those individuals "fit" within engineering careers after graduation. This paper focuses on the career pathways of alumni who participated in LTS activities as engineering students. Specifically, this is explored through correlations between participation in LTS activities while in school and two facets of their engineering careers: 1) a desire to help others as a motivator for job selection and 2) a factor in job satisfaction. The effects of engaging in LTS activities are conceptualized in this study through the Professional Social Responsibility Development Model¹⁶ and the Ethics of Care framework¹⁷, while elements of motivation for career selection and work satisfaction are understood through Social Cognitive Career Theory^{18, 19}. With this motivation and through these lenses, the following research questions are examined.

- RQ1: For practicing engineers, does participation in service activities in college correlate with motivations to help others in one's career?
 - RQ1.1: Do correlations between collegiate service experiences and motivation to help others in one's career vary between three categories: 1) participants with only one job after graduation, 2) participants describing their most satisfying job with respect to helping others or society and 3) participants describing their least satisfying job with respect to helping others or society?
- RQ2: Does participation in service activities in college correlate with one's satisfaction with an ability to help others through one's engineering job?
 - RQ2.1: Do response distributions and/or correlations vary between participants with only one job after graduation, participants describing their most satisfying job with respect to helping others or society and participants describing their least satisfying job with respect to helping others or society?

BACKGROUND

While the breadth of literature on engineering student experiences is increasing, there remains little information about the post-collegiate pathways of engineers or how experiences during school may influence those pathways. Studies that have looked at the school-to-work transition in engineering have pointed to educational elements such as positive internships and senior capstone²⁰, self-efficacy in engineering abilities²¹ and positive experiences with professors²² as correlating with

decisions to pursue engineering careers. In the Pathways of Engineering Alumni Research Study (PEARS), researchers used Social Cognitive Career Theory to examine early engineers' careers and found that participation in internship or co-ops as undergraduate students had a positive correlation with choosing engineering careers²³. This study also found that having plans to continue into engineering careers, realizing those plans shortly after graduation and having strong interest in the technical aspects of engineers all strongly correlated with alumni remaining in engineering careers four years after graduation. Baytiyeh and Naja²⁴ looked at the perceptions of young engineering professionals about their preparation and work experiences and found that young professionals pointed to challenges with communication, responsibility, and self-confidence as the most common struggles. This study also found that about one third of the engineering alumni surveyed expressed dissatisfaction, in general, with their engineering job.

In addition to intentions to pursue engineering careers or early career experiences, other studies have looked at why engineering graduates may choose careers outside of engineering. These studies found that women are more likely to leave engineering after graduation because of stronger interest in other fields and men are more likely to cite better pay and promotion opportunities as reasons for leaving^{25,26}. Brunhaver and others²⁷ posit that “[engineers] may experience low career satisfaction or even leave engineering if they perceive poor fit between their skills and interests and those traditionally associated with being an engineer.” Outside of engineering, studies have looked at discontentment in careers, pointing to a disconnect between one’s vocational interests and one’s actual job as a common cause for leaving a job or profession^{28,29}.

Related to participation in engineering service, Litchfield and Javernick-Will³⁰ found that students who participated in EWB as professionals were more likely to desire a career related to community development than those who did not, and professionals who were active in EWB-USA were generally less content with their current work than professionals who were not members in EWB-USA. They suggest misalignment between expectations and realized work experience as one factor contributing to EWB-USA members, especially female members, being less content in their work. They also found that EWB-USA members were more likely to desire “meaningful work” in their careers, where they feel that their work contributes to larger social issues than remaining simply as technical solutions. Huff and others³¹ showed that alumni who participated in Purdue University’s EPICS program, a curricular LTS program, saw their LTS experience as providing a helpful stepping stone between education and professional practice and as providing important professional experiences and skills development that was useful on the job. This study adds to these previous studies by focusing specifically on the relationships between breadth or depth of collegiate service and job satisfaction, specifically with an ability to help others or society, and as a motivator in their job selection.

Outside of engineering, no studies were found that examined the relationship between collegiate service and job satisfaction. Few studies were found that examined similar topics including one study which examined the relationship between current volunteerism and careers found that participants’ motivation in both work and volunteerism was rooted in a desire for meaningfulness and that the pull for participants to engage in volunteerism was greater if their they found their work less meaningful³². Several studies were found that looked at public service motivation as a factor in job selection across different fields (e.g. law, social service and public management) and generally found positive correlations between stronger public service motivations and jobs which emphasized service to others (e.g. ³³).

Social Responsibility in Engineering

This study builds upon the connection between satisfaction and vocational interest, specifically examining the connection between experiences of service leading to personal interest in serving others through engineering and how those personal interests may influence motivation and satisfaction in engineering careers. The Professional Social Responsibility Development Model (PSRDM) is a framework which describes the growth of personal and professional social responsibility for engineers¹⁶. Addressing engineering through a lens of social responsibility marries with perspectives of sustainability, humanitarian engineering, and LTS, as well as embodying many of the skills and dispositions called for by the professional societies highlighted earlier^{34, 35, 36}. The PSRDM framework posits that engagement in forms of service is the mechanism through which one's feelings of obligation and desire to help others through their profession deepens. Results have shown that there are strong correlations between engineering student's views of social responsibility and participation in service experiences^{9, 37}.

Using this framework sets up an argument for engagement in forms of engineering service as a catalyst for a desire to help others and connecting that personal interest with a career in engineering. Service experiences may create a personal interest which could misalign with engineering careers leading to dissatisfaction. The connection between personal interests, career motivation and satisfaction are explored through the use of Social Cognitive Career Theory.

Social Cognitive Career Theory

Social Cognitive Career Theory (SCCT) is a unifying model connecting elements of previous theories related to vocational interest, occupational choices (motivation), achieving career success and stability, and career satisfaction^{18, 19}. SCCT draws from many career and motivation theories, including expectancy-value theories and trait-factor career models. Key to this study is how SCCT frames the relationship between self-efficacy and outcome expectations with future career interests and satisfaction. Specifically, SCCT outlines how exposure to compelling learning experiences enable individuals to expand their sense of efficacy and outcome expectations into new spheres. Per SCCT, efficacy and outcome expectation lay the foundation for future career choices, persistence, and satisfaction, discussed as person-environment fit. SCCT creates a connection where previous LTS experiences could be those compelling educational activities that serve as a driver for career outcome expectations around service.

METHODS

Data Source

Data for this study came from a survey sent electronically to engineering program graduates and working engineers, many of whom were known to have been involved in some form of engineering service as either students or professionals. An exploratory sequence mixed-methods approach was used. Interviews with 19 alumni of engineering service programs regarding their career pathways and the effects of their engineering service engagement were used to inform the survey development³⁸. Results from these interviews are not included in this paper.

A survey was developed based on themes from the interviews with the aim of understanding characteristics of participants' most and least satisfying jobs with respect to an ability to engage in service or help others. The specific questions used for this study are shown in Table I. For respondents who had only one job since graduation, they were directed to answer only one set of

questions about their job, which, by default, would be both their most and least satisfying job. For this reason, these participants were examined separately. The survey questions asked about the degree to which job selection was motivated by an ability to help people or society through their work, and how satisfied initially and currently (if they were still in that job at the time of the survey) they were with that ability.

TABLE I
 CAREER SURVEY QUESTIONS AND RESPONSE OPTIONS PERTINENT TO THIS STUDY

Think about the job where you were the MOST satisfied with your ability to engage in service or to help people/society... (this could be your current job or your only job after college)							
To what extent was your ability to help people or society through your work a motivator for selecting this job?	-1: despite being a concern, I took the job anyway	0: not a factor in the decision	1: somewhat of a positive factor in the decision	2: a large positive factor in the decision	3: the primary positive factor in the decision		
How satisfied were you INITIALLY with your ability to help people/society and/or engage in service through this job?	1: Very Dissatisfied	2: Dissatisfied	3: Somewhat Dissatisfied	4: Neutral	5: Somewhat Satisfied	6: Satisfied	7: Very Satisfied
How satisfied are you CURRENTLY with your ability to help people/society and/or engage in service through this job?	1: Very Dissatisfied	2: Dissatisfied	3: Somewhat Dissatisfied	4: Neutral	5: Somewhat Satisfied	6: Satisfied	7: Very Satisfied
Think about the job after college where you were the LEAST satisfied with your ability to engage in service or to help people / society... (this could be your current job)							
To what extent was your ability to help people or society through your work a motivator for selecting this job?	-1: despite being a concern, I took the job anyway	0: not a factor in the decision	1: somewhat of a positive factor in the decision	2: a large positive factor in the decision	3: the primary positive factor in the decision		
How satisfied were you INITIALLY with your ability to help people/society and/or engage in service through this job?	1: Very Dissatisfied	2: Dissatisfied	3: Somewhat Dissatisfied	4: Neutral	5: Somewhat Satisfied	6: Satisfied	7: Very Satisfied
How satisfied are you CURRENTLY with your ability to help people/society and/or engage in service through this job?	1: Very Dissatisfied	2: Dissatisfied	3: Somewhat Dissatisfied	4: Neutral	5: Somewhat Satisfied	6: Satisfied	7: Very Satisfied

To characterize previous service experiences, participants were asked what engineering and non-engineering service activities they were engaged with as undergraduate and graduate students, shown in the Appendix. For this study, service was used broadly to include forms of civic engagement which may or may not relate directly to the participants' academics. While all the engineering forms of service could be considered under the umbrella of LTS, some of the non-engineering forms may be housed as civic engagement, such as donating blood.

To gauge the depth of service participation, participants approximated the annual number of hours spent with engineering and non-engineering related service activities in their undergraduate and graduate years. The survey also contained 19 Likert-type items from the Engineering Professional Responsibility Assessment (EPR), which is based on the PSRDM framework³⁹, though responses to these items were not used in this paper. A pilot survey was distributed to the project advisory board and through convenience sampling to four peers and alumni for initial feedback on the items. Minor adjustments were made to the survey based on feedback from these groups.

The survey was sent to seven groups in the spring of 2015, characterized in Table II. These groups were selected because of either: 1) their previous involvement in a larger social responsibility study as students (Groups 1-3), 2) their previous experiences with LTS as students (Groups 4-6), or 3) as current participants as EWB professionals (Group 7). Possible participants from Groups 1-5 were emailed individually, while participants from Group 6 and 7 were part of a mass email to their respective listservs. Response rates varied from an estimated 7% for Group 7 to 40% for Group 3. To check differences by survey group, groups 1-3 were clustered as a group that did not necessarily participate in engineering service, whereas groups 4-7 were clustered as respondents who had participated in engineering service either as students or professionals. No significant differences between these groups were found for any of the results explored in this paper (data not shown).

TABLE II.
 CAREER SURVEY PARTICIPANT GROUPS AND RESPONSE RATES⁴⁰

Group	N emails delivered	N consent and completed > 90% of survey	% response rate
1. Former seniors or graduate students in Mechanical (ME), Civil (CE), and Environmental Engineering (EnvE) majors at four institutions who had previously participated in the social responsibility study	663	135	20
2. Former seniors in engineering at 16 institutions who had previously participated in the social responsibility study	570	91	16
3. Students who graduated in EnvE in 2000-2012 from a large public doctoral institution with SL options in engineering courses	57	23	40
4. Students who graduated in CE and EnvE in 2008-2014 from a program at medium public doctoral institution with required engineering SL courses	125	26	21
5. Alumni from a large public doctoral institution who were active in EWB and/or a graduate level humanitarian engineering program	235	53	23
6. Graduates from a technical public doctoral institution who were active in EWB-type programs	Open invite	11	N/A
7. EWB-USA professionals listserv	Unknown of 1728	126	7*
ALL	3425	465	14

* Estimated; N/A = not applicable

All participants signed an electronic consent form prior to taking the survey in compliance with Institutional Review Board protocol.

The survey concluded with demographic items. The response population was predominated by relatively recent engineering graduates (54% with bachelor's degrees earned within the previous 5 years and 76% within the previous 10 years), not surprising given that groups 1-6 were solicited through their role in the study as students. There were 40% women among the respondents, which is higher than the engineering profession as a whole with only 15% women⁴¹. The overrepresentation of women for this survey is not unexpected given the higher representation of women in LTS activities⁴², higher percentage of women in Environmental Engineering majors (which were a significant portion of groups 1, 3 and 4⁴³), and higher response rates among women to surveys in general⁴⁴. Half of the respondents had graduate degrees, which was also higher than among practicing engineers at 28%⁴¹. The respondents primarily held degrees in civil engineering and related disciplines (construction, architectural; 40%), mechanical engineering and related disciplines (aerospace, industrial; 28%), and environmental engineering (24%). Thirty-four respondents did not have either undergraduate or graduate engineering degrees, so they were removed from the response pool for this analysis, leaving 431 completed responses. More details on the demographics of respondents can be found in⁴⁰.

Data Analysis

Spearman Rank Correlation was used to examine correlations and is appropriate for ordinal variables. Correlations were considered 'weak' for values from 0.2-0.4, 'moderate' for values from 0.4-0.6, 'strong' for values from 0.6-0.8, and 'very strong' for values greater than 0.8⁴⁵. All statistics were run using IBM SPSS software.

LIMITATIONS

There are several ways in which the response population used in this study should not be considered representative of the entire engineering workforce. Firstly, the results from this study are limited by the fairly small number of survey respondents (n=465), and predominately from civil and environmental engineering backgrounds. Previous studies have found differences in professional social responsibility attitudes and reasons for selecting their major among students in different engineering disciplines^{46,47}. The sample population may not be representative of all engineering professionals, as a large fraction were intentionally invited to participate in the study due to service participation during college (Groups 3 to 6, 24%) or current engineering service (27% in EWB-USA). Groups 1-3 could be considered more representative of a typical engineering alumni population in that they were participants who responded to an earlier survey, but had not specifically self-selected into any forms of engineering service. Comparing these groups with Groups 4-7 did not show any differences, but, again, with low response numbers this could be explored more thoroughly in future studies. Additionally, because of the solicitation approach, many of the respondents were recent graduates.

There are also limitations based on upon potential inaccuracies in participant's recollection of their collegiate service experiences. Participants were asked to generally characterize their involvement across their entire undergraduate or graduate experience, which likely smooths over times in which they were more or less engaged. Ideally, service involvement would be documented while participants were in school so as to not rely on potentially inaccurate recollections.

Finally, this study only looked at one facet of job satisfaction – the relationship between service and job satisfaction with an ability to help others or society. Holistic job satisfaction is much more

complex and many more elements contribute to one’s feelings about one’s job. The intention of this study is not to look at overall job satisfaction, but only this specific facet.

RESULTS AND DISCUSSION

RQ1 – Correlation between collegiate LTS experiences and motivation to help others in one’s career

Frequency distributions for the number of different types of undergraduate and graduate service engagements for the survey respondents are given in Table III. The survey included 6 different types of engineering service options and 7 types of non-engineering service options. Ninety percent of the response population had engaged in some form of service in either undergraduate or graduate school. The most common activities for undergraduates were extracurricular engineering groups (EWB or other) (43%) and service via professional societies (33%). The most common service activities for individuals during graduate school were similar. Examining participant responses regarding their collegiate service experiences showed that there were no statistically significant differences in the number of collegiate service engagements between the survey collection groups (1-3 typical graduates vs. 4-7 service-active).

TABLE III.
 DISTRIBUTION OF THE NUMBER OF DIFFERENT COLLEGIATE SERVICE ACTIVITIES

School	Service Activities	Number of Different Collegiate Service Activities Respondents Participated In							
		0	1	2	3	4	5	6	>6
Undergraduate (n=431)	Engr.	31%	34%	22%	8%	4%	1%	0%	NA
	Non-Engr.	27%	36%	21%	9%	4%	2%	0%	0%
	Both	11%	21%	26%	16%	10%	8%	4%	4%
Graduate (n=188)	Engr.	48%	32%	14%	5%	0%	0%	0%	NA
	Non-Engr.	59%	26%	9%	4%	1%	1%	1%	0%
	Both	40%	18%	20%	12%	5%	2%	1%	1%

The amount of time that respondents spent volunteering during undergraduate and graduate school is shown in Table IV. In both undergraduate and graduate school, participants generally reported more time spent on engineering-oriented service activities than non-engineering. A higher percentage of participants spent more time at moderate levels of engagement (15-60 hours/year) in undergraduate than in graduate school, but a higher percentage of participants in graduate school spent a significant amount of time (100+ hours/year) on service than in undergraduate school. These results point to a general trend where, in undergraduate school, participants engaged in more types of service activities (median 2) for less time, but in graduate school participants focused on a fewer number of different activities (median 1) but spent more time participating in them.

TABLE IV.
 FREQUENCY DISTRIBUTION FOR AVERAGE ANNUAL HOURS SPENT ENGAGING IN FORMS OF SERVICE
 IN UNDERGRADUATE AND GRADUATE SCHOOL

Category	Service Activities	% of Total reporting "None"	Percentage of those who reported spending any time annual participating in service					
			1-5 hrs/yr	5-15 hrs/yr	15-30 hrs/yr	30-60 hrs/yr	60-100 hrs/yr	>100 hrs/yr
Undergraduate School (n=431)	Engr.	28.1	16.1	21.0	21.0	17.4	10.3	14.2
	Non-Engr.	24.8	14.8	19.0	21.8	9.5	6.0	3.9
Graduate School (n=188)	Engr.	45.2	12.6	21.4	25.2	11.7	13.6	15.5
	Non-Engr.	52.7	10.1	16.0	8.0	4.8	3.2	5.3

In order to examine the effects of participation in collegiate service, the reported service frequency for engineering and non-engineering was added for both undergraduate and graduate levels. Because frequencies were reported as ranges, this created 27 different combinations of totals. For example, 1-5 hours/year of engineering service and 15-30 hours/year of non-engineering service became an aggregate range of 16-35 hours/year. To simplify the analysis, aggregate ranges were clustered into ten groups (Table V), but this resulted in some overlapping ranges. The aggregate ranges were clustered to create similar group sizes. Ten percent of respondents reported no engagement in service activities, either engineering or non-engineering, during undergraduate school, but 38% reported the same during graduate school.

TABLE V.
 FREQUENCY DISTRIBUTION FOR CLUSTERED ANNUAL HOURS SPENT ENGAGING IN FORMS OF
 SERVICE IN UNDERGRADUATE AND GRADUATE SCHOOL

Clustered Aggregate Ranges (hrs/yr)	None	Percentage with aggregate time participating in engineering and non-engineering service								
		1-10	5-20	10-30	16-45	30-65	35-90	60-120	75-160	>115->200
Undergraduate School (n=431)	10.4	10.4	11.1	11.8	10.2	12.1	6.5	8.3	12.1	7.0
Graduate School (n=188)	38.7	7.5	7.5	10.8	7.0	3.8	4.3	4.3	9.1	8.1

Participant response distributions for the degree to which a desire to help others was a motivation for them choosing their jobs are given in Table VI. The ability to help others through one's career was more commonly a motivating element for participants' first (only) job and most satisfying job with respect to their ability to engage in service or help others than with the least satisfying job to do the same. An ability to help was a large or primary positive motivator for over 65% of participants when describing their most satisfying job with respect to an ability to help others or society. More people, however, took the job they perceived as least satisfying with respect to helping despite concerns about the role that service or helping others or society would play in the job (8.1%). This points to those concerns being realized, leading to the characterization of that job as the least satisfying with respect to service or helping others. Predominately, however, the ability to help was not a motivating factor in the selection of the jobs characterized as their least satisfying for helping others (47.0%). It should be noted that those participants with only one job since graduation had response frequencies more closely mirroring others' most satisfying job with respect to an ability to help others, rather than the least satisfying.

TABLE VI.

FREQUENCY DISTRIBUTION IN RESPONSE TO THE QUESTION “TO WHAT EXTENT WAS YOUR ABILITY TO HELP PEOPLE OR SOCIETY THROUGH YOUR WORK A MOTIVATOR FOR SELECTING THIS JOB?” FOR THE MOST AND LEAST SATISFYING JOB

Job Type	Group n	Despite being a concern, I took the job anyway	Not a factor in the decision	Somewhat of a positive factor in the decision	A large positive factor in the decision	The primary positive factor in the decision
Only 1 job after graduation	232	5%	19%	36%	32%	8%
Job most satisfying for helping society	199	1%	13%	21%	41%	25%
Job least satisfying for helping society	198	8%	47%	24%	18%	4%

Spearman’s rho correlation coefficient values between the collegiate service experiences (both number of activities and total volunteer frequency) in undergraduate and graduate school to the ability to help as a motivator are given in Table VII. Note that for the correlation calculations, the first motivation response (“Despite being a concern...”) was omitted because it was not seen to be on the same continuum as the other four responses; these data are discussed separately. The correlation results point to both undergraduate and graduate service, both the number of activities and frequency of participation, as being weakly but significantly correlated to participants’ motivation to select their only job since graduation due to an ability to help people or society through the work. The total number of undergraduate service experiences also correlated weakly, but significantly, for participants’ ability to help others through their work as a motivation for selecting their least satisfying job with respect to an ability to help others.

TABLE VII.

SPEARMEN CORRELATION BETWEEN PARTICIPATION IN SERVICE DURING COLLEGE AND ABILITY TO HELP OTHERS THROUGH CAREER AS A MOTIVATING FACTOR FOR SELECTING JOB

Job type	Total Number of Service Activities				Aggregate Service Frequency			
	Undergrad.		Grad.		Undergrad.		Grad.	
	Rho	p	Rho	p	Rho	p	Rho	p
Only 1 eng job after graduation (n=217 undergrad; n=87 grad)	0.171	0.009	0.252	0.012	0.136	0.039	0.214	0.041
Eng job most satisfied with helping society (n=197 undergrad; n=96 grad)	0.054	0.439	0.156	0.132	0.039	0.584	0.153	0.136
Eng job least satisfied with helping society (n=182 undergrad; n=88 grad)	0.160	0.228	0.125	0.025	0.041	0.563	0.140	0.177

There was a small percentage of participants who, when responding to questions related to their least satisfying job, noted that they were concerned about their ability to help others initially when taking the job (8.1%, n=16 from Table 6). This subgroup had a median of 2 service activities and 30-65 annual hours of engagement as undergraduate students and no activities or annual hours as graduate students. This represents, on average, a fewer number of activities compared to the larger group (average number of activities of 1.81 vs. 2.57 for undergraduate, 0.71 v. 1.45 for graduate), but a higher percentage were very active (>100 hours/year) as undergraduate students

than the larger sample (31% vs. 15%; data not shown). There were, however, no clear patterns in this subgroup’s volunteer histories that seemed to differentiate them from the larger data set beside these two observations.

RQ2 – Correlation between collegiate LTS experiences and job satisfaction

Participants were asked on a 7-point Likert metric how satisfied they were with their ability to help people/society or to engage in service through their job both initially and currently, if they were still at their most or least satisfying job with respect to helping others. The distribution of responses is shown in Figure I. For all participants, few were initially dissatisfied to any degree with their ability to help others through their job (5%- 14%) except in the job they found the least satisfying for helping others where 38% were dissatisfied to some degree initially. For participants that were reviewing the job they currently held at the time of the survey, there was no significant difference between their initial satisfaction with an ability to help others and their satisfaction at the time of the survey for those participants in their first job and for the least satisfying job with respect to their ability to help others (using Wilcoxon signed rank tests). There was, however, a significant difference between initial and current satisfaction with helping others in their job for the most satisfying job with respect to helping (p=0.015 using Wilcoxon signed rank test) toward increased satisfaction. Though not significant, perhaps due to the low count, there was an increase in those who reported current dissatisfaction with their ability to help others in the least satisfying job (from 36% to 49%), which fits with the job being characterized as their least satisfying with respect to this facet.

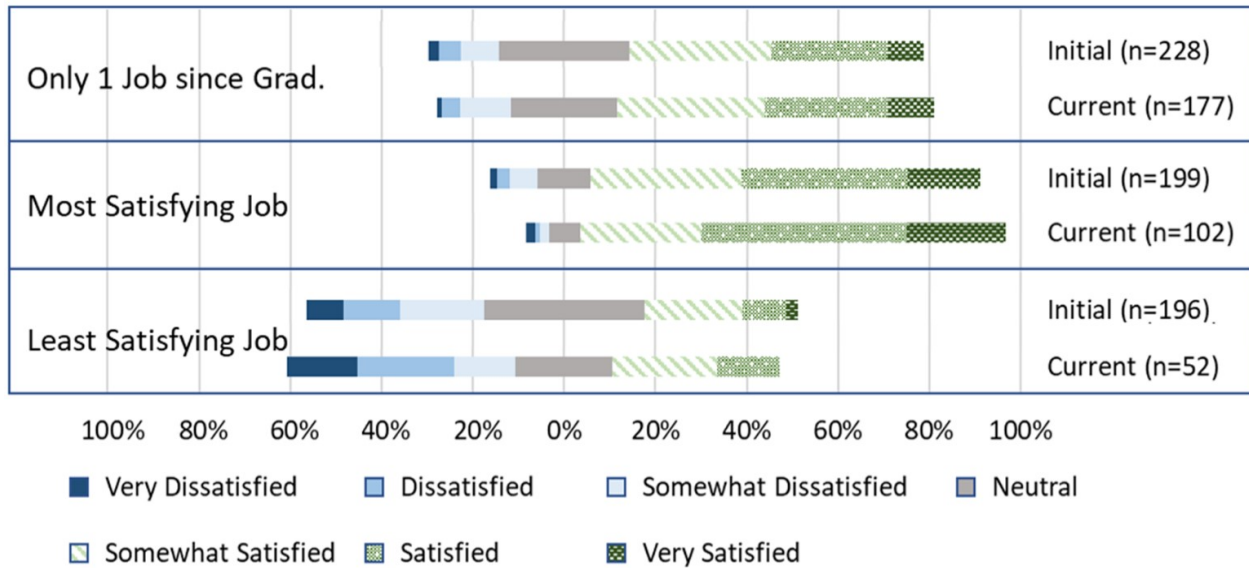


FIGURE I

INITIAL AND CURRENT JOB SATISFACTION DISTRIBUTIONS FOR FIRST AND ONLY, MOST, AND LEAST SATISFYING JOBS WITH RESPECT TO AN ABILITY TO HELP OTHERS

Correlations between job satisfaction with an ability to help others (initially and current) and collegiate LTS experiences (both number of activities and aggregate service frequency) are shown in Table VIII. Correlations between service and satisfaction with an ability to help others was

significant only with respect to graduate service. Both the total number of graduate service activities that participants engaged in and their aggregate service frequencies correlated significantly with initial satisfaction for respondents with only one job and for current satisfaction for all response groups (most and least satisfying and only one job).

TABLE VIII.

SPEARMAN CORRELATION BETWEEN SATISFACTION WITH AN ABILITY TO HELP OTHERS/SOCIETY AND COLLEGIATE LTS EXPERIENCES – TOTAL NUMBER OF ACTIVITIES AND AGGREGATE SERVICE FREQUENCY

Job Type	Satisfaction Time (<i>Undergrad n, Grad n</i>)	Total Number of Activities				Aggregate Service Frequency			
		Undergrad.		Grad.		Undergrad.		Grad.	
		Rho	p	Rho	p	Rho	p	Rho	p
Only 1 job	Initial (228, 91)	0.064	0.336	0.415	0.000	0.031	0.641	0.437	0.000
	Current (177, 70)	0.067	0.376	0.308	0.010	-0.008	0.912	0.289	0.015
Most satisfying for helping	Initial (199, 96)	0.069	0.332	0.137	0.185	0.059	0.407	0.161	0.117
	Current (102, 52)	0.061	0.541	0.275	0.048	-0.039	0.697	0.274	0.049
Least satisfying for helping	Initial (196, 95)	0.018	0.806	0.004	0.969	0.004	0.954	-0.038	0.718
	Current (52, 26)	0.051	0.722	0.443	0.023	0.031	0.830	0.492	0.011

Thus far, we have shown that, in some cases, there is a positive correlation between collegiate service participation and the degree to which helping others was a motivator for job selection, as well as weak to moderate correlation with satisfaction with respect to an ability to help others/society through their job. Figure II completes the loop by showing the relationship between the degree to which helping others was a motivator for job selection and job satisfaction (initial and current) with helping others. Across all jobs (1st and only job, most and least satisfying for helping others), participants who took that job despite concerns about the degree to which they could help others through that job had lower levels of satisfaction. Additionally, in describing their most satisfying jobs with respect to an ability to help others, satisfaction was generally higher with higher degrees of motivation to help others when choosing that job.

In general, when describing their most satisfying jobs with respect to an ability to help others, independent of their initial motivation, satisfaction averages rose from their initial to current satisfaction (except for those participants with only one job and helping others was the primary factor in their decision). Conversely, when describing their least satisfying job with respect to an ability to help others, satisfaction tended to stay the same or drop for all degrees of motivation (except for the single respondent where an ability to help others was a primary positive factor and their satisfaction rose from “Somewhat Dissatisfied” to “Neutral”).

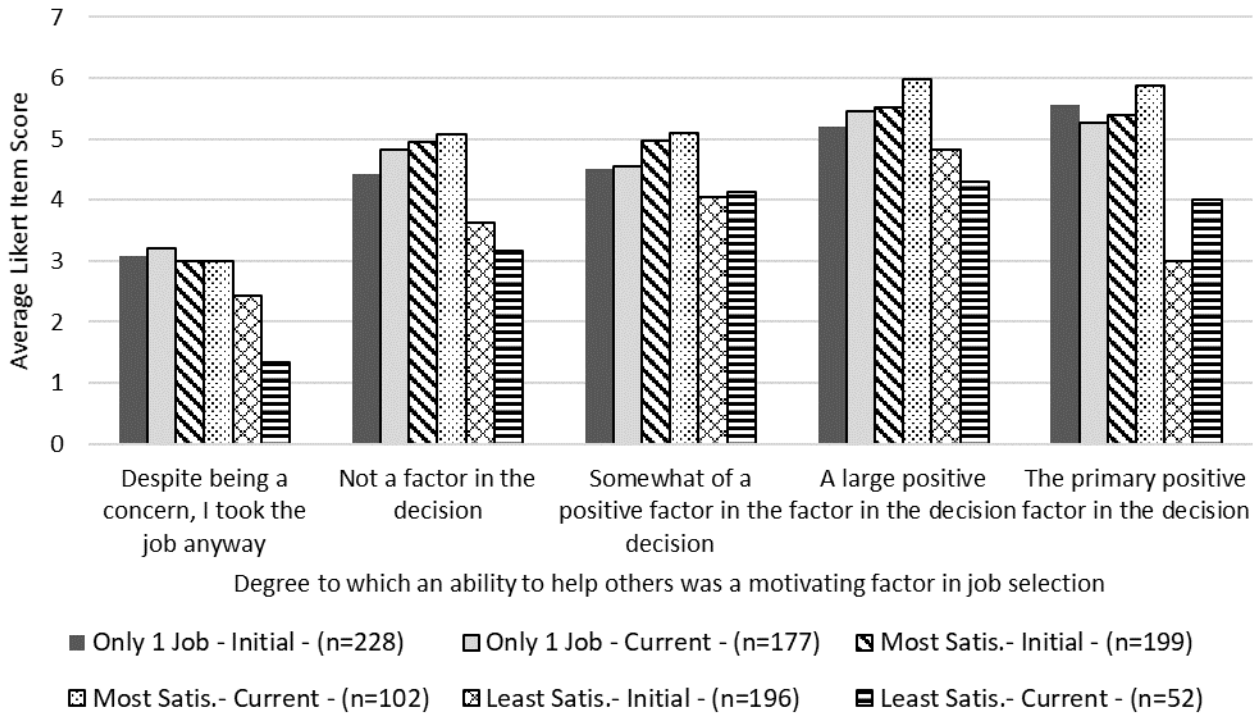


FIGURE II

AVERAGE CURRENT AND INITIAL SATISFACTION WITH AN ABILITY TO HELP OTHERS THROUGH ONE'S JOB BASED ON DEGREE TO WHICH HELPING OTHERS WAS A MOTIVATING FACTOR IN CHOOSING THAT JOB.

CONCLUSIONS AND FUTURE WORK

When examined together, collegiate service, motivation to select a job due to the potential to help others and satisfaction with service/helping aspects of their job allow us to better understand the potential effects of service on engineering student career pathways. From this study, we have seen the following results:

- Alumni with only one job since college graduation and who engaged in more service as undergraduate or graduate students were more likely to have helping others as a stronger motivator in choosing their job.
- Alumni who participated in more service as graduate students had higher levels of satisfaction with their ability to help others when describing their most satisfying job with respect to this facet.
- The more that an ability to serve others was a motivator in a participant's job selection, the higher satisfaction they expressed when describing the most satisfying job with respect to this facet.
- Participants who took a job despite concerns about their ability to serve others or society through that job, were more likely to have volunteered frequently in school and had lower satisfaction in their jobs with respect to helping others, even in their most satisfying job.

SCCT posits that increased exposure to “compelling learning experiences”, such as LTS, would expand participant’s sense of self-efficacy and outcome expectations. In other words, we would expect to see that participants who engaged in a significant amount of service as engineering students, would have stronger expectations of service as a part of their engineering career. Additionally, we would expect job satisfaction with respect to an ability to help others, another expression of outcome expectation, to be greater for participants who engaged in more service as students. The results from this study are consistent with SCCT where, in general, participants with more service engagement were more likely to more strongly hold a desire to help others (their outcome expectation) as a motivator in their job selection.

Furthermore, the PSRDM framework posits that engagement in service creates a cycle the strengthens one’s feelings of professional social responsibility to help others. From this perspective, increased quantity or depth of engagement in service activities as students should create a more robust connection between one’s personal and professional views of social responsibility. In this research, this would suggest that participants with more service engagement would have higher expectations of service ideals, like an ability to help others, when thinking about their engineering career because they have more deeply connected those expectations through the service cycle. This was seen both in the affirmative and contrary cases. Participants with more service experience as students had higher satisfaction with their ability to help others when talking about their most satisfying job. Conversely, participants who took a job where they were initially concerned about the degree to which helping others would be a part of their job and were dissatisfied in that job, were more likely to have had a significant amount of service experience as students. These results support the notion that more service engagement as students correlates with expectations that helping others will be more integrated into one’s career as an engineer.

Given that LTS is growing in use in engineering education, it seems critical, therefore, that engineering practice recognize a growing desire in young engineers to use engineering to help others. Many engineering companies have already recognized this trend and are creating corporate benefits structures that formally support EWB professional involvement through added vacation time or engage in local pro-bono projects. These corporate opportunities may help increase satisfaction among professional who bring that strong desire to help others through engineering more concretely. The flip side to this growth in service engagement in engineering education is the limited career pathways for graduates where helping others or society is explicitly connected to the engineering job. This could be one place where faculty must work to temper student expectations in tandem with industry working to increase opportunities for employees to connect their engineering work with notions of helping others or society.

This work tries to capture the diversity of career pathways for engineering students who engaged in LTS and to see how that engagement affected their pathways, providing the beginnings of work that could fill the gap in literature cited earlier in this paper. The trajectories that participants take, however, are incredibly individualized and are only broadly captured here through descriptions of most and least satisfying jobs with respect to an ability to help others. Moreover, there are complex interactions between the life experiences that an individual has and how those combine to influence their pathways. Service is only one experience that, for some, is likely combining with pre-dispositions, pre-collegiate experiences, perhaps faith, ethics, familial expectations and may other attributes to influence why a person may choose to stay or leave a given job or career. Additionally, factors outside of the individual’s desire, such as familial obligation or the strength of the economy can affect pathways. Qualitative approaches are likely

more suited to capture these nuances to better understand the broad range of factors which can affect where engineering students go and why.

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APPENDIX

TABLE AI

IN-SCHOOL SERVICE CHARACTERIZATION QUESTIONS

Did you engage in any forms of service through ENGINEERING as a student? Check all that apply.							
Does not apply No Yes, via service-learning in a class Yes, via extracurricular group (EWB or other) Yes, via professional society (ASCE, etc.) Yes, via unpaid tutoring Yes, via an integrated degree program or certificate Yes, other: _____						Undergraduate	Graduate
						On average, about how many hours per year did you engage in engineering-related service activities as an undergraduate student?	
None	1-5 hr/yr	5-10 hr/yr	10-30 hr/yr	30-60 hr/yr	60-100 hr/yr	>100 hr/yr	
On average, about how many hours per year did you engage in engineering-related service activities as a graduate student?							
None	1-5 hr/yr	5-10 hr/yr	10-30 hr/yr	30-60 hr/yr	60-100 hr/yr	>100 hr/yr	
Did you engage in any forms of NON-ENGINEERING service as a college student? Check all that apply.							
Does not apply No Yes, via service-learning in a class Yes, as an unpaid K-12 tutor Yes, via Meals on Wheels, nursing home volunteer, hospital volunteer, or similar Yes, via homeless shelter volunteer, food bank volunteer, or similar Yes, donated blood Yes, short term service trip (multi-day) Yes, other: _____						Undergraduate	Graduate
						On average, about how many hours per year did you engage in NON-engineering-related service activities as an undergraduate student?	
None	1-5 hr/yr	5-10 hr/yr	10-30 hr/yr	30-60 hr/yr	60-100 hr/yr	>100 hr/yr	
On average, about how many hours per year did you engage in NON-engineering-related service activities as a graduate student?							
None	1-5 hr/yr	5-10 hr/yr	10-30 hr/yr	30-60 hr/yr	60-100 hr/yr	>100 hr/yr	