APPENDICES

APPENDIX I. Methods

Climate Surveys

Undergraduate Survey: The engineering undergraduate climate survey was administered to undergraduate engineering majors at the University of Washington in May 2013. The 2013 climate survey was administered to 1,838 students across 10 engineering majors with an overall response rate of 13% (n=239). All students enrolled in the College of Engineering majors were sampled. The survey was administered online through UW's Catalyst site with the invitation and 4 reminder messages coming from Provost Ana Mari Cauce.

In order to group majors into the lower satisfaction, approximately average satisfaction, and higher satisfaction categories, a multi-level model was created. This allowed for estimates of averages for each subsection within each major. Also, an overall average and standard error for each subsection was estimated. Any major who scored more than three times the standard error below the overall estimated average was categorized as lower satisfaction for that subsection and any major who scored more than three times the standard error above the overall estimated average was categorized as higher satisfaction. Any major between these two extremes was categorized as approximately average satisfaction for the given subsection.

Graduate Survey: The 2013 COE graduate student climate survey was administered to graduate students in all engineering departments at the University of Washington in Fall 2013. The survey was administered to 1,368 Master and Ph.D. level students across all engineering departments with an overall response rate of 16% (n=238). The survey was administered online through UW's Catalyst site with the invitation and reminder messages coming from Priti Mody-Pan, CWD Deputy Director.

Focus Groups

Undergraduate and graduate focus groups provide richer, contextual information to support the climate survey data and learn more about underrepresented populations and groups of interest in engineering. All CEE students were emailed invitations by the undergraduate or graduate advisor, and those students who identified with one or more under-represented groups (or other groups of interest) were invited to participate in a focus group with CWD staff. One reminder was sent out to encourage recruitment. Two focus groups were conducted with four CEE undergraduate students and four CEE graduate students in October 2013.

Demographic Data

The American Society for Engineering Education's Engineering Data Management System (Data Mining Tool) was the source for demographic data on undergraduate and graduate degrees and enrollment, disaggregated by gender, race, and ethnicity. The dataset includes ABET-accredited engineering and engineering technology programs that annually contribute data to ASEE's database. The most recent data was included in this report, from 2012.

APPENDIX II. Counts for Undergraduate Climate Survey Responses

			RACE/ETHNICITY							SWD			GENDER		
Major	**Total**	**Response Rate (%)**	**Cau-casian**	**Asian**	**African Amer-ican**	**Hawaiian / Pac. Islander**	**Native Amer-ican**	**Hisp-anic**	**Inter-national**	**No Disability**	**Disability**	**% disability**	**Male**	**Female**	**% female**
A&A	18	12%	13	4	0	0	0	0	1	16	1	6%	15	3	17%
BioE	17	11%	9	5	0	0	0	0	3	15	0	0%	10	7	41%
ChemE	27	15%	12	6	1	0	1	0	6	23	2	7%	18	9	33%
CEE	26	13%	20	3	0	0	0	0	2	22	1	4%	17	9	35%
CE	21	13%	12	4	0	0	0	0	2	18	2	10%	16	5	24%
EE	59	14%	28	19	2	0	0	4	6	51	1	2%	36	23	39%
HCDE	15	38%	9	3	1	1	0	1	0	12	2	13%	8	7	47%
ISE	12	10%	6	3	0	0	0	0	3	10	0	0%	5	7	58%
MSE	13	10%	8	1	1	0	0	1	1	10	2	15%	5	8	62%
ME	31	11%	18	7	0	0	0	3	1	25	4	13%	23	8	26%
Total	**239**	**13%**	**135**	**55**	**5**	**1**	**1**	**9**	**25**	**202**	**15**	**6%**	**153**	**86**	**36%**

APPENDIX III. Counts for Graduate Climate Survey Responses

			RACE/ETHNICITY							SWD			GENDER		
Major	**Total**	**Response Rate (%)**	**Cau-casian**	**Asian**	**African Amer-ican**	**Hawaiian / Pac. Islander**	**Native Amer-ican**	**Hisp-anic**	**Inter-national**	**No Disability**	**Disability**	**% disability**	**Male**	**Female**	**% female**
A&A	21	17%	12	4	1	0	0	3	0	18	2	10%	16	5	24%
BioE	30	34%	13	13	0	0	0	2	0	29	0	0%	16	13	45%
ChemE	18	21%	12	4	0	0	0	0	0	16	0	0%	11	7	39%
CEE	32	20%	22	8	0	0	0	1	0	31	1	3%	16	15	48%
CE	38	13%	29	6	0	0	0	1	0	33	3	8%	27	10	27%
EE	30	13%	8	16	2	0	0	0	0	27	0	0%	22	7	24%
HCDE	24	22%	15	6	0	0	0	3	0	24	0	0%	15	8	35%
ISE	9	23%	3	5	0	0	0	0	0	7	1	13%	6	3	33%
MSE	8	15%	6	0	0	0	0	2	0	7	1	13%	5	3	38%
ME	28	16%	16	7	0	1	0	1	0	26	1	4%	18	9	33%
Total	**238**	**16%**	**136**	**69**	**3**	**1**	**0**	**13**	**0**	**218**	**9**	**4%**	**152**	**80**	**34%**

APPENDIX IV. Undergraduate Climate Survey Multi-level Model

Estimated mean satisfaction, standard error, student variance, and major variance for each outcome based on six separate multi-level models (note all outcomes based on 5-point rating scale ranging from one to five)

Table: Estimated mean, standard error, student variance, and major variance for each outcome based on separate multi-level models

Outcome	Estimated Mean	SE	Student variance	Major variance
Professor	3.78	0.05	0.18	0.01
Teaching Assistant	3.62	0.06	0.36	0.02
Resources	3.57	0.10	0.58	0.07
Student Interaction	3.52	0.06	0.39	0.02
Major	4.24	0.07	0.42	0.03
Campus Life	3.64	0.04	0.32	0.01

APPENDIX V. Graduate Climate Survey Multi-level Model

Estimated mean satisfaction, standard error, student variance, and major variance for each outcome based on eight separate multi-level models (note all outcomes based on 5-point rating scale ranging from one to five except Personal Experiences, which is a count of the number of "yes" responses out of a total of 18 items). Note that as the Personal Experiences section represents a count of negative experiences, a lower number is preferable.

Table: Estimated mean, standard error, student variance, and major variance for each outcome based on separate multi-level models

Outcome	Estimated Mean	SE	Student variance	Major variance
Classroom	4.02	0.06	0.29	0.02
Personal Experiences	0.87	0.19	2.04	0.25
Online	3.43	0.22	0.67	0.10
Labs	4.12	0.08	0.40	0.03
Climate	3.59	0.06	0.35	0.02
Faculty	3.61	0.07	0.58	0.03
Professional Development	3.62	0.10	0.52	0.07
Work Life Balance	3.00	0.09	0.67	0.05

APPENDIX VI. Undergraduate Climate Survey Results for Groups of Interest

This appendix examines the following groups separately: under-represented minority students (URM), students with disabilities (SWD), women students, students who are Pell eligible, transfer students, students in the military, students who are first-generation Americans, students who are first-generation college students, and students who are in large majors (defined as majors with more than 160 students). For each of these binary variables, a t-test was computed comparing the average on each item for students in the given group with the average on each item for students not within the given group. For example, the first t-test compares the mean value on the first survey item for URM students within engineering to the mean value on the first survey item for non-URM students within engineering. The "ns" indicates that the test was "non-significant" mean that there was no significant difference found between URM and non-URM students on the first survey item. The cells coded "NEG" mean there was a significant, negative difference (i.e. the group indicated scored lower on average on that item) and the cells coded "POS" indicate a positive difference. Since no adjustment for type I error were made, this table should be considered purely descriptive for analyzing trends and patterns. Please note that all negatively worded items were recoded for analysis.

URM students did not differ from non-URM students as often as some of the other groups considered. Although they often report a similar experience to non-URM students, there are some differences. URM students feel less satisfied with assistance from teaching assistants, and are less likely to report that other students take their comments and suggestions seriously. In addition to negative perceptions, they are also optimistic, being more likely to report that they expect to complete their declared major and less likely to report that it is difficult to find their way around UW. Also, please note that although results indicate there are fewer differences between URM and non-URM students within engineering, these results are in part due to the low power that resulted from the low sample size of URM students (N=18).

SWD also report a somewhat similar experience to students who don't have disabilities. However, unlike URM students, the differences for this group are all in the negative direction. SWD report being less likely to feel comfortable meeting with their TA, less confident in math and science courses, and more likely to feel increased stress when they started at UW. Also, please note that although results indicate there are fewer differences between SWD and non-SWD students within engineering, these results are in part due to the low power that resulted from the low sample size of SWD (N=16).

Women engineering students generally reported a less positive experience than males. They report feeling less comfortable with professors, less confident in their academic abilities, more uncomfortable and overwhelmed by the size of the university and classes, and less confident with the social environment at UW.

Pell eligible students report roughly similar experiences to non-Pell eligible students. However, they do report finding professors' accents difficult to understand, less satisfied with job placement services, and more uncomfortable with large lectures and adjusting to the academic standards at UW. They also report being more involved with student study groups and co-op programs.

Transfer students report a generally more negative climate with the exception that they are more likely to be satisfied with their major. They find course material difficult to understand; they feel less satisfied with resources such as study centers and job placement help; they are less likely to participate in programs such as internships, volunteer work, and intramural athletics; and they feel overwhelmed and uncomfortable with the large university and classes sizes and the social environment at UW.

Active duty/veteran students report a few differences compared with non-active duty/veteran students. They report feeling less like they understand professors' expectation and less of a sense that students help each other succeed. On the other hand, active duty/veteran students feel more confident in their academic ability and more comfortable with their declared majors.

First-generation American students report perceiving a roughly similar climate to non-first-generation Americans with a few exceptions. First-generation Americans are less confident in their academic abilities, less likely to understand course material, and more likely to perceive that professors move too quickly. They are more likely to report that professors keep the office hours that they set for students.

First-generation college students report a slightly more negative climate but are more likely to participate in some activities. These students are less likely to report that they understand course material, more likely to report that students compete with each other, and more likely to report feeling overwhelmed and uncomfortable by being at a large university. They are more likely to report participating in mentoring programs, co-op programs, and minority student programs.

Students in large majors perceive a slightly more negative climate than students from small majors. Students from large majors report feeling less likely to understand course material and less likely to feel comfortable asking questions in class. They are less satisfied with the sizes of classes and more likely to feel overwhelmed and uncomfortable by the large lecture classes and being at a large university. They are also less likely to report feeling confident in their academic abilities in their declared major.

Summary of findings relating to various groups for engineering students:

<u>Findings Relating to Professors and TAs</u>

- URM students are less likely to report feeling satisfied with the assistance they receive from teaching assistants.
- SWD report feeling less comfortable meeting with teaching assistants for academic help.
- Women students are less likely to report that their professors treat them with respect or that they are comfortable answering questions in class. However, they are more likely to report meeting with professors for extra help.
- Pell eligible students are more likely to report that professors' accents make it difficult to understand.
- Transfer students are more likely to report being unable to understand course material and that professors move through course material too quickly. They also find that professors' accents make it difficult to understand and that teaching assistants are less effective at teaching compared with the perception of non-transfer students.
- Active Duty/veteran students are less likely to report being able to understand what professors expect of them.
- First-generation American students are less likely to report that they are able to understand course material and more likely to report that professors move through course material too quickly. They also are more likely to report that professors keep the office hours that they set.
- First-generation college students are less likely to report that they understand the course material, and more likely to report that professors move too quickly through the course material and that professors' accents make it difficult to understand.
- Students from large majors are less likely to report that they are able to understand course material or are comfortable asking questions in class. They are more likely to report that professors encourage them to attend office hours and more likely to perceive that professors

move through course material too quickly and that cultural differences have made them less likely to meet with their teaching assistants.

Findings Relating to Resources

- URM students are less likely to report that other students take their comments and suggestions seriously.
- Pell eligible students are less satisfied with job placement help and more likely to be involved with student study groups.
- Transfer students are less satisfied with the size of classes, study centers, and job placement help.
- Active Duty/veteran students are less likely to report that students help each other succeed in class.
- First-generation college students are more likely to perceive that students compete with each other in classes.
- Students from large majors are less likely to report satisfaction with size of classes.
- URM students are less likely to take advantage of disability services and more likely to participate in minority student programs.
- Women students are less likely to participate in student government.
- Pell eligible students are more likely to participate in co-op programs.
- Transfer students are less likely to participate in internships, volunteer work, or intramural athletics.
- First-generation college students are more likely to participate in mentoring programs, co-op programs, and minority student programs.

Findings Relating to Academics

- URM students are more likely to report that they expect to complete their degree in the declared or expected major.
- Women students are more likely to feel pressure from parents to choose their major.
- Transfer students are more likely to agree that they have no desire to declare a different major, and less likely to feel pressure from parents to declare their major.
- Active Duty/veteran students are more likely to agree that they have no desire to declare a different major, and less likely to feel pressure from parents to declare their major. They are more likely to report that they expect to complete their degree in the declared or expected major.
- SWD are less likely to report confidence in their ability to succeed in their math and science courses.
- Women students are less likely to report confidence in their ability to succeed in their math and science courses, courses in their major, and their overall academic ability.
- Active Duty/veteran students are more likely to report confidence in their ability to succeed in their math and science courses, humanities courses, courses in their major, and their overall academic ability.
- First-generation American students are less likely to report confidence in their ability to succeed in science courses, courses in their major, and their overall academic ability.
- Students in large majors report feeling less confident in their ability to succeed in courses in their major.

Findings Relating to Campus Life

- URM students report less of a feeling that it is difficult to find their way around the UW campus.
- SWD report feeling increased stress after starting at UW.
- Women students are more likely to report feeling overwhelmed about being at a large university, feeling insecure about making friends at UW, feeling less confident about the challenges at UW, feeling overwhelmed by the size of the student body, feeling intimidated by the large class sizes, finding it difficult to make their way around campus, finding it difficult to adjust to the academic standards at UW, and finding it difficult to adjust to the social environment at UW.
- Pell eligible students feel more uncomfortable about being in large lecture classes and report that adjusting to the academic standards at UW has been difficult.
- Transfers students report that they feel less like they belong on campus, more overwhelmed at being at a large university, feeling uncomfortable about large lectures, feeling insecure about making friends, feeling intimidated by the large class sizes, finding it difficult to find their way around UW, finding it difficult to adjust to the academic standards at UW, and finding their level of stress increased after entering UW.
- First-generation Americans feel less confident about the challenges at UW.
- First-generation college students report feeling more overwhelmed about being at a large university, feeling uncomfortable about being in large lecture classes, and that there is stigma at UW for having started at a community college.
- Students from large majors are more likely to report feeling uncomfortable about being in large lecture classes, feeling overwhelmed by the size of the student body, feeling intimidated by large classes, and feeling that the UW does not have a supportive climate for all students.

The table below displays patterns of significance for various groups. Appendix VIII is the list of individual survey items organized into the various factors or survey outcomes for the multi-level model. All negatively worded items were re-coded in the positive direction for this analysis. Regardless of the wording of the question, a "POS" indicates "good" for the group in the heading while a "NEG indicates "bad" for the group in the heading.

Table legend:

- ns=not significant
- NEG=significant difference in the negative direction for this group
- POS=significant different in the positive direction for this group

Appendix Table: Patterns of Significance for Groups of Interest by Undergraduate Survey Item

	Item	URM	SWD	Women	Pell Eligible	Transfer Student	Active Duty/ Veteran	1st Gen. American	1st Gen. College	Large Major
Professors	1	ns	ns	ns	ns	ns	ns	ns	ns	ns
	2	ns	ns	ns	ns	ns	ns	ns	ns	ns
	3	ns	ns	ns	ns	ns	ns	ns	ns	ns
	4	ns	ns	ns	ns	ns	ns	ns	ns	ns
	5	ns	ns	NEG	ns	ns	ns	ns	ns	ns
	6	ns	ns	ns	ns	NEG	ns	NEG	NEG	NEG
	7	ns	ns	NEG	ns	ns	ns	ns	ns	NEG
	8	ns	ns	ns	ns	ns	ns	ns	ns	ns

	9	ns	ns	ns	ns	ns	ns	ns	ns	ns
	10	ns	ns	ns	ns	ns	ns	ns	ns	ns
	11	ns	ns	ns	ns	ns	ns	ns	ns	ns
	12	ns	ns	ns	ns	ns	ns	ns	ns	ns
	13	ns	ns	ns	ns	ns	NEG	ns	ns	ns
	14	ns	ns	ns	ns	ns	ns	ns	ns	ns
	15	ns	ns	ns	ns	ns	ns	POS	ns	ns
	16	ns	ns	ns	ns	ns	ns	ns	ns	POS
	17	ns	ns	POS	ns	ns	ns	ns	ns	ns
	18	ns	ns	ns	ns	NEG	ns	NEG	NEG	NEG
	19	ns	ns	ns	ns	ns	ns	ns	ns	ns
	20	ns	ns	ns	NEG	NEG	ns	ns	NEG	ns
TAs	21	ns	ns	ns	ns	NEG	ns	ns	ns	ns
	22	ns	ns	ns	ns	ns	ns	ns	ns	ns
	23	ns	ns	ns	ns	ns	ns	ns	ns	ns
	24	NEG	ns	ns	ns	ns	ns	ns	ns	ns
	25	ns	ns	ns	ns	ns	ns	ns	ns	NEG
	26	ns	NEG	ns	ns	ns	ns	ns	ns	ns
Resources	27	ns	ns	ns	ns	NEG	ns	ns	ns	NEG
	28	ns	ns	ns	ns	NEG	ns	ns	ns	ns
	29	ns	ns	ns	ns	ns	ns	ns	ns	ns
	30	ns	ns	ns	NEG	NEG	ns	ns	ns	ns
Student Interaction	31	ns	ns	ns	ns	ns	ns	ns	ns	ns
	32	ns	ns	ns	ns	ns	ns	ns	ns	ns
	33	ns	ns	ns	ns	ns	ns	ns	ns	ns
	34	ns	ns	ns	POS	ns	ns	ns	ns	ns
	35	ns	ns	ns	ns	ns	NEG	ns	ns	ns
	36	NEG	ns	ns	ns	ns	ns	ns	ns	ns
	37	ns	ns	ns	ns	ns	ns	ns	NEG	ns
Programs	38	ns	ns	ns	ns	ns	ns	ns	POS	ns
	39	ns	ns	ns	ns	ns	ns	ns	ns	ns
	40	NEG	ns	ns	ns	ns	ns	ns	ns	ns
	41	ns	ns	ns	ns	NEG	ns	ns	ns	ns
	42	ns	ns	ns	ns	NEG	ns	ns	ns	ns
	43	ns	ns	ns	POS	ns	ns	ns	POS	ns
	44	POS	ns	ns	ns	ns	ns	ns	POS	ns
	45	ns	ns	ns	ns	NEG	ns	ns	ns	ns
	46	ns	ns	ns	ns	ns	ns	ns	ns	ns
	47	ns	ns	ns	ns	ns	ns	ns	ns	ns
	48	ns	ns	ns	ns	ns	ns	ns	ns	ns
	49	ns	ns	NEG	ns	ns	ns	ns	ns	ns
j	50	ns	ns	ns	ns	POS	POS	ns	ns	ns

	51	ns	ns	ns	ns	ns	ns	ns	ns	ns
	52	ns	ns	NEG	ns	POS	POS	ns	ns	ns
	53	POS	ns	ns	ns	ns	POS	ns	ns	ns
Confidence	54	ns	ns	NEG	ns	ns	POS	NEG	ns	NEG
	55	ns	NEG	NEG	ns	ns	POS	NEG	ns	ns
	56	ns	NEG	NEG	ns	ns	POS	ns	ns	ns
	57	ns	ns	ns	ns	ns	POS	ns	ns	ns
	58	ns	ns	ns	ns	ns	ns	ns	ns	ns
	59	ns	ns	NEG	ns	ns	POS	NEG	ns	ns
Campus Life	60	ns	ns	ns	ns	NEG	ns	ns	ns	ns
	61	ns	ns	ns	ns	ns	ns	ns	ns	ns
	62	ns	ns	NEG	ns	NEG	ns	ns	NEG	ns
	63	ns	ns	ns	NEG	NEG	ns	ns	NEG	NEG
	64	ns	ns	NEG	ns	NEG	ns	ns	ns	ns
	65	ns	ns	NEG	ns	ns	ns	NEG	ns	ns
	66	ns	ns	ns	ns	ns	ns	ns	ns	ns
	67	ns	ns	ns	ns	ns	ns	ns	ns	ns
	68	ns	ns	ns	ns	ns	ns	ns	NEG	ns
	69	ns	ns	NEG	ns	ns	ns	ns	ns	NEG
	70	ns	ns	NEG	ns	NEG	ns	ns	ns	NEG
	71	POS	ns	NEG	ns	NEG	ns	ns	ns	ns
	72	ns	ns	NEG	NEG	NEG	ns	ns	ns	ns
	73	ns	NEG	ns	ns	NEG	ns	ns	ns	ns
	74	ns	ns	NEG	ns	ns	ns	ns	ns	ns
	75	ns	ns	ns	ns	ns	ns	ns	ns	ns
	76	ns	ns	ns	ns	ns	ns	ns	ns	ns
	77	ns	ns	ns	ns	ns	ns	ns	ns	NEG
	78	ns	ns	ns	ns	ns	ns	ns	ns	ns

APPENDIX VIII. Undergraduate Climate Survey Items by Factor/Outcome Grouping

	Item #	Survey Question
Professors	1	Do your professors care whether or not you learn the course material?
	2	Do your professors encourage you to think creatively?
	3	Do your professors place more value on their own research than on teaching?
	4	Do your professors write helpful comments on the material you turn in?
	5	Do your professors treat you with respect?
	6	Are you able to understand course material?
	7	Are you comfortable asking questions in class?
	8	Do your professors think you have a lower ability than you actually have?
	9	Do your professors grade your work fairly?
	10	Do your professors take your suggestions and comments in class seriously?
	11	Are you comfortable meeting with your professors for academic help?
	12	Are your course syllabi clear?
	13	Do you understand what your professors expect of you?
	14	Do your professors inspire you to pursue your major?
	15	Do your professors keep the office hours they set for students?
	16	Do your professors encourage you to attend their office hours?
	17	Do you meet with your professors for extra help?
	18	Do your professors move through the course material too quickly?
	19	Do you feel overwhelmed by the amount of homework you have?
	20	Do your professors' accents make it difficult to understand course material?
TAs	21	How effective are your teaching assistants at teaching?
	22	Are your teaching assistants effective communicators?
	23	Are your teaching assistants knowledgeable about the subjects they teach?
	24	Are you satisfied with the assistance you receive from your teaching assistants?
	25	Have cultural differences made you less likely to meet with your teaching assistants?
	26	Are you comfortable meeting with your teaching assistants for academic help?
Resources	27	Are you satisfied with the size of the classes?
	28	Are study centers useful?
	29	Are advisors helpful?
	30	Are you satisfied with the job placement help?
Student Interaction	31	Are group projects valuable?
	32	Do you feel like you are a part of a community?
	33	Do you like studying with other students in a group?
	34	Are you involved with student study groups?
	35	Do students help each other succeed in class?
	36	Do other students take your comments/suggestions in class seriously?
	37	Do students compete with each other in your classes?
Programs	38	Mentoring programs
	39	Department lectures and seminar series
	40	Disability services
	41	Internships

	42	Volunteer work
	43	Co-Op programs
	44	Minority student programs
	45	Intramural athletics
	46	Collegiate athletics
	47	Department honors program
	48	University honors program
	49	Student government
Major	50	I have no desire to declare a different major
	51	I can think of other majors that I would like better than the one I have declared or expect to declare
	52	I felt pressure from my parents to choose my declared/expected major
	53	I expect to complete my degree in the major I have already declared or expect to declare
Confidence	54	I am confident in my ability to succeed in my courses in my declared/expected major
	55	I am confident in my ability to succeed in my science courses
	56	I am confident in my ability to succeed in my math courses
	57	I am confident in my ability to succeed in my humanities/social science courses
	58	I am confident in my ability to succeed in my writing intensive courses
	59	I am confident in my overall academic ability
Campus Life	60	I feel like I belong on campus
	61	I feel like UW provides me with access to resources the achieve my educational goals
	62	I feel overwhelmed about being at a large university with thousands of students
	63	I feel uncomfortable about being in large lecture classes
	64	I feel insecure about making friends at UW
	65	I feel confident about the challenges at UW
	66	I would recommend UW to others
	67	If I could start over again, I would go to UW
	68	There is a stigma at UW among students for having started at a community college
	69	I often feel overwhelmed by the size of the student body
	70	The large classes intimidate me
	71	It is difficult to find my way around the UW campus
	72	Adjusting to the academic standards or expectations at UW has been difficult
	73	My level of stress increased when I started at the University of Washington
	74	Adjustment to the social environment has been difficult
	75	I am meeting as many people and making as many friends as I would like
	76	It is easy to make friends at UW
	77	The UW has a supportive climate for all students regardless of their gender, race, ethnicity, disability and/or socioeconomic status
	78	Since coming to UW, I have a greater respect for people of all backgrounds

APPENDIX IX. Graduate Climate Survey Results for Groups of Interest

This section examines the following groups separately: under-represented minority students (URM), students with disabilities (SWD), women students, students who are Pell eligible, students who are first-generation Americans, and students who are first-generation college students. For each of these binary variables, a t-test was computed comparing the average on each item for students in the given group with the average on each item for students not within the given group. For example, the first t-test compares the mean value on the first survey item for URM students within engineering to the mean value on the first survey item for non-URM students within engineering. The "ns" indicates that the test was "non-significant" mean that there was no significant difference found between URM and non-URM students on the first survey item. The cells coded "NEG" mean there was a significant, negative difference (i.e. the group indicated scored lower on average on that item) and the cells coded "POS" indicate a positive difference. Since no adjustment for type I error were made, this table should be considered purely descriptive for analyzing trends and patterns. Please note that all negatively worded items were recoded for analysis.

URM students differed significantly from non-URM students on three survey items, with URM students perceiving that the department doesn't do as much to provide travel stipends for conferences, that students compete against each other for funding, and that lab experiments are not fully explained.

SWD differed significantly from non-SWD on only one survey item, with SWD being less likely to anticipate problems or conflicts with availability of part-time work.

Women students are less comfortable asking questions in class, less likely to agree that they have been provided the knowledge to develop a course, and more likely to anticipate problems with work-life balance, including difficulty with access to child care, elder care, part-time work, and paternity/maternity benefits.

Pell eligible students report feeling less encouraged to freely express themselves in class, less likely to perceive that professors treat them with respect and less likely to feel that their department provides advising on how to secure funding.

F**irst-generation American students** are more likely to agree that their department is providing the skills and knowledge to teach a course and write a winning proposal for funding.

First-generation college students are more likely to anticipate problems with access to child care, elder care, paternity/maternity benefits, and funds to complete their graduate program, are less likely to feel that their suggestions are taken seriously by a lab group leader, more likely to feel that finances have adversely affected pursuit of a graduate degree, and more likely to report feeling comfortable asking questions in class.

The table below displays patterns of significance for various groups. Appendix X is the list of individual survey items organized into the various factors or survey outcomes for the multi-level model. All negatively worded items were re-coded in the positive direction for this analysis. Regardless of the wording of the question, a "POS" indicates "good" for the group in the heading while a "NEG indicates "bad" for the group in the heading. T-tests were not computed for groups of interest for survey items within the Personal Experiences and Online Courses survey subsections due to inadequate group sample sizes and insufficient outcome variation. For example, out of 238 survey respondents, only 23 had taken an online course from the department. Of those 23, none were students with disabilities. Therefore,

there is no data to compare students with disabilities to students without disabilities on any of the online courses items meaning a t-test is not possible for this group for these outcomes.

Table legend:

- ns=not significant
- NEG=significant difference in the negative direction for this group
- POS=significant different in the positive direction for this group

Appendix Table: Patterns of Significance for Groups of Interest by Graduate Survey Item

	Item	URM	Disability	Female	Pell Eligible	1st Gen. American	1st Gen. College
Classroom	1	ns	ns	ns	NEG	ns	ns
	2	ns	ns	ns	ns	ns	ns
	3	ns	ns	ns	NEG	ns	ns
	4	ns	ns	NEG	ns	ns	POS
	5	ns	ns	ns	ns	ns	ns
	6	ns	ns	ns	ns	ns	ns
	7	ns	ns	ns	ns	ns	ns
	8	ns	ns	ns	ns	ns	ns
Labs	9	ns	ns	ns	ns	ns	ns
	10	ns	ns	ns	ns	ns	ns
	11	NEG	ns	ns	ns	ns	ns
	12	ns	ns	ns	ns	ns	ns
	13	ns	ns	ns	ns	ns	ns
	14	ns	ns	ns	ns	ns	ns
	15	ns	ns	ns	ns	ns	ns
	16	ns	ns	ns	ns	ns	ns
	17	ns	ns	ns	ns	ns	NEG
	18	ns	ns	ns	ns	ns	ns
Climate	19	ns	ns	ns	ns	ns	ns
	20	ns	ns	ns	ns	ns	NEG
	21	ns	ns	ns	ns	ns	ns
	22	ns	ns	ns	ns	ns	ns
	23	ns	ns	ns	ns	ns	ns
	24	NEG	ns	ns	ns	ns	ns
	25	ns	ns	ns	ns	ns	ns
	26	ns	ns	ns	ns	ns	ns
	27	ns	ns	ns	ns	ns	ns
Faculty	28	ns	ns	ns	ns	ns	ns
	29	ns	ns	ns	ns	ns	ns
	30	ns	ns	ns	ns	ns	ns
	31	ns	ns	ns	ns	ns	ns
	32	ns	ns	ns	ns	ns	ns
	33	ns	ns	ns	ns	ns	ns

	34	ns	ns	ns	ns	ns	ns
	35	ns	ns	ns	ns	ns	ns
	36	ns	ns	ns	ns	ns	ns
	37	ns	ns	ns	ns	ns	ns
	38	ns	ns	ns	ns	ns	ns
	39	NEG	ns	ns	ns	ns	ns
	40	ns	ns	ns	NEG	ns	ns
	41	ns	ns	ns	ns	ns	ns
	42	ns	ns	ns	ns	ns	ns
	43	ns	ns	ns	ns	ns	ns
	44	ns	ns	ns	ns	ns	ns
	45	ns	ns	ns	ns	ns	ns
Professional Development	46	ns	ns	NEG	ns	ns	ns
	47	ns	ns	ns	ns	ns	ns
	48	ns	ns	ns	ns	POS	ns
	49	ns	ns	ns	ns	POS	ns
	50	ns	ns	ns	ns	ns	ns
	51	ns	ns	ns	ns	ns	ns
	52	ns	ns	NEG	ns	ns	NEG
	53	ns	ns	NEG	ns	ns	NEG
	54	ns	POS	NEG	ns	ns	ns
	55	ns	ns	ns	ns	ns	ns
	56	ns	ns	NEG	ns	ns	NEG
Work Life Balance	57	ns	ns	ns	ns	ns	NEG

APPENDIX X. Graduate Climate Survey Items by Factor/Outcome Grouping

	Item #	Survey Question
Classroom	1	I am encouraged to freely express myself in class.
	2	Professors care whether or not I learn the course material.
	3	Professors treat me with respect.
	4	I am comfortable asking questions in class.
	5	My comments and suggestions are taken seriously.
	6	Professors think I have a lower ability than I actually have.
	7	I understand the professor's expectations of me.
	8	I feel overwhelmed by the workload.
Labs	9	Lab equipment and instrumentation are accessible.
	10	I have sufficient access to lab resources to pursue my research goals.
	11	Lab experiments are fully explained prior to being delegated to me.
	12	Other team members view me as a leader when working in small groups in the laboratory.
	13	I feel ignored by my PI in the lab.
	14	I feel ignored by others in the lab.
	15	I am given trivial assignments in the lab.
	16	I feel productive when working in a group lab setting.
	17	My suggestions or comments are taken seriously by the lab group leader.
	18	I feel comfortable approaching the advisor or more senior staff/students/post-docs for assistance in a lab setting.
Climate	19	I feel overwhelmed by my degree program.
	20	Finances have adversely affected my pursuit of a graduate degree.
	21	I feel grades are given solely on the basis of performance in class.
	22	I feel that students help each other succeed in my department.
	23	I feel that students in my department compete against each other for awards and recognition.
	24	I feel that students in my department compete against each other for funding.
	25	My program encourages interdisciplinary research.
	26	My program encourages collaboration.
	27	I feel that I am part of a community in my department.
Faculty	28	My program provided guidance with finding an advisor.
	29	I am treated with respect by my advisor.
	30	I feel that my advisor places more value on his/her research than teaching and advising.
	31	My advisor makes himself/herself available to me.
	32	My advisor also serves as a mentor.
	33	I feel that faculty in my department serve as formal or informal mentors.
	34	I feel that faculty in my department care whether or not graduate students succeed.
	35	I have participated in formal mentoring programs during my graduate career at the University of Washington.
	36	I have one or more informal mentor(s) who have helped me learn the skills needed to navigate graduate school successfully.
P	37	My department encourages graduate student involvement in academic/discipline-based

		committees within the department.
	38	My department encourages graduate student involvement in professional associations.
	39	My department provides travel stipends for conferences.
	40	My department provides advising on how to secure funding.
	41	My graduate training is adequately preparing me for a job in industry.
	42	My graduate training is adequately preparing me for a job in an academic setting.
	43	My graduate training is adequately preparing me for a job in a public research laboratory or research organization.
	44	My graduate training is adequately preparing me to produce a paper for publication in a peer-reviewed journal in my discipline.
	45	My academic department is providing me with the skills and knowledge to design a viable dissertation proposal.
	46	My academic department is providing me with the skills and knowledge to develop a course in my field.
	47	My academic department is providing me with the skills and knowledge to produce an acceptable thesis or dissertation which contributes to knowledge in my field.
	48	My academic department is providing me with the skills and knowledge to teach a course in my field.
	49	My academic department is providing me with the skills and knowledge to write a winning proposal for funding.
	50	The academic experience in my department has reaffirmed my career choice.
Work Life Balance	51	I anticipate problems or conflicts in balancing work and family in the future.
	52	I anticipate problems or conflicts with access to child care.
	53	I anticipate problems or conflicts with access to parental or elder care programs.
	54	I anticipate problems or conflicts with availability of part-time work.
	55	I anticipate problems or conflicts with employment opportunities for my spouse/partner.
	56	I anticipate problems or conflicts with parental/maternity leave benefits.
	57	I anticipate problems or conflicts with access to funds to complete my graduate program.

APPENDIX XI. Background on Women Undergraduate Students in Engineering

By 2005, women significantly outnumbered men in college enrollment (Bradley, 2000; CPST, 2008; Jacobs, 1996). However, despite women's increased representation in college overall, they continue to lag behind men in enrollment in engineering majors. In its comprehensive literature review about women in engineering, the Goodman Research Group identified five themes to explain the lack of women in engineering (Goodman & Cunningham, 2002):

- Lack of self-confidence and engineering self-efficacy
- Lack of pre-college experience and knowledge in engineering
- Curricular focus, pedagogy, and climate in engineering
- Lack of female peers and role models
- Gender and societal issues

Choice of major

Literature on sex roles and socialization discusses why women are less likely to select engineering as a field of study than men are. A major reason women may avoid engineering is a concern about balancing work with family (Komarovsky, 1985; Moen 1991). Women may not think science and engineering careers are compatible with family and personal life (Ware & Lee, 1988).

Frehill (1997) hypothesized that since first year college students have limited information about majors and occupations, women may be less likely to understand the social relevance of being an engineer and thus are less likely to select engineering. Sax (1994) found that women are more likely to abandon scientific careers if they are more interested in a career choice that they perceive contributes to society.

Women tend to apply for such majors only when their qualifications exceeded the minimum admissions requirements, while men applied if they met the minimum admissions requirements (Ayalon, 2003). Seymour and Hewitt (1997) and Rosser (1993) point out that the engineering culture of competition is often incompatible with aspects of sex role socialization for women. Competition in engineering classes was cited as one of the most discouraging elements of women's first two years of study, and that even women doing very well academically were often discouraged by their grades (Astin & Astin, 1992; Goodman et al., 2002).

Persistence in Engineering

Recent research demonstrates that women and men are retained in engineering at the same rates (Ohland et al, 2008, Ohland et al, 2009). Objective factors of success such as GPA show women to be equal or higher than men (Adelman, 1998). Despite relatively equal or higher grade point averages, women have lower self-confidence, perceived ability, and self-reliance than men (Brainard & Carlin, 1998; Crawford & MacLeod, 1990; Grandy, 1994; Rayman & Brett, 1995). Students' assessment of ability, or their level of self-efficacy have been found to influence choice of major (Marra, Schuurman, Moore & Bogue, 2004; Nauta & Epperson, 2003).

In addition, Seymour and Hewitt (1997) suggest that, for many women, experiencing engineering education as a distinct minority automatically puts them at a psychological disadvantage with regard to confidence. Stereotypes can affect outcomes because members of the stereotyped group learn to believe them, and act accordingly (stereotype threat), or because others treat members of a stereotyped group differently than everyone else (discrimination) (Goldin & Rouse, 2000; Newman, 1978; Reskin, 2000; Steele, 1997).

While some research has shown that percentage of female faculty affects the percentage of female students in the major (Sonnert, Fox and Adkins, 2007), others have found no relationship (Canes and Rosen, 1995). Institutional composition in terms of female representation has mixed impacts on women's outcomes in general (not engineering-specific) (Jacobs, 1995).

APPENDIX XII. Background on Minority Undergraduate Students in Engineering

Although many underrepresented minority (URM) students, both men and women, express an interest in pursuing engineering careers, and are well prepared to do so, a disproportionate number of women and minorities with strong SAT scores and a strong GPAs leave the college pipeline (Maton, 2000; Schuman, Steeh, Bobo & Krysan, 1997; Seymour & Hewitt, 1997; Summers & Hrabowski, 2006). With regard to recruitment, role models can play a critical role in helping students decide to major in engineering (Anderson-Rowland, 1996). Additionally, women and minority students, in particular, may be more drawn to engineering programs where scholarships and financial aid are available (Anderson-Rowland, 1996). Anderson-Rowland (1996) also found that a Math/Science Honors Summer Program and a New Student Early registration/Orientation program were effective recruitment activities, especially for minority students.

Once matriculated, particular challenges underrepresented minority (URM) students in engineering undergraduate programs may face include differences in cultural values and socialization, stereotypes, isolation, perceptions of racism, and inadequate program support (Brown et al., 2005; Strayhorn et al., 2012; Tate & Linn, 2005; Walton & Cohen, 2007). Further, due to typically small numbers of minority students and faculty in engineering programs, they also may lack peers, faculty role models, and mentors who look like them (May & Chubin, 2003; Seymour & Hewitt, 1997). Students who feel different from the majority may be more sensitive to issues of social belonging. This can lead them to believe that *people like me do not belong here* (Tate & Linn, 2005; Walton & Cohen, 2007). Experiences that threaten social connectedness can have great effects on motivation to persist (Strayhorn et al., 2012; Walton & Cohen, 2007). Students' self-confidence may be undermined by perceptions that faculty and students see them as having inferior abilities (May & Chubin, 2003; Seymour & Hewitt, 1997). Students may also experience difficulty seeking the kind of support that could contribute to their academic performance (Tate & Linn, 2005). Lack of family support and financial stressors can create additional barriers to student persistence in engineering (Fleming, Moore, Williams, Bliss, & Smith, 2013; Robinson, 2013)

URM students enlist various strategies to navigate and manage challenges they face in their undergraduate engineering programs. One strategy involves framing negative experiences positively, offering a way for students to avoid being affected by discrimination and insulate themselves from feeling discouraged (Brown et al., 2005; Litzler & Samuelson, 2013; Seymour & Hewitt, 1997). Students also may focus on developing relationships with peers, which can provide access to academic and emotional support, social outlets, and a sense of belonging (Cole & Espinoza, 2008; Litzler & Samuelson, 2013; Tate & Linn, 2005; Walton & Cohen, 2007). Minority programs and professional societies, in particular, offer channels for social integration into college campuses, providing students with peer and professional networks, a sense of community that may be missing from engineering departments, and opportunities to develop strategies for success (Anderson & Kim, 2006; Cabrera et al., 1992; Tinto, 1987; Vogt, 2008). Finally, being proactive and seeking support can help students avoid the pitfalls of low academic performance, particularly in their first couple of years (Burtner, 2004; French et al., 2005; Huang & Brainard, 2001; Jiang & Freeman, 2011; Reichert & Absher, 1997; Seymour & Hewitt, 1997).

In addition to enlisting particular strategies to help them navigate and manage challenges, various factors can help motivate URM students and contribute to their desire and ability to continue in their engineering programs (Litzler & Samuelson, 2013). Support and encouragement from older peers and applicable coursework and engineering-related work experiences contribute to URM student motivation to persist, particularly for women(Litzler & Samuelson, 2013). In addition, many students are motivated by the desire to have an impact on society, and some students are motivated to give back while still in school—playing a supportive role for younger and/or potential engineering students (Litzler & Samuelson, 2013). This can help students confirm their commitment to both engineering and their institution (Anderson & Kim, 2006; Tate & Linn, 2005). Finally, some students, particularly those who are the first or second generation in their families to attend college are motivation by their families in various ways (Litzler & Samuelson, 2013; Fleming, Moore, Williams, Bliss & Smith, 2013).

APPENDIX XIII. Background on Underrepresented Graduate Students in Engineering

Factors thought to inhibit URM students who have high aspirations from following through and enrolling in graduate programs include financial concerns (Nettles, 1987; Weiler, 1993; Millett, 2003), undergraduate grades and performance on standardized entrance exams (Vining Brown, 1994; McCormick, Nunez, Shah, & Choy, 1999), undergraduate experiences in hostile or unwelcoming STEM departments(Vining Brown, 1994; Vining Brown, 2002); and perceptions about post-graduate employment prospects (Vining Brown, 2002).

A point of loss occurs during the first two years of graduate school, when URM students encounter departments that are at best neglectfully benign and at worst hostile to their presence. Graduate student attrition and long times-to-degree have become two of the most important assessment issues in graduate education. Estimates of graduate student attrition in science and engineering range from a low of 40% to a high of 65% (Nerad & Cerny, 1991; NRC, 1996; Bowen & Rudenstine, 1992). Numerous studies on graduate student attrition identify the primary factors as departmental culture, inadequate socialization and integration into the norms of academic research, lack of financial support, poor advising and inconsistent mentoring (Nerad & Cerny, 1991; Lovitts, 2001; Attiyeh, 1999; Haworth, 1996, Barid, 1993) Other studies suggest that attrition is highest for women and URM doctoral students (Vining Brown, 2002; Zwick, 1991).

Another point of URM talent loss is during the final stages of degree completion as students prepare for entry to the job market. Numerous reports and studies on doctoral education assert that it is too narrowly focused on research; students are not adequately provided with the skills to teach, and students are not socialized for academic careers (Applegate, 2002; Nyquist, 2002). Studies initiated by the Pew Charitable Trusts called attention to critical inconsistencies in student expectations and the reality of their doctoral programs (Golde & Dore, 2001; Nyquist & Woodford, 2000). They also found that students lack clear understanding about the doctoral study process and how to navigate it successfully. Most students enter their doctoral programs with a faculty career as a goal. The programs they enter, however, do not provide them with the socialization or training needed for faculty careers and many become discouraged over time. Socialization to an academic career introduces students to the norms, cultures and expectations of faculty life. Such socialization occurs before students enter their graduate programs and gathers momentum during the doctoral education process (Nerad & Cerny, 1991).

Students perceive the culture of science to be characterized by competition, a narrow focus and a belief in objectivity (Ferreira, 2003). These perspectives were particularly common among the female students, who also perceived a role conflict between a successful career in science and having a family.

A study by Santiago and Einarson (1998) found that relative to their white male counterparts, female graduate students have a lower degree completion rate, longer degree completion times, and are more likely to stop their graduate studies after acquiring a master's degree. This study also found that women have less positive expectations to complete a science and engineering degree compared to men.

Female graduate students reported experiencing lack of understanding by family and friends, a strain on relationships and difficulty maintaining intimacy with their partner (Padula & Miller, 1999). This strain on personal relationships could in effect decrease the emotional support needed to complete the doctoral program, forcing the women to choose between the family and school.

In order to succeed in their doctoral programs, women adapt and assimilate themselves into a male-driven self-concept. In one study, it appeared that the key to a woman's academic success in a graduate program was to adapt and assimilate to the majority (male) culture (LePage, 1997). This experience of adaptation and assimilation is a gender based graduate experience. Further, results of one study by Ulku-Steiner, Kurtz-Costes & Kinlaw (2000) indicated that women in a male dominated program expressed lower academic self-concept, less sensitivity to family issues, and lower career commitment.