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Perceptions of a Chilly Climate: Differences in Traditional and Non-traditional Majors for Women

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Abstract The purpose of this study was to examine how perceptions of a chilly climate differ between students in traditionally female-dominated majors (nursing and education) versus traditionally male-dominated majors (information technology and engineering), and how these perceptions relate to students' intentions to persist or pursue higher education in their chosen field. Students ($n = 403$) attending a community college completed the 28-item Perceived Chilly Climate Scale (PCCS). The primary research question asked: To what extent can scores on the five subscales of the PCCS be explained by the predictor variable set of gender, ethnicity, age, college major, and intent to leave the field? Canonical correlation analysis indicated that women found the climate chillier than men, non-white students found the climate chillier than white students, younger students perceived the climate chillier than older students, and students in traditionally female-dominated majors perceived the climate chillier than students in traditionally male-dominated majors. Intent to leave the field was not a significant predictor of perceptions of chilly climate.

Keywords Chilly climate · Women · Higher education · Technology · Information technology · Computers · Education

A large gender gap exists in the choice of college majors by males and females (Turner and Bowen 1999). Women continue to pursue careers that have been traditionally associated with women, particularly within the health professions, education, and the social and behavioral sciences (Larsen 2001), despite the availability of much higher salaries in traditionally male-dominated fields such as information technology (IT) and engineering. Over half of all women who do major in science, math, or engineering switch to other

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majors before completing an undergraduate degree, a much higher drop rate than for men (Seymour and Hewitt 1997).

One of the suggested reasons for this continued trend is that women do not feel welcome in traditionally male-dominated career fields and college majors. The perception of being unwelcome can result from women being ignored, treated differently, or sexually harassed. This phenomenon was labeled the "chilly climate" by Hall and Sandler (1982), who contended that differential treatment puts women at a significant educational disadvantage in college classrooms and negatively impacts their performance. The concept of the chilly climate was later expanded to include aspects of the campus environment beyond the classroom (Hall and Sandler 1984). As a result of the chilly climate, women may choose not to enter traditionally male-dominated college majors or may not persist in these majors.

The purpose of the present study was to examine how perceptions of a chilly climate differ between students in traditionally female-dominated majors (majors in which females comprise 67% or more of enrolled students) versus traditionally male-dominated majors (majors in which males comprise 67% or more of enrolled students) at a community college, and how these perceptions relate to students' intentions to persist or pursue higher education in their chosen career field or leave the field. Perceptions of students in the traditionally female-dominated fields of nursing and education were compared to perceptions of students in the traditionally male-dominated fields of IT and engineering.

Theoretical Framework

Two models have been suggested to explain why women are less likely than men to complete degrees in science and be successful in science careers, namely, the deficit model and the difference model (Barbercheck 2001). According to the deficit model, there are fewer women in science because they are treated differently from men due to formal and informal structural barriers. The difference model, on the other hand, suggests that the obstacles to a successful career lie within women themselves and are innate or result from gender-role socialization and cultural values.

Social learning theory may also help explain why women are less successful in science majors and careers. According to social learning theory, an individual's perceptions of self and of society are interconnected (Bandura 1997). Because environments influence people's cognitions and behavior, understanding how college students perceive the environment is important. Further, according to self-efficacy theory (Bandura 1997), people's beliefs in their ability to succeed in certain areas influence what they choose to pursue and how much effort they are willing to put forth to be successful.

Review of Literature

Gender Role Concept

A woman's gender-role concept can have an effect on her career choice, as women who choose traditionally male-dominated careers rate themselves as higher in masculinity than women in traditionally female-dominated careers (Rea and Strange 1983). Lackland and De Lisi (2001) found that students who had higher femininity scores were more likely to major in nursing and education, and students who had higher masculinity scores were more likely to major in the sciences.

College Environment

College environment is important for women, whether they are in traditionally male-dominated or traditionally female-dominated majors. Factors found to be influential in the persistence of nursing majors include a student's self-efficacy (Jeffreys 1998) and the perception of a supportive environment (Shelton 2003) The perception of a supportive campus environment is important to the persistence women in traditionally male-dominated majors, as women often lack confidence despite their abilities (Ethington 1988). Gender bias, in particular, has been cited as a reason for the attrition of women in IT majors (Bunderson and Christensen 1995).

The Chilly Climate for Women

The original report on the chilly climate, entitled *The Classroom Climate: A Chilly One for Women?*, was written by Hall and Sandler in 1982 and published by the Project on the Status and Education of Women of the Association of American Colleges. According to Hall and Sandler's report, some faculty treat women differently from men in the classroom, often inadvertently. Women may either be singled out or ignored because of their gender, which leads to a loss of confidence in their abilities and puts them at an educational disadvantage.

As noted by Hall and Sandler (1982), overt examples of the chilly climate include discouraging women's participation in class; preventing women from seeking help outside of class; causing women to drop classes or switch majors; making disparaging comments about women; disparaging women's intellectual abilities; implying that women lack commitment; making comments about women's physical attributes or appearance; disparaging women's professional accomplishments; referring to males as "men" and females as "girls"; making sexist jokes; ridiculing scholarship that deals with women's perceptions and feelings; and making direct sexual overtures to women.

Less obvious expressions of the chilly climate include making eye contact with men more often than with women; nodding and gesturing more often in response to men's comments; using a patronizing or impatient tone with women; appearing more attentive, such as by leaning forward when male students speak, but not when female students speak; habitually standing closer to males when lecturing; giving men detailed instructions on an assignment, but doing the assignment for women, which implies they are incapable; calling on men more than women; calling male students by name more often than female students; waiting longer for men than for women to answer a question; interrupting women students or allowing them to be interrupted by peers more often than men; asking women lower order factual questions and men higher order questions that require critical thinking; using classroom examples that reflect stereotyped roles such as referring to a doctor as "he" and a secretary as "she"; using the generic "he" to represent both men and women (Hall and Sandler 1982).

In 1984, Hall and Sandler expanded the concept of the chilly climate to include the campus in their report, *Out of the Classroom: A Chilly Campus Climate for Women?* According to this report, the campus environment was defined as including interactions with other students and staff, and students' experiences with support services such as admissions, financial aid, academic advising and career counseling, lab and field work, campus employment, internships, health care, campus safety, dormitory life, athletics, and student government and leadership, all of which may potentially contribute to a less than

accepting campus climate. The authors also suggested that certain groups of women (e.g., minorities, older women, and disabled women) may especially be affected by a chilly campus climate.

Since the initial reports, empirical research on the chilly climate for women has yielded conflicting results over the past 20 years. Some researchers have found evidence of a chilly campus climate for women (Janz and Pyke 2000; Pascarella et al. 1997; Whitt et al. 1999), but others have not (Constantinople et al. 1988; Crawford and MacLeod 1990; Drew and Work 1998; Heller et al. 1985). All four of the studies which reportedly provided evidence against the chilly climate were, in fact, studies of classroom interactions, and classroom climate is not equivalent to campus climate.

Research in Support of the Chilly Climate

There is empirical evidence that the chilly climate persists in postsecondary institutions. Pascarella et al. (1997) investigated how perceptions of a chilly campus climate affected the cognitive outcomes of women during their first year of college using the Perceived Chilly Climate for Women Scale (PCCWS), which consisted of eight Likert-scale items. A total of 23 institutions in 16 different states participated, including 18 four-year colleges and universities and 5 two-year institutions. Results at the 2-year colleges ($n = 176$) indicated that students' perceptions of a chilly climate had statistically significant negative associations with end-of-first-year cognitive development and self-reported gains in academic preparation for a career. At 4-year colleges ($n = 1{,}460$), the perception of a chilly climate had a statistically significant negative association only with self-reported gains in academic preparation for a career.

To determine the impact of a perceived chilly climate on women's cognitive growth during the second and third years of college, Whitt et al. (1999) did a follow-up to Pascarella et al.'s (1997) study with the same women. In the second-year sample, 2-year college women's ($n = 85$) perceptions of a chilly climate had statistically significant negative associations with three cognitive outcomes: self-reported gains in writing and thinking skills, understanding science, and understanding the arts and humanities. For 4-year college women ($n = 993$), perceptions of a chilly climate had statistically significant negative associations with four cognitive outcomes: self-reported gains in writing and thinking skills, understanding science, academic preparation for a career, and understanding arts and humanities. In the third-year sample ($n = 651$), the perception of a chilly climate had a statistically significant negative effect on four self-reported cognitive outcomes including gains in writing and thinking skills, understanding science, academic preparation for a career, and understanding the arts and humanities.

The relationship between perception of a chilly campus climate and various cognitive outcomes was clearly demonstrated in Whitt et al.'s study. The authors pointed out that the nature of the scale used to estimate perceptions of the chilly climate might explain the difference in 2-year and 4-year students' experiences, as the PCCWS emphasizes gender discrimination in classroom settings more than non-classroom settings. As 2-year college women tend to live off campus, they may view campus climate primarily as what occurs in class, so the scale described a comparatively large part of their college experience. Hence, choice of a scale to measure chilly climate is a consideration for future studies.

In order to study the existence of the chilly climate with a Canadian sample, Janz and Pyke (2000) developed the most comprehensive scale available to date to measure it. Initial items were generated based on Hall and Sandler's (1982) original definition of a chilly

climate, which ensured face validity. Additional items were derived from research in progress and from other scales designed to measure chilly climate. The result was a 123-item Preliminary Perceived Chilly Climate Scale (PPCCS). The PPCCS was distributed to 416 graduate and 281 undergraduate students at a large Canadian university, and 202 were returned. Statistically significant differences were found between males and females, with females perceiving the academic climate to be chillier than males. Reliability as measured by Cronbach's alpha was .92.

To further assess the validity and reliability of scores on the instrument, the researchers then went through an extensive process to construct the final scale. Internal consistency was measured by three procedures, including inter-item correlation, factor analysis, and calculation of Cronbach's alpha. Items with a minimum correlation of $r = .3$ with the total score were retained. Factor analysis yielded five factors: climate students hear about, sexist treatment, climate students experience personally, classroom climate, and safety. The final version of the Perceived Chilly Climate Scale (PCCS) consisted of 28 items. The possible range of scores is 28–196, with a midpoint of 112. The higher the score, the chillier the student perceives the climate to be.

A second study was then conducted (Janz and Pyke 2000). Questionnaire packets were distributed to a sample of 488 undergraduate and graduate students. A total of 327 completed responses were returned (269 females, 57 males, 9 unspecified). Reliability of the PCCS scores as measured by Cronbach's alpha was .90.

Janz and Pyke found significant gender differences in scores on the PCCS, with females perceiving the climate to be chillier than males. Students who described themselves as feminists perceived the climate to be chillier than those who did not and those who had taken a course in women's studies reported a chillier climate than students who had never enrolled in a women's studies course. Minority students perceived the climate to be significantly chillier than non-minority students. Students who had been in school longer perceived the climate to be chillier, as graduate students scored significantly higher on the PCCS than undergraduate students.

The process used to create the PCCS and demonstrate the validity and reliability of its scores was systematic and thorough. Consequently, it is the instrument that will be used to collect data on the dependent variables in the present study.

Statement of Research Question and Hypotheses

The primary research question was: To what extent can scores on the five subscales of the PCCS be explained by the predictor variable set of gender, ethnicity, age, college major, and intent to leave the field? The corresponding research hypotheses were:

H_1: There will be a statistically significant ($p = .05$) correlation (R_c) between the dependent variable set of subscale scores on the PCCS and the predictor variable set of gender, ethnicity, age, college major, and intent to leave the field.

H_2: Gender will be a primary contributing variable to at least one predictor canonical variate which correlates to a statistically significant ($p = .05$) degree with its corresponding dependent canonical variate.

H_3: Ethnicity will be a primary contributing variable to at least one predictor canonical variate which correlates to a statistically significant ($p = .05$) degree with its corresponding dependent canonical variate.

H_4: Age will be a primary contributing variable to at least one predictor canonical variate which correlates to a statistically significant ($p = .05$) degree with its corresponding dependent canonical variate.

H_5: College major will be a primary contributing variable to at least one predictor canonical variate which correlates to a statistically significant ($p = .05$) degree with its corresponding dependent canonical variate.

H_6: Intent to leave the field will be a primary contributing variable to at least one predictor canonical variate which correlates to a statistically significant ($p = .05$) degree with its corresponding dependent canonical variate.

Methodology

A 2-year community college in the southern United States was selected as the site for the present study because it offers academic programs in IT and nursing.

This institution ranks in the top 10 nationwide in the number of associate's degrees awarded in nursing, and in the total number of associate in science and associate in arts degrees awarded. A multi-campus institution located in an urban environment, the college has a student body of approximately 60,000. The median student age is 27; 59% of students are women; and 38% are minorities (28% African American, 5% Hispanic, 4% Asian, and 1% Native American). The college has received several public recognitions for its commitment to technology.

The research design was correlational and multivariate in that there was no manipulation of data and there were at least two variables in each set. The dependent variables were perception of chilly climate as measured by scores on the five subscales of the PCCS. The independent variables were gender, age, ethnicity, major, and intent to leave the field. All data were gathered via self-report surveys.

The variables of gender and ethnicity were selected as they were found to be correlated with perceptions of a chilly climate (Janz and Pyke 2000). While students who had been in school longer were found to perceive the climate to be chillier in Janz and Pyke's (2000) research, it is not clear if this difference was a function of age or the actual number of years the student had attended college. As class rank designations in community colleges are limited to either freshman or sophomore, the variable of age was selected because it offered a greater variation of responses. The variable of major was selected in order to test differences in perceptions of chilly climate in traditionally male-dominated and traditionally female-dominated majors. The variable of intent to leave the field was selected as a measure of satisfaction with the chosen major and to study the relationship between the perception of a chilly climate and satisfaction with the major.

The instrument for collecting data on perceptions of the chilly climate was the PCCS (Janz and Pyke 2000), which was supplemented by a questionnaire with demographic data and questions about students' intentions to persist or pursue higher education in their chosen career field or leave the field. For the purposes of the present study, the combined PCCS and questionnaire were entitled the "Climate Survey," as any reference to a chilly climate could have biased the responses of study participants and skewed the results.

The PCCS consists of 28 items which are rated on a 7-point Likert scale. The possible range of scores is 28–196, with a mid-point of 112. For both the subscale and total scores, the higher the score, the chillier the student perceives the climate to be. Subscale score ranges vary due to differing lengths of the subscales:

- Subscale 1: Climate Students Hear About (range of scores is 8–56) ,
- Subscale 2: Sexist Attitudes and Treatment (range of scores is 6–42),
- Subscale 3: Climate Students Experience Personally (range of scores is 6–42),
- Subscale 4: Classroom Climate/Course Material (range of scores is 5–35), and
- Subscale 5: Safety (range of scores is 3–21).

Using Cronbach's alpha, internal consistency reliability for scores on the PCCS was calculated to be .90 and .92 in the two studies conducted by Janz and Pyke (2000). Validity and reliability of scores on the instrument was established through an extensive process, which was described in the review of literature. As the PCCS was pilot tested by its developers, pilot testing was not necessary in the present study. Permission to use the PCCS was obtained from Dr. Sandra Pyke.

Data were collected during the first 5 weeks of Spring semester 2004. A total of 30 classes in the areas of IT (9 classes), engineering (8 classes), nursing (5 classes), and education (8 classes) were visited and students completed the Climate Survey in class. As students who perceived a chilly climate may have been more likely to drop out or change majors prior to graduation than students who did not, the sample included both freshman and sophomore students. Of the 470 surveys collected, 67 were excluded due to either incomplete data or students being enrolled in a major outside of the four areas of consideration in the present study. The final research sample consisted of 403 students. If fewer than 4 responses (15%) on the 28-item PCCS were left blank, the average score for the sample was filled in (i.e., substitution of the mean). Surveys with more than 4 incomplete items were eliminated from the sample.

The final sample was comprised of 403 students, including 91 IT majors (74 males, 17 females), 82 engineering majors (65 males, 17 females), 118 education majors (34 males, 84 females), and 112 nursing majors (13 males, 99 females). According to data provided by the participating institution, the distribution of students enrolled in the four majors of interest during the 2002–2003 academic year was as follows: 2,210 IT majors (1,520 men, 690 women), 818 engineering majors (642 men, 176 women), 302 nursing majors (43 men, 259 women), and 1,509 education majors (301 men, 1,208 women). Data from the 2003–2004 academic year were not yet available.

The data analysis included examining demographic data, running bivariate correlations among the dependent and independent variables, and conducting a reliability analysis, a canonical correlation analysis, and a canonical invariance analysis. Canonical correlation analysis (Thompson 1984) was utilized to determine if the dependent or criterion variable set of subscale scores on the PCCS could be collectively predicted by the independent variables grouped together. Canonical correlation analysis was selected as the data analysis technique instead of multiple regression because it allows for the simultaneous analysis of all the dependent variables. As a multivariate procedure, canonical correlation allowed for simultaneous analysis of all of the scale scores. As noted by Stevens (1996), multivariate procedures are generally preferable to running multiple univariate tests for at least two reasons: (a) multivariate procedures provide "a more complete and detailed description of the phenomenon under investigation" (p. 2) and (b) multivariate procedures require fewer tests of statistical significance and therefore minimize the possibility of Type I error.

The five independent variables included: gender (male, female), major (IT, engineering, nursing, education), age (numeric), ethnicity (white, African American, Hispanic, Native American, Asian, other) and intent to leave (pursue further education in major; get a job related to major; pursue further education in a different major; get a job in a field not related to major). The five dependent variables, which were subscales of the PCCS,

included: Climate Students Hear About, Sexist Attitudes and Treatment, Climate Students Experience Personally, Classroom Climate/Course Material, and Safety.

For purposes of the canonical correlation analysis, three variable categories were collapsed into dichotomous categories. Violations of multivariate normality assumption becomes problematic if there are too few responses in a given category for one or more variables, which was the case with the variables ethnicity and intent to leave the field. The variable ethnicity was collapsed from the original six categories of white, African American, Hispanic, Native American, and other into white and non-white. The variable intent to leave the field was collapsed from the original four categories into intent to stay (pursue further education in major; get a job related to major) and intent to leave (pursue further education in a different major; get a job in a field not related to major). Further, the variable major was collapsed from the four original categories of IT, engineering, nursing, and education into the categories of traditional male (IT and engineering), and traditional female (nursing and education). These dichotomous transformations helped help assure that the data were multivariate normal and therefore appropriate for use in canonical correlation analysis. The data analysis resulted in five canonical solutions or roots, which were useful in addressing the study's six research hypotheses.

Limitations and Delimitations

Investigating perceptions of the chilly campus climate is a sensitive matter. Given the nature of the study, the researcher ran the risk of reduced participation of instructors or students, the risk of students not being honest to protect themselves and their instructors, and even the risk of the college administration prohibiting such a study for fear of the results. Students may not have been aware of gender bias enough to be able to identify it. Further, students who experienced a chilly campus climate very early in their program of study or during Fall semester may have dropped out or changed majors and would not have been included in this study. As the sample was not randomly selected, results from the study have limited generalizability.

There were additional limitations as a result of the data collection and analysis. On the survey, students were asked to indicate their class standing and the number of credits they had completed at all institutions of higher education. Because students were not asked how many credits students had completed in their specific major and surveys were anonymous, it cannot be determined whether students were actually freshmen or sophomores in their specific major. Hence, data are not broken out by class standing. While class standing was not a variable of interest, it could have been useful in further analyzing the data about perceptions of chilly climate.

Three variables were collapsed into dichotomous categories for the analysis: ethnicity, intent to leave the field, and college major. Although necessary to complete the canonical correlation analysis, this procedure limits the findings of these variables with regard to chilly climate to broader and less specific categories.

The delimitations of this study were: (a) participants were males and females who were at least 18 years of age; (b) participants were enrolled in one of four community college majors including IT, engineering, nursing, or education during Spring semester 2004; (c) participants completed the survey in a traditional classroom setting as opposed to in an online course.

Findings

Demographic Data

Among the 403 students in the sample, 46% were male (n = 186), and 54% (n = 217) were female. White students constituted the largest ethnicity represented in the sample, with 68.5% (n = 276) being white, 16.6% African American (n = 67), 5.7% Hispanic (n = 23), 4% Asian (n = 17), and 1% (n = 4) Native American. A total of 4% (n = 16) of students categorized their ethnicity as "other." Education majors comprised 29.3% (34 males, 84 females) of the sample, with 27.8% majoring in nursing (13 males, 99 females), 22.6% in IT (74 males, 17 females), and 20.3% in engineering (65 males, 17 females). A total of 50% of the sample planned to get a job related to their major, 45% planned to further their education in their current major, 4% intended to pursue further education in a different major, and only 1% planned to get a job in a field not related to their major. Ages of students in the sample ranged from 18 to 60, with a mean age of 29.6 (SD = 9.5), which was approximately equal for both genders (M = 30.2, SD = 9.8 for males; M = 29.1, SD = 9.3 for females). The specific count of students in each major by gender and ethnicity is provided in Table 1 (p. 34).

Data were also collected that were not among the dependent or independent variable sets in the present study, but pertained to perceptions of chilly climate. Information was collected on students' estimated GPA, class standing, estimated number of credits completed, and estimated date of graduation. Self-reported estimates of GPA of students in the sample ranged from 1.50 to 4.00, with a mean of 3.19 (M = 3.18, SD = .53 for men;

Table 1 Major count by gender and ethnicity

Ethnicity	Gender	Major				
		IT	Engineering	Education	Nursing	Total
White	Male	46	45	23	11	125
	Female	6	11	54	80	151
	Total	52	56	77	91	276
African American	Male	16	6	10	0	32
	Female	7	4	14	10	35
	Total	23	10	24	10	67
Hispanic	Male	3	6	1	0	10
	Female	1	0	9	3	13
	Total	4	6	10	3	23
Native American	Male	0	1	0	0	1
	Female	0	2	1	0	3
	Total	0	3	1	0	4
Asian	Male	5	1	0	1	7
	Female	1	0	4	5	10
	Total	6	1	4	6	17
Other	Male	4	6	0	1	11
	Female	2	0	2	1	5
	Total	6	6	2	2	16

$M = 3.20$, $SD = .43$ for women). Estimated date of graduation for students in the sample was 46.9% ($n = 189$) in 2004, 26.1% ($n = 105$) in 2005, 14.6% ($n = 59$) in 2006, 3.7% ($n = 15$) in 2007, 2% ($n = 8$) in 2008, and 6.7% ($n = 27$) unspecified.

There was appreciable variance across the class standing variable, which could possibly warrant further study as a factor in perceptions of chilly climate. When students were asked to indicate their class standing and were given the option of either freshman or sophomore, 23% responded that they were freshmen and 77% responded that they were sophomores.

Students were then asked to estimate the total number of college credits they had completed at all institutions of higher education. Responses ranged from 0 to 200 credits, with a mean of 57.7. When class standings of students were categorized based on the total number of credits completed, with freshmen having 0–29 credits and sophomores having 30 credits or more, the sample was 22.5% freshmen and 77.5% sophomores, which is comparable to students' self-reported class standing as either freshmen or sophomores.

Information about class standing is important to the discussion of perceptions of chilly climate. Janz and Pyke (2000) compared the scores of undergraduate students and graduate students and found that students who had been in school longer were more likely to have higher scores on the PCCS. Because class standing designations in community colleges are either freshman or sophomore, the variable age was used instead of the variable class size for the purpose of the present study.

Examination of the bivariate correlations indicated that scores on the five PCCS subscales were moderately to highly correlated. Other than the high correlation of .595 between gender and major, intercorrelations among the independent variables were not noteworthy.

PCCS total scores in this sample ranged from 28 to 155, with a mean of 74.7 and a standard deviation of 25.9. Scores for students in all of the four majors combined were higher for women ($M = 78.9$, $SD = 26.1$, $n = 217$) than for men ($M = 69.7$, $SD = 24.8$, $n = 186$), a difference of about 1/3 of a standard deviation. Further, scores were higher for women than for men on four of the five PCCS subscales. Only on Subscale 4, Classroom Climate/Course Material, did men ($M = 16.7$, $SD = 5.6$) score slightly higher than women ($M = 16.5$, $SD = 5.6$), a negligible difference. Descriptive statistics for the PCCS total are included in Table 2 (pp. 35–36).

PCCS total scores of women in the traditionally-male dominated majors of IT and engineering were lower ($M = 72.9$, $SD = 20.0$, $n = 34$) than scores of women in the traditionally female-dominated majors of nursing and education ($M = 80.0$, $SD = 27.0$, $n = 183$). This trend was consistent across four of the five PCCS subscales. Only on Subscale 4, Classroom Climate/Course Material, did women in traditionally male-dominated majors ($M = 19.4$, $SD = 5.4$) score higher than women in traditionally female-dominated majors ($M = 16.0$, $SD = 5.5$). In comparing scores of women in the two traditionally male-dominated majors of IT and engineering, women majoring in IT scored lower ($M = 68.9$, $SD = 20.7$, $n = 17$) than women majoring in engineering ($M = 77.0$, $SD = 19.0$, $n = 17$) on the PCCS total, as well as across all of the PCCS subscales.

Internal consistency reliability analyses were conducted on scores from the 28-item PCCS scale and each of the five PCCS subscales. A minimum coefficient alpha of .70, as recommended by Nunnally (1978), was used to indicate an adequate level of internal consistency for the subscale scores. Each of the 28 items on the PCCS was correlated with the total score for the scale, and alpha values were computed with each item removed. Coefficient alpha for scores on the 28-item scale was .8850, and ranged from .6839 to .8558 for scores on the five subscales.

Table 2 Descriptive statistics for PCCS total scores

Gender	Recoded major	Major	Mean	*SD*	*N*
Male	Trad. male	IT	69.2	27.5	74
		Engineering	69.3	20.2	65
		Total	69.3	24.3	139
	Trad. female	Education	72.1	29.4	34
		Nursing	68.2	17.6	13
		Total	71.0	26.5	47
	Total	IT	69.2	27.5	74
		Engineering	69.3	20.2	65
		Education	72.1	29.4	34
		Nursing	68.2	17.6	13
		Total	69.7	24.8	186
Female	Trad. male	IT	68.9	20.7	17
		Engineering	77.0	19.0	17
		Total	72.9	20.0	34
	Trad. female	Education	83.3	26.1	84
		Nursing	77.3	27.5	99
		Total	80.0	27.0	183
	Total	IT	68.9	20.7	17
		Engineering	77.0	19.0	17
		Education	83.3	26.1	84
		Nursing	77.3	27.5	99
		Total	78.9	26.1	217
	Trad. male	IT	69.2	26.3	91
		Engineering	70.9	20.1	82
		Total	70.0	23.5	173
	Trad. female	Education	80.0	27.5	118
		Nursing	76.2	26.7	112
		Total	78.2	27.1	230
	Total	IT	69.2	26.3	91
		Engineering	70.9	20.1	82
		Education	80.0	27.5	118
		Nursing	76.2	26.7	112
		Total	74.7	25.9	403

Canonical Correlation Analysis

The number of canonical roots or functions for a given analysis is equal to the number of variables in the smaller of the two sets. As both sets of variables in this analysis contained five variables, five canonical roots or functions were yielded by the analysis. Each root explains a smaller amount of variance than the previous root. To determine the number of canonical roots to interpret, the combination of the magnitude of each root and its statistical significance are considered.

Root 1 ($R_c^2 = .157$) indicates that using the best set of weights for variables across the two sets, the independent variables share approximately 16% of their variances with the dependent variables, which is small but well above the 10% standard suggested by Pedhazur (1982) to be considered noteworthy. Using the second best set of statistical weights, root 2 ($R_c^2 = .090$) accounts for about 9% of the shared variance across the two sets. Similarly, root 3 ($R_c^2 = .074$) accounts for 7% of the variance, root 4 ($R_c^2 = .016$) accounts for 2% of the variance, and root 5 ($R_c^2 = .003$) accounts for less than 1% of the variance.

As root 1 produced a result of greater than .10 ($R_c^2 = .157$, $p < .001$), and root 2 produced a result of just under .10 ($R_c^2 = .090$, $p < .001$), these two roots were interpreted. Although root 3 was statistically significant, the result was not of sufficient magnitude to be of practical significance ($R_c^2 = .074$, $p < .001$), and roots 4 and 5 were both statistically non-significant and expressed a negligible level of correlation.

While both canonical function and structure coefficients may be useful in determining the contribution of a given variable to the variate composite, standardized structure coefficients are considered more reliable indicators of variable contribution (Daniel et al. 1994) and were employed for the interpretation of these results. For the purpose of this analysis, structure coefficients with a saliency level of |.5| and greater were examined. Function and structure coefficients for the independent and dependent variable sets are included in Tables 3 and 4 (pp. 37–38).

Interpretation of root 1: The squared correlation coefficient for root 1 ($R_c^2 = .157$, $p < .001$), indicated that, as a set, the predictor variables accounted for approximately 16% of the variance in subscale scores on the PCCS. Analysis of the structure coefficients across the predictor variable set for the first canonical function indicated that gender ($r_s = .890$) accounted for the highest proportion of variance of the function, followed by major ($r_s = .750$). Among the structure coefficients for the criterion variable set, only PCCS Subscale 5 (Safety) was highly correlated with Root 1 ($r_s = .810$).

These results indicated that gender and major were positively related to PCCS subscale scores, with women perceiving the climate to be chillier than men and students in traditionally female-dominated majors perceiving the climate to be chillier than students in majors that are traditionally male-dominated. The analysis of the structure coefficients indicated that this trend was particularly the case with regard to perceptions of safety, with

Table 3 Function and structure coefficients for independent/predictor variables

Variable	Root 1	Root 2	Root 3	Root 4	Root 5
Independent/predictor variable standardized canonical function coefficients					
Gender	.70	−.04	−.95	−.29	.26
Age	.07	−.63	−.22	.67	−.33
Ethnicity	−.31	.70	−.40	.38	−.36
Intent	.20	.22	.16	.58	.75
Major	.31	.33	.91	.40	−.63
Independent/predictor variable canonical structure coefficients					
Gender	.89	.17	−.39	−.11	−.11
Age	<−.01	−.64	−.25	.67	−.28
Ethnicity	−.35	.67	−.47	.36	−.28
Intent	.15	.21	.13	.59	.75
Major	.75	.28	.40	.10	−.44

Table 4 Function and structure coefficients for dependent/criterion variables[a]

Variable	Root 1	Root 2	Root 3	Root 4	Root 5
Dependent/criterion variable standardized canonical function coefficients					
PCCS 1	.22	.82	.36	.21	−.92
PCCS 2	.03	−.01	−.02	−1.26	.70
PCCS 3	.01	.11	.35	.90	.76
PCCS 4	−.59	.42	−.76	.18	−.09
PCCS 5	.87	−.19	−.55	.17	<.01
Dependent/criterion variable canonical structure coefficients					
PCCS 1	.35	.90	.22	−.08	−.14
PCCS 2	.24	.65	<−.01	−.51	.52
PCCS 3	.17	.55	.19	.38	.70
PCCS 4	−.35	.59	−.73	.09	.16
PCCS 5	.81	.13	−.55	.09	.12

[a] Subscales are: PCCS 1 (Climates Students Hear About); PCCS 2 (Sexist Attitudes and Treatment); PCCS 3 (Climate Students Experience Personally); PCCS 4 (Classroom Climate/Course Material); PCCS 5 (Safety)

women and students in traditionally female-dominated majors perceiving the campus as less safe than men and students in traditionally male-dominated majors.

Interpretation of root 2: The squared canonical correlation coefficient for root 2 ($R_c^2 = .090$, $p < .001$) indicated that the predictor variables, as a set, accounted for approximately 9% of the variance in subscale scores on the PCCS. Analysis of the structure coefficients across the predictor variable set for the second canonical function indicated that ethnicity ($r_s = .665$) accounted for the highest percentage of variance of the function, followed by age ($r_s = -.642$). Among the structure coefficients for the criterion variable set, PCCS Subscale 1 (Climate Students Hear About) and Subscale 2 (Sexist Attitudes and Treatment) were most highly associated with their canonical variate for Root 2, with r_s values of .895 and .645, respectively.

Subscale 3 (Climate Students Experience Personally) and Subscale 4 (Classroom Climate/Course Material) were moderately correlated with Root 2, with r_s values of .554 and .568, respectively.

These results indicated that ethnicity was positively related to PCCS subscale scores, with non-white students perceiving the climate to be chillier than white students. Age was found to be negatively related to PCCS subscale scores, with younger students perceiving the climate to be chillier than older students. The analysis of the structure coefficients indicated that, compared to white students and older students, non-white students and younger students found the climate to be particularly chilly with regard to the climate students hear about and perceptions of sexist attitudes and treatment, and somewhat chilly regarding the climate students experience personally and perceptions of classroom climate and course material.

Canonical invariance analysis. To test for the degree to which the canonical results are not sample dependent, an analysis of canonical invariance was conducted by splitting the sample in half, alternately numbering each dataset "1" or "2," and running the canonical correlation for each of the two new samples. Results indicated that the samples were invariant. Roots 1 and 2 were statistically significant in the combined sample, as well as in both sub-samples. In all of the samples, gender and major accounted for the greatest

percentage of variance in root 1, and ethnicity accounted for the greatest percentage of variance in root 2.

Consideration of the Primary Research Question

The primary research question in the present study asked: To what extent can scores on the five subscales of the PCCS be explained by the predictor variable set of gender, ethnicity, age, college major, and intent to leave the field? The results of this study suggest that scores on three of the five PCCS subscales including Subscale 1 (Climate Students Hear About), Subscale 2 (Sexist Attitudes and Treatment), and Subscale 5 (Safety) can be explained to some degree by the predictor variables of gender, ethnicity, age, and college major.

The first research hypothesis was: There will be a statistically significant ($p = .05$) correlation (R_c) between the dependent variable set of subscale scores on the PCCS and the predictor variable set of gender, ethnicity, age, college major, and intent to leave the field. This hypothesis was supported by the data, as three of the five canonical roots yielded by the analysis were statistically significant. Each of the variables in the predictor variable set will now be examined separately.

The second research hypothesis was: Gender will be a primary contributing variable to at least one predictor canonical variate which correlates to a statistically significant ($p = .05$) degree with its corresponding dependent canonical variate. This hypothesis was supported by the data. Females were more likely to perceive a chilly climate than males. Gender ($r_s = .890$) was a primary contributing variable to root 1, with. major ($r_s = .750$) also making a noteworthy contribution. In the dependent variable set, PCCS Subscale 5 ($r_s =$ of .810.), Safety, was the most noteworthy contributor to root 1.

The third research hypothesis was: Ethnicity will be a primary contributing variable to at least one predictor canonical variate which correlates to a statistically significant ($p = .05$) degree with its corresponding dependent canonical variate. This hypothesis was supported by the data. Non-white students were more likely to perceive a chilly climate than white students. Ethnicity ($r_s = .665$) was a primary contributing variable to root 2, with age ($r_s = -.642$) making a noteworthy contribution as well. Among the dependent variables, PCCS Subscale 1 ($r_s = .895$), Climate Students Hear About, and PCCS Subscale 2 ($r_s = .645$), Sexist Attitudes and Treatment, were noteworthy contributors to root 2.

The fourth research hypothesis was: Age will be a primary contributing variable to at least one predictor canonical variate which correlates to a statistically significant ($p = .05$) degree with its corresponding dependent canonical variate. This hypothesis was supported by the data. Younger students were more likely to perceive a chilly climate than older students. Age ($r_s = -.642$), was a primary contributing variable to root 2, with ethnicity ($r_s = .665$) making a noteworthy contribution as well. In the dependent variable set, PCCS Subscale 1 ($r_s = .895$), Climate Students Hear About, and PCCS Subscale 2 ($r_s = .645$), Sexist Attitudes and Treatment, were noteworthy contributors to root 2.

The fifth research hypothesis was: College major will be a primary contributing variable to at least one predictor canonical variate which correlates to a statistically significant ($p = .05$) degree with its corresponding dependent canonical variate. This hypothesis was supported by the data. Students in traditionally female-dominated majors were more likely to perceive a chilly climate than students in traditionally male-dominated majors. Major ($r_s = .750$) was a primary contributing variable to root 1, with gender ($r_s = .890$) making a

noteworthy contribution as well. In the dependent variable set, PCCS Subscale 5 (r_s = of .810), Safety, was the most noteworthy contributor to root 2.

The sixth research hypothesis was: Intent to leave the field will be a primary contributing variable to at least one predictor canonical variate which correlates to a statistically significant ($p = .05$) degree with its corresponding dependent canonical variate. This hypothesis was not supported by the data. The intent to leave the field variable was not a primary contributing variable to any of the canonical roots, and, consequently, not a significant predictor of scores on any of the subscales of the PCCS.

Summary of the Findings

Overall, the findings indicated that women found the climate to be chillier than men, non-white students found the climate to be chillier than white students, younger students perceived the climate to be chillier than older students, and students in traditionally female-dominated majors perceived the climate to be chillier than students in traditionally male-dominated majors. Intent to leave the field was not a significant predictor of perceptions of chilly climate.

Women and students in traditionally female-dominated majors perceived the campus as less safe than men and students in traditionally male-dominated majors. Compared to white students and older students, non-white students and younger students found the climate to be particularly chilly with regard to the climate students hear about and perceptions of sexist attitudes and treatment, and somewhat chilly regarding the climate students experience personally and perceptions of classroom climate and course material.

Discussion of the Results

In comparing the results of the present study to the findings of Janz and Pyke (2000), two of the findings are consistent; that women and minorities perceived the climate to be chillier than men or non-minorities. The finding in the previous study that students who had been in school longer perceived the climate to be chillier is inconsistent with the results of the present study. The variables of college major and intent to leave the field were not variables of interest in previous studies.

Proponents of the deficit model (Barbercheck 2001), would suggest that women in science are exposed to a chillier climate than women in traditionally female-dominated majors. However, in the present study, women in the traditionally male-dominated majors actually had lower total scores ($M = 72.9$, $SD = 20.0$, $n = 34$) on the PCCS than women in the traditionally female-dominated majors ($M = 80.0$, $SD = 27.0$, $n = 183$). As the PCCS total score for all women was a mean of 78.9, with a standard deviation of 26.1 ($n = 217$), the difference in scores between women in the two groups represents almost 1/3 of a standard deviation. Although this unexpected result indicates that women in IT and engineering perceived less of a chilly climate than women in nursing and education, it does not mean that a chillier climate exists for women in traditionally female-dominated majors or that the climate is "warm" for women in traditionally male-dominated majors.

PCCS total scores for students in all of the four majors combined were higher for women ($M = 78.9$, $SD = 26.1$, $n = 217$) than for men ($M = 69.7$, $SD = 24.8$, $n = 186$). As the PCCS total score for all students in the sample was a mean of 74.7, with a standard

deviation of 25.9, the difference in scores between men and women represents over 1/3 of a standard deviation.

These results indicate that women in the present study perceived that they were, in fact, being treated differently from men, which lends support to the deficit model. Given that a score of anything above 1 on any of the 28 individual items indicates some perception of discrimination, scores of women in the present study are indicative of a chilly climate. However, despite perceptions of chilly climate, these women intended to persist in their chosen field.

The degree to which women in traditionally male-dominated majors experienced chilly climate differently from women in traditionally female-dominated majors may be explained, in part, by their personalities. Students who have higher femininity scores were more likely to major in nursing and education, and students who had higher masculinity scores were more likely to major in the sciences (Lackland and De Lisi 2001), which is also true in the corresponding career fields (Rea and Strange 1983). Therefore, women who choose male-dominated majors may be less sensitive to chilly climate than women who choose female-dominated majors and less affected by the chilly climate when they do perceive it, which would lend support to the difference model (Barbercheck 2001).

Women's perceptions of college environment can influence their self-efficacy and, consequently, their success, according to self-efficacy theory (Bandura 1997). Findings of this study indicate that students do not intend to let a chilly college climate negatively affect their success. Perhaps this is an indication of the resiliency of the women in this sample. Women who are not resilient, or are intimidated by non-traditional majors in which there are few other women, may have self-selected out of traditionally male-dominated majors and would not have been included in the study.

Conclusions and Recommendations

The results of the present study indicate that the chilly climate continues to exist in higher education more than 20 years after the phenomenon was first identified by Hall and Sandler (1982). While the predictor variables of gender, ethnicity, age, college major, and intent to leave the field accounted for 16% of the variance in scores on the five subscales of the PCCS in the present study, 84% of the variance in scores was not accounted for. Hence, much of the variance in perceptions of chilly climate remains unexplained.

Recommendations for Educators

As expressions of chilly climate are often unintentional on the part of the perpetrator, it is important for community college administrations to raise the awareness of faculty, staff, and students about the chilly climate through education. Such education must include specific examples of behaviors that cause students to feel unwelcome or treated differently, for example, calling on males more often than on females, giving students of one gender extra help which implies that they are unable to perform, referring to nurses as "she" and to engineers as "he," making comments that imply that students do not belong in traditionally male-dominated majors, or selecting textbooks that omit references to the minority gender.

After a basic awareness is developed and faculty and staff become aware of their own behaviors that contribute to perceptions of chilly climate and resolve to change them, the chilly climate can be "warmed." Awareness can be further enhanced through feedback, for example, through classroom or office observations by trained observers. Although students may be reluctant to give feedback to faculty and staff on discriminative behaviors for fear of retribution, they can do so through faculty evaluations or even complaints to the administration.

The classroom climate can be further warmed by incorporating feminist pedagogies, i.e., instructional practices that appeal to the learning styles of women and create a better learning environment for all students (Rosser 1990). Examples of feminist pedagogies include replacing competition with collaboration, replacing didactic teaching methods with more inclusive strategies, and incorporating constructivist methods into the classroom (Roger et al. 1999). Selecting textbooks, especially in traditionally male-dominated courses, that incorporate the writings of women and photographs of women in non-submissive roles may also serve to warm the climate. Because safety continues to be an issue for women, providing adequate campus security is essential to a non-chilly climate for women.

Recommendations for Further Research

While the sample size ($n = 403$) of the present study was relatively large, the number of women in non-traditional majors (17 in IT, 17 in engineering) in the sample was small and results are generalizable primarily to students in the four majors at this specific community college site. In order to better understand perceptions of chilly climate of women in traditionally male-dominated majors, it is recommended that a larger sample such as a statewide community college system be studied, and a statewide profile of perceptions of chilly climate for women in community colleges be developed. Future studies could be expanded to include additional majors that are non-traditional for women. Qualitative studies of the chilly climate, which could help clarify how perceptions of chilly climate affect women in traditionally male-dominated majors and deepen the understanding of this phenomenon, would be of special benefit. Observational studies, utilizing trained observers, of classrooms and college departments that provide student services would provide objective evidence of the chilly climate. Longitudinal studies which illuminate how perceptions of chilly climate affect student learning, retention, and completion rates are needed as well. Finally, with the increase in student enrollment in distance learning courses in recent years, studies of perceptions of chilly climate in the online environment will become increasingly important.

Contributions of the Study

The present study is the first known research conducted on perceptions of the chilly climate that focused exclusively on community college students. Further, the sample size of community college women in this study ($n = 217$) exceeds the sample size of community college women in any previous study. It is the only study on the chilly climate that compares perceptions of men and women in traditionally male-dominated and traditionally female-dominated majors, and examines how the chilly climate affects students' intentions to remain in or leave their field of study.

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